**An Application to the**
**Board of Commissioners of Public Utilities**

# 2012 CAPITAL BUDGET

# APPLICATION

## VOLUME I

## August 2011

newfoundland labrador hydro
a nalcor energy company

newfoundland labrador hydro
a nalcor energy company

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August 3, 2011

**BY HAND**

Board of Commissioners
of Public Utilities
P.O. Box 21040
St. John's, NF
A1A 5B2

**Attention: Cheryl Blundon – Director of Corporate Services and Board Secretary**

Dear Ms. Blundon:

**Re: Newfoundland and Labrador Hydro – 2012 Capital Budget Application**

Please find enclosed ten copies of Hydro's 2012 Capital Budget Application, in two volumes, filed in accordance with the Provisional Capital Budget Application Guidelines issued by the board in October of 2007 and in accordance with the guidelines and conditions for capital budget proposals as outlined by the Board in Order No. P.U. 7 (2002-2003).

Under this Application, Hydro is seeking approval of $87.9 million in capital expenditures. Also, Hydro is seeking approval of its 2010 rate base in the amount of $1,484,659,000.

Volume I of the filing contains an Overview of Hydro's proposed 2012 Capital Budget and its 2012 Capital Plan. The Capital Plan contains a five-year plan filed in compliance with Order No. P.U. 7 (2007) and as well contains a 20-year plan that contains other information required by the Board such as information as to the Holyrood Thermal Generating Station and as to the province's Energy Plan.

The Application is generally consistent and comparable with past applications to allow ease of comparison, with the inclusion of International Financial Reporting Standards considerations, as described in the Overview.

Section A sets out the high level summary of the 2012 budget by the following categories: Generation, Transmission and Rural Operations and General Properties.

Section B contains the detailed project justifications for each period over $500,000 and contains an Overview section as well as detailed explanations. Also contained in Section B are the Multi-Year Projects. Section C sets out the projects over $200,000 but less

than $500,000; Section D contains the projects over $50,000 and less than $200,000. Section E contains the classification of the capital project proposals. Section F contains multi year projects. Section G is the section for any leases, to which there are none for this year, while Section H sets out the Schedule of Capital Expenditures for the period 2007 to 2016. Section I to the Application contains the status report for the 2011 capital program to June 30.

Section J to this Application is a report on the ten-year plan of maintenance expenditures for the Holyrood Generating Station required to be filed by Order No. P.U. 14 (2004). Section K sets out the 2011 rate base for Hydro. Reports one to five that are associated with the capital project proposals over $500,000, begin in the back of Volume I.

Volumes II of the Application contains the remaining reports 21 reports associated with the capital project proposals over $500,000.

We trust that you will find the enclosed to be in order and satisfactory. Should you have any questions or comments about any of the enclosed please contact the undersigned.

Yours truly,

***NEWFOUNDLAND AND LABRADOR HYDRO***

Geoffrey P. Young
Senior Legal Counsel

Encl.

Cc: Mr. Peter Alteen,
Newfoundland Power

Mr. Tom Johnson, Consumer Advocate
O'Dea, Earle

Mr. Dean Porter
Poole Althouse

Mr. Paul Coxworthy
Stewart McKelvey Stirling Scales

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**IN THE MATTER OF** the *Public Utilities Act*, (the "Act"); and

**IN THE MATTER OF** an Application by Newfoundland and Labrador Hydro for an Order approving: (1) its 2012 capital budget pursuant to s.41(1) of the Act; (2) its 2012 capital purchases, and construction projects in excess of $50,000 pursuant to s.41 (3) (a) of the Act; (3) its leases in excess of $5,000 pursuant to s. 41 (3) (b) of the Act; and (4) its estimated contributions in aid of construction for 2012 pursuant to s.41 (5) of the Act and for an Order pursuant to s. 78 of the Act fixing and determining its average rate base for 2010.

**TO:** The Board of Commissioners of Public Utilities ("the Board")

**THE APPLICATION** of Newfoundland and Labrador Hydro ("Hydro") ("the Applicant") states that:

1. Hydro is a corporation continued and existing under the Hydro *Corporation Act, 2007,* is a public utility within the meaning of the Act and is subject to the provisions of the *Electrical Power Control Act, 1994*.

**International Financial Reporting Standards (IFRS)**

2. Hydro, is required to adopt IFRS for interim and annual financial statements for fiscal years beginning on or after January 1, 2012, after the expiration of a one-year deferral made available to certain rate-regulated entities.

3. For the purposes of this capital budget Application, and as further explained in the 2012 Capital Projects Overview section of the attached documentation, Hydro has applied the relevant IFRS requirements to its 2012 capital proposals.

4. The IFRS requirements impact the overall 2012 capital budget as follows:

   - Major Overhauls and Inspections now capitalized;
   - Training costs no longer included in capital budget;
   - Capital Labour Overhead Allocation no longer included in capital budget;
   - Corporate Overhead Allocation no longer included in capital budget; and
   - Financing costs included in capital proposals changed from Allowance for Funds used during Construction (AFUDC), which includes both a debt and equity component, to Interest During Construction (IDC) which relates only to debt.

5. The primary rationale for Hydro's proposal to use IFRS requirements in its capital expenditures relates to transparency and the administrative burden required to maintain duplicate asset records should IFRS accounting for assets depart from regulatory capital accounting. Hydro maintains separate asset records for each unit of property it acquires, including each distribution transformer, for instance. Calculating separate capital costs, and the resultant depreciation variances, and reconciling the two sets of records for the foreseeable future would require additional investment in both personnel and systems.

6. For 2012, the most significant impact is a proposal to overhaul the Holyrood Unit 1 turbine, with a budget estimate of $4.2 million. Each turbine is on a

nine year cycle for such overhauls, and it can reasonably be expected that a similar project will therefore occur on a three year cycle.

7. The IFRS assumptions are imbedded in each capital proposal, and Hydro is therefore requesting approval of its IFRS-related changes in capital expenditure recording methodology.

**2012 Capital Budget**

8. Section A to this Application is Hydro's proposed 2012 Capital Budget in the amount of approximately $87.9 million prepared in accordance with the guidelines and conditions outlined in Order No. P.U. 7 (2002-2003) and the Capital Budget Application Guidelines issued October 29, 2007.

9. Section B to this Application is a list of the proposed 2012 Construction Projects and Capital Purchases for $500,000 and over, prepared in accordance with Order No. P.U. 7 (2002-2003) and the Capital Budget Application Guidelines.

10. Section C to this Application is a list of the proposed 2012 Construction Projects and Capital Purchases for $200,000 and over, but less than $500,000, prepared in accordance with Order No. P.U. 7 (2002-2003) and the Capital Budget Application Guidelines.

11. Section D to this Application is a list of the proposed 2012 Construction Projects and Capital Purchases in excess of $50,000 but less than $200,000 prepared in accordance with Order No. P.U. 7 (2002-2003) and the Capital Budget Application Guidelines.

12. Section E to this Application is a list of the multi year projects that have expenditures in 2012.

13. Section F to this Application summarizes Hydro's proposed 2012 capital projects by definitions, by classification and by materiality as required by the Capital Budget Application Guidelines.

14. Section G contains no new leases proposed for 2012 in excess of $5,000 per year.

15. Section H to this Application is a Schedule of Hydro's Capital Expenditures for the period 2007 to 2016.

16. Section I to this Application is a report on the status of the 2011 capital expenditures including those approved by Orders No. P.U. 38 (2010), projects under $50,000 not included in these Orders, and the 2010 capital expenditures carried forward to 2011.

17. Section J to this Application is a report on the ten year Plan of Maintenance Expenditures for the Holyrood Generating Station required to be filed by Order No. P.U. 14 (2004).

18. Section K to this Application shows Hydro's actual average rate base for 2010 of $1,484,659,000.

19. Volume I and Volume II to this Application contain the supplementary reports referred to in various capital budget proposals.

20. The proposed capital expenditures for 2012 as set out in this Application are required to allow Hydro to continue to provide to its customers service and

facilities which are reasonably safe, adequate and reliable as required by Section 37 of the Act.

21. The Applicant has estimated the total of contributions in aid of construction for 2012 to be approximately $400,000. The information contained in the 2012 Capital Budget (Section A) takes into account this estimate of the contributions in aid of construction to be received from customers. All contributions to be recovered from customers shall be calculated in accordance with the relevant policies as approved by the Board.

22. Communications with respect to this Application should be forwarded to Geoffrey P. Young, Senior Legal Counsel, P.O. Box 12400, St. John's, Newfoundland and Labrador, A1B 4K7, Telephone: (709) 737-1277, Fax: (709) 737-1782.

16. The Applicant requests that the Board make an Order as follows:

(1) Approving Hydro's proposed changes to its capital expenditure methodology to incorporate the requirements of IFRS;

(2) Approving Hydro's 2012 Capital Budget as set out in Section A hereto, pursuant to section 41 (1) of the Act;

(3) Approving 2012 Capital Purchases and Construction Projects in excess of $50,000 as set out in Sections B, C, and D hereto, and its leases as set in Section F, pursuant to section 41 (3) of the Act;

(4) Approving the proposed estimated contributions in aid of construction as set out in paragraph 11 hereof for 2012 as

required by section 41 (5) of the Act, with all such contributions to be calculated in accordance with the policies approved by the Board; and

(5) Fixing and determining Hydro's average rate base for 2010 in the amount of $1,484,659,000 pursuant to section 78 of the Act.

**DATED** at St. John's, Newfoundland, this 3rd day of August, 2011.

**NEWFOUNDLAND AND LABRADOR HYDRO**

Geoffrey P. Young
Senior Legal Counsel

Newfoundland and Labrador Hydro,
500 Columbus Drive, P.O. Box 12400
St. John's, Newfoundland, A1B 4K7
Telephone: (709) 737-1715
Facsimile: (709) 737-1782

**IN THE MATTER OF** the *Public Utilities Act*, (the "Act"); and

**IN THE MATTER OF** an Application by Newfoundland and Labrador Hydro for an Order approving: (1) its 2012 capital budget pursuant to s.41(1) of the Act; (2) its 2012 capital purchases, and construction projects in excess of $50,000 pursuant to s.41 (3) (a) of the Act; (3) its leases in excess of $5,000 pursuant to s. 41 (3) (b) of the Act; and (4) its estimated contributions in aid of construction for 2012 pursuant to s.41 (5) of the Act and for an Order pursuant to s. 78 of the Act fixing and determining its average rate base for 2010.

**AFFIDAVIT**

I, John MacIsaac, Professional Engineer, of St. John's in the Province of Newfoundland and Labrador, make oath and say as follows:

1. I am Vice-President, Project Execution and Technical Services, on behalf of Newfoundland and Labrador Hydro, the Applicant named in the attached Application.

2. I have read and understand the foregoing Application.

3. I have personal knowledge of the facts contained therein, except where otherwise indicated, and they are true to the best of my knowledge, information and belief.

**SWORN** at St. John's in the Province of Newfoundland and Labrador this 2nd day of August 2011, before me:

Barrister – Newfoundland and Labrador

John MacIsaac

August 2nd 2011.

## INTRODUCTION

Hydro is required to provide reliable service to its customers, through the provisions of the Hydro Corporation Act, the Electrical Power Control Act, 1994, and the Public Utilities Act. The provision of a safe, reliable, least cost supply of electricity requires that Hydro continuously renew, expand and modify its generation, transmission and distribution assets, and the assets that support those systems. Hydro must also address changing environmental and other regulatory requirements, challenges which often require the acquisition of new assets or improvement to existing assets. Hydro's long term planning initiatives are framed in the context of the following key drivers: current review of the Lower Churchill Project, the shift in load centers, such as the closure of a paper mill, the expected startup of a nickel processing facility, and continued load growth on the Avalon Peninsula. This Overview will discuss the projects proposed for 2012. Discussion of the draft five year plan is contained in the section entitled "2012 Capital Plan". As noted there, the five year plan and beyond is under substantive review.

## INTERNATIONAL FINANCIAL REPORTING STANDARDS (IFRS)

### Background

The Accounting Standards Board (AcSB) requires publicly-accountable enterprises to adopt IFRS for interim and annual financial statements for fiscal years beginning on or after January 1, 2011. As a result of changes to Part I of the Canadian Institute of Chartered Accountants (CICA) Handbook – Accounting, by the AcSB, certain rate-regulated entities can defer the adoption of IFRS by one year to January 1, 2012. Hydro met the criteria for deferral and as such has chosen to adopt IFRS effective January 1, 2012.

Hydro commenced its IFRS conversion project in 2008 and established a formal project governance structure which includes a steering committee consisting of senior levels of management from various disciplines as appropriate. Regular reporting is provided to the Audit Committee and the Board of Directors. Beginning in March 2010, Hydro has also provided monthly updates to the Public Utilities Board outlining the status of the IFRS transition.

Effective January 1, 2012 Hydro's financial statements will be prepared in accordance with IFRS and, as a result, Hydro has to make recommendations as to whether changes to its accounting methods and policies are warranted. In the case of its capital asset records, which Hydro primarily maintains at an individual asset (e.g. distribution transformer) level, there are several items to be considered in transitioning to IFRS, as discussed below. Calculating separate capital costs, and the resultant depreciation variances, and

reconciling the two sets of records for the foreseeable future would require additional investment in both personnel and systems. Additionally, it would impair transparency when parties, including the Board, review external and regulatory records, including financial reports.

Hydro recognizes that the move to IFRS is a significant issue in the regulated utility industry. Hydro intends to engage in a more comprehensive discussion with the Public Utilities Board in the future regarding its overall proposed approach to implementing IFRS. However, in preparing its 2012 Capital Budget Application, Hydro encountered a number of IFRS-related issues that required treatment prior to the full IFRS discourse. The issues and rationale for their treatment are provided herein.

Table- 1 below identifies the five areas of the 2012 Capital Budget Application that are affected by the move to IFRS. The changes that have resulted from the transition to IFRS are consistent with those communicated previously to the Public Utilities Board.

**Table - 1 – Treatment of IFRS-Related Issues in the 2012 Capital Budget Application**

| Description | Description | Amount excluded from capital under IFRS ( permitted under GAAP) $ x 000,000 | Amount included in capital under IFRS (expensed under GAAP) $ x 000,000 | Net Impact on Capital $ x 000,000 |
|---|---|---|---|---|
| Major Overhauls and Inspection | Major Overhauls and Inspections were expensed as operating costs in previous budget applications but capitalized under IFRS | - | 6.8 | 6.8 |
| Training costs | Training costs are operating expenses under IFRS | 0.2 | - | (0.2) |
| Capital Labour Overheads (10% and 20%) | Capital Labour overheads are not allowed under IFRS | 1.3 | - | (1.3) |
| Corporate Overhead Allocation (2-4%) | Current corporate overheads methodology not allowed under IFRS | 2.1 | - | (2.1) |
| AFUDC vs. IDC | AFUDC is excluded and IDC permitted | 2.6 | 2.7 | 0.1 |

Major Overhauls and Inspections

International Accounting Standard (IAS) 16 (Appendix A) states that a condition of continuing to operate an item of property, plant and equipment may be performing regular major inspections or overhauls. The cost of these inspections or overhauls should be recognized in the carrying amount of the asset.

Hydro has adopted the following policies and guidelines with respect to capitalizing Major Inspections and Overhauls:

1) The overhaul or inspection will occur at regular intervals throughout the life of the asset, and would occur on a frequency of greater than one year;
2) The total cost of the overhaul or inspection will be greater that $50,000; and
3) Any remaining carrying amount of the previous overhaul or inspection will be derecognized when a new overhaul or inspection occurs.

Hydro believes that it is appropriate to capitalize Major Inspections and Overhauls under these conditions as they represent a benefit that will last over periods of greater than one year and to include the full cost in the year the work was performed would result in volatility in operating costs.

The projects capitalized in the Hydro 2012 Capital Budget Application as Major Inspections and Overhauls under IAS 16 are as follows:

1) Major Overhaul of a turbine at Holyrood generating station $4.2 million

2) Major Overhaul of diesel generators $1.0 million

3) Major Overhaul of Hydro generators $0.4 million

4) Major Inspection of Holyrood plant $1.2 million

These major overhauls or inspections will deliver economic benefit over future years and meet the IFRS capital recognition criteria.

Training Costs

Under Generally Accepted Accounting Principles (GAAP), Hydro included training costs associated with capital projects in the cost of those projects. IFRS no longer allows the capitalization of training costs. This does not represent a material change and therefore Hydro proposed to include training costs in operating rather than capital expenditures for 2012 and beyond.

Allowance for Funds Used During Construction (AFUDC)

Under GAAP, Hydro capitalized borrowing costs using AFUDC which includes both the cost of debt and equity. IAS 23 (Appendix B) only allows the capitalization of borrowing costs based on the cost of debt. Hydro's AFUDC, based on the 2007 approved Test Year Weighted Average Cost of Capital is 7.59%, compared to the forecast[1] interest rate of 8.2% included in this Application. As shown in Table 1, this does

[1] The actual interest rate will be used for the actual capital expenditures.

not result in a material change and therefore Hydro proposes to include interest at the cost of debt in its capital expenditures, rather than AFUDC.

Capital Overheads

IAS 16 specifically disallows the capitalization of administrative and general overheads. Previously, Hydro included in the cost of property, plant and equipment an allocation of two types of overheads.

The first overhead allocation consisted of Engineering Managers and Supervisors who did not charge directly to capital work orders. An overhead of 10% and 20% was applied to labour charged to capital by individuals working in the corporate office and individuals working in the field respectively. This overhead was intended to capture costs of management which could not be easily identified with a specific project. As a result of a re-alignment of the Project Execution and Technical Services group, specifically the establishment of the Project Execution responsibilities, discussed in more detail in the 2012 Capital Plan section of this Application, Hydro is now able to more accurately capture the hours of all engineers that work on capital. Hydro is therefore proposing to replace this overhead allocation by including hours directly charged to capital. This change is also reflected in the estimate for each project.

The second overhead allocation consisted of an allocation of time for support business units that did not charge directly to capital (e.g. Accounts Payable, Inventory and Purchasing services). Under IFRS, Hydro is only able to capitalize an allocation of labour for individuals who would be incremental due to the capital program. Hydro has not identified any of the costs of these support services as incremental costs due solely to the capital programs, as the personnel in these areas provide the same services for capital and operating programs. As a result, has included no allocation of overhead labour to capital in the 2012 estimates.

IFRIS Summary

Hydro's 2012 Capital Budget Application has been prepared in accordance with IFRS. Aligning Hydro's regulatory reporting and external reporting will eliminate administrative costs associated with duplicate accounting records and will allow for greater comparability and transparency in Hydro's financial statements. Hydro has assessed each area impacted by IFRS to determine if it was prudent to align regulatory and external financial reporting. This assessment process will be ongoing as changes are made to IFRS.

**2012 PLAN CONSIDERATIONS**

Maintaining Hydro's systems in reliable operating condition is accomplished through a combination of planned maintenance, renewal, and rehabilitation of existing assets, and replacement of assets which have reached the end of their useful lives and are worn beyond the point of economic repair. Assets may also be replaced by ones which will result in lower life cycle costs or improved operational characteristics (repair, renewal, and replacement within the long-term Asset Management Strategy).

The large portion of Hydro's installed assets is approximately forty years old. This is true of Hydro's largest hydro installation at Bay d'Espoir, Holyrood Thermal Generating Station, and much of Hydro's transmission and distribution systems. In addition, many other generation assets, such as Stephenville Gas Turbine, Hardwoods Gas Turbine and Hinds Lake Generating Station are more than 30 years old.

The sustaining capital portion contained in this, and previous capital budget applications, linked the age and condition of Hydro's assets, which are approaching full life cycle and require replacement. The quantity and value of these sustaining capital proposals can be expected to continue to be a major factor as the assets age and condition continues to be assessed, where they impact reliability and customer service. In other cases, the introduction of newer, more efficient technologies justifies the replacement of old equipment. The age of Hydro's assets also has implications for efficient operating methods and safety. Some of Hydro's generating plants were constructed at a time when most systems and auxiliary equipment were manually operated. Today, most equipment is automated or remotely controlled, which permits the operators to spend more time focused on maximizing efficiency and equipment monitoring. This application contains proposals to improve the safety of Hydro's workplaces, and to implement automation or improvements in the control of equipment that enable the efficient operation of assets.

During 2007, Hydro initiated an internal review of its major assets to develop a long term asset refurbishment and replacement plan. This process resulted in the production of a 20-Year Capital Plan which identifies the major capital expenditures which will be required to maintain the existing assets in safe, reliable operating condition to serve our customers. This 2007 initiative marked the first time Hydro consciously considered the long term requirements of its existing assets. Prior to this Hydro had the luxury of operating assets which were relatively new, but now that many assets have reached, or are about to reach, maturity it has required Hydro to look much further into the future to plan the long term effective

management of these assets to their impending retirement or refurbishment dates. The plan takes into consideration the condition of assets, reliability criteria and updated system load growth forecast. On an ongoing basis, Hydro has continued to strategically adjust the five year plan based on the updated inputs of condition assessments and system load requirements. The plan continues to be a living document which will be reviewed and revised annually as new information about the condition of Hydro's assets and the operating demands placed on them becomes available. General revisions will be made annually and major reviews will occur in years three and five.

Consideration in the development of a capital proposal is given to:

- System performance and reliability criteria
- Long term asset management strategy
- Load growth and system planning criteria
- Maintenance history
- Condition assessment
- Performance assessment
- Legislative requirements
- Cost efficiencies
- Operating experience
- Changing operating conditions
- Discussions between Regulated Operations and Technical Services
- Familiarity with equipment
- Operating and Maintenance cost; and,
- Professional judgment.

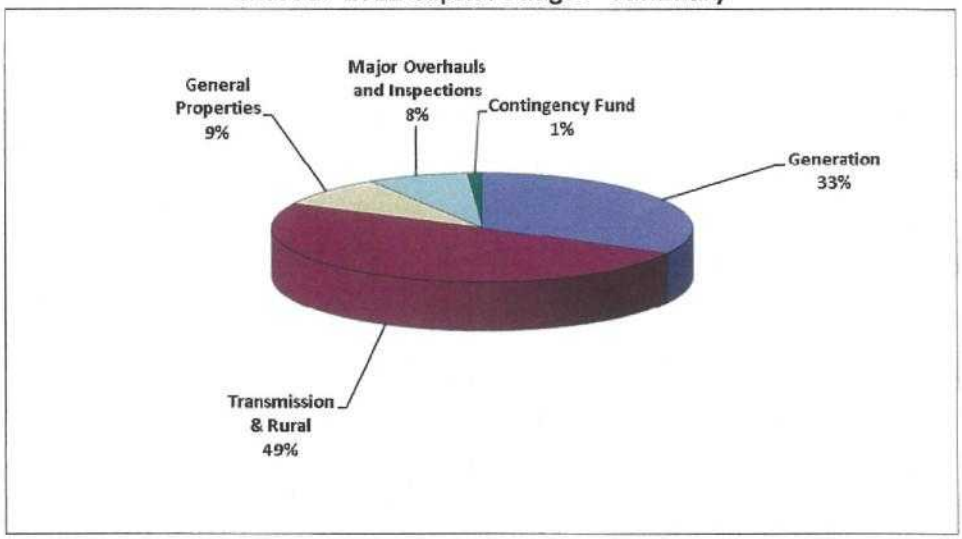
There are three broad categories of replacement criteria:

- Time and condition based, such as diesel generators (100,000 hours of operation) and vehicles (combination of years and operating hours for some classes);
- Condition based, such as transmission line wood poles and turbine bushings and seals; and
- Technical assessment based, where an evaluation of reliability, performance, condition, costs and other factors results in a capital proposal.

In summary, this Application contains a capital plan in which the overriding consideration is least cost reliable generation, transmission and distribution of electricity while maintaining and enhancing safety and environmental performance.

Chart 1 shows the breakdown of the 2012 Capital Budget by major classification. The classifications, other than the contingency fund, which represents only 1 percent of the 2012 budget, are then discussed further.

**Chart 1: 2012 Capital Budget - Summary**

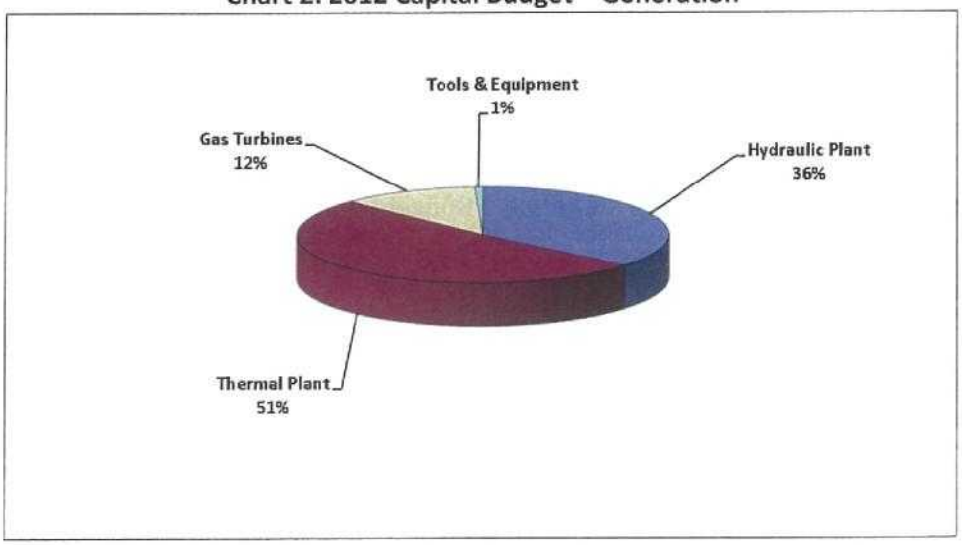



**GENERATION ASSETS**

On the Island Interconnected System, power and energy are provided by Hydro through a mix of hydroelectric and fossil-fired generation, as well as some power purchases. This production, along with the transmission system, is managed by Hydro's Energy Control Centre to ensure economic and reliable dispatch of available resources. At the end of 2010, Hydro's Island Interconnected production facilities consisted of 15 generating stations varying in size from 360 kW to 592 MW, with a total 1,517 MW of net capacity. Additionally, tools and equipment are required for the operating and maintenance of these generation assets.

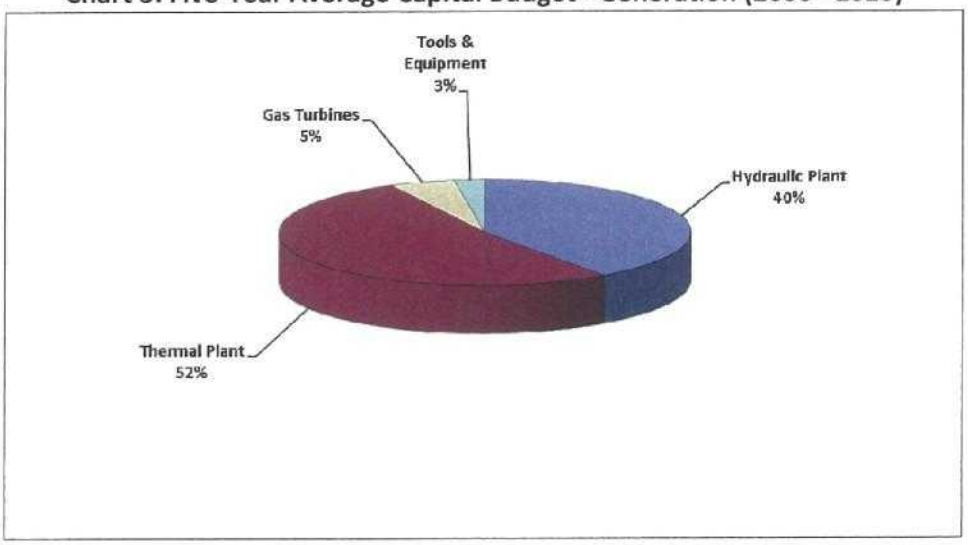
The division of the 2012 Capital Budget for Island Interconnected generation among Hydraulic Plant, Thermal Plant, Gas Turbines and Tools and Equipment expenditures is shown in Chart 2.

**Chart 2: 2012 Capital Budget – Generation**




The five-year (2006 to 2010) average is shown in Chart 3. For 2012, thermal plant represents 51 percent of the Island Interconnected generation budget, compared with 52 percent over the past five years. Thermal plants continue to require major capital expenditures as the majority of the plants have reached the age of maturity and significant expenditures are required to ensure that these important generating assets can continue to operate reliably.

**Chart 3: Five-Year Average Capital Budget - Generation (2006 - 2010)**



**Hydraulic Plant**

Hydro's hydraulic generating plants range from less than 10 years to more than 40 years of age. Capital expenditures are required to ensure reliability and to maximize the potential useful operating lives of these assets, of which many components have reached or are coming to the end of their expected service lives. This application includes proposals for the rewind of the stators on Units 1, 3, and 4 at Bay d'Espoir and for the refurbishment of the Burnt Dam Spillway.

**Thermal Plant**

The three units of the Holyrood Thermal Generating Station have now reached or exceeded their generally expected service life of 30 years. Condition assessment and selective life extension will permit them to operate reliably until 2020. Holyrood remains critical to the reliable supply of power to the Island Interconnected System, as it serves the base load of the system and will be required to do so in the short to medium term. The long term operational plan for this facility has been developed in the context of the proposed Labrador Interconnection, as Hydro has investigated the feasibility of developing the Lower Churchill River and importing electricity from Labrador to the Island. Should that project proceed, Holyrood will remain a critically important facility prior to completion of the Lower Churchill Project. Following completion of the Lower Churchill project, the Holyrood plant will continue to be an essential component of the Provincial electrical grid as a synchronous condensing facility. Additionally, the plant will function as a standby facility during the early years of operation of the Lower Churchill generating plant and direct current link between Labrador and Newfoundland, until 2020, when it will be converted and repositioned for new use in synchronous condensing configuration.

The challenges faced by Hydro are complex because circumstances require that Holyrood must operate in a manner quite different than the norm for thermal plants. Conventional practice is that a thermal plant is base loaded throughout its career until it reaches maturity and then the plant is operated as a peaking or standby facility in its final years, thus operating at a very low capacity factor, often less than 10 percent. This thermal plant has passed the age at which other utilities have performed condition assessment and life extension studies and have either retired the facilities or have initiated life extension projects. However, until the Lower Churchill Project is completed and power is brought to the Island Interconnected System via a HVDC link, the Holyrood plant must continue to operate at, or near, its historical average capacity factor of 40 percent to 50 percent annually and much higher through the critical winter period. The closure of the

paper mill at Grand Falls has reduced demand on Holyrood in the short term. However, when the nickel processing plant being constructed at Long Harbour begins commissioning and operation in 2011 demand on Holyrood will increase. The capital projects contained in this application are necessary to replace assets which are at the end of their useful lives, and which must be replaced to maintain reliability through to the completion of the HVDC link to the Lower Churchill development.

The Holyrood Projects for 2012 are listed below:

- Rewind generators, Units 1 and 2
- Upgrade marine terminal
- Upgrade stack breeching units 2 and 3
- Upgrade fuel oil heat tracing
- Install Plant Operator Training Simulator
- Upgrade Forced Draft Fan Ductwork Units 2 and 3
- Replace Beta Attenuation Monitoring Analyzers

**Gas Turbines**

Hydro's gas turbine plants at Stephenville, Hardwoods and Holyrood are more than thirty years old. The generally accepted life expectancy for gas turbine plants is between twenty-five and thirty years. A complicating factor in Hydro's case is that the manufacturer of the power turbines at the Stephenville and Hardwoods plants, one of the key components, went out of business years ago, eliminating the availability of factory technical support and spare parts. Also, the manufacturer of the gas generators (jet engines) at the Stephenville and Hardwoods plants, another key component, has declared them obsolete and the supply of spare parts, technical support and repair facilities continues to diminish.

During 2007, Hydro engaged a consultant to perform a condition assessment of the Hardwoods and Stephenville gas turbines. Their findings and recommendations were used to prepare plans for refurbishment of these facilities to ensure that they can operate reliably and that their useful service lives can be extended as long as can be financially justified. Gas turbines will continue to play an important role within Hydro's integrated generation plan.

**TRANSMISSION AND RURAL OPERATIONS ASSETS**

Hydro owns and operates thermal generation with 39 MW of net capacity on the Labrador Interconnected system and owns and operates diesel generation assets with 31 MW of net capacity in 21 isolated rural systems. On the Island Interconnected System, Hydro owns and operates 3,473 kilometers of transmission lines and 53 high voltage terminal stations operating at voltages of 230, 138 and 69/66 kV. On the Labrador Interconnected system, Hydro owns and maintains 269 km of 138 kV transmission line and the associated terminal stations interconnecting Happy Valley/Goose Bay to Churchill Falls. In addition, Hydro owns and operates approximately 3,397km of distribution lines, principally in rural Newfoundland and Labrador.

Hydro's Transmission and Rural Operations assets are replaced based on age and condition, and require ongoing capital expenditures to maintain reliable service, to comply with environmental guidelines, and to ensure the safety of employees, contractors, and the general public.

The division of the 2012 Capital Budget for Transmission and Rural Operations is shown in Chart 4. These breakdowns are generally consistent with the five-year (2006-2010) average as shown in Chart 5 below. The Labrador City voltage conversion project is a very large multi year project involving the construction of new terminal stations and the reconfiguration of the entire Labrador City system, which has a significant effect on the pattern of expenditures during its implementation.

**Chart 4: 2012 Capital Budget - Transmission and Rural Operations**

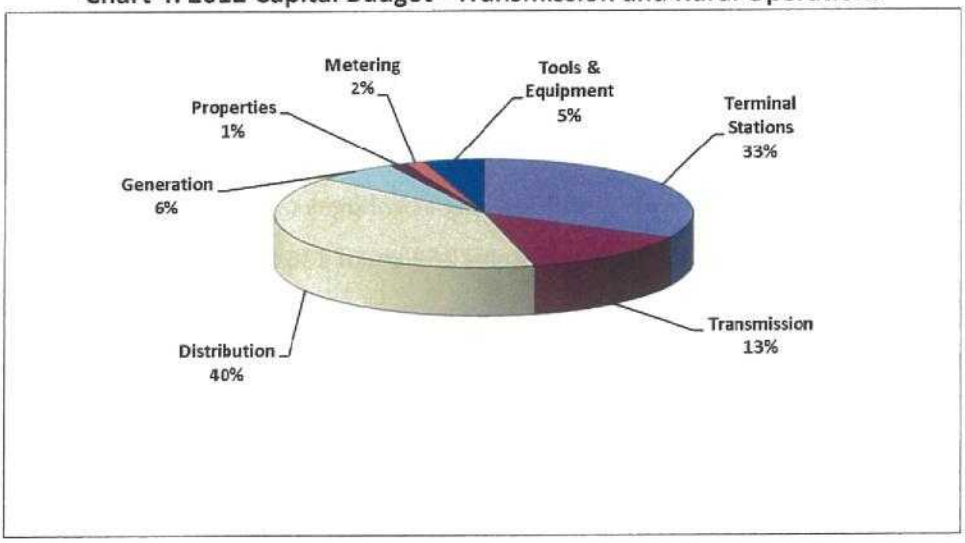
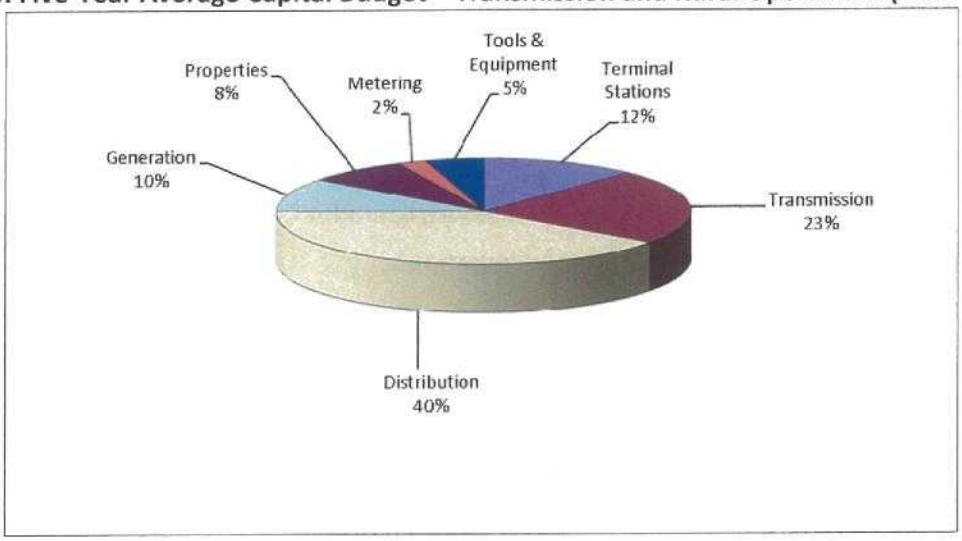



**Chart 5: Five-Year Average Capital Budget – Transmission and Rural Operations (2006 - 2010)**




### Terminal Stations and Transmission

Many of Hydro's transmission lines were constructed in the 1960s with expected useful lives in the 40-year range. Annual reconstruction and general upgrades are needed to ensure that Hydro can continue to provide our customers with reliable electrical service. Regular capital replacement and upgrading is required to ensure that the maximum useful economic life is extracted from these assets to ensure the supply of reliable, least cost energy to our customers.

The terminal station and transmission proposals for 2012 are:

- Installing an additional 230kV transformer at Oxen Pond;
- Upgrading aging power transformers;
- Replacing failing insulators at various locations;
- Replacing surge arrestors at various locations;
- Replacing instrument transformers;
- Upgrading aging circuit breakers;
- Replacing aging disconnect switches at various locations;
- Replacing compressed air piping and installing a dew point monitor at Buchans;
- Upgrading the transmission line corridor between Bay d'Espoir and Western Avalon; and,
- Upgrading transmission line access trails.

**Distribution and Diesel Generation**

The 21 remote electrical systems along the coasts of Labrador and the Island are served by diesel generation. Providing service to customers in these communities requires that the fuel storage, diesel generating units and distribution systems all be kept in safe, reliable and environmentally responsible working order. This application includes projects specifically directed towards meeting these requirements, such as upgrading of fuel storage at St. Lewis and increasing generation capacity at Mary's Harbour.

Hydro also provides service to residential and general service customers on the Island Interconnected System. Hydro has included projects in this application that are intended to ensure that distribution lines and equipment that require replacement due to age are replaced prior to failure, thereby reducing the probability of interrupting service to our customers. These projects include the replacement of recloser control panels.

Aside from projects that are designed to ensure reliable service, this application also includes projects to provide distribution upgrades and service extensions to new customers throughout Hydro's service area.

**GENERAL PROPERTIES ASSETS**

The General Properties category includes projects related to Hydro's Information Systems, where technology is strategically deployed in a wide variety of business applications. This section of the application

also includes proposals for vehicle replacements and telecommunications system replacements which are all necessary for the provision of reliable and cost effective service to customers.

Charts 6 and 7 show the breakdown of the General Properties Capital Budget for 2012 and the previous five year average, respectively.

**Chart 6: 2012 Capital Budget - General Properties**

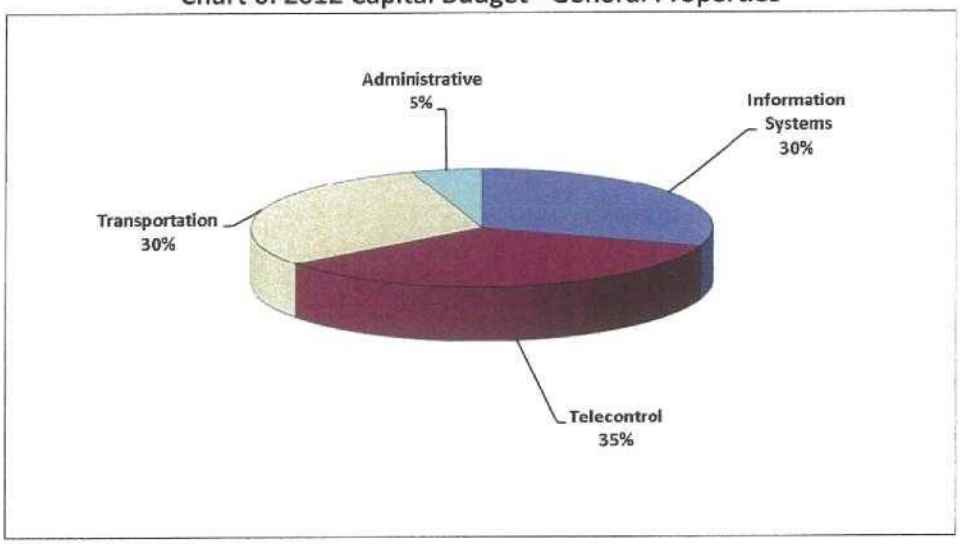
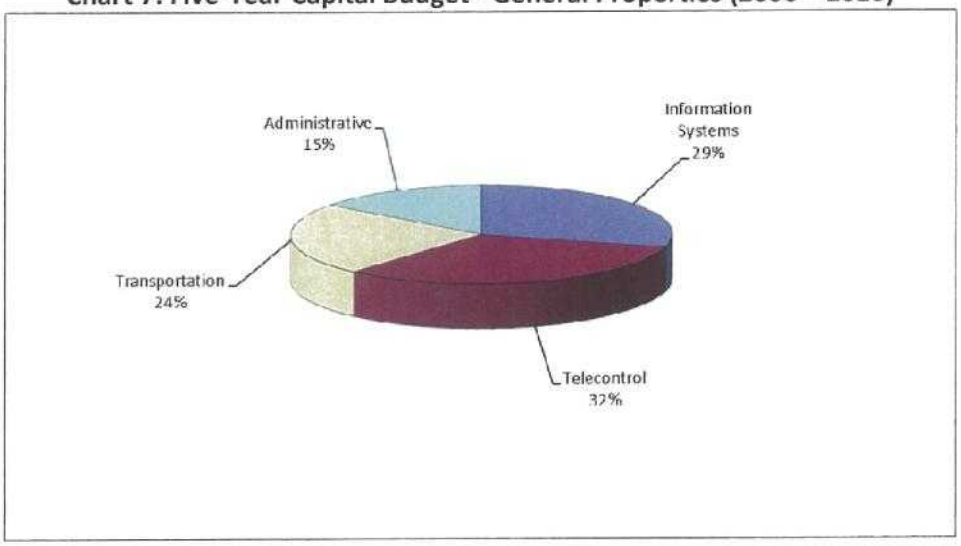



**Chart 7: Five-Year Capital Budget - General Properties (2006 – 2010)**



**Information Systems**

The Information Systems proposals include ongoing capital expenditures, and are directed towards maintaining Hydro's computing capacity and associated infrastructure ensuring that it remains current and reliable. Projects include upgrades to the software applications used throughout the Hydro system, the replacement of personal computers, and the replacement of peripheral infrastructure.

**Telecontrol**

Operating an integrated electrical system requires reliable communication systems across Hydro's province-wide facilities and among its employees, many of whom work in remote locations. The 2012 capital budget proposals in this category include infrastructure replacements and, in some cases, ongoing replacement or refurbishment programs, for such items as:

- Radome replacements;
- Replacing network communications equipment; and,
- Replacing battery banks and battery chargers.

In summary, Hydro's Capital Budget Application for 2012 contains various projects designed to provide cost effective and reliable power and energy to the residents and businesses of the province while ensuring employee and public safety and enabling Hydro to fulfill its environmental obligations.

**APPENDIX A**

**International Accounting Standard 16 - Property, Plant And Equipment**

January 1, 2011 >> IAS 16 Property, plant and equipment

# INTERNATIONAL ACCOUNTING STANDARD 16
# property, plant and equipment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## Objective

1 The objective of this Standard is to prescribe the accounting treatment for property, plant and equipment so that users of the financial statements can discern information about an entity's investment in its property, plant and equipment and the changes in such investment. The principal issues in accounting for property, plant and equipment are the recognition of the assets, the determination of their carrying amounts and the depreciation charges and impairment losses to be recognised in relation to them.

## Scope

2 This Standard shall be applied in accounting for property, plant and equipment except when another Standard requires or permits a different accounting treatment.

3 This Standard does not apply to:

(a) property, plant and equipment classified as held for sale in accordance with IFRS 5 *Non-current Assets Held for Sale and Discontinued Operations*;

(b) biological assets related to agricultural activity (see IAS 41 *Agriculture*);

(c) the recognition and measurement of exploration and evaluation assets (see IFRS 6 *Exploration for and Evaluation of Mineral Resources*); or

(d) mineral rights and mineral reserves such as oil, natural gas and similar non-regenerative resources.

However, this Standard applies to property, plant and equipment used to develop or maintain the assets described in (b)–(d).

4 Other Standards may require recognition of an item of property, plant and equipment based on an approach different from that in this Standard. For example, IAS 17 *Leases* requires an entity to evaluate its recognition of an item of leased property, plant and equipment on the basis of the transfer of risks and rewards. However, in such cases other aspects of the accounting treatment for these assets, including depreciation, are prescribed by this Standard.

5 An entity using the cost model for investment property in accordance with IAS 40 *Investment Property* shall use the cost model in this Standard.

**Definitions**

6 The following terms are used in this Standard with the meanings specified:

*Carrying amount* is the amount at which an asset is recognised after deducting any accumulated depreciation and accumulated impairment losses.

*Cost* is the amount of cash or cash equivalents paid or the fair value of the other consideration given to acquire an asset at the time of its acquisition or construction or, where applicable, the amount attributed to that asset when initially recognised in accordance with the specific requirements of other IFRSs, eg IFRS 2 *Share-based Payment*.

*Depreciable amount* is the cost of an asset, or other amount substituted for cost, less its residual value.

*Depreciation* is the systematic allocation of the depreciable amount of an asset over its useful life.

*Entity-specific value* is the present value of the cash flows an entity expects to arise from the continuing use of an asset and from its disposal at the end of its useful life or expects to incur when settling a liability.

*Fair value* is the amount for which an asset could be exchanged between knowledgeable, willing parties in an arm's length transaction.

An *impairment loss* is the amount by which the carrying amount of an asset exceeds its recoverable amount.

*Property, plant and equipment* are tangible items that:

**(a) are held for use in the production or supply of goods or services, for rental to others, or for administrative purposes; and**

**(b) are expected to be used during more than one period.**

*Recoverable amount* is the higher of an asset's fair value less costs to sell and its value in use.

The *residual value* of an asset is the estimated amount that an entity would currently obtain from disposal of the asset, after deducting the estimated costs of disposal, if the asset were already of the age and in the condition expected at the end of its useful life.

*Useful life* is:

**(a) the period over which an asset is expected to be available for use by an entity; or**

**(b) the number of production or similar units expected to be obtained from the asset by an entity.**

## Recognition

7 The cost of an item of property, plant and equipment shall be recognised as an asset if, and only if:

**(a) it is probable that future economic benefits associated with the item will flow to the entity; and**

**(b) the cost of the item can be measured reliably.**

8 Spare parts and servicing equipment are usually carried as inventory and recognised in profit or loss as consumed. However, major spare parts and stand-by equipment qualify as property, plant and equipment when an entity expects to use them during more than one period. Similarly, if the spare parts and servicing equipment can be used only in connection with an item of property, plant and equipment, they are accounted for as property, plant and equipment.

9 This Standard does not prescribe the unit of measure for recognition, ie what constitutes an item of property, plant and equipment. Thus, judgement is required in applying the recognition criteria to an entity's specific circumstances. It may be appropriate to aggregate individually insignificant items, such as moulds, tools and dies, and to apply the criteria to the aggregate value.

10 An entity evaluates under this recognition principle all its property, plant and equipment costs at the time they are incurred. These costs include costs incurred initially to acquire or construct an item of property, plant and equipment and costs incurred subsequently to add to, replace part of, or service it.

### Initial costs

11 Items of property, plant and equipment may be acquired for safety or environmental reasons. The acquisition of such property, plant and equipment, although not directly increasing the future economic benefits of any particular existing item of property, plant and equipment, may be necessary for an entity to obtain the future economic benefits from its other assets. Such items of property, plant and equipment qualify for recognition as assets because they enable an entity to derive future economic benefits from related assets in excess of what could be derived had those items not been acquired. For example, a chemical manufacturer may install new chemical handling processes to comply with environmental requirements for the production and storage of dangerous chemicals; related plant enhancements are recognised as an asset because without them the entity is unable to manufacture and sell chemicals. However, the resulting carrying amount of such an asset and related assets is reviewed for impairment in accordance with IAS 36 *Impairment of Assets*.

### Subsequent costs

12 Under the recognition principle in paragraph 7, an entity does not recognise in the carrying amount of an item of property, plant and equipment the costs of the day-to-day servicing of the item. Rather, these costs are recognised in profit or loss as incurred. Costs of day-to-day servicing are primarily the costs of labour and consumables, and may include the cost of small parts. The purpose of these expenditures is often described as for the 'repairs and maintenance' of the item of property, plant and equipment.

13 Parts of some items of property, plant and equipment may require replacement at regular intervals. For example, a furnace may require relining after a specified number of hours of use, or aircraft interiors such as seats and galleys may require replacement several times during the life of the airframe. Items of property, plant and equipment may also be acquired to make a less frequently recurring replacement, such as replacing the interior walls of a building, or to make a nonrecurring replacement. Under the recognition principle in paragraph 7, an entity recognises in the carrying amount of an item of property, plant and equipment the cost of replacing part of such an item when that cost is incurred if the recognition criteria are met. The carrying amount of those parts that are replaced is derecognised in accordance with the derecognition provisions of this Standard (see paragraphs 67–72).

14 A condition of continuing to operate an item of property, plant and equipment (for example, an aircraft) may be performing regular major inspections for faults regardless of whether parts of the item are replaced. When each major inspection is performed, its cost is recognised in the carrying amount of the item of property, plant and equipment as a replacement if the recognition criteria are satisfied. Any remaining carrying amount of the cost of the previous inspection (as distinct from physical parts) is derecognised. This occurs regardless of whether the cost of the previous inspection was identified in the transaction in which the item was acquired or constructed. If necessary, the estimated cost of a future similar inspection may be used as an indication of what the cost of the existing inspection component was when the item was acquired or constructed.

**Measurement at recognition**

15 An item of property, plant and equipment that qualifies for recognition as an asset shall be measured at its cost.

**Elements of cost**

16 The cost of an item of property, plant and equipment comprises:

(a) its purchase price, including import duties and non-refundable purchase taxes, after deducting trade discounts and rebates.

(b) any costs directly attributable to bringing the asset to the location and condition necessary for it to be capable of operating in the manner intended by management.

(c) the initial estimate of the costs of dismantling and removing the item and restoring the site on which it is located, the obligation for which an entity incurs either when the item is acquired or as a consequence of having used the item during a particular period for purposes other than to produce inventories during that period.

17 Examples of directly attributable costs are:

(a) costs of employee benefits (as defined in IAS 19 *Employee Benefits*) arising directly from the construction or acquisition of the item of property, plant and equipment;

(b) costs of site preparation;

(c) initial delivery and handling costs;

(d) installation and assembly costs;

(e) costs of testing whether the asset is functioning properly, after deducting the net proceeds from selling any items produced while bringing the asset to that location and condition (such as samples produced when testing equipment); and

(f) professional fees.

18 An entity applies IAS 2 *Inventories* to the costs of obligations for dismantling, removing and restoring the site on which an item is located that are incurred during a particular period as a consequence of having used the item to produce inventories during that period. The obligations for costs accounted for in accordance with IAS 2 or IAS 16 are recognised and measured in accordance with IAS 37 *Provisions, Contingent Liabilities and Contingent Assets.*

19 Examples of costs that are not costs of an item of property, plant and equipment are:

(a) costs of opening a new facility;

(b) costs of introducing a new product or service (including costs of advertising and promotional activities);

(c) costs of conducting business in a new location or with a new class of customer (including costs of staff training); and

(d) administration and other general overhead costs.

20 Recognition of costs in the carrying amount of an item of property, plant and equipment ceases when the item is in the location and condition necessary for it to be capable of operating in the manner intended by management. Therefore, costs incurred in using or redeploying an item are not included in the carrying amount of that item. For example, the following costs are not included in the carrying amount of an item of property, plant and equipment:

(a) costs incurred while an item capable of operating in the manner intended by management has yet to be brought into use or is operated at less than full capacity;

(b) initial operating losses, such as those incurred while demand for the item's output builds up; and

(c) costs of relocating or reorganising part or all of an entity's operations.

21 Some operations occur in connection with the construction or development of an item of property, plant and equipment, but are not necessary to bring the item to the location and condition necessary for it to be capable of operating in the manner intended by management. These incidental operations may occur before or during the construction or development activities. For example, income may be earned through using a building site as a car park until construction starts. Because incidental operations are not necessary to bring an item to the location and condition necessary for it to be capable of operating in the manner intended by management, the income and related expenses of incidental operations are recognised in profit or loss and included in their respective classifications of income and expense.

22 The cost of a self-constructed asset is determined using the same principles as for an acquired asset. If an entity makes similar assets for sale in the normal course of business, the cost of the asset is usually the same as the cost of constructing an asset for sale (see IAS 2). Therefore, any internal profits are eliminated in arriving at such costs. Similarly, the cost of abnormal amounts of wasted material, labour, or other resources incurred in self-constructing an asset is not included in the cost of the asset. IAS 23 *Borrowing Costs* establishes criteria for the recognition of interest as a component of the carrying amount of a self-constructed item of property, plant and equipment.

**Measurement of cost**

23 The cost of an item of property, plant and equipment is the cash price equivalent at the recognition date. If payment is deferred beyond normal credit terms, the difference between the cash price equivalent and the total payment is recognised as interest over the period of credit unless such interest is capitalised in accordance with IAS 23.

24 One or more items of property, plant and equipment may be acquired in exchange for a non-monetary asset or assets, or a combination of monetary and non-monetary assets. The following discussion refers simply to an exchange of one non-monetary asset for another, but it also applies to all exchanges described in the preceding sentence. The cost of such an item of property, plant and equipment is measured at fair value unless (a) the

exchange transaction lacks commercial substance or (b) the fair value of neither the asset received nor the asset given up is reliably measurable. The acquired item is measured in this way even if an entity cannot immediately derecognise the asset given up. If the acquired item is not measured at fair value, its cost is measured at the carrying amount of the asset given up.

25 An entity determines whether an exchange transaction has commercial substance by considering the extent to which its future cash flows are expected to change as a result of the transaction. An exchange transaction has commercial substance if:

(a) the configuration (risk, timing and amount) of the cash flows of the asset received differs from the configuration of the cash flows of the asset transferred; or

(b) the entity-specific value of the portion of the entity's operations affected by the transaction changes as a result of the exchange; and

(c) the difference in (a) or (b) is significant relative to the fair value of the assets exchanged.

For the purpose of determining whether an exchange transaction has commercial substance, the entity-specific value of the portion of the entity's operations affected by the transaction shall reflect post-tax cash flows. The result of these analyses may be clear without an entity having to perform detailed calculations.

26 The fair value of an asset for which comparable market transactions do not exist is reliably measurable if (a) the variability in the range of reasonable fair value estimates is not significant for that asset or (b) the probabilities of the various estimates within the range can be reasonably assessed and used in estimating fair value. If an entity is able to determine reliably the fair value of either the asset received or the asset given up, then the fair value of the asset given up is used to measure the cost of the asset received unless the fair value of the asset received is more clearly evident.

27 The cost of an item of property, plant and equipment held by a lessee under a finance lease is determined in accordance with IAS 17.

28 The carrying amount of an item of property, plant and equipment may be reduced by government grants in accordance with IAS 20 *Accounting for Government Grants and Disclosure of Government Assistance*.

**Measurement after recognition**

29 An entity shall choose either the cost model in paragraph 30 or the revaluation model in paragraph 31 as its accounting policy and shall apply that policy to an entire class of property, plant and equipment.

**Cost model**

30 After recognition as an asset, an item of property, plant and equipment shall be carried at its cost less any accumulated depreciation and any accumulated impairment losses.

**Revaluation model**

31 After recognition as an asset, an item of property, plant and equipment whose fair value can be measured reliably shall be carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent accumulated depreciation and subsequent accumulated impairment losses. Revaluations shall be made with sufficient regularity to ensure that the carrying amount does not differ materially from that which would be determined using fair value at the end of the reporting period.

32 The fair value of land and buildings is usually determined from market-based evidence by appraisal that is normally undertaken by professionally qualified valuers. The fair value of items of plant and equipment is usually their market value determined by appraisal.

33 If there is no market-based evidence of fair value because of the specialised nature of the item of property, plant and equipment and the item is rarely sold, except as part of a continuing business, an entity may need to estimate fair value using an income or a depreciated replacement cost approach.

34 The frequency of revaluations depends upon the changes in fair values of the items of property, plant and equipment being revalued. When the fair value of a revalued asset differs materially from its carrying amount, a further revaluation is required. Some items of property, plant and equipment experience significant and volatile changes in fair value, thus necessitating annual revaluation. Such frequent revaluations are unnecessary for items of property, plant and equipment with only insignificant changes in fair value. Instead, it may be necessary to revalue the item only every three or five years.

35 When an item of property, plant and equipment is revalued, any accumulated depreciation at the date of the revaluation is treated in one of the following ways:

(a) restated proportionately with the change in the gross carrying amount of the asset so that the carrying amount of the asset after revaluation equals its revalued amount. This method is often used when an asset is revalued by means of applying an index to determine its depreciated replacement cost.

(b) eliminated against the gross carrying amount of the asset and the net amount restated to the revalued amount of the asset. This method is often used for buildings.

The amount of the adjustment arising on the restatement or elimination of accumulated depreciation forms part of the increase or decrease in carrying amount that is accounted for in accordance with paragraphs 39 and 40.

36 If an item of property, plant and equipment is revalued, the entire class of property, plant and equipment to which that asset belongs shall be revalued.

37 A class of property, plant and equipment is a grouping of assets of a similar nature and use in an entity's operations. The following are examples of separate classes:

(a) land;

(b) land and buildings;

(c) machinery;

(d) ships;

(e) aircraft;

(f) motor vehicles;

(g) furniture and fixtures; and

(h) office equipment.

38 The items within a class of property, plant and equipment are revalued simultaneously to avoid selective revaluation of assets and the reporting of amounts in the financial statements that are a mixture of costs and values as at different dates. However, a class of assets may be revalued on a rolling basis provided revaluation of the class of assets is completed within a short period and provided the revaluations are kept up to date.

39 If an asset's carrying amount is increased as a result of a revaluation, the increase shall be recognised in other comprehensive income and accumulated in equity under the heading of revaluation surplus. However, the increase shall be recognised in profit or loss to the extent that it reverses a revaluation decrease of the same asset previously recognised in profit or loss.

40 If an asset's carrying amount is decreased as a result of a revaluation, the decrease shall be recognised in profit or loss. However, the decrease shall be recognised in other comprehensive income to the extent of any credit balance existing in the revaluation surplus in respect of that asset. The decrease recognised in other comprehensive income reduces the amount accumulated in equity under the heading of revaluation surplus.

41 The revaluation surplus included in equity in respect of an item of property, plant and equipment may be transferred directly to retained earnings when the asset is derecognised. This may involve transferring the whole of the surplus when the asset is retired or disposed of. However, some of the surplus may be transferred as the asset is used by an entity. In such a case, the amount of the surplus transferred would be the difference between depreciation based on the revalued carrying amount of the asset and depreciation based on the asset's original cost. Transfers from revaluation surplus to retained earnings are not made through profit or loss.

42 The effects of taxes on income, if any, resulting from the revaluation of property, plant and equipment are recognised and disclosed in accordance with IAS 12 *Income Taxes*.

**Depreciation**

43 Each part of an item of property, plant and equipment with a cost that is significant in relation to the total cost of the item shall be depreciated separately.

44 An entity allocates the amount initially recognised in respect of an item of property, plant and equipment to its significant parts and depreciates separately each such part. For example, it may be appropriate to depreciate separately the airframe and engines of an aircraft, whether owned or subject to a finance lease. Similarly, if an entity acquires property, plant and equipment subject to an operating lease in which it is the lessor, it may be appropriate to depreciate separately amounts reflected in the cost of that item that are attributable to favourable or unfavourable lease terms relative to market terms.

45 A significant part of an item of property, plant and equipment may have a useful life and a depreciation method that are the same as the useful life and the depreciation method of another significant part of that same item. Such parts may be grouped in determining the depreciation charge.

46 To the extent that an entity depreciates separately some parts of an item of property, plant and equipment, it also depreciates separately the remainder of the item. The remainder consists of the parts of the item that are individually not significant. If an entity has varying expectations for these parts, approximation techniques may be necessary to depreciate the remainder in a manner that faithfully represents the consumption pattern and/or useful life of its parts.

47 An entity may choose to depreciate separately the parts of an item that do not have a cost that is significant in relation to the total cost of the item.

48 The depreciation charge for each period shall be recognised in profit or loss unless it is included in the carrying amount of another asset.

49 The depreciation charge for a period is usually recognised in profit or loss. However, sometimes, the future economic benefits embodied in an asset are absorbed in producing other assets. In this case, the depreciation charge constitutes part of the cost of the other asset and is included in its carrying amount. For example, the depreciation of manufacturing plant and equipment is included in the costs of conversion of inventories (see IAS 2). Similarly, depreciation of property, plant and equipment used for development activities may be included in the cost of an intangible asset recognised in accordance with IAS 38 *Intangible Assets*.

**Depreciable amount and depreciation period**

50 The depreciable amount of an asset shall be allocated on a systematic basis over its useful life.

51 The residual value and the useful life of an asset shall be reviewed at least at each financial year-end and, if expectations differ from previous estimates, the change(s) shall be accounted for as a change in an accounting estimate in accordance with IAS 8 *Accounting Policies, Changes in Accounting Estimates and Errors.*

52 Depreciation is recognised even if the fair value of the asset exceeds its carrying amount, as long as the asset's residual value does not exceed its carrying amount. Repair and maintenance of an asset do not negate the need to depreciate it.

53 The depreciable amount of an asset is determined after deducting its residual value. In practice, the residual value of an asset is often insignificant and therefore immaterial in the calculation of the depreciable amount.

54 The residual value of an asset may increase to an amount equal to or greater than the asset's carrying amount. If it does, the asset's depreciation charge is zero unless and until its residual value subsequently decreases to an amount below the asset's carrying amount.

55 Depreciation of an asset begins when it is available for use, ie when it is in the location and condition necessary for it to be capable of operating in the manner intended by management. Depreciation of an asset ceases at the earlier of the date that the asset is classified as held for sale (or included in a disposal group that is classified as held for sale) in accordance with IFRS 5 and the date that the asset is derecognised. Therefore, depreciation does not cease when the asset becomes idle or is retired from active use unless the asset is fully depreciated. However, under usage methods of depreciation the depreciation charge can be zero while there is no production.

56 The future economic benefits embodied in an asset are consumed by an entity principally through its use. However, other factors, such as technical or commercial obsolescence and wear and tear while an asset remains idle, often result in the diminution of the economic benefits that might have been obtained from the asset. Consequently, all the following factors are considered in determining the useful life of an asset:

(a) expected usage of the asset. Usage is assessed by reference to the asset's expected capacity or physical output.

(b) expected physical wear and tear, which depends on operational factors such as the number of shifts for which the asset is to be used and the repair and maintenance programme, and the care and maintenance of the asset while idle.

(c) technical or commercial obsolescence arising from changes or improvements in production, or from a change in the market demand for the product or service output of the asset.

(d) legal or similar limits on the use of the asset, such as the expiry dates of related leases.

57 The useful life of an asset is defined in terms of the asset's expected utility to the entity. The asset management policy of the entity may involve the disposal of assets after a specified time or after consumption of a specified proportion of the future economic benefits embodied in the asset. Therefore, the useful life of an asset may be shorter than its economic life. The estimation of the useful life of the asset is a matter of judgement based on the experience of the entity with similar assets.

58 Land and buildings are separable assets and are accounted for separately, even when they are acquired together. With some exceptions, such as quarries and sites used for landfill, land has an unlimited useful life and therefore is not depreciated. Buildings have a limited useful life and therefore are depreciable assets. An increase in the value of the land on which a building stands does not affect the determination of the depreciable amount of the building.

59 If the cost of land includes the costs of site dismantlement, removal and restoration, that portion of the land asset is depreciated over the period of benefits obtained by incurring those costs. In some cases, the land itself may have a limited useful life, in which case it is depreciated in a manner that reflects the benefits to be derived from it.

**Depreciation method**

60 The depreciation method used shall reflect the pattern in which the asset's future economic benefits are expected to be consumed by the entity.

61 The depreciation method applied to an asset shall be reviewed at least at each financial year-end and, if there has been a significant change in the expected pattern of consumption of the future economic benefits embodied in the asset, the method shall be changed to reflect the changed pattern. Such a change shall be accounted for as a change in an accounting estimate in accordance with IAS 8.

62 A variety of depreciation methods can be used to allocate the depreciable amount of an asset on a systematic basis over its useful life. These methods include the straight-line method, the diminishing balance method and the units of production method. Straight-line depreciation results in a constant charge over the useful life if the asset's residual value does not change. The diminishing balance method results in a decreasing charge over the useful life. The units of production method results in a charge based on the expected use or output. The entity selects the method that most closely reflects the expected pattern of consumption of the future economic benefits embodied in the asset. That method is applied consistently from period to period unless there is a change in the expected pattern of consumption of those future economic benefits.

**Impairment**

63 To determine whether an item of property, plant and equipment is impaired, an entity applies IAS 36 *Impairment of Assets*. That Standard explains how an entity reviews the carrying amount of its assets, how it determines the recoverable amount of an asset, and when it recognises, or reverses the recognition of, an impairment loss.

64 [Deleted]

**Compensation for impairment**

65 Compensation from third parties for items of property, plant and equipment that were impaired, lost or given up shall be included in profit or loss when the compensation becomes receivable.

66 Impairments or losses of items of property, plant and equipment, related claims for or payments of compensation from third parties and any subsequent purchase or construction of replacement assets are separate economic events and are accounted for separately as follows:

(a) impairments of items of property, plant and equipment are recognised in accordance with IAS 36;

(b) derecognition of items of property, plant and equipment retired or disposed of is determined in accordance with this Standard;

(c) compensation from third parties for items of property, plant and equipment that were impaired, lost or given up is included in determining profit or loss when it becomes receivable; and

(d) the cost of items of property, plant and equipment restored, purchased or constructed as replacements is determined in accordance with this Standard.

**Derecognition**

67 The carrying amount of an item of property, plant and equipment shall be derecognised:

**(a) on disposal; or**

**(b) when no future economic benefits are expected from its use or disposal.**

68 The gain or loss arising from the derecognition of an item of property, plant and equipment shall be included in profit or loss when the item is derecognised (unless IAS 17 requires otherwise on a sale and leaseback). Gains shall not be classified as revenue.

68A However, an entity that, in the course of its ordinary activities, routinely sells items of property, plant and equipment that it has held for rental to others shall transfer such assets to inventories at their carrying amount when they cease to be rented and become held for sale. The proceeds from the sale of such assets shall be recognised as revenue in accordance with IAS 18 *Revenue*. IFRS 5 does not apply when assets that are held for sale in the ordinary course of business are transferred to inventories.

69 The disposal of an item of property, plant and equipment may occur in a variety of ways (eg by sale, by entering into a finance lease or by donation). In determining the date of disposal of an item, an entity applies the criteria in IAS 18 for recognising revenue from the sale of goods. IAS 17 applies to disposal by a sale and leaseback.

70 If, under the recognition principle in paragraph 7, an entity recognises in the carrying amount of an item of property, plant and equipment the cost of a replacement for part of the item, then it derecognises the carrying amount of the replaced part regardless of whether the replaced part had been depreciated separately. If it is not practicable for an entity to determine the carrying amount of the replaced part, it may use the cost of the replacement as an indication of what the cost of the replaced part was at the time it was acquired or constructed.

71 The gain or loss arising from the derecognition of an item of property, plant and equipment shall be determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item.

72 The consideration receivable on disposal of an item of property, plant and equipment is recognised initially at its fair value. If payment for the item is deferred, the consideration received is recognised initially at the cash price equivalent. The difference between the nominal amount of the consideration and the cash price equivalent is recognised as interest revenue in accordance with IAS 18 reflecting the effective yield on the receivable.

**Disclosure**

73 The financial statements shall disclose, for each class of property, plant and equipment:

**(a) the measurement bases used for determining the gross carrying amount;**

**(b) the depreciation methods used;**

**(c) the useful lives or the depreciation rates used;**

**(d) the gross carrying amount and the accumulated depreciation (aggregated with accumulated impairment losses) at the beginning and end of the period; and**

**(e) a reconciliation of the carrying amount at the beginning and end of the period showing:**

**(i) additions;**

**(ii) assets classified as held for sale or included in a disposal group classified as held for sale in accordance with IFRS 5 and other disposals;**

**(iii) acquisitions through business combinations;**

**(iv) increases or decreases resulting from revaluations under paragraphs 31, 39 and 40 and from impairment losses recognised or reversed in other comprehensive income in accordance with IAS 36;**

**(v) impairment losses recognised in profit or loss in accordance with IAS 36;**

**(vi) impairment losses reversed in profit or loss in accordance with IAS 36;**

**(vii) depreciation;**

**(viii) the net exchange differences arising on the translation of the financial statements from the functional currency into a different presentation currency, including the translation of a foreign operation into the presentation currency of the reporting entity; and**

**(ix) other changes.**

74 The financial statements shall also disclose:

**(a) the existence and amounts of restrictions on title, and property, plant and equipment pledged as security for liabilities;**

**(b) the amount of expenditures recognised in the carrying amount of an item of property, plant and equipment in the course of its construction;**

**(c) the amount of contractual commitments for the acquisition of property, plant and equipment; and**

**(d) if it is not disclosed separately in the statement of comprehensive income, the amount of compensation from third parties for items of property, plant and equipment that were impaired, lost or given up that is included in profit or loss.**

75 Selection of the depreciation method and estimation of the useful life of assets are matters of judgement. Therefore, disclosure of the methods adopted and the estimated useful lives or depreciation rates provides users of financial statements with information that allows them to review the policies selected by management and enables comparisons to be made with other entities. For similar reasons, it is necessary to disclose:

(a) depreciation, whether recognised in profit or loss or as a part of the cost of other assets, during a period; and

(b) accumulated depreciation at the end of the period.

76 In accordance with IAS 8 an entity discloses the nature and effect of a change in an accounting estimate that has an effect in the current period or is expected to have an effect in subsequent periods. For property, plant and equipment, such disclosure may arise from changes in estimates with respect to:

(a) residual values;

(b) the estimated costs of dismantling, removing or restoring items of property, plant and equipment;

(c) useful lives; and

(d) depreciation methods.

77 If items of property, plant and equipment are stated at revalued amounts, the following shall be disclosed:

**(a) the effective date of the revaluation;**

**(b) whether an independent valuer was involved;**

**(c) the methods and significant assumptions applied in estimating the items' fair values;**

**(d) the extent to which the items' fair values were determined directly by reference to observable prices in an active market or recent market transactions on arm's length terms or were estimated using other valuation techniques;**

**(e) for each revalued class of property, plant and equipment, the carrying amount that would have been recognised had the assets been carried under the cost model; and**

**(f) the revaluation surplus, indicating the change for the period and any restrictions on the distribution of the balance to shareholders.**

78 In accordance with IAS 36 an entity discloses information on impaired property, plant and equipment in addition to the information required by paragraph 73(e)(iv)–(vi).

79 Users of financial statements may also find the following information relevant to their needs:

(a) the carrying amount of temporarily idle property, plant and equipment;

(b) the gross carrying amount of any fully depreciated property, plant and equipment that is still in use;

(c) the carrying amount of property, plant and equipment retired from active use and not classified as held for sale in accordance with IFRS 5; and

(d) when the cost model is used, the fair value of property, plant and equipment when this is materially different from the carrying amount.

Therefore, entities are encouraged to disclose these amounts.

**Transitional provisions**

80 The requirements of paragraphs 24–26 regarding the initial measurement of an item of property, plant and equipment acquired in an exchange of assets transaction shall be applied prospectively only to future transactions.

**Effective date**

81 An entity shall apply this Standard for annual periods beginning on or after 1 January 2005. Earlier application is encouraged. If an entity applies this Standard for a period beginning before 1 January 2005, it shall disclose that fact.

81A An entity shall apply the amendments in paragraph 3 for annual periods beginning on or after 1 January 2006. If an entity applies IFRS 6 for an earlier period, those amendments shall be applied for that earlier period.

81B IAS 1 *Presentation of Financial Statements* (as revised in 2007) amended the terminology used throughout IFRSs. In addition it amended paragraphs 39, 40 and 73(e)(iv). An entity shall apply those amendments for annual periods beginning on or after 1 January 2009. If an entity applies IAS 1 (revised 2007) for an earlier period, the amendments shall be applied for that earlier period.

81C IFRS 3 *Business Combinations* (as revised in 2008) amended paragraph 44. An entity shall apply that amendment for annual periods beginning on or after 1 July 2009. If an entity applies IFRS 3 (revised 2008) for an earlier period, the amendment shall also be applied for that earlier period.

81D Paragraphs 6 and 69 were amended and paragraph 68A was added by *Improvements to IFRSs* issued in May 2008. An entity shall apply those amendments for annual periods beginning on or after 1 January 2009. Earlier application is permitted. If an entity applies the amendments for an earlier period it shall disclose that fact and at the same time apply the related amendments to IAS 7 *Statement of Cash Flows.*

81E Paragraph 5 was amended by *Improvements to IFRSs* issued in May 2008. An entity shall apply that amendment prospectively for annual periods beginning on or after 1 January 2009. Earlier application is permitted if an entity also applies the amendments to paragraphs 8, 9, 22, 48, 53, 53A, 53B, 54, 57 and 85B of IAS 40 at the same time. If an entity applies the amendment for an earlier period it shall disclose that fact.

**Withdrawal of other pronouncements**

82 This Standard supersedes IAS 16 *Property, Plant and Equipment* (revised in 1998).

83 This Standard supersedes the following Interpretations:

(a) SIC-6 *Costs of Modifying Existing Software*;

(b) SIC-14 *Property, Plant and Equipment — Compensation for the Impairment or Loss of Items*; and

(c) SIC-23 *Property, Plant and Equipment — Major Inspection or Overhaul Costs.*

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# APPENDIX B

## International Accounting Standard 23 - Borrowing Costs

**Accounting >> Part I – International Financial Reporting Standards >> 2011 Edition >> IFRSs in effect on January 1, 2011 >> IAS 23 Borrowing costs**

## INTERNATIONAL ACCOUNTING STANDARD 23
## borrowing costs

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### Core principle

1 Borrowing costs that are directly attributable to the acquisition, construction or production of a qualifying asset form part of the cost of that asset. Other borrowing costs are recognised as an expense.

### Scope

2 An entity shall apply this Standard in accounting for borrowing costs.

3 The Standard does not deal with the actual or imputed cost of equity, including preferred capital not classified as a liability.

4 An entity is not required to apply the Standard to borrowing costs directly attributable to the acquisition, construction or production of:

(a) a qualifying asset measured at fair value, for example a biological asset; or

(b) inventories that are manufactured, or otherwise produced, in large quantities on a repetitive basis.

### Definitions

5 This Standard uses the following terms with the meanings specified:

*Borrowing costs* are interest and other costs that an entity incurs in connection with the borrowing of funds.

A *qualifying asset* is an asset that necessarily takes a substantial period of time to get ready for its intended use or sale.

6 Borrowing costs may include:

(a) interest expense calculated using the effective interest method as described in IAS 39 *Financial Instruments: Recognition and Measurement*;

(b) [deleted]

(c) [deleted]

(d) finance charges in respect of finance leases recognised in accordance with IAS 17 *Leases*; and

(e) exchange differences arising from foreign currency borrowings to the extent that they are regarded as an adjustment to interest costs.

7 Depending on the circumstances, any of the following may be qualifying assets:

(a) inventories

(b) manufacturing plants

(c) power generation facilities

(d) intangible assets

(e) investment properties.

Financial assets, and inventories that are manufactured, or otherwise produced, over a short period of time, are not qualifying assets. Assets that are ready for their intended use or sale when acquired are not qualifying assets.

## Recognition

8 An entity shall capitalise borrowing costs that are directly attributable to the acquisition, construction or production of a qualifying asset as part of the cost of that asset. An entity shall recognise other borrowing costs as an expense in the period in which it incurs them.

9 Borrowing costs that are directly attributable to the acquisition, construction or production of a qualifying asset are included in the cost of that asset. Such borrowing costs are capitalised as part of the cost of the asset when it is probable that they will result in future economic benefits to the entity and the costs can be measured reliably. When an entity applies IAS 29 *Financial Reporting in Hyperinflationary Economies*, it recognises as an expense the part of borrowing costs that compensates for inflation during the same period in accordance with paragraph 21 of that Standard.

### Borrowing costs eligible for capitalisation

10 The borrowing costs that are directly attributable to the acquisition, construction or production of a qualifying asset are those borrowing costs that would have been avoided if the expenditure on the qualifying asset had not been made. When an entity borrows funds specifically for the purpose of obtaining a particular qualifying asset, the borrowing costs that directly relate to that qualifying asset can be readily identified.

11 It may be difficult to identify a direct relationship between particular borrowings and a qualifying asset and to determine the borrowings that could otherwise have been avoided. Such a difficulty occurs, for example, when the financing activity of an entity is co-ordinated centrally. Difficulties also arise when a group uses a range of debt instruments to borrow funds at varying rates of interest, and lends those funds on various bases to other entities in the group. Other complications arise through the use of loans denominated in or linked to foreign currencies, when the group operates in highly inflationary economies, and from fluctuations in exchange rates. As a result, the determination of the amount of borrowing costs that are directly attributable to the acquisition of a qualifying asset is difficult and the exercise of judgement is required.

12 To the extent that an entity borrows funds specifically for the purpose of obtaining a qualifying asset, the entity shall determine the amount of borrowing costs eligible for capitalisation as the actual borrowing costs incurred on that borrowing during the period less any investment income on the temporary investment of those borrowings.

13 The financing arrangements for a qualifying asset may result in an entity obtaining borrowed funds and incurring associated borrowing costs before some or all of the funds are used for expenditures on the qualifying asset. In such circumstances, the funds are often temporarily invested pending their expenditure on the qualifying asset. In determining the amount of borrowing costs eligible for capitalisation during a period, any investment income earned on such funds is deducted from the borrowing costs incurred.

14 To the extent that an entity borrows funds generally and uses them for the purpose of obtaining a qualifying asset, the entity shall determine the amount of borrowing costs eligible for capitalisation by applying a capitalisation rate to the expenditures on that asset. The capitalisation rate shall be the weighted average of the borrowing costs applicable to the borrowings of the entity that are outstanding during the period, other than borrowings made specifically for the purpose of obtaining a qualifying asset. The amount of borrowing costs that an entity capitalises during a period shall not exceed the amount of borrowing costs it incurred during that period.

15 In some circumstances, it is appropriate to include all borrowings of the parent and its subsidiaries when computing a weighted average of the borrowing costs; in other circumstances, it is appropriate for each subsidiary to use a weighted average of the borrowing costs applicable to its own borrowings.

**Excess of the carrying amount of the qualifying asset over recoverable amount**

16 When the carrying amount or the expected ultimate cost of the qualifying asset exceeds its recoverable amount or net realisable value, the carrying amount is written down or written off in accordance with the requirements of other Standards. In certain circumstances, the amount of the write-down or write-off is written back in accordance with those other Standards.

**Commencement of capitalisation**

17 An entity shall begin capitalising borrowing costs as part of the cost of a qualifying asset on the commencement date. The commencement date for capitalisation is the date when the entity first meets all of the following conditions:

**(a) it incurs expenditures for the asset;**

**(b) it incurs borrowing costs; and**

**(c) it undertakes activities that are necessary to prepare the asset for its intended use or sale.**

18 Expenditures on a qualifying asset include only those expenditures that have resulted in payments of cash, transfers of other assets or the assumption of interest-bearing liabilities. Expenditures are reduced by any progress payments received and grants received in connection with the asset (see IAS 20 *Accounting for Government Grants and Disclosure of Government Assistance*). The average carrying amount of the asset during a period, including borrowing costs previously capitalised, is normally a reasonable approximation of the expenditures to which the capitalisation rate is applied in that period.

19 The activities necessary to prepare the asset for its intended use or sale encompass more than the physical construction of the asset. They include technical and administrative work prior to the commencement of physical construction, such as the activities associated with obtaining permits prior to the commencement of the physical construction. However, such activities exclude the holding of an asset when no production or development that changes the asset's condition is taking place. For example, borrowing costs incurred while land is under development are capitalised during the period in which activities related to the development are being undertaken. However, borrowing costs incurred while land acquired for building purposes is held without any associated development activity do not qualify for capitalisation.

**Suspension of capitalisation**

20 An entity shall suspend capitalisation of borrowing costs during extended periods in which it suspends active development of a qualifying asset.

21 An entity may incur borrowing costs during an extended period in which it suspends the activities necessary to prepare an asset for its intended use or sale. Such costs are costs of holding partially completed assets and do not qualify for capitalisation. However, an entity does not normally suspend capitalising borrowing costs during a period when it carries out substantial technical and administrative work. An entity also does not suspend capitalising borrowing costs when a temporary delay is a necessary part of the process of getting an asset ready for its intended use or sale. For example, capitalisation continues during the extended period that high water levels delay construction of a bridge, if such high water levels are common during the construction period in the geographical region involved.

**Cessation of capitalisation**

22 An entity shall cease capitalising borrowing costs when substantially all the activities necessary to prepare the qualifying asset for its intended use or sale are complete.

23 An asset is normally ready for its intended use or sale when the physical construction of the asset is complete even though routine administrative work might still continue. If minor modifications, such as the decoration of a property to the purchaser's or user's specification, are all that are outstanding, this indicates that substantially all the activities are complete.

24 When an entity completes the construction of a qualifying asset in parts and each part is capable of being used while construction continues on other parts, the entity shall cease capitalising borrowing costs when it completes substantially all the activities necessary to prepare that part for its intended use or sale.

25 A business park comprising several buildings, each of which can be used individually, is an example of a qualifying asset for which each part is capable of being usable while construction continues on other parts. An example of a qualifying asset that needs to be complete before any part can be used is an industrial plant involving several processes which are carried out in sequence at different parts of the plant within the same site, such as a steel mill.

## Disclosure

26 An entity shall disclose:

**(a) the amount of borrowing costs capitalised during the period; and**

**(b) the capitalisation rate used to determine the amount of borrowing costs eligible for capitalisation.**

## Transitional provisions

27 When application of this Standard constitutes a change in accounting policy, an entity shall apply the Standard to borrowing costs relating to qualifying assets for which the commencement date for capitalisation is on or after the effective date.

28 However, an entity may designate any date before the effective date and apply the Standard to borrowing costs relating to all qualifying assets for which the commencement date for capitalisation is on or after that date.

**Effective date**

29 An entity shall apply the Standard for annual periods beginning on or after 1 January 2009. Earlier application is permitted. If an entity applies the Standard from a date before 1 January 2009, it shall disclose that fact.

29A Paragraph 6 was amended by *Improvements to IFRSs* issued in May 2008. An entity shall apply that amendment for annual periods beginning on or after 1 January 2009. Earlier application is permitted. If an entity applies the amendment for an earlier period it shall disclose that fact.

**Withdrawal of IAS 23 (revised 1993)**

30 This Standard supersedes IAS 23 *Borrowing Costs* revised in 1993.

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A Report to the

Board of Commissioners of Public Utilities

# 2012 Capital Plan

# 2011-08-01

newfoundland labrador hydro
a nalcor energy company

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## *Introduction*

In Board Order No. P.U. 30 (2007), Hydro was directed to file a five-year capital expenditure plan. The Board indicated the plan should focus on strategic spending priorities beginning with the current year of the Application. As well, the capital expenditure plan should identify shifts in spending priorities over the five-year period, the circumstances contributing to these shifts, and alternative approaches under consideration. Additionally, the Board requested a separate section concerning Holyrood, including the impacts of the Provincial Energy Plan, an impact statement concerning alternative development scenarios reflecting how decisions associated with each scenario might influence the physical plant, the environmental, operational and management imperatives, as well as forecast maintenance and capital requirements for the ensuing five years. Each individual project at the Holyrood plant contained in the annual capital budget submission could then be reconciled, justified and costed in respect of one or more development scenarios. Hydro developed and filed a five and twenty-year plan with the 2010 Capital Budget Application.

Hydro has a responsibility to provide safe, reliable, and least-cost service to meet the needs of its customers. Providing a reliable supply of electrical energy depends on maintaining assets in sound condition. Utility assets are kept in reliable working condition by routine maintenance and replacement when necessary. Asset additions are determined through analysis of long term requirements to address future demands for power and energy, and transmission and distribution additions are also identified.

The 1960's saw a vast expansion in assets to fulfill the mandate of the Newfoundland and Labrador Power Commission, Hydro's predecessor, which was to electrify the province. This rapid expansion means that many of the assets constructed have reached their expected service lives and many others are approaching that juncture. Other major assets have not reached their expected service lives but some of their components, auxiliary equipment and systems have, or are about to do so. This includes components of major facilities such as the Bay d'Espoir Generating Station, the Holyrood Thermal Generating Station, the Hardwoods and Stephenville gas turbines, the Holyrood gas turbine and much of Hydro's transmission and distribution systems. Hydro has a responsibility to maintain this infrastructure to a level that continues to allow Newfoundlanders and Labradorians to live in a modern society, dependent on a reliable supply of electricity for home and business use.

In 2007, the Government of Newfoundland and Labrador released its Energy Plan which outlines the importance of maintaining a reliable electricity supply. Replacing and maintaining assets is a vital component to sustaining and improving existing systems. It also indicates that the preferred solution to the Province's long term electrical energy needs is the construction of the Lower Churchill Project and delivery of electricity to the Island via high voltage direct current (HVdc) transmission.

## *Twenty Year Plan*

Hydro's planning horizon for asset additions extends to twenty years in the future, depending on the asset, and these additions are planned for construction on a just-in-time basis. This 20 Year Capital Plan does not include additional generation capacity to address future energy requirements of the interconnected electrical systems, nor does it include proposals for Conservation and Demand Management (CDM). The plan does contain some additional generation capacity for isolated diesel generation systems. CDM may include other capital plans intended to reduce demand and energy needs that, aside from reducing fuel requirements, may impact generation additions. Asset replacements are planned based on condition assessments, maintenance and operating cost reviews, changing technology, expected service lives of equipment and knowledge of individual assets. Table 1 summarizes Hydro's service lives for major asset classes.

**Table 1 - Asset Service Lives**

| Asset Type | Typical Useful Life |
|---|---|
| Thermal Power Plant | 25 and 30 years |
| Hydroelectric Power Plant | 25, 50, 75, and 100 years |
| Gas Turbine Plant | 15 years |
| Diesel Plant | 20 years |
| Transmission Line | 40 and 50 years |
| Terminal Station | 40 years |
| Transformer | 40 years |
| Distribution System | 30 years |

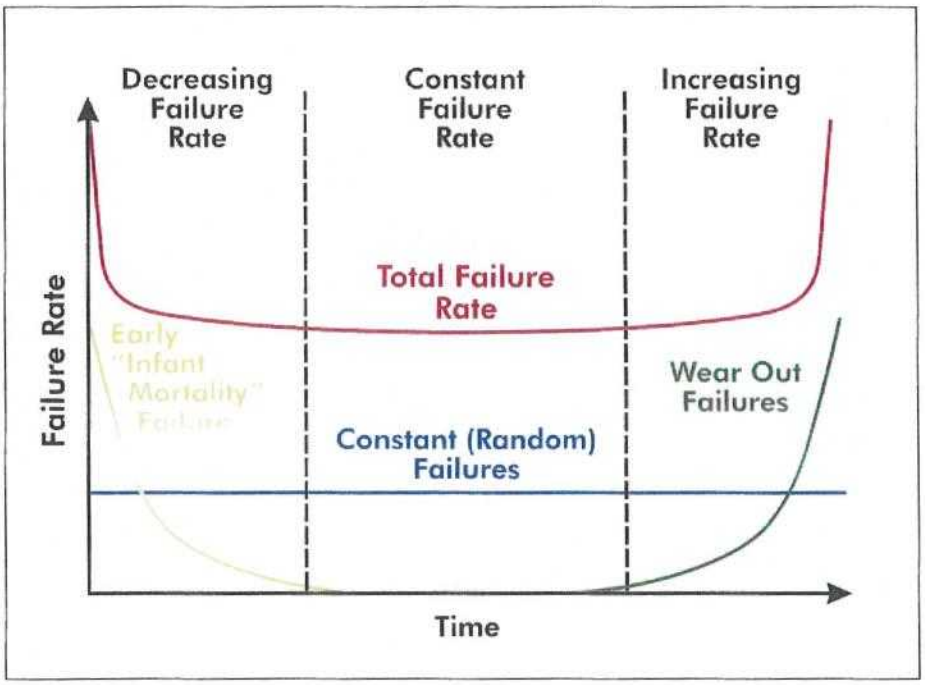
Table 2 indicates when some of Hydro's major assets were placed in service.

**Table 2 - Age of Selected Hydro Assets**

| Facility | Year Commissioned |
|---|---|
| Bay d'Espoir Stage 1 | 1967 |
| Bay d'Espoir Stage 2 | 1969 |
| Bay d'Espoir Stage 3 | 1977 |
| Holyrood Generating Station Stage 1 | 1971 |
| Holyrood Generating Station Stage 2 | 1979 |
| Stephenville Gas Turbine | 1976 |
| Hardwoods Gas Turbine | 1977 |
| Hinds Lake | 1980 |
| Upper Salmon | 1983 |
| Cat Arm | 1985 |
| Paradise River | 1989 |
| Granite Canal | 2003 |
| Transmission lines (numerous) | Beginning 1967 |
| Terminal Stations (numerous) | Beginning 1967 |

The reliability of most equipment over its lifespan follows a generally accepted trend, known as the bathtub curve, as illustrated in the following diagram:

**Chart 1 – Equipment Lifespan**




Total Failure Rate, which in its graphic form is known as a "bathtub" curve because of its shape, is the sum of three individual types of failures:

1. Random failures, which are failures caused by a variety of reasons with unpredictable frequency.

2. Infant mortality failures, which occur during the first years of operation and are generally attributed to design, application, material or manufacturing defects or improper operation. These are "break in" failures.

3. Wear out failures, which, as the term implies, occur as the asset, or some of its components, reach the end of their service lives and break down.

The above tables and diagram indicate that many of Hydro's major assets have reached, or are about to reach, maturity, at which time steps must be taken to ensure that reliable service is maintained. These steps can include refurbishment and partial or total replacement. Over recent years many projects were implemented to refurbish or replace mature assets or asset components, and the number of these projects will continue to grow to ensure Hydro continues to provide a reliable supply of electricity to its

customers. Hydro manages its assets to provide reliable least cost electricity to its customers. Beyond the 2012 submittal, Hydro's five year plan is under substantive review.

The five and 20-year plans are living documents and will be revised on an ongoing basis as new information about the condition of Hydro's assets becomes available, as asset management strategies evolve, and as demands and priorities change within asset classes. During 2011, Hydro devoted significant effort into developing and refining the five and 20 year plans. A key finding of this work is the general increase in required sustaining capital to continue to provide safe, reliable, least cost power to Hydro's customers. Furthermore, the work highlighted additional capital activity the will be required to address load growth.

Coming out of this work, Hydro expects that more robust five and 20 year plans will be developed. As Hydro continues to leverage the benefits of its asset management activity and the realignment of its Project Execution and Technical Services group, further enhancements to plan quality will result

As the Board is aware, a Labrador Interconnection scenario is more likely than ever, and reviews of the Muskrat Falls project are ongoing. Since the analysis of the least cost option was prepared using the report entitled *Generation Planning Issues 2010 Mid Year Report*, no further update to that report has yet been prepared. Therefore there are still two long term expansions scenarios: an interconnected scenario based upon importation of electricity from the Lower Churchill Project; and an Isolated Island scenario in which future energy requirements are derived from an assortment of renewable and non-renewable assets. For the sake of clarity and simplicity, none of these generation expansion scenarios is included in the 20 year Capital Plan; it addresses existing assets only with a few exceptions, such as terminal station and transmission line additions which will be required whether or not an HVdc infeed is constructed, and capacity additions at isolated diesel plants as well as distribution system expansion.

Hydro anticipates that its 2012 – 2016 sustaining capital expenditures to maintain the existing systems will rise, and the draft five year plan is currently under substantive review. Hydro will update the five year projection in in the December 2011 quarterly report. Expenditures for new generation and transmission assets are not included in these estimates, with the exception of the addition of a transformer at Oxen Pond Terminal Station, and the upgrade of the transmission line corridor between Bay d'Espoir and Western Avalon.

## *Strategic Spending Priorities*

The strategic priorities are:

1. Mandatory Issues:
    - Ensuring the safety of Hydro personnel, its contractors, and the general public;
    - Compliance with legislative and regulatory requirements; and
    - Dealing with environmental risks.
2. Meeting projected load growth and customer requests;
3. Achieving cost efficiencies;
4. Asset Maintenance Philosophy initiated in 2007
    - Maintaining reliability by addressing issues identified by:
        - Operating experience
        - Maintenance history
        - Condition assessments
        - Performance assessments
        - Familiarity with equipment
        - Operating and maintenance cost
        - Professional judgment
        - Asset Maintenance Strategy
        - Discussion between Regulated Operations and Technical Services
    - Reliability improvement

## Asset Management Philosophy

Hydro's Asset Management Philosophy is a multi-pronged approach to formally documenting, reviewing and revising asset maintenance tactics in the short, medium and long term. Asset management is the comprehensive management of asset requirements, planning, procurement, operations, maintenance, and evaluation in terms of life extension or rehabilitation, replacement or retirement to achieve maximum value for the stakeholders based on the required standard of service to current and future generations.

A detailed review of Hydro's asset management strategy is well advanced and will be completed in 2011. This review will ensure that all maintenance activities are the most appropriate for the installed asset base.

## Asset Management, Project Execution and Technical Services Division

The Asset Management, Project Execution and Technical Services division is responsible for providing full and comprehensive services to support the asset management and technical needs of the business, as well as manage and perform design, planning and delivery for both operating and capital projects from concept to final implementation and close-out.

In late 2010 and in 2011, a series of reorganizations were made within the organization to assist with enhancing its asset management philosophy as well as the manner in which capital and operating projects are planned and executed. Key elements of this activity included:

- Establishment of the Office of Asset Management (OAM) to lead activities in the drive for asset management excellence, and to ensure a best practice based, consistent approach is applied to asset management across the business. The OAM also coordinates and leads multi-disciplined technical groups to assist with ensuring that these best practices are identified and propagated through the organization.

- Realigning engineering functions into Project Execution functions and Technical Services. Project Execution is accountable for the on-time, on-budget delivery of projects that satisfy the requirements of the business, and defining project management standards, guidelines, and methods. Project managers draw support from the Technical Services and Project Support groups. Project Execution is involved in all elements of the planning, design and execution of

projects. The primary focus of this section is to ensure the timely and cost-effective completion of the annual capital and operating program, and the role oversees the coordination of project teams and work execution in consultation with discipline leads and their teams.

The Technical Services section consists of separate departments for Civil, Electrical, Mechanical, Protection, Control and Communications, and Transmission and Distribution Engineering. This section represents the functional experts in their respective areas of engineering expertise, and provides project execution and technical/operating assistance from the appropriate discipline experts when needed.

The Project Support group provides services in the areas of contract administration, procurement and document control

## *Resource Planning in Support of 2012 Execution*

In addition to Hydro's normal planning efforts associated with the development of capital budget applications, extra rigor has been applied in the area of resource planning as it related to the 2012 Capital Budget Application. Particular effort has gone into identifying resource requirements for 2012 work, and reviewing these requirements in light of available resources. Specific steps taken this year include:

- Defining resource requirements for each project as it is being considered and formulated
- Performing a high level execution planning and resource leveling exercise that confirms and optimizes resource allocation in support of execution
- Comparing execution planning and resource leveling needs to available resources
- Identifying gaps between needs and availability
- Identifying options and solutions for these gaps

The activity and rigor that has been applied to the 2012 projects puts Hydro in a solid position to be prepared for execution of projects identified in this application.

In addition to the resource planning activity, Hydro has undertaken a number of other steps to enhance capital program delivery. Specific steps taken include:

- Developing a portfolio approach, with Project Leads accountable for the delivery of the portfolio
- Implementing visual management tools to measure and manage progress
- Structuring communications processes for early identification of exposures to plan and supporting resolution of any identified issues.

The resource planning is in the review for approval stage, pending the outcome of the review by the Public Utilities Board and approval of Hydro's proposed 2012 Capital Budget.

## *Five and Twenty Year Capital Plans – Substantive Review in Progress*

Revision three of the five and twenty year plan is under substantive review, and is a work in progress. The proposed capital expenditures in future years are being reviewed in detail to vet for reasonableness, reprioritization based on updated current state of the assets, confirmation of resource requirements and resource planning, and final review.

There is significant work to be done in delivering the next update to the five and twenty year plans. The current application is for approval of 2012 only. Information provided for the balance of the years in the plans remains tentative, but is indicative of the upward pressure on total capital expenditures into the future.

## *Five-Year Plan*

The detailed five-year plan is presented in Appendix A.

The five-year plan indicates an increasing trend in expenditures as noted; beyond 2012 this plan is in review.

The upward pressure on capital expenditures has a number of key drivers:

- Age and condition of current infrastructure/assets;
- Shift in location of load;

- Continued load growth on the Avalon Peninsula; and,
- Domestic price escalation.

## *Generation*

The requirement to invest sustaining capital in generation facilities began increasing several years ago as parts of Hydro's generating plants reached or surpassed their normally expected service lives. As each year passes more assets reach this point in their operating lives, requiring increased expenditures to maintain reliability and to ensure that the maximum economic life is extracted from each asset. Primary drivers for these projects are the realization of end of service lives for equipment, reductions in reliability or performance, the availability of new more efficient technology and considerations for safety.

## *Hydraulic*

Ensuring reliability is the primary priority for Hydro's five-year capital plan. In recent years, Hydro has detected deterioration in the condition of the stator windings of Units 1 through 4 in the Bay d'Espoir Generating Station. These four units, the oldest of the six installed in that plant, were equipped with asphalt insulated windings, the standard insulation system of that time. These windings have deteriorated and begun to show signs of imminent failure. To address this issue, Hydro included the purchase of a spare winding in the 2009 Capital Plan and included the installation of that spare winding and the purchase of another in the 2010 Capital Plan. The rewind of the remaining three units – 1, 3 and 4 - is included in the plan (2012 – 2014). The condition of auxiliary systems and equipment is as great of a concern as the main generating units, as their failure could also remove a unit or plant from service. To address this concern the 2012 Capital Plan includes projects to replace the exciters at Upper Salmon and Hinds Lake, and to upgrade the Burnt Spillway.

## *Holyrood Thermal Generating Station*

Expenditures at the Holyrood Thermal Generating Station are discussed in detail later in this document.

## Gas Turbines

Maintaining reliability of existing assets is also the priority for Hydro's gas turbines, which provide emergency and peaking power and function as synchronous condensers to help control voltage on the Island Interconnected system. These facilities accumulate few operating hours generating electricity but are crucial sources of power and energy during emergencies and system peaks and provide voltage support, especially when operating as synchronous condensers. These plants, especially the 50 MW plants at Hardwoods and Stephenville, required relatively little capital expenditure until recent years. Despite their low operating hours, these units are beyond their normal life expectancy and are deteriorating, requiring an increase in capital expenditures to extend their reliable economic service lives to the greatest extent possible. A multiyear life extension project for the Hardwoods plant was begun in 2010 and a similar project is planned for Stephenville, beginning in 2013. Hydro's newest gas turbine plant located at Happy Valley was constructed in 1992. This plant has required only minor upgrades since that time. Projects are planned in 2013 and 2015 to upgrade the PLC and install a diesel automation and charger system, respectively.

## Terminal Stations

Increasing load and maintaining reliability are the principal drivers for terminal station expenditures over the next five years. The largest single project continues to be the construction of two new terminal stations in Labrador City and the conversion of the distribution system from 4.16 and 12.5 kV to 25 kV. The distribution system is old and is loaded to capacity, requiring the construction of the two stations and the reconfiguration of the distribution system to maintain reliability and to ensure acceptable voltage levels in response to load growth. This work is contained in several capital projects which began in 2009 and will continue until late 2013. Increased demand is also driving the requirement for an additional transformer at the Oxen Pond Terminal Station in St. John's. This project will cost $10.5 million, and is proposed to begin in 2012 and be completed over three years.

Aging equipment is a major concern and is considered when reviewing short and long term plans. The five-year plan contains expenditures in the form of several programs to replace instrument transformers, surge arrestors, insulators, circuit breakers and disconnect switches among others. The plan also contains station specific projects such as replacing the compressed air piping at the Buchans

Terminal Station. Hydro will, to the greatest extent possible, consolidate equipment replacements into multi year programs to ease the administrative effort for both the Board and Hydro.

## *Transmission*

Reliability maintenance is the primary driver for transmission investment. The wood pole line management program forms the backbone of Hydro's asset management strategy for these facilities. This strategy has been in place for eight years and its effectiveness and value has been tested and demonstrated, enabling Hydro to realize the maximum useful life from these transmission systems. The program is based on periodic assessment of the wooden transmission poles and facilitates their replacement before failure, while extracting the maximum possible reliable life from each pole. During the next five years Hydro will upgrade TL-241 (Plum Point to Peter's Barrens) and TL-221 (Hawkes Bay to Peter's Barren) and reroute remote sections of TL-220 and TL-215 along with other projects. A major project to upgrade the transmission line corridor between Bay d'Espoir and Western Avalon is required to facilitate additional power and energy delivery to the East Coast growth area and meet transmission planning criteria.

Safety of Hydro personnel, contractors, and the public is also a factor in the five-year plan for Transmission.

## *Distribution*

New customer additions and reliability maintenance are the strategic areas addressed by the five-year Capital Plan for distribution assets. This equipment is subject to the same aging and wear as the generation and transmission assets and must be replaced periodically to ensure reliable service. The largest distribution project for the next five years will be the reconfiguration of the Labrador City distribution system, which is now in progress. As was mentioned in the previous section of this document on Terminal Stations, the distribution system is aging and is loaded to capacity, requiring its reconfiguration to maintain reliability, ensure acceptable voltage levels and to respond to continued load growth. The principle feature of the reconfiguration will be the increase of the distribution system voltage from 4.16 and 12.5 kV to 25 kV, enabling more energy to be distributed while maintaining acceptable voltage levels. The majority of other distribution system expenditures for the next five years

will consist of service extensions and upgrades to distribution systems, distribution pole replacement, and substation upgrading, all to maintain or improve system performance.

## Rural Generation

Aging infrastructure replacement to ensure reliability is required for Hydro's twenty-one isolated electrical systems which are supplied with electricity by diesel generating sets. Hydro's diesel generating sets have the shortest lives of all its generating assets, requiring replacement after 100,000 hours of operation. During the next five years Hydro plans to replace or add generating sets in Nain, Port Hope Simpson, L'Anse au Loup, Hopedale, Paradise River and Mary's Harbour (2014), and Postville (2015). These replacements and additions are required to ensure that reliable service is provided to Hydro's isolated rural customers. Many of Hydro's diesel plants have deteriorated to a great extent and will require renovation or replacement in the near to medium term. To prioritize this process, Hydro conducted a review of the condition of the older plants to assist in planning the replacement or modification in a logical sequence. A report summarizing the findings and recommendations was submitted to the Board on December 18, 2009. This report will be used to develop a long-term replacement and renovation plan for diesel plants. Currently, the five-year plan includes the replacement of the Charlottetown diesel plant (2013 – 2015) in response to a significant increase in demand from the fish plant expansion, which was communicated to Hydro late in 2008. Also, a new fish plant expansion at Mary's Harbour is scheduled to be in service in the spring of 2012. Mary's Harbour is in a similar situation to Charlottetown in that there is insufficient generation to meet the load and expansion within the existing diesel plant. Given the prospect of spending several millions of dollars on two new diesel plants located approximately 100 kilometers apart and given that Port Hope Simpson is approximately 50 kilometers between Charlottetown and Mary's Harbour, the possibility of an interconnection among the three systems may yet be viable to optimize generation needs for the area. Hydro will continue with studies for a long term solution to the electrical supply needs of the area. Hydro plans to submit a recommended solution with the 2013 Capital Budget Application.

## Information Systems

Obsolete technology and aging hardware are the strategic drivers which most significantly contribute to the five-year plan for information systems. Hydro's information systems provide the data required to

effectively manage and control the activities of a complex business. Expenditures on these systems and personal computers will average $2.5 million per year during the next five years.

## *Telecontrol*

Obsolete technology and aging hardware are also the strategic reasons which most significantly contribute to the five-year plan for telecontrol assets. Hydro's communications network is vital to the operation and control of the power systems. Communications must be reliable and rapid to protect and control the generation, transmission and distribution equipment. It is expected that capital expenditures will average approximately $5.6 million per year for the next five years. The most significant of these projects will be the refurbishment of microwave sites, the replacement of obsolete radio equipment and the replacement of fibre optic cable.

## *Transportation*

Hydro's vehicles and mobile equipment must continue to be both safe and reliable. Hydro operates a diversified and dispersed fleet of mobile equipment throughout the Province that is required to operate and maintain our facilities in a challenging and sometimes harsh physical environment. Hydro selects, operates and maintains this equipment in a manner designed to achieve the least life cycle cost and replacements are scheduled in accordance with criteria submitted to the Board on previous occasions. Hydro anticipates that expenditures on mobile equipment will average approximately $2.9 million over the next five years.

## *Administration*

Safety, cost efficiencies, reliability and security are the primary drivers of the five-year administration capital plan. Hydro expects to spend an average of $2 million on items such as office equipment and building infrastructure, during the next five years.

## *Major Overhauls and Inspections*

Hydro is proposing to include major inspections and overhauls as capital items under this application. Details are found in the IFRS section of the Overview of the application. 2012 items included as capital in this application are:

- Major overhaul of a turbine at Holyrood generating station, $4.2 M
- Overhaul of diesel generators, $1.0M
- Overhaul of hydro generators, $0.5M
- Condition Assessment and Life Extension Phase 2, $1.2M

## *Holyrood*

The Holyrood Generating Station is among the largest generating plants on the Island Interconnected system, and, as a thermal plant, is by far the most complex. Stage I (Units 1 and 2) was commissioned in 1971 and has passed the normal 30-year design life for such a facility. Stage II (Unit 3) was commissioned in 1979 and has reached the end of its normal life. Units 1 and 2 were modified in the late 1980s to increase their capacity from 150 to 170 MW each. This was achieved by availing of the overcapacity inherently contained in equipment of that vintage and by modifying the plant's auxiliary systems. Similar age plants have been retired or have been subjected to life assessment and extension studies and have received large injections of capital to extend their useful lives. Some have been redeveloped into other configurations, such as combined cycle power plants.

Hydro's long term role for Holyrood considers two scenarios. In an HVdc infeed scenario, all three units will be required to operate as synchronous condensers after the infeed is completed; in an isolated island scenario all three units will be required to operate as essential generating assets, as they do now. Depending on which scenario unfolds, some or all of the Holyrood Generating plant will be required for decades into the future. Hydro has completed Phase 1 of a condition assessment for the Holyrood Generating Station. The report was filed in May of 2011. When all phases of the study are completed, Hydro will have the necessary information to determine the capital replacements required to maintain Holyrood in an efficient and reliable condition. The study is being performed in phases to ensure that the scope and progress of the work matches the progress of the Lower Churchill project so that only necessary expenditures are made. Hydro will continue to periodically report to the Board on progress and will seek approval for the proposed scope of successive phases of the assessment as the work advances.

## Holyrood Thermal Generating Station Requirements 2011 to 2020

The Holyrood Generating Station (Holyrood), which was initially commissioned in late 1970 (40 years ago), has been and continues to be an essential generating plant in Hydro's Island Interconnected electrical system. This is largely due to the major load growth and lack of other major hydraulic resources on the Avalon Peninsula. The plant's purpose is to supply power and energy as well as capacity support to the Avalon Peninsula due to transmission limitations to this part of the grid. The station provides 466 MW of net capacity and could be called upon to deliver up to 3 TWh of energy to the Island Interconnected system. The plant comprises of two 170 MW units (1970), one 150 MW unit (1981) and a 10 MW gas turbine. Unit 3 currently has the capability to operate as a synchronous condenser and does so during summer months when output from Holyrood is not required. The amount of time it operates in this mode depends on the loading needs, particularly on the Avalon Peninsula. Following a DC infeed, it has been established that units 1 and 2 will also need to have that ability which will require some modifications to the units, similar to that completed on unit 3 previously.

Hydro's hydraulic energy supply capability is subject to inflow conditions that can vary substantially from year to year. While Hydro plans to secure energy supply for a repeat of the firm hydrological sequence (1958-1961), it also responds to annual variation of inflows in its regular operational planning process. Optimized generation dispatch is based on the current situation with respect to reservoir storages, expected snow melt, projected rainfall and forecast customer requirements.

Hydro's projected requirements for Holyrood are based on the load forecast for its utility and industrial customers, as well as Hydro's direct Island Interconnected distribution system customers and internal needs (losses, station services).

The Muskrat Falls Generating Station and interconnection via the Labrador Island Link will displace the current power and energy needs from Holyrood and ultimately change Newfoundland and Labrador's electricity system. In addition, the second interconnection to Nova Scotia via the Maritime Link will potentially provide options for a short term supply through reserve available outside of the province. First power is currently expected in late 2016 and work is ongoing to finalize sanction of the project(s) and prepare for the integration impacts on the power system.

In the unlikely event there are delays in power delivery, Hydro has a responsibility to take a prudent approach and ensure that Holyrood is available and continues to be a safe and reliable generation source during the transition period.

Prior to interconnection, the demands on Holyrood will increase to serve growing customer requirements. Over the past several years, industrial demand has declined from the closure of two paper mills and reduction at a third, however there is substantial growth occurring particularly on the Avalon Peninsula, which is expected to cause demand to climb back to historical levels and beyond.

Following the full commissioning of the DC interconnections, it is intended that Holyrood will remain operable as a generating station for a number of years before the thermal aspect of the station is decommissioned. At that time, the units will continue to operate as synchronous condensers. The final generation availability year is currently projected to be 2020.

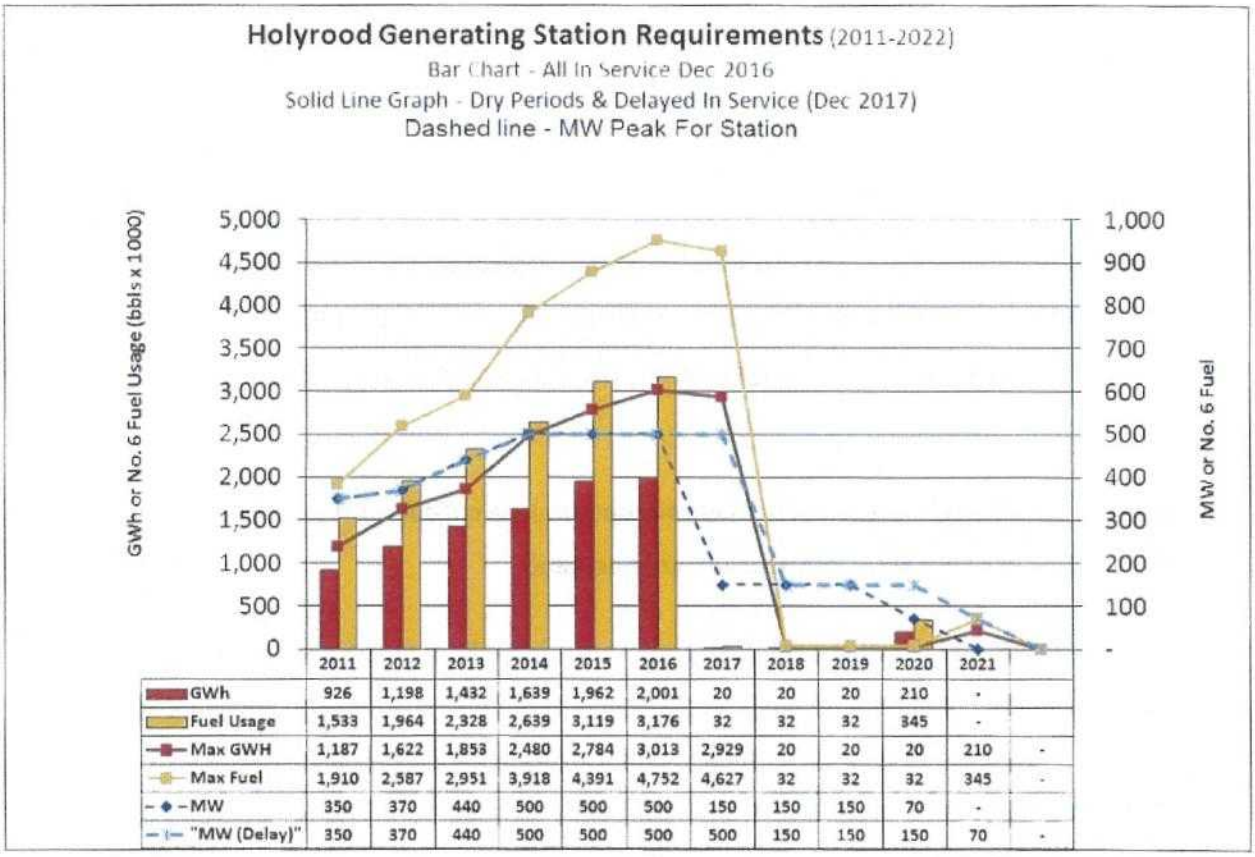
Hydro continues to plan for safe, reliable and least cost operation of the system as it moves towards and transitions to the new operating regime which will be established as a result of the DC infeed to the island. Accordingly, the Holyrood facility must continue to operate until final commissioning of the infeed, and conversion to a synchronous condenser plant. The plant will also be available for a period of time following interconnection as a fully functioning thermal plant as a backup generation source. For planning purposes, Hydro is using 2020 as the approximate year in which Holyrood will also be available for generation after which it will be available for synchronous condenser operation only. Beyond 2020, considerable further capital reinvestment at Holyrood will be required if it were to continue as a power generation source due to the age and condition of the asset.

The current base case is to operate as needed through 2016 and as a backup with minimal operation for 2017 to 2020 (32,000 bbls of oil per year versus three million during 2016). The plan is to operate each unit for a period of time to ensure they are fully operational, and to ensure that staff retains the skills required to keep the complex plant operational in the event there are sustained outages to the DC interconnections during commissioning and initially during operation. The minimum assumption is each unit would operate one week per year - two days at full load and five days at 100 MW to ensure availability. As well, consideration is being given to maintaining one unit in hot stand-by for the first winter season to ensure that unit is available within two hours. With the hot stand-by approach, the fuel use would increase by approximately 60,000 bbls from the minimum.

In 2016, the Holyrood plant will have been in operation for 45 years which is beyond the life of many similar plants. This assumes that carbon emissions from the plant are still tolerated up to that time, which for this limited period is a reasonable assumption. Beyond that period releasing $CO_2$ at levels necessary at full production may not be acceptable under environmental regulations as government regulations regarding greenhouse gas are likely to change.

The expected base scenario and a maximum Holyrood production scenario are shown in Chart 1.

Chart 1: Forecast Holyrood Generation Requirements




| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWh | 926 | 1,198 | 1,432 | 1,639 | 1,962 | 2,001 | 20 | 20 | 20 | 210 | - | |
| Fuel Usage | 1,533 | 1,964 | 2,328 | 2,639 | 3,119 | 3,176 | 32 | 32 | 32 | 345 | - | |
| Max GWH | 1,187 | 1,622 | 1,853 | 2,480 | 2,784 | 3,013 | 2,929 | 20 | 20 | 20 | 210 | - |
| Max Fuel | 1,910 | 2,587 | 2,951 | 3,918 | 4,391 | 4,752 | 4,627 | 32 | 32 | 32 | 345 | - |
| MW | 350 | 370 | 440 | 500 | 500 | 500 | 150 | 150 | 150 | 70 | - | |
| "MW (Delay)" | 350 | 370 | 440 | 500 | 500 | 500 | 500 | 150 | 150 | 150 | 70 | - |

The bar chart elements of the graph are based on average inflow conditions and indicate the energy output expected, as well as the fuel consumed. The dashed line indicates the maximum Holyrood production scenario, in which maximum gross MW output is required from Holyrood to meet customer requirements.

As indicated, the power and energy requirements from Holyrood will increase over the next 5-6 years due to increased industrial and utility demand as we approach the interconnection to Muskrat Falls.

During a poor inflow year, an annual output increase up to 900 GWh could occur. This is a major risk and one Hydro must plan to accommodate. The plant must be ready to produce that level of hydraulic production shortfall, or it could lead to a curtailment of customer load. During a repeat of the critical dry sequence, annual required production from Holyrood, prior to an infeed, would be significant, up to 3TWh per year. This maximum Holyrood production scenario is represented as the line graphs in Chart 1 for "Max GWh" and "Max Fuel". The sensitivity case assumes a one year delay in the interconnections along with low inflow conditions.

Holyrood must be maintained in a safe, reliable and ready state throughout the build-up to, and transition to, the DC infeed. To continue to ensure the security of supply, capital investment will still be necessary throughout the period 2011 to 2020 to ensure Holyrood can provide the level of service required. Various types of investments and expenditures for the Holyrood facility are anticipated, including: fuel and offloading storage facilities, operator training, skills retention tools, and general plant infrastructure work. As well there will be some operational challenges with respect to ensuring competent employees are attracted, retained and trained for all aspects of operation and maintenance required for this complex plant, and all systems are available, and maintained to continue a reliable level of service.

In summary, the Holyrood Generating Station continues to be a critical asset that must be maintained in a reliable and cost effective state to meet customer demand.

In reviewing the capital needs of the plant, Hydro has considered the time lines discussed above and proposes to submit only those projects necessary for the safe, reliable operation of the plant as a generator up to the time of decommissioning. It is also expected that additional capital investments requirements will continue through to synchronous condenser operation and will be treated as all other capital needs of Hydro which reflect ongoing operational requirements.

Capital projects being put forward as part of this and upcoming budget submissions have been, and will continue to be, reviewed in light of the future plant requirements and are considered to be the minimum amount that is essential to fulfill Hydro's mandate to serve its customers and meet safety and environmental requirements.

## *Five-Year Plan for Holyrood*

Maintaining Holyrood for winter reliability is the primary focus of the five-year plan. The closure of the paper mill at Grand Falls has reduced demands on Holyrood in the short term, however continued load growth, particularly on the Avalon Peninsula, will place continued and increasing reliance on the Holyrood facility. Holyrood remains a vital generation asset and must be maintained in reliable condition. Due to the environmental issues with the plant, legislative and regulatory requirements also contribute to the required expenditures. Each of the projects proposed to be implemented within the next five years is discussed below. These projects, required to ensure that the facility can continue to operate reliably until the completion of the Lower Churchill project, are associated with equipment required for generation, synchronous condensing, or are related to safety or environmental concerns. This Five Year Plan for Holyrood contains projects not previously identified. As new information becomes available about the condition of components and as new problems become apparent, new projects will be added to the list annually.

## 2012 Projects

**Rewind Generators 1 and 2 (continues to 2016):** The existing windings have reached the end of their expected life. Failure to replace will jeopardize reliability of generation supply and the ability to operate as a synchronous condenser. This project is required whether the plant operates in generation or synchronous condensing mode.

**Upgrade Marine Terminal:** Construction of a new tanker docking facility with an improved fendering system, incorporating portions of the existing facility.

**Upgrade Stack Breeching Units 2 and 3:** Breeching is large insulated ductwork which conducts exhaust gases from the boilers to the stacks. It carries hot corrosive gases, operating under very hostile conditions. The Breeching on the three units has been repaired many times and now requires replacement which will be performed over several years. This project is required to ensure continued reliable operation until completion of the HVdc infeed.

**Upgrade Fuel Oil Heat Tracing:** The existing heat tracing is 30 years old and has become unreliable. Replacement is required to ensure plant reliability.

**Install Plant Operator Training Simulator:** A training simulator will provide operators with a platform on which to practice plant operations and response strategies to outages and equipment failure. Operator training simulators are also used for process optimization, DCS logic verification, as well as maintaining regulatory compliance.

**Upgrade Forced Draft Fan Ductwork Units 2 and 3:** This work is required to eliminate a severe air flow induced vibration condition which is cracking the ductwork of Units 2 and 3. The ducts will be replaced with stronger material and aerodynamic features to eliminate the vibration problem and ensure reliable operation.

**Replace Beta Attenuation Monitoring Analyzers:** The existing PM2.5 continuous particulate monitoring equipment installed at monitoring stations no longer meets provincial regulations and must be replaced.

## *Holyrood Projects in a No Infeed Scenario*

The Province's Energy Plan indicated that should the Lower Churchill Project not be sanctioned, the emissions issues at the Holyrood Generating Station would be improved by the installation of scrubbers and precipitators. Hydro identified the technical parameters, construction schedule, capital and operating costs for this facility in a study performed during 2008. Should the Lower Churchill Project not be constructed, or be delayed, there is a significant amount of additional work required at Holyrood.

**APPENDIX A**

**Five-Year Capital Plan**

| | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| GENERATION | 8,374 | 28,971 | 33,490 | 30,931 | 30,971 | 26,005 | 158,742 |
| TRANSMISSION AND RURAL OPERATIONS | 15,627 | 43,287 | 73,392 | 95,990 | 109,101 | 97,870 | 435,267 |
| GENERAL PROPERTIES | 3,421 | 7,765 | 11,606 | 17,035 | 13,118 | 15,734 | 68,678 |
| MAJOR OVERHAULS AND INSPECTIONS | 0 | 6,840 | 1,882 | 6,731 | 1,047 | 6,365 | 22,863 |
| CONTINGENCY FUND | 0 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 5,000 |
| TOTAL CAPITAL BUDGET | 27,422 | 87,862 | 121,369 | 151,686 | 155,237 | 146,973 | 690,550 |

| | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **GENERATION** | | | | | | | |
| Hydraulic Plant | 1,200 | 11,033 | 11,424 | 10,090 | 10,473 | 4,884 | 49,104 |
| Thermal Plant | 4,546 | 14,375 | 17,558 | 16,289 | 18,272 | 20,450 | 91,489 |
| Gas Turbines | 2,629 | 3,367 | 4,344 | 4,528 | 2,142 | 650 | 17,660 |
| Tools and Equipment | 0 | 196 | 164 | 24 | 84 | 21 | 488 |
| TOTAL GENERATION | 8,374 | 28,971 | 33,490 | 30,931 | 30,971 | 26,005 | 158,742 |
| **TRANSMISSION AND RURAL OPERATIONS** | | | | | | | |
| Terminal Stations | 8,399 | 14,149 | 12,695 | 15,687 | 14,090 | 8,020 | 73,041 |
| Transmission | 289 | 5,829 | 36,498 | 53,816 | 72,219 | 72,643 | 241,295 |
| Distribution | 5,636 | 17,416 | 14,947 | 14,539 | 15,748 | 13,726 | 82,012 |
| Generation | 516 | 2,681 | 3,257 | 9,989 | 4,598 | 2,539 | 23,581 |
| Properties | 0 | 566 | 2,340 | 777 | 686 | 190 | 4,558 |
| Metering | 292 | 628 | 962 | 581 | 153 | 157 | 2,774 |
| Tools and Equipment | 494 | 2,019 | 2,692 | 600 | 1,606 | 595 | 8,006 |
| TOTAL TRANSMISSION AND RURAL OPERATIONS | 15,627 | 43,287 | 73,392 | 95,990 | 109,101 | 97,870 | 435,267 |
| **GENERAL PROPERTIES** | | | | | | | |
| Information Systems | 999 | 2,347 | 2,922 | 2,561 | 1,845 | 2,909 | 13,583 |
| Telecontrol | 72 | 2,686 | 1,988 | 8,693 | 6,510 | 8,119 | 28,068 |
| Transportation | 2,351 | 2,350 | 4,116 | 3,143 | 1,359 | 3,657 | 16,975 |
| Administrative | 0 | 381 | 2,580 | 2,638 | 3,405 | 1,049 | 10,052 |
| TOTAL GENERAL PROPERTIES | 3,421 | 7,765 | 11,606 | 17,035 | 13,118 | 15,734 | 68,678 |
| **MAJOR OVERHAULS AND INSPECTIONS** | | | | | | | |
| Major Overhauls and Inspections | 0 | 6,840 | 1,882 | 6,731 | 1,047 | 6,365 | 22,863 |
| TOTAL MAJOR OVERHAULS AND INSPECTIONS | 0 | 6,840 | 1,882 | 6,731 | 1,047 | 6,365 | 22,863 |
| CONTINGENCY FUND | 0 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 5,000 |
| TOTAL CAPITAL BUDGET | 27,422 | 87,862 | 121,369 | 151,686 | 155,237 | 146,973 | 690,550 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **HYDRAULIC PLANT** | | | | | | | |
| Rewind Stators Units 1, 3 and 4 - Bay d'Espoir | | 4,954 | 5,054 | 3,635 | | | 13,643 |
| Replace Static Excitation System - Upper Salmon, Hinds Lake and Holyrood | 487 | 2,403 | 1,219 | | | | 4,109 |
| Upgrade Burnt Dam Spillway - Bay d'Espoir | | 1,703 | 994 | 959 | | | 3,656 |
| Automate Generator Deluge Systems - Bay d'Espoir | | | 479 | 300 | 478 | | 1,257 |
| Upgrade Public Safety Around Dams and Waterways - Bay d'Espoir | | 48 | 250 | 256 | 261 | 265 | 1,080 |
| Replace Powerhouse Emergency Diesel Generator - Bay d'Espoir | | 611 | 283 | | | | 894 |
| Upgrade Intake Gate Controls - Bay d'Espoir | 352 | 468 | | | | | 820 |
| Upgrade Generating Station Service Water System - Cat Arm | 360 | 440 | | | | | 800 |
| Purchase Hydrometeorological Stations - Various Sites | | | 332 | 285 | | | 616 |
| Replace Fuel Tank at Burnt Dam - Bay d'Espoir | | 208 | | | | | 208 |
| Replace Rip Rap - Bay d'Espoir | | 199 | | | | | 199 |
| Install Automated Fuel Monitoring System - North Salmon Spillway | | | 173 | | | | 173 |
| Install Protective Coating on Surge Tanks - Bay d'Espoir | | | 615 | 615 | 631 | | 1,861 |
| Replace Units 1-6 Autogreasing Systems - Bay d'Espoir | | | 210 | 190 | 191 | | 591 |
| Upgrade Generator Bearings - Bay d'Espoir | | | 200 | 189 | 170 | | 559 |
| Install Automatic Sprinkler System in Office Area - Bay d'Espoir | | | 303 | | | | 303 |
| Upgrade Units 1 to 6 S/V By Pass Valves - Bay d'Espoir | | | 100 | 100 | 100 | | 300 |
| Replace Surge Tanks Cathodic Protection Systems - Bay d'Espoir | | | 100 | 100 | 100 | | 300 |
| Replace Site Pumphouse and Pumping Station - Bay d'Espoir | | | 200 | | | | 200 |
| Replace Microscada Computers - Granite Canal | | | 187 | | | | 187 |
| Upgrade Unit 2 Generator Bearing - Bay d'Espoir | | | 161 | | | | 161 |
| Replace Bridge 5 on Granite Canal Access Road - Granite Canal | | | 115 | | | | 115 |
| Replace Turbine/Generator Flow Measuring Devices - Upper Salmon | | | 114 | | | | 114 |
| Install Gates RR Pond - Granite Canal | | | 84 | | | | 84 |
| Purchase LP Screw Compressor Set - Bay d'Espoir | | | 75 | | | | 75 |
| Replace Cooling Water Pumps 2 and 4 in Powerhouse 1 - Bay d'Espoir | | | 69 | | | | 69 |
| Replace Fall Arrest System on Surge Tank 2 - Bay d'Espoir | | | 50 | | | | 50 |
| Replace Emergency Diesel Fuel Tank - Paradise River | | | 40 | | | | 40 |
| Install Waste Oil Storage Tank for PCB's - Bay d'Espoir | | | 16 | | | | 16 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **HYDRAULIC PLANT (cont'd.)** | | | | | | | |
| Upgrade Victoria Structure - Bay d'Espoir | | | | 450 | 461 | 250 | 1,161 |
| Refurbish Turbines - Snook's Arm and Venam's Bight | | | | 375 | 750 | | 1,125 |
| Pilot Asset Health Monitoring Template - Upper Salmon | | | | 500 | 200 | 200 | 900 |
| Upgrade Access Roads - Bay d'Espoir | | | | 704 | | | 704 |
| Upgrade Breakwater (Shoreline Protection) - Cat Arm | | | | 546 | | | 546 |
| Replace Accommodations/Septic System at EBBE - Bay d'Espoir | | | | 375 | | | 375 |
| Install Automatic Fuel Monitoring System West Salmon Spillway - Upper Salmon | | | | 237 | | | 237 |
| Replace West Salmon Emergency Lift System - Upper Salmon | | | | 85 | | | 85 |
| Increase Height on Earth Dam - Paradise River | | | | 73 | | | 73 |
| Install Unit 1 Governor Oil Filtration System - Upper Salmon | | | | 67 | | | 67 |
| Replace Fall Arrest System on Surge Tank 2 - Bay d'Espoir | | | | 50 | | | 50 |
| Replace Penstock and Auxiliaries - Venam's Bight | | | | | 3,800 | | 3,800 |
| Upgrade Access Roads - Bay d'Espoir and Cat Arm | | | | | 900 | 800 | 1,700 |
| Upgrade Site Facilities - Bay d'Espoir | | | | | 800 | 800 | 1,600 |
| Install Dyn Air Gap Monitoring System on Units - Upper Salmon and Hinds Lake | | | | | 680 | 380 | 1,060 |
| Replace Rectifier Transformer Unit 1 - Bay d'Espoir | | | | | 350 | | 350 |
| Replace Site Pumphouse, Pumps and Controls - Bay d'Espoir | | | | | 250 | | 250 |
| Upgrade Unit Relay Protection - Paradise River | | | | | 151 | | 151 |
| Install Infrared Viewports - Bay d'Espoir | | | | | 100 | | 100 |
| Replace Slip Ring Assembly - Hinds Lake | | | | | 100 | | 100 |
| Install New Vent Chambers Units 1 to 6 - Bay d'Espoir | | | | | | 594 | 594 |
| Refurbish Generation Unit - Venam's Bight | | | | | | 425 | 425 |
| Replace Rectifier Transformer Unit 2 - Bay d'Espoir | | | | | | 370 | 370 |
| Upgrade Station Service Water System - Upper Salmon | | | | | | 344 | 344 |
| Purchase Bearing Cooler Sets - Cat Arm and Hinds Lake | | | | | | 255 | 255 |
| Upgrade Unit Relay Protection - Paradise River | | | | | | 151 | 151 |
| Upgrade Jockey Pumps - Upper Salmon and Hinds Lake | | | | | | 50 | 50 |
| **TOTAL HYDRAULIC PLANT** | 1,200 | 11,033 | 11,424 | 10,090 | 10,473 | 4,884 | 49,104 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **THERMAL PLANT** | | | | | | | |
| Rewind Generator Units 1 and 2 - Holyrood | | 112 | 1,108 | 4,886 | 5,796 | | 11,901 |
| Upgrade Marine Terminal - Holyrood | | 5,860 | | | | | 5,860 |
| Upgrade Stack Breaching Units 2 and 3 - Holyrood | | 1,505 | | | 1,900 | | 3,405 |
| Replace Programmable Logic Controllers - Holyrood | 2,230 | 902 | | | | | 3,132 |
| Replace Fuel Oil Heat Tracing - Holyrood | | 1,474 | 1,414 | | | | 2,888 |
| Install Plant Operator Training Simulator - Holyrood | | 1,028 | 1,073 | | | | 2,101 |
| Upgrade Hydrogen System - Holyrood | 1,192 | 800 | | | | | 1,992 |
| Upgrade Forced Draft Fan Ductwork Units 2 and 3 - Holyrood | | 929 | 880 | | | | 1,808 |
| Install Backup System for Raw Water Supply and Clarifiers - Holyrood | | | 904 | | | | 904 |
| Upgrade Synchronous Condenser Unit 3 - Holyrood | 484 | 406 | | | | | 889 |
| Replace Relay Panels Unit 3 - Holyrood | 277 | 554 | | | | | 831 |
| Upgrade Electrical Equipment - Holyrood | 188 | 206 | 285 | | | | 679 |
| Replace Steam Seal Regulator Unit 2 - Holyrood | 175 | 438 | | | | | 613 |
| Replace Beta Attenuation Monitoring Analyzers - Holyrood | | 161 | | | | | 161 |
| Refurbish Fuel Storage Facility - - Holyrood | | | 2,853 | | | | 2,853 |
| Modify Control Room - - Holyrood | | | 1,250 | 1,250 | | | 2,500 |
| Install Variable Speed Drives on 6 FD Fans - Holyrood | | | 1,950 | | | | 1,950 |
| Upgrade Governors on Units 1, 2 and 3 - Holyrood | | | 1,000 | | | | 1,000 |
| Replace Waste Water Basin Building - Holyrood | | | 981 | | | | 981 |
| Upgrade Lunch Room, Fitness Room and Women's Washroom - Holyrood | | | 750 | | | | 750 |
| Upgrade Plant Access Road - Holyrood | | | 600 | | | | 600 |
| Upgrade Fuel Oil Day Tank - Holyrood | | | 500 | | | | 500 |
| Install Nitrogen Generator on Boilers - Holyrood | | | 450 | | | | 450 |
| Purchase Critical Spare 4kV Motors - Holyrood | | | 421 | | | | 421 |
| Upgrade Vibration Monitoring Equipment Units 1, 2 and 3 - Holyrood | | | 300 | | | | 300 |
| Upgrade Fire Protection (Out Buildings) - Holyrood | | | 272 | | | | 272 |
| Install Unit 3 CR Condensate Drains and HP Heater Trip Level - Holyrood | | | 248 | | | | 248 |
| Replace Condensate Polisher Annunciator Panels Units 1 and 2 - Holyrood | | | 221 | | | | 221 |
| Install Visible Isolation for 600 V HVAC System Admin Area - Holyrood | | | 100 | | | | 100 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **THERMAL PLANT (cont'd.)** | | | | | | | |
| Upgrade Unit 3 4160 Volt System - Holyrood | | | | 1,000 | 1,000 | | 2,000 |
| Complete Eng. Review to Determine System for SYN CND, Unit 1 and 2 - Holyrood | | | | 2,000 | | | 2,000 |
| Upgrade 129 Volt DC Plant Wide Distribution System - Holyrood | | | | 650 | 650 | 650 | 1,950 |
| Upgrade Soot Blowing Controls Units 1, 2 and 3 - Holyrood | | | | 1,807 | | | 1,807 |
| Upgrade Excitation Systems Units 1 and 2 - Holyrood | | | | 750 | 750 | | 1,500 |
| Upgrade Powerhouse Roofing - - Holyrood | | | | 500 | 500 | 500 | 1,500 |
| Replace Plant Elevators - Holyrood | | | | 1,000 | | | 1,000 |
| Replace Powerhouse Overhead Crane Doors - Holyrood | | | | 300 | 300 | 300 | 900 |
| Upgrade Cranes and Hoists - Holyrood | | | | 560 | | | 560 |
| Replace Stage 2 Diesel - Holyrood | | | | 378 | | | 378 |
| Install Fire Protection (Fuel Delivery System) - Holyrood | | | | 321 | | | 321 |
| Replace UPS 1 and 2 - Holyrood | | | | 227 | | | 227 |
| Replace Compressor #2 - Holyrood | | | | 223 | | | 223 |
| Replace Carpentry Shop - Holyrood | | | | 220 | | | 220 |
| Install Variable Speed Drivers for Boiler Feed Water Pumps - Holyrood | | | | 217 | | | 217 |
| Install Auxiliary Boiler - Holyrood | | | | | 5,000 | 10,000 | 15,000 |
| Complete Eng. Review to De-Commission Storage Tanks and Marine Terminal - Holyrood | | | | | 600 | | 600 |
| Complete Eng. Review to De-Commission Boilers & Steam Turbines - Holyrood | | | | | 600 | | 600 |
| Replace UPS 3 and 4 - Holyrood | | | | | 233 | | 233 |
| Replace Compressor #1 - Holyrood | | | | | 228 | | 228 |
| Replace Armour Stone at Tressel Area - Holyrood | | | | | 200 | | 200 |
| Upgrade Slope at Marine Terminal - Holyrood | | | | | 200 | | 200 |
| Replace HVAC System in Administration Area - Holyrood | | | | | 183 | | 183 |
| Upgrade Powerhouse Door and Siding - Holyrood | | | | | 132 | | 132 |
| Rewind Generators 3 and Install Rotor Flux Probe - Holyrood | | | | | | 8,000 | 8,000 |
| Upgrade Unit 1 4160 Volt System - Holyrood | | | | | | 1,000 | 1,000 |
| **TOTAL THERMAL PLANT** | 4,546 | 14,375 | 17,558 | 16,289 | 18,272 | 20,450 | 91,489 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **GAS TURBINES** | | | | | | | |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 2,629 | 3,367 | | | | | 5,995 |
| Upgrade Gas Turbine Plant Life Extension - Stephenville | | | 1,413 | 3,516 | 1,392 | | 6,321 |
| Upgrade Gas Turbine PLC - Happy Valley | | | 1,703 | | | | 1,703 |
| Replace Gas Turbine Exhaust Stack - Holyrood | | | 750 | | | | 750 |
| Replace Gas Turbine Radiator - Holyrood | | | 295 | | | | 295 |
| Construct Gas Turbine Outside Fuel Pumps & Distribution Enclosure - Hardwoods | | | 183 | | | | 183 |
| Replace Gas Turbine Air Intake Structure - Holyrood | | | | 629 | | | 629 |
| Install Sprinkler System at Gas Turbine - Holyrood | | | | 214 | | | 214 |
| Refurbish Gas Turbine Building Enclosure - Holyrood | | | | 169 | | | 169 |
| Refurbish Power Turbine Clutch - Holyrood | | | | | 500 | | 500 |
| Install Diesel Automation and Charger System - Happy Valley | | | | | 250 | | 250 |
| Upgrade Engine - Holyrood | | | | | | 500 | 500 |
| Replace Compressors and Dryers - Holyrood | | | | | | 100 | 100 |
| Replace Storage Tank - Holyrood | | | | | | 50 | 50 |
| **TOTAL GAS TURBINE PLANTS** | 2,629 | 3,367 | 4,344 | 4,528 | 2,142 | 650 | 17,660 |
| **TOOLS AND EQUIPMENT** | | | | | | | |
| Purchase Tools and Equipment Less than $50,000 | | 196 | 77 | 24 | 84 | 21 | 402 |
| Install Handheld Pendant to Overhead Crane - Bay d'Espoir | | | 87 | | | | 87 |
| **TOTAL TOOLS AND EQUIPMENT** | 0 | 196 | 164 | 24 | 84 | 21 | 488 |
| **TOTAL GENERATION** | 8,374 | 28,971 | 33,490 | 30,931 | 30,971 | 26,005 | 158,742 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **TERMINAL STATIONS** | | | | | | | |
| Upgrade Circuit Breakers - Various Sites | | 1,677 | 2,714 | 2,879 | 3,366 | 3,640 | 14,277 |
| Install Additional 230kV Transformer - Oxen Pond | | 3,535 | 3,354 | 3,650 | | | 10,540 |
| Upgrade Power Transformers - Various Sites | | 1,246 | 1,217 | 1,270 | 4,983 | 1,306 | 10,023 |
| Upgrade Terminal Stations to 25kV -Labrador City | 6,483 | 3,507 | | | | | 9,990 |
| Replace Instrument Transformers - Various Sites | | 452 | 442 | 453 | 458 | 462 | 2,267 |
| Replace Insulators - Various Sites | | 412 | 402 | 411 | 422 | 431 | 2,078 |
| Replace Disconnects - Various Sites | | 352 | 330 | 325 | 332 | 328 | 1,668 |
| Perform Grounding Upgrades - Various Sites | 321 | 324 | 329 | 337 | 345 | | 1,657 |
| Upgrade Substation - Wabush | 459 | 626 | | | | | 1,086 |
| Upgrade Station Reliability and Safety - Rocky Harbour | 435 | 360 | | | | | 795 |
| Replace 69 KV SF6 Breakers - St. Anthony Airport | 490 | 290 | | | | | 780 |
| Upgrade Compressed Air System - Bay d'Espoir | 84 | 564 | | | | | 648 |
| Replace 230 KV Circuit Breaker - Sunnyside | 41 | 590 | | | | | 631 |
| Replace Surge Arrestors - Various Sites | | 76 | 74 | 76 | 78 | 79 | 382 |
| Replace Compressed Air Piping and Install Dew Point Monitor - Buchans | | 28 | 278 | | | | 307 |
| Install Alternate Station Services - Stony Brook and Massey Drive | 86 | 109 | | | | | 195 |
| Install 20 MVAR Reactor - Bottom Brook | | | 1,026 | 1,578 | | | 2,604 |
| Reconfigure T.S. to Install New 138/69 kV Transformer for TL241 Tie - Happy Valley | | | 60 | 2,000 | | | 2,060 |
| Replace Compress Air Piping and Install DP Monitoring - Sunny Side and Bottom Brook | | | 487 | 524 | | | 1,010 |
| Upgrade Terminal Station - Wiltondale | | | 347 | 457 | | | 804 |
| Replace Optimho Relays on East Coast - Various Sites | | | 200 | 200 | 200 | 200 | 800 |
| Replace Telecontrol Building and Upgrade Equipment - Daniel's Harbour | | | 600 | | | | 600 |
| Terminal Stations Compressor Replacement Program - Various Sites | | | 116 | 119 | 121 | 124 | 480 |
| Perform Site Work to Accommodate Mobile Transformer - Various Sites | | | 187 | 289 | | | 476 |
| Replace Compressed Air Piping and Install New Dryer - Stony Brook | | | 165 | 165 | | | 331 |
| Install Online Vibration Monitoring System - Corner Brook Frequency Converter | | | 200 | | | | 200 |
| Upgrade 230 kV Breaker Controls - Various Sites | | | 45 | 46 | 48 | 49 | 188 |
| Install Transformer Fans - Conne River | | | 70 | | | | 70 |
| Upgrade Transformer Differential Circuit on T1 - Grandy Brook | | | 52 | | | | 52 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **TERMINAL STATIONS (cont'd.)** | | | | | | | |
| Upgrade Control Building for Staff Working Spaces - South Brook and Doyles | | | | 516 | 516 | | 1,032 |
| Install Drainage to Stop Surface Flooding - Indian River | | | | 391 | 391 | | 782 |
| Upgrade Control Wiring Phase 1 to TS1 - Bay d'Espoir | | | | | 450 | 450 | 900 |
| Replace Telecontrol Building and Upgrade Equipment - Daniel's Harbour | | | | | 600 | | 600 |
| Upgrade T12 - Bay d'Espoir | | | | | 500 | | 500 |
| Replace 66kV S/S Cable Feed to Plant - Holyrood | | | | | 400 | | 400 |
| Install Remote Control Sectionalizer TL251(2)(3) - Hampden | | | | | 300 | | 300 |
| Install 2nd AC Station Service - Howley | | | | | 200 | | 200 |
| Upgrade DC Station Service - Oxen Pond | | | | | 150 | | 150 |
| Install Telephone System - Bottom Waters | | | | | 150 | | 150 |
| Upgrade Terminal Station for Mobile Substation - Rocky Harbour | | | | | 80 | | 80 |
| Upgrade Control Wiring Phase 1 to Terminal Station 1 - Bay d'Espoir | | | | | | 450 | 450 |
| Extend Control Building Washroom - Indian River | | | | | | 200 | 200 |
| Upgrade Station Access Road - Cat Arm | | | | | | 200 | 200 |
| Upgrade Terminal Station for Mobile Substation - Cow Head | | | | | | 100 | 100 |
| **TOTAL TERMINAL STATIONS** | 8,399 | 14,149 | 12,695 | 15,687 | 14,090 | 8,020 | 73,041 |
| **TRANSMISSION** | | | | | | | |
| Upgrade Transmission Line Corridor - Bay d'Espoir to Western Avalon | | 2,632 | 30,195 | 46,525 | 63,199 | 66,825 | 209,376 |
| Perform Wood Pole Line Management Program - Various Sites | | 2,519 | 3,682 | 4,344 | 4,316 | 4,118 | 18,980 |
| Upgrade Transmission Line Access Trails - Various Sites | | 313 | 308 | 319 | 328 | 332 | 1,599 |
| Replace Guy Wires - TL215 | 289 | 318 | 350 | 530 | | | 1,487 |
| Install Ice Monitoring Equipment - Various Sites | | 47 | | | | | 47 |
| Relocate Sections of Remote Lines - Various Sites | | | 317 | 1,075 | 1,704 | | 3,096 |
| Construct Transmission Line Equipment Off-Loading Areas - Various Sites | | | 784 | 456 | | | 1,240 |
| Upgrade Angle Structures - TL259 | | | 662 | | | | 662 |
| Replace Aircraft Markers at Grand Lake Crossing - TL228 | | | 200 | | | | 200 |
| Upgrade Transmission Lines - Various Sites | | | | 314 | 2,672 | 868 | 3,855 |
| Conduct LIDAR Surveys - Various Sites | | | | 254 | | 500 | 754 |
| **TOTAL TRANSMISSION** | 289 | 5,829 | 36,498 | 53,816 | 72,219 | 72,643 | 241,295 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **DISTRIBUTION** | | | | | | | |
| Provide Service Extensions - All Service Areas | | 4,172 | 4,275 | 4,379 | 4,486 | 4,581 | 21,893 |
| Upgrade Distribution Systems - Various Sites | | 3,557 | 4,431 | 5,873 | 3,049 | 2,225 | 19,135 |
| Upgrade Distribution Systems - All Service Areas | | 2,508 | 2,569 | 2,632 | 2,697 | 2,753 | 13,159 |
| Voltage Conversion - Labrador City | 4,590 | 3,841 | 970 | | | | 9,400 |
| Upgrade L2 Distribution Feeder - Glenburnie | 845 | 2,115 | 597 | | | | 3,556 |
| Upgrade Distribution Systems - Francois, Rigolet and Happy Valley | 73 | 652 | | | | | 726 |
| Replace Recloser Control Panels - Various Sites | | 202 | 186 | 146 | | | 534 |
| Replace Substation Infrastructure - Burgeo | 128 | 368 | | | | | 496 |
| Replace Submarine Cable from Pilley's Island to Long Island - South Brook | | | 826 | 621 | | | 1,446 |
| Replace Poles, Insulators, Cut-outs, and Install Isolating Points - St. Lewis | | | 731 | | | | 731 |
| Construct Storage Building - Springdale | | | 213 | | | | 213 |
| Install Mobile Diesel Quick Connect/Disconnect - Various Sites | | | 150 | | | | 150 |
| Automate Reclosers - Various Sites | | | | 400 | | | 400 |
| Replace 25 Poles and Underground Feeder - McCallum | | | | 368 | | | 368 |
| Construct Heated Storage Building - Change Islands | | | | 121 | | | 121 |
| Replace Distribution and Power Transformers - Various Sites | | | | | 4,388 | 800 | 5,188 |
| Convert Section of Line to 25kV - Various Sites | | | | | 364 | 295 | 659 |
| Replace Poles - King's Point | | | | | 561 | | 561 |
| Implement Geographical Information Systems - Various Sites | | | | | 70 | 72 | 142 |
| Survey Lines - Various Sites | | | | | 133 | | 133 |
| Replace Submarine Cable - Fogo | | | | | | 3,000 | 3,000 |
| **TOTAL DISTRIBUTION** | 5,636 | 17,416 | 14,947 | 14,539 | 15,748 | 13,726 | 82,012 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **GENERATION** | | | | | | | |
| Upgrade Fuel Storage - Various Sites | | 465 | 750 | 356 | 100 | 600 | 2,271 |
| Perform Arc Flash Remediation - Various Sites | 430 | 380 | 391 | 402 | 413 | | 2,016 |
| Increase Generation Capacity - Mary's Harbour | | 1,489 | | | | | 1,489 |
| Replace Mini Hydro Turbine - Roddickton | 87 | 235 | | | | | 322 |
| Perform FEED for Diesel Plant Remediation - Various Sites | | 110 | | | | | 110 |
| Construct New Diesel Plant - Charlottetown | | | 1,524 | 3,590 | 1,607 | | 6,722 |
| Increase Generation - Various Sites | | | 66 | 2,900 | | | 2,966 |
| Replace Diesel Units - Various Sites | | | 65 | 795 | 624 | 470 | 1,954 |
| Increase Generation by Installing New Unit - l'Anse au Loup | | | 90 | 800 | | | 890 |
| Install Engine Fuel Additive Injection System - William's Harbour | | | 100 | 200 | 340 | | 640 |
| Install Sequence of Events Monitor in Diesel Plants - Various Sites | | | 160 | 164 | | | 324 |
| Overhaul 2 Diesel Units - Gull Pond Hill | | | 56 | | | | 56 |
| Recore Secondary Radiator - Mary's Harbour | | | 55 | | | | 55 |
| Install Nox Monitors at 2 Sites - Various Sites | | | | 596 | 300 | | 896 |
| Install Automatic Oil Filling System - Various Sites | | | | 186 | 214 | | 400 |
| Upgrade Bulk Storage Tanks - Various Sites | | | | | 200 | 200 | 400 |
| Upgrade Generator Transformer - Cartwright | | | | | 23 | 258 | 282 |
| Build Roadway for Freight Delivery - Norman Bay | | | | | 250 | | 250 |
| Install Engine Starting System - Various Sites | | | | | 109 | 111 | 220 |
| Upgrade Station Service - Grey River | | | | | 154 | | 154 |
| Install Intermediate Tank - Nain | | | | | 135 | | 135 |
| Install 9000 Litre Bulk Fuel Tank for Trailer - William's Harbour | | | | | 74 | | 74 |
| Insulate Diesel Plant - St. Anthony | | | | | 55 | | 55 |
| Replace Main Breaker and Extend Plant - Little Bay Islands | | | | | | 400 | 400 |
| Replace Radiators on Unit 2081 - Rigolet | | | | | | 300 | 300 |
| Upgrade Lighting System - Cartwright and Hopedale | | | | | | 200 | 200 |
| **TOTAL GENERATION** | 516 | 2,681 | 3,257 | 9,989 | 4,598 | 2,539 | 23,581 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **PROPERTIES** | | | | | | | |
| Legal Survey of Primary Distribution Line Right of Ways - Various Sites | | 198 | 189 | 190 | 192 | 190 | 958 |
| Install Fall Protection Equipment - Various Sites | | 199 | 207 | | | | 406 |
| Upgrade Structures to Mechanical Workshop - St. Anthony | | 87 | | | | | 87 |
| Install Waste Oil Storage Tank - L'Anse au Loup | | 82 | | | | | 82 |
| Install Pole Storage Ramps - Various Sites | | | 473 | 484 | 494 | | 1,451 |
| Replace Warehouse - Bay d'Espoir | | | 1,100 | | | | 1,100 |
| Replace Accommodations at Ebbegunbaeg - Bay d'Espoir | | | 245 | | | | 245 |
| Upgrade Warehouse Lighting - Bishop's Falls | | | 81 | | | | 81 |
| Upgrade Classroom and Boardroom in Main Office - Bishop's Falls | | | 45 | | | | 45 |
| Construct Steel Storage Building - Makkovik | | | | 104 | | | 104 |
| **TOTAL PROPERTIES** | 0 | 566 | 2,340 | 777 | 686 | 190 | 4,558 |
| **METERING** | | | | | | | |
| Install Automated Meter Reading - Various Sites | 292 | 438 | 714 | 431 | | | 1,875 |
| Purchase Meters, Equipment and Metering Tanks - Various Sites | | 190 | 147 | 150 | 153 | 157 | 797 |
| Refurbish 5-Position Test Console - Various Sites | | | 102 | | | | 102 |
| **TOTAL METERING** | 292 | 628 | 962 | 581 | 153 | 157 | 2,774 |
| **TOOLS AND EQUIPMENT** | | | | | | | |
| Replace Off Road Track Vehicles - Various Sites | 494 | 1,092 | 2,027 | | 850 | | 4,464 |
| Replace Light Duty Mobile Equipment - Various Sites | | 401 | 308 | 315 | 322 | 462 | 1,808 |
| Purchase Tools and Equipment Less than $50,000 | | 406 | 212 | 143 | 131 | 133 | 1,025 |
| Replace Excavator - Various Sites | | 120 | | 142 | | | 262 |
| Purchase High Voltage Breaker Timing Sets - Various Sites | | | 69 | | | | 69 |
| Purchase Infrared Cameras - Bishop's Falls | | | 76 | | | | 76 |
| Replace Bulldozer - Bishop's Falls | | | | | 303 | | 303 |
| **TOTAL TOOLS AND EQUIPMENT** | 494 | 2,019 | 2,692 | 600 | 1,606 | 595 | 8,006 |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 15,627 | 43,287 | 73,392 | 95,990 | 109,101 | 97,870 | 435,267 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **INFORMATION SYSTEMS** | | | | | | | |
| **SOFTWARE APPLICATIONS** | | | | | | | |
| **New Infrastructure** | | | | | | | |
| Perform Minor Application Enhancements - Hydro Place | | 123 | 125 | 128 | 131 | 135 | 642 |
| Cost Recoveries | | (42) | (40) | (41) | (42) | (43) | (208) |
| Implement Work Protection Safety Code Application - Hydro Place | | 116 | 250 | 250 | | | 616 |
| **Upgrade of Technology** | | | | | | | |
| Corporate Application Environment - Upgrade Microsoft Products | 1,426 | 678 | | | | | 2,104 |
| Cost Recoveries | (428) | (203) | | | | | (631) |
| Upgrade JD Edwards - Hydro Place | | 284 | 588 | | | | 872 |
| Cost Recoveries | | (97) | (200) | | | | (296) |
| Upgrade Energy Management System - Hydro Place | | 118 | 290 | 355 | 195 | 195 | 1,152 |
| Upgrade Microsoft Project - Hydro Place | | 91 | | | | | 91 |
| Cost Recoveries | | (31) | | | | | (31) |
| Upgrade Creditron System (Treasury) - Hydro Place | | 38 | | | | | 38 |
| Upgrade Microsoft Office Products - Hydro Place | | | 336 | 344 | 460 | 460 | 1,600 |
| Cost Recoveries | | | (108) | (110) | (147) | (147) | (512) |
| Upgrade Business Intelligence Toolset Software - Hydro Place | | | 170 | | | | 170 |
| Cost Recoveries | | | (54) | | | | (54) |
| Upgrade Lotus Notes - Hydro Place | | | | 520 | | | 520 |
| Cost Recoveries | | | | (167) | | | (167) |
| Upgrade Security Configuration Auditing - Hydro Place | | | | | | 129 | 129 |
| Upgrade Corporate Application Environment - Hydro Place | | | | | | 1,000 | 1,000 |
| **TOTAL SOFTWARE APPLICATIONS** | 999 | 1,075 | 1,357 | 1,280 | 596 | 1,728 | 7,034 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **COMPUTER OPERATIONS** | | | | | | | |
| **Infrastructure Replacement** | | | | | | | |
| Replace Personal Computers - Various Sites | | 491 | 526 | 527 | 493 | 350 | 2,385 |
| Replace Peripheral Infrastructure - Various Sites | | 328 | 355 | 262 | 478 | 191 | 1,614 |
| Upgrade Enterprise Storage Capacity - Hydro Place | | 306 | 266 | 241 | 92 | 700 | 1,606 |
| Cost Recoveries | | (104) | (85) | (77) | (30) | (224) | (520) |
| Blue Coat Upgrade - Hydro Place | | | 79 | | | | 79 |
| Cost Recoveries | | | (25) | | | | (25) |
| TriGeo Upgrade - Hydro Place | | | 31 | | | | 31 |
| Cost Recoveries | | | (10) | | | | (10) |
| **New Infrastructure** | | | | | | | |
| Develop Learning Management System Courses - Hydro Place | | | 140 | 143 | | | 283 |
| Cost Recoveries | | | (45) | (46) | | | (90) |
| **Upgrade of Technology** | | | | | | | |
| Upgrade Server Technology Program - Hydro Place | | 203 | 490 | 341 | 317 | 241 | 1,592 |
| Cost Recoveries | | (31) | (157) | (109) | (101) | (77) | (475) |
| Upgrade Computer Room - Hydro Place | | 122 | | | | | 122 |
| Cost Recoveries | | (42) | | | | | (42) |
| **TOTAL COMPUTER OPERATIONS** | 0 | 1,273 | 1,565 | 1,281 | 1,249 | 1,181 | 6,548 |
| **TOTAL INFORMATION SYSTEMS** | 999 | 2,347 | 2,922 | 2,561 | 1,845 | 2,909 | 13,583 |

| PROJECT DESCRIPTION | Expended to 2011 ($000) | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| **TELECONTROL** | | | | | | | |
| **NETWORK SERVICES** | | | | | | | |
| **Infrastructure Replacement** | | | | | | | |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | 72 | 683 | | | | | 755 |
| Replace Radomes - Various Sites | | 172 | 160 | 164 | 168 | | 664 |
| Purchase Tools and Equipment Less than $50,000 | | 85 | 89 | 92 | 94 | 98 | 458 |
| Upgrade Communication Services - Paradise River | | 98 | | | | | 98 |
| Replace MDR 4000 Microwave Radio (West) - Various Sites | | | 202 | 1,963 | | | 2,165 |
| Install Fiber Optic Cable Deer Lake to Berry Hill - TL226 | | | 210 | 1,905 | | | 2,115 |
| Replace Remote Terminal Units - Various Sites | | | 87 | 85 | 330 | 220 | 723 |
| Replace Mobile Radio System Churchill Falls to Happy Valley | | | 57 | 554 | | | 612 |
| Replace Power Line Carrier Bottom Brook to Doyles - TL214 | | | 431 | | | | 431 |
| Replace MDR 4000 Microwave Radio (East) - Various Sites | | | | 931 | 1,200 | | 2,131 |
| Refurbish Microwave Sites - Various Sites | | | | 1,830 | | | 1,830 |
| Expand West Coast Microwave - Various Sites | | | | 433 | | 5,600 | 6,033 |
| Replace Microwave Radio - Various Sites | | | | | | 1,992 | 1,992 |
| Refurbish Microwave Towers - Various Sites | | | | | | 105 | 105 |
| Install Fiber Optics - Stony Brook | | | | | | 50 | 50 |
| **Network Infrastructure** | | | | | | | |
| Replace Battery Banks and Chargers - Various Sites | | 881 | 282 | 289 | 296 | | 1,747 |
| Replace Network Communications Equipment - Various Sites | | 522 | 126 | 142 | 146 | | 935 |
| Install Substation Communications Management - Various Sites | | | 204 | | | | 204 |
| **Upgrade of Technology** | | | | | | | |
| Replace Telephone Systems - Port Saunders and Whitbourne | | 199 | 90 | 90 | 90 | | 469 |
| Upgrade Site Facilities - Various Sites | | 47 | 50 | 51 | 52 | 54 | 253 |
| Upgrade Communications System - Cat Arm | | | | 70 | 1,900 | | 1,970 |
| Upgrade IP Scada Network - Various Sites | | | | 93 | 359 | | 452 |
| Replace PLC - Plum Point and Bear Cove | | | | | 900 | | 900 |
| Replace PLC (Berry Hill to Peters Barron) - TL227 | | | | | 708 | | 708 |
| Build Remote Computer Link Between Cat Arm Governors and Bay d'Espoir | | | | | 268 | | 268 |
| **TOTAL TELECONTROL** | 72 | 2,686 | 1,988 | 8,693 | 6,510 | 8,119 | 28,068 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---|---|---|---|---|---|---|---|
| | | | | ($000) | | | |
| **TRANSPORTATION** | | | | | | | |
| Replace Vehicles and Aerial Devices Hydro System - Various Sites | 2,351 | 2,350 | 4,116 | 3,143 | 1,359 | 3,657 | 16,975 |
| **TOTAL TRANSPORTATION** | 2,351 | 2,350 | 4,116 | 3,143 | 1,359 | 3,657 | 16,975 |
| **ADMINISTRATION** | | | | | | | |
| Remove Safety Hazards - Various Sites | | 249 | 244 | 250 | 257 | 263 | 1,264 |
| Purchase Tools and Equipment Less than $50,000 | | 132 | 94 | 69 | 71 | 136 | 501 |
| Upgrade Systems and Exterior - Hydro Place | | | 1,908 | 2,073 | 2,818 | 500 | 7,299 |
| Perform Upgrades as Determined in Building Condition Study - Hydro Place | | | 166 | 246 | 159 | | 571 |
| Replace AC Unit 12A and Unit 14 - Hydro Place | | | 168 | | | | 168 |
| Upgrade Outside Property - Various Sites | | | | | 100 | 100 | 200 |
| Upgrade Fire System - Bishop's Falls | | | | | | 50 | 50 |
| **TOTAL ADMINISTRATION** | 0 | 381 | 2,580 | 2,638 | 3,405 | 1,049 | 10,052 |
| **TOTAL GENERAL PROPERTIES** | 3,421 | 7,765 | 11,606 | 17,035 | 13,118 | 15,734 | 68,678 |
| **MAJOR OVERHAULS AND INSPECTIONS** | | | | | | | |
| Overhaul Diesel Units - Various Sites | | 974 | 995 | 1,019 | 1,047 | 1,065 | 5,099 |
| Overhaul Turbine Units 1, 2 and 3 - Holyrood | | 4,193 | | 4,800 | | 5,300 | 14,293 |
| Condition Assessment and Life Extension Phase 2 - Holyrood | | 1,216 | 887 | 912 | | | 3,015 |
| Overhaul Turbine/Generator Units - Granite Canal and Upper Salmon | | 457 | | | | | 457 |
| **TOTAL MAJOR OVERHAULS AND INSPECTIONS** | 0 | 6,840 | 1,882 | 6,731 | 1,047 | 6,365 | 22,863 |

**APPENDIX B**

**Twenty-Year Capital Plan**

| | Accuracy 10% | Accuracy 25% | | | | Accuracy 50% | | | | Accuracy 50% to order of magnitude | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
| **Generation** | | | | | | | | | | | | | | | | | | | | |
| Hydro plants | 11,490 | 11,669 | 10,090 | 10,473 | 4,884 | 2,190 | 695 | 515 | 760 | 575 | 810 | 275 | 425 | 510 | 1,025 | 150 | 510 | 525 | 545 | 550 |
| Thermal Plant | 19,983 | 18,652 | 22,001 | 18,272 | 25,750 | 4,200 | 2,750 | 5,100 | 5,250 | 3,700 | 6,750 | 5,300 | 2,325 | 2,850 | 3,000 | 4,700 | 3,650 | 3,900 | 3,620 | 3,775 |
| Gas Turbines | 3,367 | 4,344 | 4,528 | 2,142 | 650 | 250 | 950 | 2,450 | 3,450 | 3,100 | 3,325 | 3,410 | 3,450 | 3,250 | 3,530 | 2,220 | 1,600 | 1,200 | 2,360 | 2,180 |
| Tools and Equipment | 196 | 164 | 24 | 84 | 21 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 | 393 |
| **Transmission and Terminals** | | | | | | | | | | | | | | | | | | | | |
| Terminal Stations | 14,149 | 12,695 | 15,687 | 14,090 | 8,020 | 7,480 | 10,225 | 10,105 | 10,535 | 7,935 | 8,751 | 8,280 | 7,870 | 7,685 | 8,205 | 8,115 | 8,395 | 5,395 | 7,560 | 7,535 |
| Transmission | 6,027 | 36,687 | 54,006 | 72,411 | 72,833 | 10,407 | 9,428 | 8,123 | 8,591 | 11,574 | 12,476 | 11,370 | 18,594 | 16,250 | 15,201 | 16,072 | 17,556 | 23,434 | 25,786 | 19,610 |
| Metering | 628 | 962 | 581 | 153 | 157 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Tools and Equipment | 2,019 | 2,692 | 600 | 1,606 | 595 | 1,071 | 1,672 | 1,030 | 1,069 | 1,904 | 1,981 | 2,658 | 1,605 | 1,659 | 1,341 | 2,190 | 931 | 2,855 | 1,260 | 493 |
| **Rural Systems** | | | | | | | | | | | | | | | | | | | | |
| Distribution | 17,416 | 15,420 | 15,023 | 16,242 | 13,726 | 13,267 | 14,276 | 14,307 | 11,437 | 11,007 | 9,559 | 10,138 | 10,452 | 9,955 | 10,066 | 9,362 | 8,730 | 9,767 | 3,970 | 3,885 |
| Diesel Plants | 3,823 | 4,252 | 11,112 | 5,645 | 3,604 | 4,220 | 5,085 | 4,460 | 2,605 | 2,660 | 2,190 | 1,180 | 575 | 1,247 | 4,029 | 3,940 | 1,595 | 2,275 | 2,615 | 2,890 |
| **General Properties** | | | | | | | | | | | | | | | | | | | | |
| Information Systems | 2,347 | 2,922 | 2,561 | 1,845 | 2,909 | 4,303 | 4,682 | 3,488 | 2,848 | 6,700 | 1,880 | 6,652 | 2,203 | 2,746 | 1,752 | 1,752 | 2,235 | 1,818 | 2,061 | 1,924 |
| Telecontrol | 2,686 | 1,988 | 8,693 | 6,510 | 8,119 | 1,140 | 2,119 | 2,000 | 3,550 | 6,037 | 5,762 | 1,984 | 3,247 | 1,805 | 2,592 | 1,251 | 2,931 | 2,373 | 2,190 | 2,267 |
| Transportation | 2,350 | 4,116 | 3,143 | 1,359 | 3,657 | 2,501 | 2,009 | 2,601 | 4,687 | 1,735 | 1,634 | 3,354 | 2,290 | 3,071 | 2,495 | 3,718 | 1,984 | 1,408 | 4,371 | 1,729 |
| Administrative | 381 | 3,807 | 2,638 | 3,405 | 1,049 | 318 | 398 | 478 | 618 | 518 | 518 | 418 | 678 | 718 | 468 | 718 | 618 | 318 | 618 | 718 |
| **Contingency Fund** | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| **Total Existing Assets** | 87,862 | 121,369 | 151,686 | 155,237 | 146,973 | 52,773 | 55,715 | 56,083 | 56,827 | 58,871 | 57,062 | 56,445 | 55,141 | 53,172 | 55,130 | 55,615 | 52,162 | 56,694 | 58,383 | 48,981 |
| ***Total for 20 Years*** | 1,492,182 | | | | | | | | | | | | | | | | | | | |
| ***Average*** | 74,609 | | | | | | | | | | | | | | | | | | | |

| | Expended to 2011 | 2012 | Future Years | Total |
|---|---|---|---|---|
| | | ($000) | | |
| **GENERATION** | 8,374 | 28,971 | 24,751 | 62,096 |
| **TRANSMISSION AND RURAL OPERATIONS** | 15,627 | 43,287 | 220,484 | 279,399 |
| **GENERAL PROPERTIES** | 3,421 | 7,765 | 1,607 | 12,792 |
| **MAJOR OVERHAULS AND INSPECTIONS** | 0 | 6,840 | 0 | 6,840 |
| **CONTINGENCY FUND** | | 1,000 | 0 | 1,000 |
| **TOTAL CAPITAL BUDGET** | 27,422 | 87,862 | 246,842 | 362,126 |

| | Expended to 2011 | 2012 | Future Years | Total |
|---|---|---|---|---|
| | | ($000) | | |
| **GENERATION** | | | | |
| **Hydraulic Plant** | 1,200 | 11,033 | 10,191 | 22,424 |
| **Thermal Plant** | 4,546 | 14,375 | 14,560 | 33,480 |
| **Gas Turbines** | 2,629 | 3,367 | 0 | 5,995 |
| **Tools and Equipment** | 0 | 196 | 0 | 196 |
| **TOTAL GENERATION** | 8,374 | 28,971 | 24,751 | 62,096 |
| **TRANSMISSION AND RURAL OPERATIONS** | | | | |
| **Terminal Stations** | 8,399 | 14,149 | 8,294 | 30,843 |
| **Transmission** | 289 | 5,829 | 207,625 | 213,743 |
| **Distribution** | 5,636 | 17,416 | 2,677 | 25,728 |
| **Generation** | 516 | 2,681 | 1,206 | 4,403 |
| **Properties** | 0 | 566 | 0 | 566 |
| **Metering** | 292 | 628 | 288 | 1,208 |
| **Tools and Equipment** | 494 | 2,019 | 396 | 2,909 |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 15,627 | 43,287 | 220,484 | 279,399 |
| **MAJOR OVERHAULS AND INSPECTIONS** | | | | |
| **Major Overhauls and Inspections** | 0 | 6,840 | 0 | 6,840 |
| **TOTAL MAJOR OVERHAULS AND INSPECTIONS** | 0 | 6,840 | 0 | 6,840 |
| **GENERAL PROPERTIES** | | | | |
| **Information Systems** | 999 | 2,347 | 388 | 3,734 |
| **Telecontrol** | 72 | 2,686 | 0 | 2,758 |
| **Transportation** | 2,351 | 2,350 | 1,219 | 5,920 |
| **Administrative** | 0 | 381 | 0 | 381 |
| **TOTAL GENERAL PROPERTIES** | 3,421 | 7,765 | 1,607 | 12,792 |
| **CONTINGENCY FUND** | | 1,000 | | 1,000 |
| **TOTAL CAPITAL BUDGET** | 27,422 | 87,862 | 246,842 | 362,126 |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **HYDRAULIC PLANT** | | | | | |
| Rewind Stators Units 1, 3 and 4 - Bay d'Espoir | | 4,954 | 8,689 | 13,643 | B - 3 |
| Replace Static Excitation Systems - Upper Salmon, Holyrood and Hinds Lake | 487 | 2,403 | 1,219 | 4,109 | |
| Upgrade Burnt Dam Spillway - Bay d'Espoir | | 1,703 | | 1,703 | B - 14 |
| Replace Emergency Diesel Generator - Bay d'Espoir | | 611 | 283 | 894 | B - 25 |
| Upgrade Intake Gate Controls - Bay d'Espoir | 352 | 468 | | 820 | |
| Upgrade Generating Station Service Water System - Cat Arm | 360 | 440 | | 800 | |
| Replace Fuel Tank - Burnt Dam | | 208 | | 208 | C - 2 |
| Replace Rip Rap - Bay d'Espoir | | 199 | | 199 | D - 2 |
| Upgrade Public Safety Around Dams and Waterways - Bay d'Espoir | | 48 | | 48 | |
| **TOTAL HYDRAULIC PLANT** | 1,200 | 11,033 | 10,191 | 22,424 | |
| **THERMAL PLANT** | | | | | |
| Rewind Generator Units 1 and 2 - Holyrood | | 112 | 11,789 | 11,901 | B - 5 |
| Upgrade Marine Terminal - Holyrood | | 5,860 | | 5,860 | B - 7 |
| Replace Programmable Logic Controllers - Holyrood | 2,230 | 902 | | 3,132 | |
| Replace Fuel Oil Heat Tracing - Holyrood | | 1,474 | 1,414 | 2,888 | B - 9 |
| Install Plant Operator Training Simulator - Holyrood | | 1,028 | 1,073 | 2,101 | B -12 |
| Upgrade Hydrogen System - Holyrood | 1,192 | 800 | | 1,992 | |
| Upgrade Stack Breaching Unit 2 - Holyrood | | 1,505 | | 1,505 | B - 20 |
| Upgrade Forced Draft Fan Ductwork Unit 2 - Holyrood | | 929 | | 929 | B - 23 |
| Upgrade Synchronous Condenser Unit 3 - Holyrood | 484 | 406 | | 889 | |
| Replace Relay Panels Unit 3 - Holyrood | 277 | 554 | | 831 | |
| Upgrade Electrical Equipment - Holyrood | 188 | 206 | 285 | 679 | |
| Replace Steam Seal Regulator Unit 2 - Holyrood | 175 | 438 | | 613 | |
| Replace Beta Attenuation Monitoring Analyzers - Holyrood | | 161 | | 161 | D - 21 |
| **TOTAL THERMAL PLANT** | 4,546 | 14,375 | 14,560 | 33,480 | |
| **GAS TURBINES** | | | | | |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 2,629 | 3,367 | | 5,995 | |
| **TOTAL GAS TURBINE PLANTS** | 2,629 | 3,367 | 0 | 5,995 | |
| **TOOLS AND EQUIPMENT** | | | | | |
| Purchase Tools and Equipment Less than $50,000 | | 196 | | 196 | |
| **TOTAL TOOLS AND EQUIPMENT** | 0 | 196 | 0 | 196 | |
| **TOTAL GENERATION** | 8,374 | 28,971 | 24,751 | 62,096 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **TERMINAL STATIONS** | | | | | |
| Install Additional 230kV Transformer - Oxen Pond | | 3,535 | 7,004 | 10,540 | B - 29 |
| Upgrade Terminal Stations to 25 kV - Labrador City | 6,483 | 3,507 | | 9,990 | |
| Upgrade Circuit Breakers - Various Sites | | 1,677 | | 1,677 | B - 45 |
| Perform Grounding Upgrades - Various Sites | 321 | 324 | 1,012 | 1,657 | |
| Upgrade Power Transformers - Various Sites | | 1,246 | | 1,246 | B - 49 |
| Upgrade Substation - Wabush | 459 | 626 | | 1,086 | |
| Upgrade Station Reliability and Safety - Rocky Harbour | 435 | 360 | | 795 | |
| Replace 69 kV SF6 Breakers - St. Anthony Airport | 490 | 290 | | 780 | |
| Replace Compressed Air System - Bay d'Espoir | 84 | 564 | | 648 | |
| Replace 230 kV Circuit Breaker - Sunnyside | 41 | 590 | | 631 | |
| Replace Instrument Transformers - Various Sites | | 452 | | 452 | C - 35 |
| Replace Insulators - Various Sites | | 412 | | 412 | C - 113 |
| Replace Disconnects - Various Sites | | 352 | | 352 | C - 126 |
| Replace Compressed Air Piping and Install Dew Point Monitor - Buchans | | 28 | 278 | 307 | C - 166 |
| Install Alternate Station Services - Stony Brook and Massey Drive | 86 | 109 | | 195 | |
| Replace Surge Arrestors - Various Sites | | 76 | | 76 | D - 173 |
| **TOTAL TERMINAL STATIONS** | 8,399 | 14,149 | 8,294 | 30,843 | |
| **TRANSMISSION** | | | | | |
| Upgrade Transmission Line Corridor - Bay d'Espoir to Western Avalon | | 2,632 | 206,744 | 209,376 | B - 27 |
| Perform Wood Pole Line Management Program - Various Sites | | 2,519 | | 2,519 | B - 36 |
| Replace Guy Wires TL-215 - Doyles to Grand Bay | 289 | 318 | 880 | 1,487 | |
| Upgrade Transmission Line Access Trails - Stony Brook to Springdale | | 313 | | 313 | C - 136 |
| Install Ice Monitoring Equipment - Various Sites | | 47 | | 47 | |
| **TOTAL TRANSMISSION** | 289 | 5,829 | 207,625 | 213,743 | |
| **DISTRIBUTION** | | | | | |
| Voltage Conversion - Labrador City | 4,590 | 3,841 | 970 | 9,400 | |
| Provide Service Extensions - All Service Areas | | 4,172 | | 4,172 | B - 32 |
| Upgrade L2 Distribution Feeder - Glenburnie | 845 | 2,115 | 597 | 3,556 | |
| Upgrade Distribution Systems - All Service Areas | | 2,508 | | 2,508 | B - 38 |
| Distribution System Additions - Various Sites | | 2,172 | | 2,172 | B - 42 |
| Upgrade Distribution Lines - Bay d'Espoir, Parsons Pond and Plum Point | | 1,385 | 1,111 | 2,496 | B - 34 |
| Upgrade Distribution Systems - Francois, Rigolet and Happy Valley | 73 | 652 | | 726 | |
| Replace Substation Infrastructure - Burgeo | 128 | 368 | | 496 | |
| Replace Recloser Control Panels - Various Sites | | 202 | | 202 | C - 176 |
| **TOTAL DISTRIBUTION** | 5,636 | 17,416 | 2,677 | 25,728 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years ($000) | Total | Page Ref |
|---|---|---|---|---|---|
| **GENERATION** | | | | | |
| Perform Arc Flash Remediation - Various Sites | 430 | 380 | 1,206 | 2,016 | |
| Increase Generation Capacity - Mary's Harbour | | 1,489 | | 1,489 | B - 48 |
| Replace Fuel Storage Tanks - St. Lewis | | 465 | | 465 | C - 10 |
| Replace Mini Hydro Turbine - Roddicton | 87 | 235 | | 322 | |
| Perform Front End Engineering Design for Diesel Plant Remediation -Various Sites | | 110 | | 110 | D - 131 |
| **TOTAL GENERATION** | 516 | 2,681 | 1,206 | 4,403 | |
| **PROPERTIES** | | | | | |
| Install Fall Protection Equipment - Various Sites | | 199 | | 199 | D - 87 |
| Legal Survey of Primary Distribution Line Right of Way - Various Sites | | 198 | | 198 | D - 98 |
| Upgrade Mechanical Workshop - St. Anthony | | 87 | | 87 | D - 134 |
| Install Waste Oil Storage Tank - L'Anse au Loup | | 82 | | 82 | D - 170 |
| **TOTAL PROPERTIES** | 0 | 566 | 0 | 566 | |
| **METERING** | | | | | |
| Install Automated Meter Reading - Rocky Harbour and Glenburnie | | 380 | 288 | 667 | B - 53 |
| Install Automated Meter Reading - Labrador City | 292 | 58 | | 351 | |
| Purchase Meters, Equipment and Metering Tanks - Various Sites | | 190 | | 190 | D - 103 |
| **TOTAL METERING** | 292 | 628 | 288 | 1,208 | |
| **TOOLS AND EQUIPMENT** | | | | | |
| Replace Off-Road Track Vehicles - Bishop's Falls and Fogo | 494 | 609 | | 1,104 | |
| Replace Off Road Track Vehicles - Flower's Cove and Cow Head | | 483 | 396 | 878 | B - 51 |
| Purchase Tools and Equipment Less than $50,000 | | 406 | | 406 | |
| Replace Light Duty Mobile Equipment - Various Sites | | 401 | | 401 | C - 119 |
| Replace Excavator - L'Anse au Loup | | 120 | | 120 | D - 128 |
| **TOTAL TOOLS AND EQUIPMENT** | 494 | 2,019 | 396 | 2,909 | |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 15,627 | 43,287 | 220,484 | 279,399 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **INFORMATION SYSTEMS** | | | | | |
| **SOFTWARE APPLICATIONS** | | | | | |
| **New Infrastructure** | | | | | |
| Perform Minor Application Enhancements - Hydro Place | | 123 | | 123 | D - 208 |
| Cost Recoveries | | (42) | | (42) | |
| Implement Work Protection Safety Code Application - Hydro Place | | 116 | | 116 | D - 202 |
| **Upgrade of Technology** | | | | | |
| Corporate Application Environment - Upgrade Microsoft Products | 1,426 | 678 | | 2,104 | |
| Cost Recoveries | (428) | (203) | | (631) | |
| Upgrade JD Edwards - Hydro Place | | 284 | 588 | 872 | B - 60 |
| Cost Recoveries | | (97) | (200) | (296) | |
| Upgrade Energy Management System - Hydro Place | | 118 | | 118 | D - 200 |
| Upgrade Microsoft Project - Hydro Place | | 91 | | 91 | D - 216 |
| Cost Recoveries | | (31) | | (31) | |
| Upgrade Creditron System - Hydro Place | | 38 | | 38 | |
| **TOTAL SOFTWARE APPLICATIONS** | 999 | 1,075 | 388 | 2,461 | |
| **COMPUTER OPERATIONS** | | | | | |
| **Infrastructure Replacement** | | | | | |
| Replace Personal Computers - Various Sites | | 491 | | 491 | C - 194 |
| Replace Peripheral Infrastructure - Various Sites | | 328 | | 328 | C - 199 |
| Upgrade Enterprise Storage Capacity - Hydro Place | | 306 | | 306 | C - 210 |
| Cost Recoveries | | (104) | | (104) | |
| **Upgrade of Technology** | | | | | |
| Upgrade Server Technology Program - Hydro Place | | 203 | | 203 | D - 195 |
| Cost Recoveries | | (31) | | (31) | |
| Upgrade Computer Room - Hydro Place | | 122 | | 122 | D - 210 |
| Cost Recoveries | | (42) | | (42) | |
| **TOTAL COMPUTER OPERATIONS** | 0 | 1,273 | 0 | 1,273 | |
| **TOTAL INFORMATION SYSTEMS** | 999 | 2,347 | 388 | 3,734 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **TELECONTROL** | | | | | |
| **NETWORK SERVICES** | | | | | |
| **Infrastructure Replacement** | | | | | |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | 72 | 683 | | 755 | |
| Replace Radomes - Various Sites | | 172 | | 172 | D - 178 |
| Upgrade Communication Services - Paradise River | | 98 | | 98 | D - 205 |
| Purchase Tools and Equipment Less than $50,000 | | 85 | | 85 | |
| **Network Infrastructure** | | | | | |
| Replace Battery Banks and Chargers - Various Sites | | 881 | | 881 | B - 58 |
| Replace Network Communications Equipment - Various Sites | | 522 | | 522 | B - 62 |
| **Upgrade of Technology** | | | | | |
| Replace Telephone Systems - Port Saunders and Whitbourne | | 199 | | 199 | D -176 |
| Upgrade Site Facilities - Various Sites | | 47 | | 47 | |
| **TOTAL TELECONTROL** | 72 | 2,686 | 0 | 2,758 | |
| **TRANSPORTATION** | | | | | |
| Replace Vehicles and Aerial Devices (2011-2012) - Various Sites | 2,351 | 639 | | 2,989 | |
| Replace Vehicles and Aerial Devices (2012-2013) - Various Sites | | 1,711 | 1,219 | 2,930 | B - 56 |
| **TOTAL TRANSPORTATION** | 2,351 | 2,350 | 1,219 | 5,920 | |
| **ADMINISTRATION** | | | | | |
| Remove Safety Hazards - Various Sites | | 249 | | 249 | C - 205 |
| Purchase Tools and Equipment Less than $50,000 | | 132 | | 132 | |
| **TOTAL ADMINISTRATION** | 0 | 381 | 0 | 381 | |
| **TOTAL GENERAL PROPERTIES** | 3,421 | 7,765 | 1,607 | 12,792 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **MAJOR OVERHAULS AND INSPECTIONS**[1] | | | | | |
| Overhaul Unit 1 Turbine - Holyrood | | 4,193 | | 4,193 | B - 66 |
| Condition Assessment and Life Extension Phase 2 - Holyrood | | 1,216 | | 1,216 | B - 68 |
| Overhaul Diesel Units - Various Sites | | 974 | | 974 | B - 70 |
| Overhaul Turbine/Generator Units - Granite Canal and Upper Salmon | | 457 | | 457 | C - 215 |
| **TOTAL MAJOR OVERHAULS AND INSPECTIONS** | 0 | 6,840 | 0 | 6,840 | |

[1] Capital Budget proposals after consideration of International Financial Reporting Standards (IFRIS) Requirements

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **GENERATION** | | | | | |
| Rewind Stators Units 1, 3 and 4 - Bay d'Espoir | | 4,954 | 8,689 | 13,643 | B - 3 |
| Rewind Generator Units 1 and 2 - Holyrood | | 112 | 11,789 | 11,901 | B - 5 |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 2,629 | 3,367 | | 5,995 | |
| Upgrade Marine Terminal - Holyrood | | 5,860 | | 5,860 | B - 7 |
| Replace Static Excitation Systems - Upper Salmon, Holyrood and Hinds Lake | 487 | 2,403 | 1,219 | 4,109 | |
| Replace Programmable Logic Controllers - Holyrood | 2,230 | 902 | | 3,132 | |
| Replace Fuel Oil Heat Tracing - Holyrood | | 1,474 | 1,414 | 2,888 | B - 9 |
| Install Plant Operator Training Simulator - Holyrood | | 1,028 | 1,073 | 2,101 | B - 12 |
| Upgrade Hydrogen System - Holyrood | 1,192 | 800 | | 1,992 | |
| Upgrade Burnt Dam Spillway - Bay d'Espoir | | 1,703 | | 1,703 | B - 14 |
| Upgrade Stack Breaching Unit 2 - Holyrood | | 1,505 | | 1,505 | B - 20 |
| Upgrade Forced Draft Fan Ductwork Unit 2 - Holyrood | | 929 | | 929 | B - 23 |
| Replace Emergency Diesel Generator - Bay d'Espoir | | 611 | 283 | 894 | B - 25 |
| Upgrade Synchronous Condenser Unit 3 - Holyrood | 484 | 406 | | 889 | |
| Replace Relay Panels Unit 3 - Holyrood | 277 | 554 | | 831 | |
| Upgrade Intake Gate Controls - Bay d'Espoir | 352 | 468 | | 820 | |
| Upgrade Generating Station Service Water System - Cat Arm | 360 | 440 | | 800 | |
| Upgrade Electrical Equipment - Holyrood | 188 | 206 | 285 | 679 | |
| Replace Steam Seal Regulator Unit 2 - Holyrood | 175 | 438 | | 613 | |
| **TOTAL GENERATION** | 8,374 | 28,159 | 24,751 | 61,284 | |
| | | | | | |
| **TRANSMISSION AND RURAL OPERATIONS** | | | | | |
| Upgrade Transmission Line Corridor - Bay d'Espoir to Western Avalon | | 2,632 | 206,744 | 209,376 | B - 27 |
| Install Additional 230kV Transformer - Oxen Pond | | 3,535 | 7,004 | 10,540 | B - 29 |
| Upgrade Terminal Stations to 25 kV - Labrador City | 6,483 | 3,507 | | 9,990 | |
| Voltage Conversion - Labrador City | 4,590 | 3,841 | 970 | 9,400 | |
| Provide Service Extensions - All Service Areas | | 4,172 | | 4,172 | B - 32 |
| Upgrade L2 Distribution Feeder - Glenburnie | 845 | 2,115 | 597 | 3,556 | |
| Upgrade Distribution Lines - Bay d'Espoir, Parsons Pond and Plum Point | | 1,385 | 1,111 | 2,496 | B - 34 |
| Perform Wood Pole Line Management Program - Various Sites | | 2,519 | | 2,519 | B - 36 |
| Upgrade Distribution Systems - All Service Areas | | 2,508 | | 2,508 | B - 38 |
| Distribution System Additions - Various Sites | | 2,172 | | 2,172 | B - 42 |
| Perform Arc Flash Remediation - Various Sites | 430 | 380 | 1,206 | 2,016 | |
| Upgrade Circuit Breakers - Various Sites | | 1,677 | | 1,677 | B - 45 |
| Perform Grounding Upgrades - Various Sites | 321 | 324 | 1,012 | 1,657 | |
| Increase Generation Capacity - Mary's Harbour | | 1,489 | | 1,489 | B - 48 |
| Replace Guy Wires TL-215 - Doyles to Grand Bay | 289 | 318 | 880 | 1,487 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Page Ref |
|---|---|---|---|---|---|
| | | ($000) | | | |
| **TRANSMISSION AND RURAL OPERATIONS (cont'd.)** | | | | | |
| Upgrade Power Transformers - Various Sites | | 1,246 | | 1,246 | B - 49 |
| Replace Off-Road Track Vehicles - Bishop's Falls and Fogo | 494 | 609 | | 1,104 | |
| Upgrade Substation - Wabush | 459 | 626 | | 1,086 | |
| Replace Off Road Track Vehicles - Flower's Cove and Cow Head | | 483 | 396 | 878 | B - 51 |
| Upgrade Station Reliability and Safety - Rocky Harbour | 435 | 360 | | 795 | |
| Replace 69 kV SF6 Breakers - St. Anthony Airport | 490 | 290 | | 780 | |
| Upgrade Distribution Systems - Francois, Rigolet and Happy Valley | 73 | 652 | | 726 | |
| Install Automated Meter Reading - Rocky Harbour and Glenburnie | | 380 | 288 | 667 | B - 53 |
| Replace Compressed Air System - Bay d'Espoir | 84 | 564 | | 648 | |
| Replace 230 kV Circuit Breaker - Sunnyside | 41 | 590 | | 631 | |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 15,035 | 38,376 | 220,206 | 273,616 | |
| **GENERAL PROPERTIES** | | | | | |
| Replace Vehicles and Aerial Devices (2011-2012) - Various Sites | 2,351 | 639 | | 2,989 | |
| Replace Vehicles and Aerial Devices (2012-2013) - Various Sites | | 1,711 | 1,219 | 2,930 | B - 56 |
| Corporate Application Environment - Upgrade Microsoft Products | 999 | 475 | | 1,473 | |
| Replace Battery Banks and Chargers - Various Sites | | 881 | | 881 | B - 58 |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | 72 | 683 | | 755 | |
| Upgrade JD Edwards - Hydro Place | | 187 | 388 | 575 | B - 60 |
| Replace Network Communications Equipment - Various Sites | | 522 | | 522 | B - 62 |
| **TOTAL GENERAL PROPERTIES** | 3,421 | 5,098 | 1,607 | 10,126 | |
| **MAJOR OVERHAULS AND INSPECTIONS**[1] | | | | | |
| Overhaul Turbine Unit 1 - Holyrood | | 4,193 | | 4,193 | B - 66 |
| Condition Assessment and Life Extension Phase 2 - Holyrood | | 1,216 | | 1,216 | B - 68 |
| Overhaul Diesel Units - Various Sites | | 974 | | 974 | B - 70 |
| **TOTAL MAJOR OVERHAULS AND INSPECTIONS** | 0 | 6,383 | 0 | 6,383 | |
| **TOTAL PROJECTS OVER $500,000** | 26,830 | 78,016 | 246,564 | 351,409 | |

[1] Capital Budget proposals after consideration of International Financial Reporting Standards (IFRIS) requirements

**Project Title:** Rewind Stators Units 1, 3 and 4

**Location:** Bay d'Espoir

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of the replacement of the stator windings for Units 1, 3 and 4. The work will also include an upgrade to the generator protection, the remediation of asbestos from stator components and the refurbishment of other generator components such as the rotor poles to ensure the new windings operate at their full capability. Hydro intends to replace the stator in Unit 4 in 2012, Unit 1 in 2013 and Unit 3 in 2014. The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 190.0 | 190.0 | 190.0 | 570.0 |
| **Labour** | 592.0 | 592.0 | 592.0 | 1,776.0 |
| **Consultant** | 144.1 | 143.9 | 147.7 | 435.7 |
| **Contract Work** | 3,290.0 | 3,290.0 | 2,025.0 | 8,605.0 |
| **Other Direct Costs** | 40.0 | 40.0 | 40.0 | 120.0 |
| **Interest and Escalation** | 272.1 | 372.7 | 340.4 | 985.2 |
| **Contingency** | 425.6 | 425.6 | 299.5 | 1,150.7 |
| **TOTAL** | **4,953.8** | **5,054.2** | **3,634.6** | **13,642.6** |

**Operating Experience:**

Units 1 through 4 of the Bay d'Espoir Generating Station are designed for continuous operation with varying loads to meet system requirements. With the exception of maintenance outages, the four units have been operating continuously since they were commissioned in 1967-1968.

**Project Justification:**

This project is required to maintain system reliability. Unit 2 stator winding was replaced in 2010 on budget and on schedule. The remaining three units are in similar states of deterioration and should be replaced.

**Project Title:** Rewind Stators Units 1, 3 and 4 **(cont'd.)**

**Project Justification: (cont'd.)**

The failure of a stator in service would cause significant damage to the stator core and rotor. Presently, a spare stator is on site. The outage to replace the stator only is approximately six months. If the unit ran to failure, more than the stator would be damaged. In this situation, the outage could be anywhere from 12 to 18 months. Thus failure to replace the windings would impair Hydro's ability to provide least-cost, reliable electricity.

The life expectancy for asphalt insulated stator windings is 40 years. Since the windings of Units 1, 3 and 4 are beyond their anticipated useful life, stator replacements are necessary.

During Unit 2 stator replacement work in 2010, it was determined that movement or migration of the stator laminations had occurred. It is anticipated this condition will exist on the remaining units, although the level of this condition cannot be determined until the actual replacement takes place on Units 1, 3 and 4. The amount of migration of the stator core is unknown but any migration is a serious condition that can lead to failure of the stator winding. The uncertainty of this condition has further reduced the reliability of these units.

The presence of asbestos in the stator components is an environmental concern that should be addressed.

**Future Plans:**

None.

**Attachments:**

See report entitled "Replacement of Stator Windings at the Bay d'Espoir Hydroelectric Generating Station" located in Volume I, Tab 1, for further project details.

**Project Title:** Rewind Generator Units 1 and 2

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of the replacement of the stator windings for Unit 1 and Unit 2 thermal generating units at the Holyrood Thermal Generating Station (Holyrood). Along with the replacement of stator windings, the project would include an upgrade to the generator protection and remediation of asbestos from the stator windings. Hydro intends to replace the stator winding in Unit 2 in 2014 and Unit 1 in 2015. The budget estimate is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 10.0 | 850.0 | 2,500.0 | 3,360.0 |
| **Labour** | 80.0 | 80.0 | 180.0 | 340.0 |
| **Consultant** | 9.1 | 55.3 | 0.0 | 64.4 |
| **Contract Work** | 0.0 | 0.0 | 5,000.0 | 5,000.0 |
| **Other Direct Costs** | 5.0 | 15.0 | 24.7 | 44.7 |
| **Interest and Escalation** | 8.1 | 107.3 | 2,149.8 | 2,265.2 |
| **Contingency** | 0.0 | 0.0 | 826.9 | 826.9 |
| **TOTAL** | **112.2** | **1,107.6** | **10,681.4** | **11,901.2** |

**Operating Experience:**

Unit 1 and Unit 2 at Holyrood are designed for continuous operation with varying loads to meet system requirements. Unit 1 and Unit 2 each have a capacity of 175 MW, which are the largest individual units on the Island Interconnected System. As the largest units, they play a pivotal role in balance of the energy for the energy system, particularly the power requirements of Avalon Peninsula.

**Project Title:** Rewind Generator Units 1 and 2 **(cont'd.)**

**Project Justification:**

This project is required to maintain system reliability and to align with the anticipated mode of operation for the Holyrood facility, as a generating station and a synchronous condenser facility.

The life expectancy for Micapal, multi-turn coil insulated stator windings is approximately 35 years.

Unit 1 and Unit 2 stator windings have reached the end of their useful service lives and have been recommended for replacement in several instances. In 2003 and 2005, GE Energy Services recommended replacement windings of Unit 1 and Unit 2 respectively and AMEC, in 2010 as part of the Holyrood plant condition assessment, used an independent generator expert to recommend the replacement of Unit 1 and Unit 2.

As part of the anticipated mode of operation of the Holyrood plant from a generating station to a synchronous condenser facility in 2020, this project aligns itself with that plan as the windings will be required as a generating station and a synchronous condenser facility.

**Future Plans:**

None.

**Attachments:**

See report entitled "Unit 1 And Unit 2 Generator Stator Rewind - Holyrood Generating Station" located in Volume I, Tab 2, for further project details.

**Project Title:** Upgrade Marine Terminal

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

The purpose of this project is to refurbish the Marine Terminal Facility (Jetty) at the Holyrood Thermal Generating Station. The refurbishments are required to provide a life extension to the facility while improving its capability to dock modern vessels. Work includes but is not necessarily limited to: inspection, assessment and repairs to the swinging gravity fender system; replacement of detached swinging gravity fender; modifications to fuel oil offloading components; inspection and assessment of steel casing for pile foundations; inspection, assessment and replacement of anodes and attachment brackets; and improvements to life safety through installation of devices such as a support vessel access system, a man-overboard recovery system and improvements to the jetty deck lighting system. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 132.0 | 0.0 | 0.0 | 132.0 |
| **Consultant** | 605.4 | 0.0 | 0.0 | 605.4 |
| **Contract Work** | 4,330.0 | 0.0 | 0.0 | 4,330.0 |
| **Other Direct Costs** | 38.0 | 0.0 | 0.0 | 38.0 |
| **Interest and Escalation** | 243.7 | 0.0 | 0.0 | 243.7 |
| **Contingency** | 510.5 | 0.0 | 0.0 | 510.5 |
| **TOTAL** | **5,859.6** | **0.0** | **0.0** | **5,859.6** |

**Operating Experience:**

The Holyrood Marine Terminal Facility is an integral component of the fuel oil handling system and is the single point of entry for all of the No.6 (Bunker C) fuel oil utilized at the plant.

The marine terminal consists of a 125m shore arm link that bridges the jetty to the adjacent land. The jetty is approximately 74m long by 12m wide, and supports the fuel oil offloading arms and associated pipeline and controls related to the fuel oil offloading process. Both the shore arm link and jetty

**Project Title:** Upgrade Marine Terminal **(cont'd.)**

**Operating Experience: (cont'd.)**

consist of a concrete superstructure, supported on concrete filled, circular steel piles. The superstructure of the jetty also supports the gravity fender system that absorbs the forces created from the vessels as they approach the marine terminal. The vessels are secured to the Holyrood marine terminal using four mooring dolphins located on the shore and mooring bollards located on the jetty superstructure.

**Project Justification:**

This project is justified on the requirement to upgrade inadequate and deteriorated marine terminal infrastructure. These upgrades are required to provide Holyrood with the ability to provide safe, environmentally responsible, least-cost, reliable electrical service.

The existing marine terminal has deteriorated to the state where it no longer meets the requirements of the larger, modern vessels utilizing the facility. Vessels offloading fuel oil, in recent years, have required the facility to function outside of its original design limitations, thus elevating the risk of damage to both the marine terminal and the vessel.

The Holyrood Marine Terminal Facility is an integral component of the fuel oil handling system, and is the single point of entry for all of the No.6 (bunker C) fuel oil utilized by the plant. The failure of any component of the HTGS marine terminal facility will result in a complete cutoff of fuel oil supply.

**Future Plans:**

None.

**Attachments:**

See report entitled "Refurbishment of the Marine Terminal" located in Volume I, Tab 3, for further project details.

**Project Title:** Replace Fuel Oil Heat Tracing

**Location:** Holyrood Generating Station

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is a two-year plan to replace the electric heat tracing system on the fuel oil delivery pipeline at the Holyrood Thermal Generating Station. The existing copper mineral insulated electric heat tracing cables will be replaced with new stainless steel electric heat tracing cable.

The scope of work for this project includes the following:

- Erection of scaffolding
- Removal of existing insulation, metal cladding and mineral insulated electric heating cables
- Testing the pipe thickness at prescribed intervals
- Coating of the pipe for corrosion protection
- Installation of the new electric heat tracing cable
- Installation of new insulation and metal cladding
- Installation of programmable controller with self diagnostics
- Commissioning of the new heat tracing system

The fuel oil pipeline is approximately 1,200 meters in length and consists of two electric heat tracing circuits designated as North Section and South Section. The South Section of the fuel oil pipeline will be replaced in 2012, and the North Section will be replaced in 2013, each taking approximately three months to complete. The budget estimate for this project is shown in Table 1.

**Project Title:** Replace Fuel Oil Heat Tracing **(cont'd.)**

**Project Description: (cont'd.)**

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 5.0 | 5.0 | 0.0 | 10.0 |
| **Labour** | 234.1 | 191.0 | 0.0 | 425.1 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 1,027.0 | 917.0 | 0.0 | 1,944.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 86.9 | 213.1 | 0.0 | 300.0 |
| **Contingency** | 121.3 | 87.8 | 0.0 | 209.1 |
| **TOTAL** | **1,474.3** | **1,413.9** | **0.0** | **2,888.2** |

**Operating Experience:**

The existing heat tracing cables are showing deterioration, and are at, or beyond, the end of their useful life. Since installation, the high density polyethylene jacket on the cable has melted off and moisture has accumulated within the insulation causing corrosion of the copper sheath of the cable. As a result, there have been problems with the performance of the existing application. The corrosion has caused sections of heat tracing to fail due to open electrical circuits, and ground faults.

Repetitive failures have resulted in operations personnel modifying the existing three phase system into a two phase system to mitigate the failure in one phase. This two phase system is a temporary measure until replacement of the entire heat tracing system occurs.

**Project Justification:**

This project is justified on the requirement to replace deteriorated equipment on the basis of the safety and environmental concerns and operational reliability. Failure to initiate this project increases the likelihood of failure to receive fuel oil, and could lead to equipment damage, and pose serious risk to both personnel safety and the environment.

**Project Title:** Replace Fuel Oil Heat Tracing **(cont'd.)**

**Project Justification: (cont'd.)**

The Holyrood generating units cannot operate without a supply of Bunker C fuel oil. The fuel is integral to the generating units, and therefore integral to the Holyrood system and the reliability of generation supply to the Island Interconnected System. Failure of the heat tracing system could result in an entire plant shutdown, negatively impacting public safety.

**Future Plans:**

None.

**Attachment:**

See report entitled "Replace Fuel Oil Heat Tracing" located in Volume I, Tab 4, for further details.

**Project Title:** Install Plant Operator Training Simulator

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This proposal is for the purchase of the development of and materials for an Operator Training Simulator (OTS) and operator training program for the Holyrood Thermal Generating Station. The simulator is a stand-alone platform that mimics the response of the plant systems to operator actions. Approximately four months of preparation are required to gather detailed system information on Holyrood plant operations for the development of the training simulator by the manufacturer. The OTS would be maintained by the same staff that maintain the DCS at the Holyrood Plant. A simulator is a valuable tool for training, plant optimization, logic testing and regulatory compliance.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 38.0 | 121.0 | 0.0 | 159.0 |
| **Consultant** | 16.6 | 13.9 | 0.0 | 30.5 |
| **Contract Work** | 899.7 | 736.1 | 0.0 | 1,635.8 |
| **Other Direct Costs** | 0.0 | 30.0 | 0.0 | 30.0 |
| **Interest and Escalation** | 73.9 | 134.7 | 0.0 | 208.6 |
| **Contingency** | 0.0 | 37.1 | 0.0 | 37.1 |
| **TOTAL** | **1,028.2** | **1,072.7** | **0.0** | **2,100.9** |

**Operating Experience:**

Plant Operators at Holyrood use the existing unit control board to complete their training program. As this is a live system, access is limited and the trainee requires constant supervision. It takes approximately two years to complete operator training on the unit control board. It is anticipated that an operator training simulator will enable a trainee to complete unit control board training in six

**Project Title:** Install Plant Operator Training Simulator **(cont'd.)**

**Operating Experience: (cont'd.)**

months. Hydro has experience with Operator Training Simulators at the Churchill Falls Hydroelectric Facility and the Energy Control Center. The training simulator and training program will be developed by Invensys, a company that has in excess of 80 installations worldwide.

**Project Justification:**

Operators presently have limited access to the unit control board for training purposes due to the nature of its use. A training simulator will provide operators with a platform on which to practice plant operations and response strategies to outages and equipment failure. Operator training simulators are also used for process optimization, DCS logic verification, as well as maintaining regulatory compliance. The OTS will help optimize plant efficiency, develop response schemes to system disturbances, test DCS logic changes before implementation, enhance operator training, reduce operator overtime, and maintain regulatory compliance. A cost benefit analysis shows that the installation of a new OTS is more cost effective than continuing with the status quo.

**Future Plans:**

None.

**Attachments:**

See report entitled "Install Operator Training Simulator" located in Volume I, Tab 5 for further project details.

**Project Title:** Upgrade Burnt Dam Spillway

**Location:** Bay d'Espoir

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is the second year of a four-year program to upgrade mechanical and electrical equipment at Burnt Dam Spillway Structure (Burnt Spillway). The project involves the refurbishment, replacement and inspection of components of Burnt Spillway. The scope of the project involves upgrading the stop log system and gate infrastructure.

This project involves the refurbishment, replacement and inspection of components of the Burnt Spillway. The scope of the project involves:

- Refurbish existing stop logs;
- Install a stop log storage system;
- Inspect spillway structure concrete and gate embedded parts;
- Inspect gate main and side rollers, pins and bushings, gate connection pins and links, and gate limit switches;
- Replace or refurbish gate hoists (two per gate);
- Inspect and clean gate screw stems;
- Install gate screw protectors;
- Procure spare drive nuts;
- Modify gate screw access hatch to allow for easier inspection, lubricating and cleaning;
- Clean and inspect drive shafts and replace drive shaft couplings;
- Replace or refurbish gate main gearbox (one per gate).

Although the list above identifies many work items, a number of those items relate to the mechanical drive components (hoists, screws, couplings, gearboxes) for both gates. They form a significant portion of the overall scope of work for this project. To assist Hydro with developing the scope and cost estimate to refurbish the mechanical drive components a service contractor, Weir Power and Industrial (Weir), was engaged to perform a site visit and limited visual inspection. A copy of the report prepared by Weir is provided in Appendix B.

This work is required to ensure the continued safe and reliable operation of the Burnt Dam Spillway.

**Project Title:** Upgrade Burnt Dam Spillway **(cont'd.)**

**Project Description: (cont'd.)**

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 68.5 | 0.0 | 0.0 | 68.5 |
| **Labour** | 278.1 | 0.0 | 0.0 | 278.1 |
| **Consultant** | 135.0 | 0.0 | 0.0 | 135.0 |
| **Contract Work** | 935.0 | 0.0 | 0.0 | 935.0 |
| **Other Direct Costs** | 52.6 | 0.0 | 0.0 | 52.6 |
| **Interest and Escalation** | 86.7 | 0.0 | 0.0 | 86.7 |
| **Contingency** | 146.9 | 0.0 | 0.0 | 146.9 |
| **TOTAL** | **1,702.8** | **0.0** | **0.0** | **1,702.8** |

**Operating Experience:**

Hydro maintains two personnel at the Burnt Spillway site on a continual basis. The spillway gates operate on a periodic basis with approximately four to five gate operations per year.

**Project Justification:**

This project is justified on the requirement to replace failing or deteriorated infrastructure in order for Hydro to provide safe, reliable flood management for the Victoria Lake and Burnt Pond Reservoirs as well as fisheries compensation flow into the White Bear River. A condition assessment study was performed by a professional engineering firm, Hatch, in 2008 ( see Appendix A) which identified Burnt Spillway as having the lowest overall Health Index when compared to seven other hydraulic structures of similar vintage within the Bay d'Espoir Development. Hydro's ability to continue to manage flood waters and meet its fisheries compensation commitments is contingent upon the successful upgrade of Burnt Spillway. When the four-year upgrade program for Burnt Spillway is complete, this hydraulic structure will be in a condition to operate safely and reliably for at least another 15 years.

**Project Title:** Upgrade Burnt Dam Spillway **(cont'd.)**

**Project Justification: (cont'd.)**

In addition to the high level condition assessment performed by HATCH, Hydro employed Weir Industrial and Power (Weir), a hydro generation repair service company, to complete an on site inspection of the gate hoists and gearboxes. Using information gathered during this site visit, along with past experience assessing and refurbishing similar equipment, Weir recommended that the gearboxes and hoists be removed from site and sent to a qualified machine shop for disassembly to enable an internal assessment and determine a refurbishment scope of work. In order to facilitate removal of the hoists and gearboxes from the Burnt Spillway the gates have to be disconnected, drive shafts and couplings removed, and the drive screw's disengaged and lowered from the structure. This is a time and labour intensive process but provides an opportunity to perform comprehensive inspections on major mechanical drive components of a 45 year old spillway structure to ensure they are in safe and reliable operating condition.

In 2006 there was an incident whereby the gates at Burnt Spillway failed to operate when required. A crew was dispatched from Bay d'Espoir to perform emergency work on both gates but could not get either of the gates open to the position requested by Hydro's Energy Control Centre (ECC) in order to lower the reservoir water level. This is a serious situation during times of high reservoir levels as the potential is there to cause a fuse plug failure. The incident in 2006 did not cause a fuse plug failure however, it did cause the loss of a significant amount of reservoir water that could not be used for hydro generation. It is estimated at that time that the cost to replace the value of the lost hydro generation with thermal generation from the Holyrood station was $2.6 million (based on $50 per barrel).

Failure of the fuse plug would have significant consequences including lost reservoir water, fuse plug reconstruction cost, and disruption of effective water management for the Bay d'Espoir Reservoir System while the fuse plug was being reconstructed. Reconstruction of the fuse plug is estimated to cost $1,000,000 and would take between six and ten months to complete, depending upon the time of year of the failure. If the fuse plug ruptured, the Burnt Pond Reservoir would drain down to the bottom elevation of the fuse plug resulting in loss of storage from the Burnt Pond Reservoir. While

**Project Title:** Upgrade Burnt Dam Spillway **(cont'd.)**

**Project Justification: (cont'd.)**

awaiting reconstruction, there would be loss of the full potential use of the Victoria Lake Reservoir, which could be up to 550 Gigawatt-hours of additional stored energy. It is estimated that to replace that amount of energy with thermal generation from Holyrood would be $78 million at today's oil prices (based on $85 per barrel). Water that would normally be released from the Victoria Lake Reservoir into the Burnt Pond Reservoir, and which would subsequently flow through the Burnt Canal to the remainder of the Bay d'Espoir Reservoir System, would instead be spilled through the Burnt Spillway, and/or the failed fuse plug, and lost for hydro generation.

During the aforementioned event, when neither gate would rise to the required open position, the dispatch crew was successful in raising the gate to prevent failure of the fuse plug. However once the reservoir levels where reduced to an acceptable level the crew had difficulty closing the gates. This resulted in three days of additional work but more importantly the loss of a significant amount of stored energy in the form of lost water through the spillway.

Critical component failure in a major piece of drive equipment would result in the inability to open or close a gate. If the reservoir water elevations are rising and a gate is unable to be opened it will diminished spill capacity and increase the potential of a fuse plug failure. However if reservoir elevations are decreasing and a spillway gate is stuck in the open position it results in a potential spill of up to 575 cubic meters of water per second. Spilled water is lost and can not be used for power generation any where else in the system.

The current stop log storage system in use at Burnt Spillway is very small and only allows for the logs to be stored perpendicular to their operating position when they are installed to obstruct water flow. Prior to installing each stop log, the heaviest of which weighs 3.25 tons and is seven meters wide, it must be rotated 90 degrees to allow it to be lowered into guide tracks. Currently the stop logs are rotated by lifting them with a monorail hoist and having two Hydro employee's pull on the ends of the log via tag lines until it is rotated ninety degrees. During this exercise personnel have to maneuver in tight working spaces where pinch points hazards exist. In recent years there have been several near misses and a one high potential incident associated with the rotation of a stop logs. Heightened safety

**Project Title:** Refurbish Burnt Dam Spillway **(cont'd.)**

**Project Justification: (cont'd.)**

awareness is embedded in Hydro's number one corporate goal and the existing method used for the storage and handling of stop logs is no longer acceptable. To mitigate these hazards a stop log storage system is required where all logs can be stored parallel to the operating position. In 2008 a stop log storage system was installed at the Salmon River Spillway for reasons similar to those being experienced at Burnt Spillway.

**Future Plans:**

Future plans include additional upgrade work at the Burnt Spillway in years three and four as follows:

Year Three – 2013

*Gates and gates electrical and controls.*

1. For each gate, repair concrete and embedded parts (gate roller tracks and seal plates).
2. For each gate, replace gate rollers.
3. For each gate, repair gate coating.
4. For each gate, replace upper and lower cut-off limit switches, overload switches and gate positioning measurement and controls. Provide accuracy needed for fish compensation adjustments (small gate openings).
5. For each gate, reroute control cabling to remove junction box on top of structure. Replace disconnect switches in the control building with 600 Volt distribution panel and disconnects with viewing window. Right-size the starter overloads. For each gate, install stepped, thermostatic control and monitoring on gate, gain and sill heaters. Put sill heaters on two separate circuit breakers. Replace flexible cables for heaters. Modify the sill heaters to make them easier to replace.
6. Replace 120/240 Volt distribution panel.
7. Replace the 600 Volt to 120/240 Volt transformer.

**Project Title:** Refurbish Burnt Dam Spillway **(cont'd.)**

**Future Plans: (cont'd.)**

Year Four – 2014

*Emergency hydraulic drive and diesel generation.*

8. For each gate, install permanent emergency hydraulic drive for the gate hoist, complete with enclosure, piping, sump, and clutches.
9. Replace 25 kilowatt and 75 kilowatt diesel generator sets and controls.
10. Replace DC disconnect switches in the diesel building with non-fusible disconnects with viewing window.
11. Replace cables from the diesel building to the gate control building. Raise cable penetrations above flood water line and seal penetrations.
12. Modify the existing generator exhaust stacks for improved dispersion of pollutants.
13. Raise generator radiator above snowline or move indoors with adequate ducting and air supply.

**Attachments:**

See report entitled "Burnt Spillway Refurbishment" located in Volume II, Tab 6 for further project details.

**Project Title:** Upgrade Stack Breeching Unit 2

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of refurbishing the stack breeching serving Unit 2. The stack breeching refers to the sections of breeching that extend from the outlet of the air preheaters (located inside the power house) to the exhaust stack. The stack breeching ducts will be reinforced with a carbon steel plate, the support structures and expansion joints will be replaced; and the insulation system will be upgraded by installing new insulation covered with water tight cladding and flashing.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 163.4 | 0.0 | 0.0 | 163.4 |
| **Consultant** | 55.9 | 0.0 | 0.0 | 55.9 |
| **Contract Work** | 1,055.3 | 0.0 | 0.0 | 1,055.3 |
| **Other Direct Costs** | 4.0 | 0.0 | 0.0 | 4.0 |
| **Interest and Escalation** | 98.7 | 0.0 | 0.0 | 98.7 |
| **Contingency** | 127.9 | 0.0 | 0.0 | 127.9 |
| **TOTAL** | **1,505.1** | **0.0** | **0.0** | **1,505.1** |

**Operating Experience:**

The existing stack breeching ducts, installed in 1990, are fabricated from carbon steel plates that were originally 0.25 inches thick. The duct's exterior surface is coated with a corrosion inhibiter. Its interior is lined with borosilicate (glass) block insulation that is secured in place by an adhesive. The insulation installed on the floor of the horizontal sections of duct is covered with silicate concrete that is 1.5 inches thick. Expansion joints in the breeching allow the duct to expand and contract with changes in temperature during operating conditions.

**Project Title:** Upgrade Stack Breeching Unit 2 **(cont'd.)**

**Operating Experience: (cont'd.)**

Maintaining the correct flue gas temperature is critical to the successful operation of the breeching system. If the flue gas temperature is too low, the sulphur present in the flue gas will condense into sulphuric acid. The flue gas temperature must be at least 50 degrees Fahrenheit higher than the sulphuric acid dew point of the bunker C fuel otherwise, sulphuric acid condensation will form. Sulphuric acid is very corrosive and its presence can be detrimental to the carbon steel duct of the breeching system.

Sulphuric acid causes localized corrosion to the inside of the breeching duct which has to be repaired. In addition, areas with loose or missing insulation blocks may expose the underlying insulation adhesive which has an operating limit of 200 degrees Fahrenheit. Exposed adhesive that is subjected to flue gas temperatures of up to 311 degrees Fahrenheit deteriorates. This deterioration also undermines the adhesive underneath adjacent blocks resulting in even more insulation coming loose.

**Project Justification:**

This project is justified on the need to provide reliable least cost power. Unit 2 would experience a forced outage if one of its breeching support structures failed during peak winter load demand. The duration of the forced outage was estimated at four weeks and was assumed to occur in January of the year 2015. The standby gas turbine generators at Hardwoods and Holyrood would be deployed to meet customer demand. However, this would lead to a shortfall of 1,600 MWh to the Island Interconnected System. The additional incremental cost to operate the gas turbines during the forced outage period was calculated to be $2,866,322, based on an energy requirement of 21.4 GWh during the outage. This represents the incremental cost of consuming diesel fuel to operate the gas turbine generators as opposed to No. 6 fuel oil to operate Unit 2 at Holyrood.

At the completion of this project, the reliability of the stack breeching serving Unit 2 will be substantially improved. This will ensure that a forced outage to Unit 2 will not result from a failed stack breeching system.

**Project Title:** Upgrade Stack Breeching Unit 2 **(cont'd.)**

**Future Plans:**

The upgrading of the stack breeching serving Unit 3 is planned for 2015.

**Attachments:**

See report entitled "Upgrade Unit 2 Stack Breeching" located in Volume II, Tab 7, for further project details.

**Project Title:** Upgrade Forced Draft Fan Ductwork Unit 2

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Justifiable

**Project Description:**

This project is required to upgrade the ductwork on the east and west forced draft (FD) fans servicing generating Unit 2. It will reduce fan power consumption by approximately 16 percent and reduce vibration which has been causing cracks to develop in the ductwork. A Computational Fluid Dynamics (CFD) analysis will be completed on the fans while they are in operation in order to model the air flow characteristics inside the intake and discharge ductwork. CFD analysis is a computer modeling technique commonly used in the industry to model fluid flows and analyze problems in mechanical systems by simulating the interaction of fluid flows with equipment surfaces. Based on the results of the CFD analysis, custom fabricated equipment will be installed inside the FD fan intake and discharge ductwork. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Labour** | 93.3 | 0.0 | 0.0 | 93.3 |
| **Consultant** | 33.6 | 0.0 | 0.0 | 33.6 |
| **Contract Work** | 649.9 | 0.0 | 0.0 | 649.9 |
| **Other Direct Costs** | 3.2 | 0.0 | 0.0 | 3.2 |
| **Interest and Escalation** | 48.7 | 0.0 | 0.0 | 48.7 |
| **Contingency** | 80.0 | 0.0 | 0.0 | 80.0 |
| **TOTAL** | **928.6** | **0.0** | **0.0** | **928.6** |

**Operating Experience:**

The east and west FD fan systems servicing the Unit 2 boiler are identical. During operation, the geometry of the existing FD fan ductwork causes air flow turbulence which creates vibrations on the intake and discharge ductwork as well as the fan housing. The vibrations result in cracking in the ductwork and on internal parts of the fan housing. These cracks are normally identified and repaired by Alstom Power during the annual Unit 2 outage. However, extensive ductwork cracking has the

**Project Title:** Upgrade Forced Draft Fan Ductwork Unit 2 **(cont'd.)**

**Operating Experience: (cont'd.)**

potential to cause an unscheduled outage. An unscheduled unit outage during the peak winter load demand would result in a loss of 170 MW of power generation to the Island Interconnected System. This represents approximately 11 percent of Hydro's Island Interconnected System's capacity.

**Project Justification:**

The FD fans servicing Unit 2 at Holyrood have an ongoing problem with flow induced vibration on the fan intake and discharge ductwork systems. During operation, the ductwork geometry causes air flow turbulence to develop which creates vibration on the intake and discharge ductwork causing cracks to develop. The cracks are normally repaired during the annual Unit 2 outage, however, continued crack development threatens the integrity of the ductwork and reduces the reliability of Unit 2.

In November of 2006, there was a forced outage on Unit 2 due to a failure of the dorsal fins inside the FD fan. Failure of the dorsal fins was the result of high vibration levels caused by air flow turbulence on both the intake and discharge ductwork.

Failure of the FD fan ductwork can result in an unplanned Unit 2 outage of three to four weeks in duration. An unscheduled unit outage during the peak winter load demand would result in a loss of 170 MW of power generation to the Island Interconnected System which represents approximately 11 percent of the Island Interconnected System's capacity. A cost benefit analysis indicates that it is cost effective to proceed with upgrading Unit 2 forced draft fan ductwork.

This project is required to maintain the reliability of generating Unit 2 at Holyrood.

**Future Plans:**

A Project to upgrade the FD fan ductwork servicing Unit 3 is planned for 2013. Please see the five-year capital plan (Capital Plan 2012 Tab, Appendix A).

**Attachments:**

See report entitled "Upgrade Generating Unit 2 Forced Draft Fan Ductwork" located in Volume II, Tab 8, for further details.

**Project Title:** Replace Emergency Diesel Generator

**Location:** Bay d'Espoir

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to replace the emergency diesel generator, control panel and associated auxiliary equipment in Powerhouse No. 1 at the Bay d'Espoir Generating Station.

The existing diesel generator (genset) and associated equipment are original and were installed when Powerhouse No. 1 was constructed in 1967. Since that time additional hydroelectric generating units and auxiliary equipment have been added to the plant resulting in an increase to the essential station service load. This increase has resulted in the existing 200 kW diesel generator being undersized for the task. The size of the new unit required is 500 kW. As a result, the new unit will also be physically larger than the old unit and cannot be accommodated inside the existing diesel generating room.

The current diesel room was built onto the west side of the powerhouse between two power transformers during original plant construction. It is not possible to extend the room to allow for a larger generating unit due to its proximity to the transformers. To mitigate this problem a self-contained packaged unit will be purchased and installed on a concrete pad directly outside of the powerhouse beyond the transformers. It will consist of a single module including the genset, switchgear, fuel system and auxiliary equipment all housed inside a weather proof enclosure suitable for the location. The cost estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 377.5 | 100.0 | 0.0 | 477.5 |
| **Labour** | 162.4 | 29.6 | 0.0 | 192.0 |
| **Consultant** | 10.8 | 7.9 | 0.0 | 18.7 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 29.9 | 4.2 | 0.0 | 34.1 |
| **Interest and Escalation** | 30.9 | 68.8 | 0.0 | 99.7 |
| **Contingency** | 0.0 | 72.2 | 0.0 | 72.2 |
| **TOTAL** | **611.4** | **282.7** | **0.0** | **894.1** |

**Project Title:** Replace Emergency Diesel Generator **(cont'd.)**

**Project Description: (cont'd.)**

**Operating Experience:**

The emergency genset operates as a standby unit and is only required to perform when no other power is available in the powerhouse. However, as part of the standard operating procedure for the diesel generating unit it is tested once a month by running it for a period of one hour.

**Project Justification:**

This project is required to replace deteriorated equipment in order for Hydro to provide safe, least-cost and reliable electrical service to its customers. The existing genset is over 40 years old, undersized for present day needs, and spare parts are no longer available. For these reasons this unit needs to be replaced

**Future Plans:**

None

**Attachment:**

See report entitled "Replace Powerhouse One Emergency Diesel Generator" located in Volume II, Tab 9, for further details.

**Project Title:** Upgrade Transmission Line Corridor

**Location:** Bay d'Espoir to Western Avalon

**Category:** Transmission and Rural Operations - Transmission

**Definition:** Other

**Classification:** Normal

**Project Description:**

This proposal describes the upgrade to the transmission line corridor from Bay d'Espoir to Western Avalon Terminal Station. These upgrades will consist of a testing program on insulators for TL206, as well as the construction of a new 230 kV transmission line. These upgrades are requirements to ensure the security of supply to growing loads east of Bay d'Espoir. These upgrades will be required for generation expansion scenarios involving either a Labrador Infeed or continued Isolated Island operation. The new transmission line will be 188 km in length from Bay d'Espoir to Western Avalon and will require terminal station modifications at each end.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 14,288.8 | 33,788.0 | 48,076.8 |
| **Labour** | 1,948.0 | 2,330.0 | 7,763.1 | 12,041.1 |
| **Consultant** | 242.6 | 247.8 | 0.0 | 490.4 |
| **Contract Work** | 0.0 | 9,354.0 | 64,756.0 | 74,110.1 |
| **Other Direct Costs** | 165.0 | 180.0 | 818.1 | 1,163.1 |
| **Interest and Escalation** | 276.3 | 3,794.8 | 55,835.6 | 59,906.7 |
| **Contingency** | 0.0 | 0.0 | 13,588.1 | 13,588.1 |
| **TOTAL** | **2,631.9** | **30,195.4** | **176,549.0** | **209,376.3** |

**Operating Experience:**

Hydro identified that the transfer of power to load centres east of Bay d'Espoir is constrained as a result of the thermal limitations of the transmission lines and the voltage stability of the power system. As a result, Newfoundland and Labrador Hydro must operate units at the Holyrood Thermal Generating Station in an inefficient manner, resulting in increased fuel consumption and increased spill at hydroelectric facilities.

**Project Title:** Upgrade Transmission Line Corridor **(cont'd.)**

**Project Justification:**

The new transmission line from Bay d'Espoir to Western Avalon Terminal Station is required under generation expansion scenarios involving either an HVdc Infeed from Labrador or the continued Isolated Island operation of the Island Interconnected System.

In a Labrador Infeed Scenario, the new circuit is a technical requirement as it would ensure the system remains stable during severe ac events such as a three-phase fault in the 230kV system and security of supply in the event of the failure of the HVdc link from Labrador.

In a generation expansion scenario involving continued isolated operation, the efficient dispatch of thermal and hydroelectric generators would be required. This is due to the fact that 67 percent of forecasted loads within the Island Interconnected Transmission System will be located east of Bay d'Espoir and all new least-cost sources of generation would be located west of Bay d'Espoir. Analysis indicates that a new 230 kV transmission line would present an optimal alternative for the transfer of power to eastern load centers from the system's bulk hydroelectric resources. This is demonstrated in the attached report, where the new transmission line would minimize dispatch of generating units at the Holyrood Generating Station.

**Future Plans:**

None.

**Attachments:**

A report entitled "Upgrade Transmission Line Corridor – Bay d'Espoir to Western Avalon" will be filed by the end of August 2011 (To be placed in Volume II, Tab 10).

**Project Title:** Install Additional 230 kV Transformer

**Location:** Oxen Pond

**Category:** Transmission and Rural Operations – Terminal Stations

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is to install a fourth 230/66 kV power transformer at Oxen Pond Terminal Station with a rating of 75/100/125 MVA. As part of the project, a 230 kV ring bus arrangement will be added to increase the level of reliability and maintainability of the station. In addition, the remaining 230 kV air blast circuit breaker, B1L36, will be replaced with a new 230 kV sulphur hexafluoride ($SF_6$) gas filled circuit breaker. As all the air blast breakers have been removed from the station, the associated air handling and compression system will be removed as well to facilitate the installation of the required protection and control panels without the need to extend the existing control building.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 814.5 | 1,575.0 | 1,694.5 | 4,084.0 |
| **Labour** | 366.9 | 500.6 | 288.0 | 1,155.5 |
| **Consultant** | 48.6 | 0.0 | 0.0 | 48.6 |
| **Contract Work** | 2,073.3 | 750.0 | 0.0 | 2,823.3 |
| **Other Direct Costs** | 50.4 | 38.6 | 34.7 | 123.7 |
| **Interest and Escalation** | 181.6 | 489.9 | 857.1 | 1528.6 |
| **Contingency** | 0.0 | 0.0 | 775.9 | 775.9 |
| **TOTAL** | **3,535.2** | **3,354.1** | **3,650.2** | **10,539.5** |

**Operating Experience:**

To meet additional demand for electric power, the installed transformer capacity at the Oxen Pond Terminal Station must be increased to avoid overload and damage to existing transformation equipment. The transformer addition to meet load growth and transformer back-up criterion is within Hydro's established transmission planning criteria.

**Project Justification:**

Load forecasts for the St. John's area indicate that peak loads in 2012 will exceed firm transformer

**Project Title:** Install Additional 230 kV Transformer **(cont'd.)**

**Project Justification: (cont'd.)**

capacity in the Hardwoods-Oxen Pond Loop System by approximately 11 percent. Any overload of firm transformer capacity is in violation of Newfoundland and Labrador Hydro's System Planning Criteria.

A cost benefit analysis was performed to investigate alternatives for increased transformer capacity. These alternatives included (1) the replacement of the existing transformer T1, currently rated for 40/53.3/66.6 MVA with a 75/100/125 MVA unit or (2) the installation of a fourth transformer (T4), rated for 75/100/125 MVA. The results of the cost-benefit analysis indicate that the installation of a fourth transformer would be the least-cost alternative, particularly as the replacement of transformer T1 would only provide sufficient capacity until 2015.

A secondary cost benefit analysis was performed to determine the optimal solution to accommodate the additional protection and control panels associated with the project. Alternatives included options to expand the control building or to replace the air blast circuit breaker B1L36 and its ancillaries with a new gas filled circuit breaker. The space now occupied by the air handling equipment could therefore be utilized to accommodate the additional protection and control panels. When consideration was given to forecasted air blast breaker maintenance costs and maintenance and replacement costs associated with ancillaries (including air receivers, air dryers, compressors, piping, etc.), analysis indicated a cumulative present worth preference for the breaker replacement option.

During the addition of T4 at Hardwoods Terminal Station in 1992, a 230 kV bus tie circuit breaker was added at Hardwoods to reduce the risk of outage to the entire station. A 230 kV bus tie circuit breaker is warranted at Oxen Pond given the magnitude of the installed transformer capacity and the load being supplied. A fourth 230 kV circuit breaker is warranted to complete at 230 kV ring bus arrangement at Oxen Pond Terminal Station so that breaker maintenance can be performed without having to remove a transmission line from service.

**Project Title:** Install Additional 230 kV Transformer **(cont'd.)**

**Future Plans:**

None.

**Attachments:**

A report entitled "Install Additional 230 kV Transformer – Oxen Pond Terminal Station" will be filed by the end of August 2011 (To be placed in Volume II, Tab 11).

**Project Title:** Provide Service Extensions

**Location:** All Service Areas

**Category:** Transmission and Rural Operations - Distribution

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

This project is an annual allotment based on past expenditures to provide for service connections including street lights to new customers. Table 1 identifies the total budget for the Central, Northern and Labrador operating regions.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 2,014.0 | 0.0 | 0.0 | 2,014.0 |
| **Labour** | 1,530.0 | 0.0 | 0.0 | 1,530.0 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 235.0 | 0.0 | 0.0 | 235.0 |
| **Contingency** | 393.0 | 0.0 | 0.0 | 393.0 |
| **TOTAL** | **4,172.0** | **0.0** | **0.0** | **4,172.0** |

**Operating Experience:**

An analysis of average historical expenditures (2006 - 2010) on new customer connections by region is shown in the Table 2. All historical dollars were converted to 2010 dollars using the Statistics Canada Utility Distribution Line Construction index and a five year average was calculated.

**Table 2: Average Annual Expenditures**

| **Region** | **Avg. Annual Expenditures (2006 - 2010) (2010 $000)** |
|---|---|
| Central | 1,143 |
| Northern | 1,206 |
| Labrador | 1,624 |
| **Total** | 3,973 |

**Project Title:** Provide Service Extensions **(cont'd.)**

**Operating Experience: (cont'd.)**

The five year actual expenditures for service extensions by region are shown in Table 3.

**Table 3: Five Year Expenditures**

| Expenditures ($000) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 |
| **Region** | **Budget** | **Actual** | **Budget** | **Actual** | **Budget** | **Actual** | **Budget** | **Actual** | **Budget** | **Actual** | **Budget** |
| Central | 761 | 824 | 844 | 967 | 910 | 1,186 | 1,028 | 1,133 | 1,001 | 1,448 | 1,045 |
| Northern | 580 | 614 | 618 | 960 | 637 | 803 | 758 | 1,432 | 768 | 1,356 | 1,092 |
| Labrador | 643 | 535 | 622 | 873 | 612 | 1,340 | 653 | 1,446 | 659 | 2,051 | 1,248 |
| **Total** | 1,984 | 1,973 | 2,084 | 2,800 | 2,159 | 3,329 | 2,439 | 4,011 | 2,428 | 4,855 | 3,385 |

**Project Justification:**

Based on the three-year average of service extension expenditures for the period 2006 - 2010 the budget shown in Table 4 was developed for the Northern and Labrador regions, assuming distribution line cost escalation in 2012 of approximately five percent over 2010. The same assumptions are valid for the Central region as well except that it was based on a five-year average.

**Table 4: Budget**

| **Region** | **2011 Budget[2] ($000)** |
|---|---|
| Central | 1,200 |
| Northern | 1,267 |
| Labrador | 1,705 |
| **Total** | 4,172 |

**Future Plans:**

This is an annual allotment which is adjusted from year to year depending on historical expenditures. Please see the five-year capital plan (2012 Capital Plan tab, Appendix A).

[1] In recent years increased numbers of housing starts in Labrador has pushed the annual cost of service extensions in Labrador above the historical five year average. With the planned expansion at the Iron Ore Company of Canada's operations in Labrador City and anticipated growth in Innu and Inuit communities, the number of housing starts is expected to continue into 2011 and 2012. Because of this, a three-year historical average was used to determine the service extension budget for 2012 for the Labrador region and the Northern region which serves the south cost of Labrador. A five-year average was used for the Central region.

**Project Title:** Upgrade Distribution Lines

**Location:** Bay d'Espoir, Parsons Pond and Plum Point

**Category:** Transmission and Rural Operations - Distribution

**Definition:** Other

**Classification:** Normal

**Project Description:**

Newfoundland and Labrador Hydro (Hydro) provides service to residents in select rural communities within the province through the use of existing distribution systems. The distribution systems typically consist of a substation coupled with a wood pole distribution line that directs power from the station to service drops throughout the community. This project will be focused on distribution lines located in the distribution systems of Bay d'Espoir, Parsons Pond and Plum Point that have been identified as requiring upgrades to the existing infrastructure. The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 315.0 | 270.0 | 0.0 | 585.0 |
| **Labour** | 255.0 | 120.0 | 0.0 | 375.0 |
| **Consultant** | 49.4 | 39.0 | 0.0 | 88.4 |
| **Contract Work** | 495.0 | 450.0 | 0.0 | 945.0 |
| **Other Direct Costs** | 65.0 | 30.0 | 0.0 | 95.0 |
| **Interest and Escalation** | 92.5 | 105.9 | 0.0 | 198.4 |
| **Contingency** | 113.3 | 95.6 | 0.0 | 208.9 |
| **TOTAL** | **1,385.2** | **1,110.5** | **0.0** | **2,495.7** |

**Operating Experience:**

The distribution lines were originally constructed over 40 years ago. Most of the line components were installed at the time of original construction and have exceeded the expected service life of 30 years. In addition, standardized inspection and testing procedures indicate line components are deteriorated and have remaining life spans of only one to five years before widespread failure occurs.

**Project Justification:**

This project is justified on reliability. The conditions of the components could result in system failures and have a negative effect on the safety and reliability performance of the line. The failure of a line

**Project Title:** Upgrade Distribution Lines **(cont'd.)**

**Project Justification: (cont'd.)**

may also result in unplanned power outages to customers at a time when required repairs may be hampered by severe weather conditions.

**Future Plans:**

Future distribution line upgrades will be proposed in future capital budget applications. See five-year capital plan (Capital Plan 2011 Tab, Appendix A).

**Attachments:**

See report entitled "Distribution Line Upgrades 2012" located in Volume II, Tab 12, for further project details.

**Project Title:** Perform Wood Pole Line Management Program

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Transmission

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

The objective of this program is to maintain a comprehensive pole inspection and testing program using the conventional sound and bore methods supplemented by Non Destructive Evaluation (NDE), periodic full scale tests of poles removed from service, and remedial treatment application. Structural analysis to assess the line reliability, taking into account the system concept, is applied against all inspection information. Any replacement and/or refurbishment will be based on the assessment of quantitative risk with respect to in-service pole strength. The budget estimate for the project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 539.7 | 0.0 | 0.0 | 539.7 |
| **Labour** | 804.5 | 0.0 | 0.0 | 804.5 |
| **Consultant** | 200.0 | 0.0 | 0.0 | 200.0 |
| **Contract Work** | 500.0 | 0.0 | 0.0 | 500.0 |
| **Other Direct Costs** | 80.3 | 0.0 | 0.0 | 80.3 |
| **Interest and Escalation** | 158.9 | 0.0 | 0.0 | 158.9 |
| **Contingency** | 209.9 | 0.0 | 0.0 | 209.9 |
| **TOTAL** | **2,519.3** | **0.0** | **0.0** | **2,519.3** |

**Operating Experience:**

Hydro operates approximately 2,400 kilometers of wood pole transmission lines, including approximately 26,000 poles. Hydro inspects 20 percent of a line each year using visual inspections and a rule of thumb approach to identify the health of a typical pole. Based on this program, Hydro has not had to replace many transmission size poles during the past 30 years. Previous intensive inspections targeting lines for specific issues on the Avalon Peninsula showed that decay and preservative retention were becoming an issue, showed extremely low preservative levels which are below

**Project Title:** Perform Wood Pole Line Management Program **(cont'd.)**

**Operating Experience: (cont'd.)**

minimum acceptable levels, and indicated that rot is becoming more prevalent in the 30-40 year old poles.

**Project Justification:**

Previous pole inspections indicate that almost half of the poles sampled did not meet the minimum preservative retention levels and full scale pole tests of selected poles completed at Memorial University since 1999 indicate a 25 percent reduction of average pole strength over a 35 year period. When combined, these facts justify the strong need for a well managed wood pole inspection and treatment program that detects and corrects any dangerous poles in the system which will ensure safety as well as reliability.

**Future Plans:**

The program is based on two 10 year inspection cycles beginning in 2005. It provides an annual report to identify problem areas for the regional asset managers and to develop recommendations for appropriate pole replacements, as well as other components in the following years. Please see five-year capital plan (Capital Plan 2012 Tab, Appendix A).

**Attachment:**

See report entitled "2012 Wood Pole Line Management" located in Volume II, Tab 13, for further project details.

**Project Title:** Upgrade Distribution Systems

**Location:** All Service Areas

**Category:** Transmission and Rural Operations - Distribution

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

This project is an annual allotment based on historic expenditures to provide for the replacement of deteriorated poles, substandard structures, corroded and damaged conductors, rusty and overloaded transformers/street lights/reclosers and other associated equipment. This upgrading is identified through preventive maintenance inspections or when there is damage caused by storms and adverse weather conditions and salt contamination. The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 1,539.0 | 0.0 | 0.0 | 1,539.0 |
| **Labour** | 591.0 | 0.0 | 0.0 | 591.0 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 128.0 | 0.0 | 0.0 | 128.0 |
| **Contingency** | 250.0 | 0.0 | 0.0 | 250.0 |
| **TOTAL** | **2,508.0** | **0.0** | **0.0** | **2,508.0** |

**Operating Experience:**

An analysis of historical expenditures (2006 - 2010) on distribution upgrades by region is shown in Table 2. All historical dollars were converted to 2010 dollars using the Statistics Canada Utility Distribution Line Construction index and a five-year average was calculated.

**Table 2: Average Annual Expenditures**

| **Region** | **Avg. Annual Expenditures (2006 - 2010) (2010 $000)** |
|---|---|
| Central | 946 |
| Northern | 1,037 |
| Labrador | 405 |
| **All Regions** | 2,388 |

**Project Title:** Upgrade Distribution Systems **(cont'd.)**

**Operating Experience: (cont'd.)**

The five-year expenditures for distribution upgrades by region are shown in Table 3.

**Table 3: Five-Year Expenditures**

| Expenditures ($000) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 |
| Region | Budget | Actual | Budget | Actual | Budget | Actual | Budget | Actual | Budget | Actual | Budget |
| Central | 701 | 909 | 806 | 824 | 915 | 782 | 1,050 | 1,028 | 1,032 | 1,037 | 998 |
| Northern | 836 | 835 | 873 | 842 | 969 | 1,140 | 1,026 | 1,148 | 1,072 | 1,071 | 1,051 |
| Labrador | 375 | 404 | 356 | 558 | 409 | 313 | 450 | 484 | 468 | 191 | 450 |
| **Total** | 1,912 | 2,148 | 2,035 | 2,224 | 2,293 | 2,235 | 2,526 | 2,660 | 2,572 | 2,299 | 2,499 |

Other specifically approved projects for 2006 - 2011F are listed in Table 5.

**Project Justification:**

Based on the five-year average for distribution system upgrades for the period 2006 - 2010 the budget shown in Table 4 was developed, assuming distribution line cost escalation in 2012 of approximately five percent.

**Table 4: Budget for Distribution System**

| Region | 2012 Budget ($000) |
|---|---|
| Central | 993 |
| Northern | 1,089 |
| Labrador | 426 |
| **Total** | 2,508 |

**Future Plans:**

This is an annual allotment which is adjusted from year to year depending on historical expenditures. See the five-year capital plan (2012 Capital Plan Tab, Appendix A).

Table 5 shows the history of other specific distribution system upgrades that have been completed over the past 5 years.

**Project Title:** Upgrade Distribution Systems **(cont'd.)**

**Future Plans: (cont'd.)**

**Table 5: Five-Year Historical Information**

| Year | Project Description | Budget ($000) | Actuals ($000) |
|---|---|---|---|
| 2011F | Replace Poles - Westport | 256.4 | |
| | Replace Poles - Grandy Brook | 286.4 | |
| | Replace Poles - Farewell Head | 339.6 | |
| | Upgrade Distribution System - Line 1 Rigolet (yr 1 of 2) | 72.0 | |
| | Upgrade Distribution System - Line 1 Francois | 440.9 | |
| | Upgrade Distribution System - Line 8 Happy Valley | 553.5 | |
| | Upgrade Distribution System - Line 1 Makkovik (yr 2 of 2) | 742.4 | |
| | Upgrade Distribution System - Line 4 Roddickton (yr 2 of 2) | 902.6 | |
| | Upgrade Distribution System - Line 2 Glenburnie (yr 2 of 4) | 578.2 | |
| 2010 | Replace Poles - English Harbour West | 274.8 | 249.8 |
| | Replace Poles - Line 1 Fleur De Lys | 269.2 | 246.9 |
| | Replace Poles - Barachoix | 273.3 | 256.1 |
| | Upgrade Distribution System - Line 1 Makkovik (yr 1 of 2) | 57.1 | 25.1 |
| | Upgrade Distribution System - Line 4 Roddickton (yr 1 of 2) | 160.6 | 98.4 |
| | Upgrade Distribution System - Line 2 Glenburnie (yr 1 of 4) | 267.3 | 134.8 |
| | Upgrade Distribution System - Line 4 Happy Valley | 265.3 | 251.6 |
| 2009 | Upgrade Distribution System - Line 7 St. Anthony | 689.3 | 503.6 |
| | Replace Insulators - Line 1 and Line 2 Jackson's Arm, Hampden | 691.5 | 590.6 |
| | Replace Insulators - Line 2 Little Bay Islands | 182.7 | 120.8 |
| | Replace Poles - Line 1 and Line 2 Jackson's Arm | 433.7 | 416.1 |
| | Replace Poles - Line 1 Hampden | 263.1 | 243.6 |
| | Upgrade Distribution Feeder - Line 36 Wabush | 498.0 | 466.1 |

**Project Title:** Upgrade Distribution Systems **(cont'd.)**

**Future Plans: (cont'd.)**

**Table 5: Five-Year Historical Information**

| Year | Project Description | Budget ($000) | Actuals ($000) |
|---|---|---|---|
| 2008 | Replace Distribution Line - Line 1 South Brook | 987.4 | 1,056.4 |
| | Upgrade Distribution System - Line 1 Glenburnie | 533.9 | 405.5 |
| | Upgrade Distribution System - Line 3 St Anthony | 480.1 | 445.0 |
| | Upgrade Distribution System - Mary's Harbour | 263.5 | 215.6 |
| | Upgrade Distribution System - Port Hope Simpson | 205.4 | 215.6 |
| | Upgrade Distribution System - Line 4 Bear Cove | 149.8 | 96.8 |
| | Upgrade Distribution Line - Line 11 Wabush | 107.2 | 115.3 |
| | Replace Insulators - Upper Salmon | 236.8 | 194.9 |
| | Replace Insulators - Line 1 Hind's Lake | 168.7 | 158.0 |
| | Replace Insulators - Coney Arm | 126.8 | 132.1 |
| | Replace Insulators - Line 2 Westport | 90.2 | 87.2 |
| | Replace Poles - South Brook | 377.5 | 331.2 |
| | Replace Poles - Bay D'Espoir | 322.7 | 257.3 |
| 2007 | Replace Poles - Barachoix Line 4 | 229.9 | 276.0 |
| | Insulator Replacement - Barachoix Line 4 | 120.1 | 123.0 |
| | Replace Distribution Line - Brighton | 192.9 | 230.9 |
| | Replace Distribution Line - Seal Cove to Pass Island | 547.6 | 552.1 |
| | Upgrade Distribution System - Line 2, Line 3 Farewell Head | 385.3 | 282.0 |
| | Replace Poles - Farewell Head | 355.0 | 295.3 |
| | Replace Poles - St. Brendan's | 159.1 | 175.4 |
| | Extend Mud Lake Submarine Cable | 480.9 | 813.6 |
| | Upgrade Distribution System - Line 1, Line 2 St. Anthony | 364.3 | 301.0 |
| | Upgrade Distribution System Line 1, Line 2 Rocky Harbour | 513.5 | 393.7 |
| | Upgrade Distribution System - Nain | 179.4 | 185.8 |

**Project Title:** Distribution System Additions

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Distribution

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

For 2012 a total of three projects have been identified by Hydro which are justified on the requirement to support annual load growth and to ensure peak capacity can meet the increasing demand. One project is in the Bay d'Espoir Distribution System, one is in the Happy Valley Distribution System and the last is in the Wabush Distribution System. Low voltages are forecasted to be experienced on Happy Valley feeder Line 7 (L7) and Bay d'Espoir feeder Line 1 (L1) in 2012 and conductor upgrades are required to ensure the systems can provide reliable service to customers. The Wabush Distribution System is expected to experience low voltages on feeder Line 12 (L12) and overloads on transformer T3. A load transfer from feeder L12 to Line 3 (L3) will improve operating voltages for customers and alleviate the transformer overload. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 590.0 | 0.0 | 0.0 | 590.0 |
| **Labour** | 355.0 | 0.0 | 0.0 | 355.0 |
| **Consultant** | 77.9 | 0.0 | 0.0 | 77.9 |
| **Contract Work** | 675.0 | 0.0 | 0.0 | 675.0 |
| **Other Direct Costs** | 146.0 | 0.0 | 0.0 | 146.0 |
| **Interest and Escalation** | 143.8 | 0.0 | 0.0 | 143.8 |
| **Contingency** | 184.4 | 0.0 | 0.0 | 184.4 |
| **TOTAL** | **2,172.1** | **0.0** | **0.0** | **2,172.1** |

**Operating Experience:**

The Bay d'Espoir L1 distribution feeder is a 25 kV three-phase radial line that was originally constructed in 1965. The feeder is over 20 km long and utilizes #2 ACSR Pickerel conductor. Hydro

**Project Title:** Distribution System Additions **(cont'd.)**

**Operating Experience: (cont'd.)**

supplies power to 1,107 residential customers and 164 business customers in the communities of St. Veronica, St. Joseph's Cove, Swanger's Cove, St. Alban's, Head of Bay d'Espoir, Milltown and Morrisville using distribution feeder L1.

Happy Valley Feeder L7, originating at the Happy Valley Terminal Station, is a 40 km, 25 kV three-phase, radial distribution line. The line is constructed as a double circuit with feeder L1 for the first 1.2 km after leaving the terminal station, with a 5 km section of legacy 2/0 ACSR conductor beginning after the double circuit feeder construction. The remaining length of the line is 4/0 AASC conductor. Feeder L7 supplies power to 701 residential customers and 173 business customers in the North Side Industrial Park, along the North West River Road and the communities of Sheshatshiu and North West River.

The Wabush Distribution System supplies electrical power to the community of Wabush in Western Labrador. The system consists of a 46 kV subtransmission line, Line 36 (L36), a distribution substation, Wabush Substation, and six distribution feeders; four 12.5 kV feeders (Line 3 (L3), Line 9 (L9), Line 11 (L11), and Line 12 (L12) and two 4.16 kV feeders (Line 7 and Line 8). The distribution system was originally constructed by Wabush Mines in the 1960s and had several additions throughout the 1960s and 1970s due to rapid growth. In 1985, Wabush Mines transferred ownership of the town distribution system to Hydro. The system consisted of a subtransmission line, a substation featuring 5 kV Westinghouse switchgear, and seven 4.16 kV distribution feeders. Similar to the distribution system of Labrador City, the Wabush system required a considerable amount of upgrading to make it safe to operate, and to provide acceptable service to existing and future customers. Hydro completed a major upgrade to the system which included: converting and reconfiguring five of the seven 4.16 kV distribution feeders into four 12.5 kV distribution feeders; installing conventional outdoor substation equipment such as transformers, disconnects, bus work, and reclosers for the 12.5 kV feeders

**Project Justification:**

This project is justified on the requirement to accommodate a growing electrical load.

**Project Title:** Distribution System Additions **(cont'd.)**

**Future Plans:**

Further work is planned for the Wabush Distribution System. There is a project proposed to upgrade the existing transformer capacity and construct a new feeder to the industrial park.

**Attachment:**

See report entitled "Distribution System Additions to Accommodate Load Growth" located in Volume II, Tab 14, for further project details.

**Project Title:** Upgrade Circuit Breakers

**Location:** Various Stations

**Category:** Transmission and Rural Operations

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

Newfoundland and Labrador Hydro (Hydro) has been working to maximize the life of its circuit breakers. In recent years it has been upgrading Air Blast Circuit Breakers, overhauling operating mechanisms on Sulphur Hexafluoride (SF6) breakers, and attempting to deal with the phase out of PCBs bushing associated with Oil Circuit Breakers.

This project is to replace and refurbish Air Blast and SF6 circuit breakers, and replace Oil Circuit breakers throughout Hydro's Interconnected System. Many circuit breakers have been in service for more than 30 years and are approaching the at-risk phase of their life cycle.

The scope of work for each type of circuit breaker includes:

***Air Blast Circuit Breakers***

Complete one overhaul on air blast circuit breakers, replace air blast circuit breakers after being in service between 10 and 15 years after an overhaul, and replace breakers between the age of 50 and 55 years.

***Oil Circuit Breakers***

For all oil circuit breakers containing sealed bushings which have the possibility of containing Polychlorinated Byphenols (PCBs) greater than 500 mg/kg, Hydro has a plan to replace all oil circuit breakers prior to 2025.

***SF6 Breakers***

Complete one overhaul at 20 years of service for all new SF6 breakers, and complete an overhaul between 20 to 30 years on existing in-service units. The plan for routine replacement will be after 40 years of service.

**Project Title:** Upgrade Circuit Breakers **(cont'd.)**

**Project Description: (cont'd.)**

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 706.0 | 0.0 | 0.0 | 706.0 |
| **Labour** | 450.0 | 0.0 | 0.0 | 450.0 |
| **Consultant** | 71.0 | 0.0 | 0.0 | 71.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 141.0 | 0.0 | 0.0 | 141.0 |
| **Interest and Escalation** | 109.3 | 0.0 | 0.0 | 109.3 |
| **Contingency** | 200.0 | 0.0 | 0.0 | 200.0 |
| **TOTAL** | **1,677.3** | **0.0** | **0.0** | **1,677.3** |

**Operating Experience:**

The overall population of circuit breakers is well past a breaker's midlife of 20 years and is approaching the manufacturers' specified design end-of-life of 40 years. 59 breakers are already greater than 40 years of age.

Hydro has experienced problems with air blast circuit breakers including air leaks and sticking valves, increasing maintenance costs and breaker unavailability. Problems experienced with SF6 breakers have been SF6 gas leaks and problems with the operating mechanism. These problems experienced by Hydro are common in the utility industry and owners of these circuit breakers have addressed the problems though similar upgrading programs.

In the past ten years there have been overhauls completed on air blast circuit breakers and the operating mechanism associated with selected SF6 breakers. These overhauls have proven to maintain the reliability of the equipment and extend the service life of the circuit breakers by 10 to 15 years.

There has been no major overhaul work associated with oil circuit breakers. The plan is to replace all oil circuit breakers by 2025 to ensure Hydro is compliant with the latest PCB regulations.

**Project Title:** Upgrade Circuit Breakers **(cont'd.)**

**Project Justification:**

This project is justified on the requirement to replace failing or deteriorated circuit breakers in order for Hydro to provide safe, reliable electrical service, and to comply with PCB regulations.

To maintain the reliability of in-service breakers, Hydro has to implement a plan to address the aging circuit breaker fleet. To balance the financial impacts and system outage constraints, Hydro has developed a long term asset management plan for circuit breaker replacement and refurbishment.

The plan will see all the current in-service air blast breakers replaced by 2031, all current in-service SF6 breakers overhauled at mid-life and replaced at or near age 40, and all oil circuit breakers replaced by 2023.

**Future Plans:**

Continue with this long term replacement and refurbishment program.

**Attachments:**

See report entitled "Upgrade Circuit Breakers" located in Volume II, Tab 15, for further project details.

**Project Title:** Increase Generation Capacity

**Location:** Mary's Harbour

**Category:** Transmission and Rural Operations - Generation

**Definition:** Other

**Classification:** Normal

**Project Description:**

The purpose of this project is to increase the firm generation capacity as well as the capacity of the substation at the Mary's Harbour Diesel Generating Station. This proposal consolidates all costs associated with the procurement and installation of a 725 kW mobile diesel generator and three 500 kVA transformers at the Mary's Harbour Diesel Plant.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 891.8 | 0.0 | 0.0 | 891.8 |
| **Labour** | 208.6 | 0.0 | 0.0 | 208.6 |
| **Consultant** | 83.8 | 0.0 | 0.0 | 83.8 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 80.6 | 0.0 | 0.0 | 80.6 |
| **Interest and Escalation** | 98.1 | 0.0 | 0.0 | 98.1 |
| **Contingency** | 126.5 | 0.0 | 0.0 | 126.5 |
| **TOTAL** | **1,489.4** | **0.0** | **0.0** | **1,489.4** |

**Project Justification:**

This project is justified on the requirement to meet growing electricity needs, and to deliver reliable electrical service to Hydro's customers in Mary's Harbour.

**Future Plans:**

Future plans consist of the establishment of a long-term supply for Charlottetown, Mary's Harbour, and Port Hope Simpson.

**Attachment:**

See report entitled "Increase Generating Capacity Mary's Harbour Diesel Generating Station" located in Volume II, Tab 16, for further project details.

**Project Title:** Upgrade Power Transformers

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of upgrading power transformers which will include either refurbishment or replacement based upon condition assessment techniques. A transformer replacement is based on the degree of degradation of the cellulose insulation and the amount of dissolved gas in the transformer oil. The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 427.0 | 0.0 | 0.0 | 427.0 |
| **Labour** | 404.0 | 0.0 | 0.0 | 404.0 |
| **Consultant** | 45.5 | 0.0 | 0.0 | 45.5 |
| **Contract Work** | 61.0 | 0.0 | 0.0 | 61.0 |
| **Other Direct Costs** | 140.0 | 0.0 | 0.0 | 140.0 |
| **Interest and Escalation** | 61.1 | 0.0 | 0.0 | 61.1 |
| **Contingency** | 107.7 | 0.0 | 0.0 | 107.7 |
| **TOTAL** | **1,246.3** | **0.0** | **0.0** | **1,246.3** |

**Operating Experience:**

With approximately 55 percent of all 230 kV, 138 kV and 66 kV power transformers at an age of 30 years or greater, recent experience has shown the need to upgrade some of them due to problems with oil quality, tap changers, gasket systems, bushings, radiators and protective devices.

**Project Justification:**

The power transformers are one of the most important components on the transmission system. To maintain reliable operation of the transformer fleet it is critical to use condition assessments techniques to selectively target weak units or problem areas within a unit for upgrading. The recommended upgrades will serve to extend the service lives of the transformers and decrease the probability of an unplanned outage.

**Project Title:** Upgrade Power Transformers **(cont'd.)**

**Future Plans:**

Future upgrades will be proposed in future capital budget applications. See five-year capital plan (2012 Capital Plan Tab, Appendix A).

**Attachment:**

See report entitled "Upgrade Power Transformers" located in Volume II, Tab 17, for further project details.

**Project Title:** Replace Off-Road Track Vehicles

**Location:** Flower's Cove and Cow Head

**Category:** General Properties - Transportation

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

This project involves the replacement of V7734 (Flower's Cove), a 1993 heavy-duty off-road track vehicle, and V7846 (Cow Head), a 1994 heavy-duty off-road track vehicle. The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 462.0 | 331.0 | 0.0 | 793.0 |
| **Labour** | 0.0 | 0.4 | 0.0 | 0.4 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 6.0 | 0.0 | 6.0 |
| **Interest and Escalation** | 20.5 | 18.2 | 0.0 | 38.7 |
| **Contingency** | 0.0 | 40.0 | 0.0 | 40.0 |
| **TOTAL** | **482.5** | **395.6** | **0.0** | **878.1** |

**Operating Experience:**

The heavy-duty off-road track vehicles have an average life expectancy which ranges from 12 to 15 years, dependent on location and usage. Unit V7734 will be 22 years old at replacement and Unit V7846 will be 18 years old.

**Project Justification:**

This project provides for the normal replacement of heavy-duty off-road track vehicles due to age and condition.

**Project Title:** Replace Off-Road Track Vehicles **(cont'd.)**

**Future Plans:**

Future replacements will be proposed in future capital budget applications. See five year capital plan (2012 Capital Plan Tab, Appendix A).

**Attachment:**

See report entitled "Replace Off-Road Track Vehicles 2012 – Flower's Cove and Cow Head", Volume II, Tab 18, for further project details.

**Project Title:** Automated Meter Reading

**Location:** Rocky Harbour and Glenburnie

**Category:** Transmission and Rural Operations - Metering

**Definition:** Other

**Classification:** Justifiable

**Project Description:**

This project is required to implement Automated Meter Reading (AMR) in Newfoundland and Labrador Hydro's (Hydro) customer service areas of Rocky Harbour and Glenburnie, as well as the purchase of AMR equipment to ensure that meters required to be replaced by Measurement Canada in 2012 in other customer service areas are AMR compatible.

AMR is being implemented in all of the Rocky Harbour and Glenburnie service areas (1,800 customers). The work includes (i) the replacement of existing customer meters with AMR equipped meters, (ii) the installation of data collectors in the substations in Rocky Harbour and Glenburnie, (iii) communications to the AMR server located in St. John's, and (iv) configuring computer systems in St. John’s to handle the AMR meter readings and billing for customers in the Rocky Harbour and Glenburnie service areas.

AMR equipment will also be purchased to make new residential meters being procured by Hydro in 2012 AMR compatible.

The budget estimate for this project is shown in Table 1.

**Project Title:** Automated Meter Reading **(cont'd.)**

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **Rocky Harbour – Glenburnie** | | | **AMR Equipment Purchase** | | |
|---|---|---|---|---|---|---|
| | **2012** | **2013** | **Total** | **2012** | **2013** | **Total** |
| **Material Supply** | 182.0 | 100.0 | 282.0 | 74.0 | 0.0 | 74.0 |
| **Labour** | 78.0 | 76.0 | 154.0 | 3.4 | 0.0 | 3.4 |
| **Consultant** | 14.6 | 9.5 | 24.1 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 16.8 | 16.8 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 15.8 | 37.8 | 53.6 | 4.1 | 0.0 | 4.1 |
| **Contingency** | 0.0 | 47.9 | 47.9 | 7.7 | 0.0 | 7.7 |
| **TOTAL** | **290.4** | **288.0** | **578.4** | **89.2** | **0.0** | **89.2** |

**Operating Experience:**

The AMR system will replace manual handheld devices used to collect meter readings at each customer's site and eliminate the requirement for personnel to read customer's meters. Previous AMR projects completed by Hydro have implemented AMR in the service areas of Bay d'Espoir, Change Islands, Conne River, Cow Head, Daniel's Harbour, Fogo, Gaultois, Hawke's Bay, Parsons Pond, St. Anthony and St. Brendan's. The AMR system being implemented has proven to be reliable and accurate.

**Project Justification:**

This project is justified on the results of a cost benefit analysis which shows that the new AMR system has economic benefit over the existing system through a reduction in controllable costs.

This purchase of AMR equipment is also justified on the results of a cost benefit analysis which shows that purchasing meters with the AMR equipment installed has economic benefit over purchasing the AMR equipment and installing after the meters have been deployed.

**Project Title:** Automated Meter Reading **(cont'd.)**

**Future Plans:**

This project is the fifth deployment of AMR to Hydro's service areas and AMR system expansion to other service areas is planned in future capital budget proposals.

**Attachments:**

See report entitled "Automated Meter Reading" located in Volume II, Tab 19, for further project details.

**Project Title:** Replace Vehicles and Aerial Devices

**Location:** Various Sites

**Category:** General Properties - Transportation

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project proposes the replacement of thirty four light-duty vehicles and nine heavy-duty vehicles in accordance with the established replacement criteria for vehicle age and kilometers (kms) as follows:

- Light-duty vehicles 5-7 years or 150,000 kms
- Heavy-duty work vehicles
  - Class 4, 5 and 6 6-8 years or 200,000 kms
  - Class 7 and 8 6-8 years or 250,000 kms

All vehicles that meet the entire criteria are being replaced. The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 1,634.0 | 1,050.0 | 0.0 | 2,684.0 |
| **Labour** | 5.4 | 0.5 | 0.0 | 5.9 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 6.0 | 3.0 | 0.0 | 9.0 |
| **Interest and Escalation** | 66.0 | 57.3 | 0.0 | 123.3 |
| **Contingency** | 0.0 | 108.0 | 0.0 | 108.0 |
| **TOTAL** | **1,711.4** | **1,218.8** | **0.0** | **2,930.2** |

**Project Title:** Replace Vehicles and Aerial Devices **(cont'd.)**

**Operating Experience:**

The Transportation Section maintains a close liaison with other utilities across Canada and has established the replacement criteria based on industry standards and Hydro's operating experience. Extension of the service life of a vehicle beyond the replacement criteria results in increased operating and maintenance costs.

**Project Justification:**

This project provides for the normal replacement of on-road fleet vehicles based on projected age and kilometers at disposal. The transportation vehicles are subjected to a lease, or purchase cost/benefit analysis during the tender process, to determine the least cost alternative.

The cost benefit analysis is best done in the year of replacement to ensure consideration of current year fleet incentives offered by the manufacturers. This proposal provides the funding required to purchase the projected replacements and will be adjusted to reflect the outcome of the lease or purchase cost/benefit analysis.

The transportation vehicles are an average of 6 years old with 187,000 kms, and the heavy-duty work vehicles are an average of 9 years old with 213,000 kms.

**Future Plans:**

Transportation will continue to replace vehicles and aerial devices as per our replacement criteria.

**Attachments:**

See report entitled "Replace Vehicles and Aerial Devices" located in Volume II, Tab 20 for further details.

**Project Title:** Replace Battery Banks and Chargers

**Location:** Various Sites

**Category:** General Properties - Telecontrol

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is part of Hydro's ongoing program to replace stationary batteries and chargers at generating sites, terminal stations and telecommunications microwave sites. These batteries are the source of power for telecommunications and protection and control equipment during the loss of station service. The batteries are a direct current (DC) power source and thus require a charging system that converts alternating current (AC) to direct current (DC). The budget estimate for this project is shown in Table 1 below.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 241.1 | 0.0 | 0.0 | 241.1 |
| **Labour** | 321.2 | 0.0 | 0.0 | 321.2 |
| **Consultant** | 129.2 | 0.0 | 0.0 | 129.2 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 69.8 | 0.0 | 0.0 | 69.8 |
| **Interest and Escalation** | 43.4 | 0.0 | 0.0 | 43.4 |
| **Contingency** | 76.1 | 0.0 | 0.0 | 76.1 |
| **TOTAL** | **880.8** | **0.0** | **0.0** | **880.8** |

**Operating Experience:**

Hydro generally inspects its battery banks semi-annually but more often as needed depending on age and condition. From inspection and testing, Hydro determines which banks need to be replaced. The rate of battery deterioration increases with age and reaches a point where they are unable to provide the required power level to operate equipment in the event of an outage.

**Project Title:** Replace Battery Banks and Chargers **(cont'd.)**

**Project Justification:**

When the capacity of a battery falls to 80 percent of its rated capacity it has to be replaced as recommended by IEEE standards 450 and 1188. The batteries to be replaced are near the end of their useful lives and have deteriorated to the 80 percent capacity level. Batteries have to be replaced before total failure occurs to ensure continued reliable operation.

**Future Plans:**

To continue the on going program of monitoring and testing Hydro's battery banks to determine a timely replacement.

**Attachment:**

See report entitled "Stationary Battery and Charger Replacement Program" located in Volume II, Tab 21, for further project details.

**Project Title:** Upgrade JD Edwards

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

The JD Edwards (JDE) suite of applications has been used by Hydro since 1998 to manage data entry and reporting for all business and customer service processes within the company. The system is used to record information in connection with the following business activities:

- General Ledger
- Accounts Payable
- Accounts Receivable
- Fixed Assets
- Job Costing
- Purchasing
- Inventory
- Human Resources
- Payroll
- Plant Equipment Management
- Work Orders
- Customer Services

This suite generates Hydro's customer billing, payroll and work orders for the maintenance of assets. In addition, it maintains all underlying accounting transactions.

The budget estimate for this project is shown in Table 1.

**Project Title:** Upgrade JD Edwards **(cont'd.)**

**Project Description: (cont'd.)**

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 130.3 | 136.8 | 0.0 | 267.1 |
| **Consultant** | 135.4 | 296.4 | 0.0 | 431.8 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 4.9 | 8.4 | 0.0 | 13.3 |
| **Interest and Escalation** | 13.4 | 39.2 | 0.0 | 52.6 |
| **Contingency** | 0.0 | 106.8 | 0.0 | 106.8 |
| **Sub-Total** | 284.0 | 587.6 | | 871.6 |
| **Cost Recoveries** | (96.6) | (199.8) | | (296.3) |
| **TOTAL** | **187.5** | **387.8** | **0.0** | **575.3** |

**Operating Experience:**

The JDE suite of applications is run on a continuous basis. Since the last upgrade in 2004, the vendor, Oracle, introduced an "Applications Unlimited" strategy for all of its newly purchased applications. Under this strategy, Oracle guaranteed support of Hydro's version A7.3 CUME 14 of the JD Edwards World application until December 13, 2013.

**Project Justification:**

The JDE Upgrade Project is required to upgrade the software applications to the latest supported release from the vendor. Support for Hydro's existing release expires December 31, 2013. Without the upgrade the software will not be supported and updates which allow for normal business processes such as payroll will cease to work properly as tax table updates would not be available.

**Future Plans:**

Future products upgrades will be based on product support expiry dates and/or need for additional functionality as determined by business needs.

**Attachments:**

See report entitled "JD Edwards Upgrade Project" located in Volume II, Tab 22 for further details.

**Project Title:** Replace Network Communications Equipment

**Location:** Various Sites

**Category:** General Properties - Telecontrol

**Definition:** Other

**Classification:** Normal

**Project Description:**

The Network Upgrade Program is required to upgrade networking devices and network infrastructure in the Administrative, Energy Management System (EMS) and Supervisory Control and Data Acquisition (SCADA) networks. Key drivers include device and infrastructure obsolescence, network performance concerns, network availability/reliability concerns, increasing headcount and evolving enterprise application requirements. In 2012 the following items will be addressed: 1.) Eight routers will be replaced due to equipment obsolescence; 2.) one frame-relay connected area office will be migrated to Internet Protocol Virtual Private Network (IPVPN) connectivity; and 3.) the Wide Area Network (WAN) circuit from Hydro Place to Sandy Brook Hill will be upgraded. This proposal includes consideration for unforeseen network expenditures. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 261.9 | 0.0 | 0.0 | 261.9 |
| **Labour** | 121.3 | 0.0 | 0.0 | 121.3 |
| **Consultant** | 40.6 | 0.0 | 0.0 | 40.6 |
| **Contract Work** | 2.0 | 0.0 | 0.0 | 2.0 |
| **Other Direct Costs** | 19.9 | 0.0 | 0.0 | 19.9 |
| **Interest and Excalation** | 31.3 | 0.0 | 0.0 | 31.3 |
| **Contingency** | 44.6 | 0.0 | 0.0 | 44.6 |
| **TOTAL** | **521.6** | **0.0** | **0.0** | **521.6** |

**Project Title:** Replace Network Communications Equipment **(cont'd.)**

**Operating Experience:**

Hydro's administrative network provides employees across the Province with access to enterprise software applications and tools, including Lotus Notes, File Servers, Printers, J.D. Edwards, Workplace Hazardous Materials Information System (WHMIS) information and the public Internet. The administrative network also provides remote access to telecommunications and other operational devices located throughout the Island for remote monitoring purposes.

Hydro's primary EMS network is located at Hydro Place and provides the communications necessary for the Energy Control Center (ECC) to remotely control and collect operational data pertaining to Hydro's electric system. This operational data resides on the SCADA network. It is segregated from the administrative network and it contains applications which reach into the SCADA network to collect vital operational data as well as make operational changes. For disaster recovery purposes a secondary/backup EMS network, known as the Backup Control Center (BCC), is located in Holyrood.

Hydro's SCADA network is another segregated network which extends across more than 59 sites throughout the Province. The SCADA network enables ECC operators to remotely control and monitor operational devices on the Island Interconnected System.

**Project Justification:**

Equipment obsolescence poses multiple risks to Hydro in that vendor support and replacement parts are no longer available and software and security updates for these devices are no longer available. The replacement of obsolete devices is required in order to ensure the reliability and availability of the Administrative and EMS networks.

The migration of remote area offices from legacy frame relay technology to IPVPN technology is required to keep pace with third party telecommunication providers' technology migration.

The WAN circuit between Hydro Place and Sandy Brook Hill is required to address current and future bandwidth requirements to area offices. Access to the corporate network at the Bay D'Espoir, Bishop's

**Project Title:** Replace Network Communications Equipment **(cont'd.)**

**Project Justification: (cont'd.)**

Falls, Deer Lake and Holyrood offices, as well as the various hydro plants in the Bay D'Espoir area is via Hydo's own microwave radio network. The current design of these WAN circuits separates the total traffic to all sites and even within sites into several individual circuits, resulting in inefficient use of available network bandwidth. In addition, the bandwidth requirements at these remote area offices has increased sharply in the last four years due to increased use of video conferencing, as well as the increased data demand of increasingly sophisticated applications. This project proposes to increase the available bandwidth to these sites by installing equipment to create a single high speed circuit between Hydro Place and Sandy Brook Hill microwave repeater site, utilizing available spare bandwidth on Hydro's microwave radio network. The Sandy Brook Hill site will act as an aggregation point for traffic from the remote area offices and hydro plants, thereby increasing the available bandwidth to these sites by both making more bandwidth available and making more efficient use of this bandwidth. This is required to more adequately address current needs as well as support future needs of the business.

The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Discussions with Stakeholders<br>Site Visits | February 2012<br>February 2012 | February 2012<br>March 2012 |
| Design | Prepare Design Brief<br>Prepare Design Transmittal | March 2012<br>April 2012 | March 2012<br>April 2012 |
| Procurement | Order Equipment – Obsolete Routers<br>Order Equipment – Hydro Place to Sandy Brook Hill WAN Circuit | March 2012<br>April 2012 | April 2012<br>April 2012 |
| Construction/ Commissioning | Implement IPVPN to Area Office<br>Replace Obsolete Routers<br>Upgrade Hydro Place to Sandy Brook Hill WAN circuit | May 2012<br>June 2012<br>October 2012 | May 2012<br>September 2012<br>November 2012 |
| Closeout | Project Closeout | December 2012 | December 2012 |

**Project Title:** Replace Network Communications Equipment **(cont'd.)**

**Future Plans:**

Future replacements will be proposed in future capital budget proposals.

**Attachments:**

See report entitled "Network Communications Equipment Upgrade Program" located in Volume II, Tab 23, for further project details.

**Project Title:** Overhaul Turbine Unit 1

**Location:** Holyrood Generating Station

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to perform a scheduled major overhaul of Unit 1 Turbine, Generator and auxiliary systems located at the Holyrood Thermal Generating Station. This major overhaul consists of total dismantling of all turbine stages, removal of the generator rotor, and internal inspections of all auxiliary equipment. The work will be completed by contracted services with assistance from plant personnel as required. The contracted work consists of technical services, labor, materials and supervision. Plant support is required for work protection application and services, removal of specific monitoring and control systems, overall project supervision and liaison with Hydro's management personnel.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 350.0 | 0.0 | 0.0 | 350.0 |
| **Labour** | 257.1 | 0.0 | 0.0 | 257.1 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 2,850.0 | 0.0 | 0.0 | 2,850.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 395.2 | 0.0 | 0.0 | 395.2 |
| **Contingency** | 340.8 | 0.0 | 0.0 | 340.8 |
| **TOTAL** | **4,193.1** | **0.0** | **0.0** | **4,193.1** |

**Operating Experience:**

The Unit 1 operating hours to the end of February 2011 were 171,951. Assuming the generator operates for approximately 5,000 hours per year until 2012, it is expected to attain approximately 179,000 hours before the next major inspection in 2012. Based on System requirements, the unit has

**Project Title:** Overhaul Turbine Unit 1 **(cont'd.)**

**Operating Experience: (cont'd.)**

averaged about 14 starts per year which when projected to end of 2011 will total about 126 for the nine year operating period. Unit 1 has undergone scheduled major and valve outages on a six-year and three-year basis respectively from 1969 to 2003.

**Project Justification:**

This project is justified on the requirement to maintain the generating equipment in its optimal operating condition for Hydro to provide safe, least-cost, reliable electrical service to its customers. The overhaul is on a nine-year cycle, where cyclically the turbine stages are dismantled, inspected and repaired or refurbished as required. The purpose of the major overhaul is to return the turbine, generator and auxiliary systems to design specifications such that they can perform safely, efficiently, and reliably to meet system demands until the next major overhaul. The overhaul will also identify any internal conditions that if not corrected or controlled could lead to premature failure of the equipment. The overhaul is critical to ensure the unit will remain in service as long as required, and to eliminate identifiable issues which could lead to catastrophic failure if not remedied.

**Future Plans:**

Unit 1 at the Holyrood TG Station will continue the current operating regime until 2016.

**Attachments:**

See report entitled "Unit 1 Turbine Generator Major Overhaul" located in Volume 1, Tab 24 for further details.

**Project Title:** Condition Assessment and Life Extension Phase 2

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is the first year of Phase 2 of a condition assessment and life extension (CALE) program that began as Phase 1 in 2009 and was completed in March 2011. Phase 2 is a three year project. The scope of work is to perform more detailed internal investigation on select equipment/systems as identified by Phase 1 to determine the actions required to ensure that reliable and safe operation of the Holyrood plant will be maintained into the future with consideration to the plant's projected operating requirements.

Table 1 provides the budget estimate for this project.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 95.0 | 0.0 | 0.0 | 95.0 |
| **Consultant** | 133.3 | 0.0 | 0.0 | 133.3 |
| **Contract Work** | 800.0 | 0.0 | 0.0 | 800.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 84.6 | 0.0 | 0.0 | 84.6 |
| **Contingency** | 102.8 | 0.0 | 0.0 | 102.8 |
| **TOTAL** | **1,215.7** | **0.0** | **0.0** | **1,215.7** |

**Operating Experience:**

The Holyrood plant has been in operation since 1970 and operates under a seasonal regime. Full generating capacity is required during the winter months and no generation is required during the summer. During the spring and fall seasons the plant generation load varies but is normally less than plant capacity. In late spring, when power generation is not required, generating Unit 3 is converted to synchronous condenser mode of operation. Synchronous condensing is required during the summer to provide voltage support and ensure stability of the Island Interconnected System.

**Project Title:** Condition Assessment and Life Extension Phase 2 **(cont'd.)**

**Project Justification:**

The Holyrood thermal generating station is over 40 years old and is past its 30-year expected life to provide reliable least cost power. Considering the operating hours it has incurred, there are areas that need to undergo detailed investigation to determine what actions, if any, should be taken to ensure that equipment can continue to remain in service from a safety perspective. This project will provide information that will enable Hydro to make informed decisions as it plans for the projected operational requirements of the plant, with consideration to the implications of the Lower Churchill project, and to ensure a safe reliable operation that can deliver least cost power as needed. Phase 2 will provide information to assist Hydro in identifying the long term cost of energy produced by this facility for comparison with other alternatives to ensure power is provided to customers at the least possible cost.

**Future Plans:**

Upon completion of Phase 2 of the condition assessment and life extension program in 2014, the future operating requirements of the Holyrood plant will be considered. A decision will be made as to whether Phase 3 of the CALE program should be pursued and what its scope should be.

**Attachments:**

See report entitled "Condition Assessment and Life Extension" located in Volume II, Tab 25, for further project details.

**Project Title:** Overhaul Diesel Units

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Generation

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

This project is required to overhaul the diesel engines at diesel generating plants. The project consists of overhauling 12 engines in 2012. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 585.4 | 0.0 | 0.0 | 585.4 |
| **Labour** | 132.0 | 0.0 | 0.0 | 132.0 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 16.6 | 0.0 | 0.0 | 16.6 |
| **Other Direct Costs** | 73.4 | 0.0 | 0.0 | 73.4 |
| **Interest and Escalation** | 88.8 | 0.0 | 0.0 | 88.8 |
| **Contingency** | 77.9 | 0.0 | 0.0 | 77.9 |
| **TOTAL** | **974.1** | **0.0** | **0.0** | **974.1** |

**Operating Experience:**

Isolated diesel generation plants operate continuously since they provide the primary source of electricity to communities isolated from the Province's electrical grid. A given unit is not in operation continually since the number of units in service varies based on the demand. In automated plants the engine mix is automatically controlled by a control system to maximize fuel efficiency. In a manually controlled plant, this control is completed by the operator. In any of the plants the operator has the flexibility to shut down engines for maintenance provided there is another engine available to supply the load for that time. As a result outages to engines can occur without outages to customers.

**Project Title:** Overhaul Diesel Units **(cont'd.)**

**Project Justification:**

Hydro's current maintenance philosophy is to complete an engine overhaul on all diesel engines every 20,000 hrs. This philosophy was established in 2003 as a result of a review of the maintenance tactics and failure history. Performing overhauls too frequently results in additional expenditure for negligible improvement in reliability. An overhaul interval of 20,000 hours is considered to be the optimum interval for providing least-cost, reliable electrical service.

**Future Plans:**

The overhaul of diesel engines is a continuous program. The 20 year plan for diesel engine overhauls (2012 - 2031) has an average of 10.5 overhauls annually and is based on an overhaul interval of 20,000 operating hours. The 20 year plan is based on the present-day operating conditions which are subject to change depending on load demand and operating factors. Changes to the operating conditions can change the average number of annual overhauls.

**Attachments:**

See report entitled "Overhaul Diesel Engines" located in Volume II, Tab 26 for further details.

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years ($000) | Total | Page Ref |
|---|---|---|---|---|---|
| **GENERATION** | | | | | |
| Replace Fuel Tank - Burnt Dam | | 208 | | 208 | C - 2 |
| **TOTAL GENERATION** | 0 | 208 | 0 | 208 | |
| | | | | | |
| **TRANSMISSION AND RURAL OPERATIONS** | | | | | |
| Replace Substation Infrastructure - Burgeo | 128 | 368 | | 496 | |
| Replace Fuel Storage Tanks - St. Lewis | | 465 | | 465 | C - 10 |
| Replace Instrument Transformers - Various Sites | | 452 | | 452 | C - 35 |
| Replace Insulators - Various Sites | | 412 | | 412 | C - 113 |
| Replace Light Duty Mobile Equipment - Various Sites | | 401 | | 401 | C - 119 |
| Replace Disconnects - Various Sites | | 352 | | 352 | C - 126 |
| Install Automated Meter Reading - Labrador City | 292 | 58 | | 351 | |
| Upgrade Transmission Line Access Trails - Stony Brook to Springdale | | 313 | | 313 | C - 136 |
| Replace Mini Hydro Turbine - Roddicton | 87 | 235 | | 322 | |
| Replace Compressed Air Piping and Install Dew Point Monitor - Buchans | | 28 | 278 | 307 | C - 166 |
| Replace Recloser Control Panels - Various Sites | | 202 | | 202 | C - 176 |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 507 | 3,287 | 278 | 4,072 | |
| | | | | | |
| **GENERAL PROPERTIES** | | | | | |
| Replace Personal Computers - Various Sites | | 491 | | 491 | C - 194 |
| Replace Peripheral Infrastructure - Various Sites | | 328 | | 328 | C - 199 |
| Remove Safety Hazards - Various Sites | | 249 | | 249 | C - 205 |
| Upgrade Enterprise Storage Capacity - Hydro Place | | 202 | | 202 | C - 210 |
| **TOTAL GENERAL PROPERTIES** | 0 | 1,269 | 0 | 1,269 | |
| | | | | | |
| **MAJOR OVERHAULS AND INSPECTIONS**[1] | | | | | |
| Overhaul Turbine/Generator Units - Granite Canal and Upper Salmon | | 457 | | 457 | C - 215 |
| **TOTAL MAJOR OVERHAULS AND INSPECTIONS** | 0 | 457 | 0 | 457 | |
| | | | | | |
| **TOTAL PROJECTS OVER $200,000 AND UNDER $500,000** | 507 | 5,221 | 278 | 6,006 | |

[1] Capital Budget proposals after consideration of International Financial Reporting Standards (IFRIS) Requirements

**Project Title:** Replace Fuel Tank

**Location:** Burnt Dam

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project involves the purchase and installation of an 18,000 litre, double wall, horizontal jet fuel tank, complete with proper aviation fuel pump and filtration system, to replace the existing tank and system. Work will include the construction of a new concrete pad for the tank and dispensing cabinet. All components of the new system will be installed to meet the current aviation fuel dispensing standards. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 89.0 | 0.0 | 0.0 | 89.0 |
| **Labour** | 41.7 | 0.0 | 0.0 | 41.7 |
| **Consultant** | 7.7 | 0.0 | 0.0 | 7.7 |
| **Contract Work** | 15.0 | 0.0 | 0.0 | 15.0 |
| **Other Direct Costs** | 26.5 | 0.0 | 0.0 | 26.5 |
| **Interest and escalation** | 9.6 | 0.0 | 0.0 | 9.6 |
| **Contingency** | 18.0 | 0.0 | 0.0 | 18.0 |
| **TOTAL** | **207.5** | **0.0** | **0.0** | **207.5** |

**Existing System:**

The Burnt Dam jet fuel tank was installed in 1989. At the time of installation there were no standards for aviation fuel tanks. The existing system is at the end of its useful service life and does not comply with current regulations, the most noticeable of which is the lack of an interior coating system (see Legislative and Regulatory requirements below).

Other issues with the fuel supply system include: no means of safe access to the top of the tank; differential settlement of the tank; lack of access to the tank interior to facilitate cleaning and inspection; and recent issues with the pumping system which will require the pump to be replaced.

Fuel testing is carried out in accordance with current industry standards, however, this provides an indication of suspended particles only and fails to indicate the amount of sediment which has accumulated in the tank. While there have been no reports of rust scale or water in the fuel at Burnt Dam, Hydro is unable to conclude that an issue does not exist, as heavier scale will settle to the bottom of the tank.

After 22 years of service, good maintenance practice would see the tank drained to permit an internal inspection and the removal of sludge and rust accumulation from the tank bottom. The absence of an access hatch makes it impossible to gain entry inside the tank, to complete these tasks.

Age of Equipment or System

The Burnt Dam jet fuel tank is 22 years old.

Major Work/or Upgrades

There have been no major upgrades since installation of the tank.

Anticipated Useful life

The fuel storage tank has an anticipated useful life of 20 years. The fuel storage tank at Burnt Dam is two years beyond its useful life.

Maintenance History

Maintenance of the fuel supply system at Burnt Dam is performed by Hydro personnel. Inspections are completed annually and repairs are performed as required.

There is no record of maintenance or repairs performed on the tank in the last five years. Given that Burnt Dam is occupied year round, work performed at the site is typically charged out under routine operations and, as a result, would not be tracked separately.

There are, however, several current issues related to this tank, including: leveling of the fuel tank, repairs to the fuel metering system, and repairs to fuel pump. A work order has been initiated for the fuel tank leveling but work has not commenced as of the writing of this proposal. Repairs to the

fuel pump and fuel metering system are also planned to be completed but are being delayed in anticipation of a new fuel supply system being necessary. Until an appropriate analysis is done on the most cost effective approach these repairs will not be executed.

Outage Statistics

There have been no outages attributed to the fuel tank.

Industry Experience

Industry experience is not available to this project.

Maintenance or Support Arrangements

Maintenance of the fuel supply system at Burnt Dam is performed by Hydro personnel. Inspections are completed annually and repairs are performed as required. As noted earlier, while annual maintenance and minor repairs have been carried out on the tank, this work is considered routine operation and as a result has not been tracked.

Vendor Recommendations

There are no vendor recommendations.

Availability of Replacement Parts

As the jet fuel supply system in Burnt Dam is 22 years old the availability of replacement parts is a growing concern. The existing fuel pump has surpassed its anticipated service life and has recently experienced some issues with minor leaking. Given the age of the pump, the availability of parts has proved to be a problem. With the fuel pump becoming aged, replacement parts are increasingly difficult to procure as they are no longer considered standard stock items by suppliers. Therefore, a new pump and filter system will have to be purchased and installed.

Safety Performance

The Burnt Dam aviation fuel supply system has outlived its anticipated service life and fails to comply with a number of aviation fuel standards. Given the age and construction type of the tank, bringing the tank in- line with current standards would be difficult and potentially not provide a safe fuel supply with the existing system. A safe fuel supply is crucial, particularly when dealing with

aviation requirements, due to the potential impacts poor fuel quality may have on the operation of the helicopters accessing fuel from this system.

The uncertainty of the fuel system's ability to safely meet Hydro's fuel requirements would not be viewed in such a high priority were the fuel intended for another purpose. As the fuel system is utilized for aviation purposes there is an increased potential with respect to loss of life.

Environmental Performance

While the existing fuel supply system is not in direct violation of current environmental regulations, there are a number of issues with the system which lead to concerns surrounding the potential for fuel spills:

- A recent leak, detected in the pump system, is indicative of the fuel system's age. It is not unreasonable to anticipate the occurrence of similar leaks in the near future;
- A lack of isolation valves, within the fuel supply system, increase the potential for a significant fuel spill in the event that a leak were to occur;
- There are no spill pans in place to capture fuel leakage from the dispensing cabinet.

Operating Regime

Given the remote nature of the Burnt Dam site, access by helicopter is the only acceptable mode of travel to carry out operations and maintenance work. This is particularly true during the period of December through June, when the road is impassable due to snow/ice accumulation. The onsite fuel storage capacity was selected to satisfy Hydro's fuel demand for this period when fuel trucks are unable to access the site to replenish the fuel stock.

The fuel supply system at Burnt Dam serves as a regular aviation fuel source for Hydro operations in the region, and is a critical refueling site, as there are no other alternative fuel sources in this area.

**Justification:**

As refueling options at this remote site are limited, the existing fuel supply system remains in service despite concerns over the quality and dependability of the existing fuel supply system.

As noted the fuel supply system in Burnt Dam has outlived its anticipated service life and fails to comply with a number of current regulations pertaining to the storage, handling, and dispensing of aviation fuels at aerodromes (see Legislative and Regulatory requirements below).

Furthermore, there are issues pertaining to: safe access to the top of the tank; differential settlement of the tank; possible corrosion to the underside of the tank; lack of access to the tank interior to facilitate cleaning and inspection; and recent issues with the pumping system which will require the pump to be replaced.

Given the age of the system, and the cost required to complete the required upgrades, the most feasible option would be to install a complete new system.

Net Present Value

A net present value calculation has not been performed as there is no viable alternative replacing the tank.

Levelized Cost of Energy

As no new generation source is considered, this project has no effect on the levelized cost of electricity.

Cost Benefit Analysis

A cost benefit analysis is not required for this project proposal, as there are no quantifiable financial benefits.

Legislative or Regulatory Requirements

The existing jet fuel supply system is not up to current aviation fuel standards. A review of CSA B836-05, Standard for Storage, Handling and Dispensing of Aviation Fuel at Aerodromes, has revealed the following deficiencies:

1. Section 4.3.2 – Internal Coating

   "Carbon steel fuel storage tanks shall have an epoxy-coated internal surface. Surface preparation shall be adequate to ensure bonding of the epoxy coating to the steel."

2. Section 4.5 Piping and Fittings

   (i) Section 4.5.1.6

   "Piping downstream of the final filter-separator or the continuous fuel monitor shall be stainless steel, aluminum, or carbon steel internally coated with aviation-fuel-resistant epoxy. In-line carbon steel components of the piping system such as meters, strainers, and pressure vessels shall be internally coated."

   (ii) Section 4.5.1.16

   "Connections shall be provided to drain water or fuel at each low point."

3. Section 4.6.1 – Isolating Valves

   "Isolation valves shall be provided at suitable locations to allow the isolation of equipment and sections of piping to facilitate maintenance and repairs and to serve as emergency shut-off valves in the event of a failure of automatic flow control valves."

4. Section 4.13.2 – Accessories

   "Each fueling cabinet shall include the following:

   (a) a weatherproof enclosure designed to protect the cabinet contents from the elements

   (k) a pressure-relief system to relieve thermal pressure build-up in hoses exceeding normal operating pressure

5. Section 4.13.6 – Spill Pan

   "Cabinet bases shall incorporate a fuel spill pan to capture leakage within the cabinet."

<u>Historical Information</u>

Similar tank replacements were approved by the Board under Order No. P.U. 1(2010) and Order No. P.U. 26(2010) for Bishop Falls and Bay d'Espoir respectively.

The tank in Bishop Falls was installed in 1990, while the tank in Bay d'Espoir was installed in 2001. Neither of these tanks contained an interior coating system and both were replaced, in large part, due to the presence of dirt and rust accumulations in the tank.

Prior to replacing the tanks, in Bishop Falls and Bay d'Espoir, options were evaluated to have them upgraded. After considering all of the issues and the overall cost, associated with the upgrades, replacement of the tanks was deemed to be the most feasible solution.

Table 2 provides a summary of the previously approved projects.

**Table 2: Historical Information**

| **Project Cost:** *($ x1,000)* | **Year** | **Budget** | **Actual** |
|---|---|---|---|
| Bishop Falls | 2010 | 87.5 | 86.2 |
| Bay d'Espoir*** | 2010 | 120.4 | - |

****Note: The Bay d'Espoir project carried over into 2011.*

The remote location of Burnt Dam contributes significantly to the overall cost of this project, resulting in it being a higher cost than comparable upgrades at other more readily accessible sites.

Forecast Customer Growth

Customer load growth does not affect this project.

Energy Efficiency Benefits

There are no energy efficiency benefits that can be attributed to this project.

Losses during Construction

There will be no power outages required for this project.

Status Quo

The consequence of not completing this project is the continued reliance on an old, outdated fuel supply system to serve Hydro's aviation fuel consumption requirements for the region.

Alternatives

Given the age of the fuel supply system, and the major upgrades required to bring the tank in line with current standards, replacement of the existing fuel supply system is the only viable option.

**Conclusion:**

The existing fuel supply system provides an important aviation fuel source for the remote site of Burnt Dam. A safe, reliable fuel supply is crucial to Hydro's operations in the region and, therefore, the fuel storage system needs to be replaced.

Project Schedule

The anticipated project schedule is shown in Table 3.

**Table 3: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Completion of Design Transmittal | March 2012 | April 2012 |
| Design | Preparation of Tender Package | April 2012 | April 2012 |
| Procurement | Fuel Supply System Purchase | May 2012 | July 2012 |
| Construction | Fuel Supply System Installation | August 2012 | September 2012 |
| Commissioning | System Commissioning | September 2012 | September 2012 |
| Closeout | Project Closeout | October 2012 | October 2012 |

**Project Title:** Replace Fuel Storage Tanks

**Location:** St. Lewis

**Category:** Transmission and Rural Operations - Generation

**Definition:** Other

**Classification:** Mandatory

**Project Description:**

This project involves the purchase and installation of two new 45,000 litre, double wall, horizontal fuel storage tanks, to replace the six existing 68,190 litre, horizontal tanks. Work will include: removal of the earthen dyke and associated site grading; installation of the new fuel tanks; and modifications to the fuel header system to accommodate the new tanks. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 100.0 | 0.0 | 0.0 | 100.0 |
| **Labour** | 46.0 | 0.0 | 0.0 | 46.0 |
| **Consultant** | 18.0 | 0.0 | 0.0 | 18.0 |
| **Contract Work** | 213.0 | 0.0 | 0.0 | 213.0 |
| **Other Direct Costs** | 19.0 | 0.0 | 0.0 | 19.0 |
| **O/H, AFUDC & Escln.** | 29.5 | 0.0 | 0.0 | 29.5 |
| **Contingency** | 39.6 | 0.0 | 0.0 | 39.6 |
| **TOTAL** | **465.1** | **0.0** | **0.0** | **465.1** |

**Existing System:**

The St. Lewis diesel storage system consists of six 68,190 litre, single-wall, horizontal steel fuel tanks, which provide 409,140L of site storage capacity. The existing tanks are located within an earthen dyke system, complete with Hypalon Synthetic Liner.

Five of the existing tanks were installed in 1982.The sixth tank was relocated to St. Lewis from Makkovik in 1991.

In 2010, a visual inspection and ultrasonic testing of the tanks wall thickness was completed, in accordance with the requirements of ULC-S601. The inspection found that two of the tanks are missing the required Underwriters Laboratories of Canada (ULC) labels and, consequently, fail to

meet the requirements specified under the Storage and Handling of Gasoline and Associated Products Regulation (GAP), 2003 Section 27. (5) (see Legislative and Regulatory Requirements).

Furthermore, ultrasonic test results show that the four remaining tanks, which have the required ULC certification labels, have wall thicknesses less than those specified under the ULC–S601 design criteria. In fact, one of the four tanks, displayed metal thicknesses so low that it was immediately deemed unsuitable for use. It has since been tagged and removed from operation. Given the age of the tanks, combined with the substandard metal thickness measurements, sound engineering practice dictates that the tanks should be removed from service and replaced. A copy of the inspection report can be found in Appendix A.

The current fuel storage capacity was selected to provide a nine month fuel supply as the tanks are filled by way of a bulk tanker vessel. The tanker visits St. Lewis twice a year, once in the spring and once in the fall.

The completion of the St. Lewis Access Road, in 2001, has eliminated the requirement to maintain such a large site storage capacity as presently exists. Through consultations with representatives from Project Execution, Operations, and the Woodward Group of Companies (the current fuel supply vendor) it was determined that 90,000 L of onsite storage was adequate. Based on current fuel consumption and load forecasts the selected storage capacity will satisfy Hydro's fuel consumption requirements for a two month period, during the peak loads experience in the winter months. Road access to the community will permit monthly truck delivery to the diesel plant and the additional month's storage capacity provides a buffer to account for adverse weather conditions which may delay the fuel delivery.

A reduction in the number of onsite storage tanks will greatly reduce the potential for fuel oil spills on Hydro property while, at the same time, significantly reducing costs associated with maintaining the tanks.

Age of Equipment or System

All six tanks located in St. Lewis were fabricated in 1982. They are 29 years old.

Major Work/or Upgrades

There have been no major upgrades completed on the fuel tanks since installation.

Anticipated Useful life

For depreciation purposes the estimated service life of both fuel tanks and synthetic dyke liners is 20 years.

Maintenance History

The five-year maintenance history for the St. Lewis Diesel Tanks is shown in Table 2.

Records indicate that two corrective maintenance actions have been completed in the past five years. These consist of a visual inspection and ultrasonic testing, completed in 2010, and a cleaning and inspection of the tanks carried out in 2007. A copy of the 2010 Tank Inspection Report is included in Appendix A.

The preventative maintenance costs consist of routine operator duties, which are completed annually for the tanks.

**Table 2: Five-Year Maintenance History**

| Year | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($ 000) |
|---|---|---|---|
| 2010 | 2.4 | 9.5 | 11.9 |
| 2009 | 2.2 | | 2.2 |
| 2008 | 2.1 | | 2.1 |
| 2007 | 2.1 | 11.8 | 13.9 |
| 2006 | 2.0 | | 2.0 |

Outage Statistics

There have been no outages which can be attributed to the fuel storage system.

Industry Experience

There is no relevant industry experience applicable to this project.

Maintenance or Support Arrangements

The St. Lewis Diesel Plant fuel storage facility is maintained by Hydro personnel. Regular tank inspections are contracted out to local companies using the Public Tendering process.

Vendor Recommendations

There are no vendor recommendations.

Availability of Replacement Parts

The availability of replacement parts is not applicable to this project.

Safety Performance

There are no safety issues related to this project.

Environmental Performance

The existing fuel storage tanks in St. Lewis have outlived their anticipated service life. Ultrasonic thickness testing, completed in 2010, found that a number of the tanks contained metal thickness readings which failed to meet the requirements of ULC-S601. The reduction in metal thickness, combined with the age of the existing tanks, raises concerns as to the ability of the tanks to adequately serve Hydro's storage requirements without resulting in fuel spills or leaks.

Furthermore, the synthetic dyke liner has also outlived its anticipated useful service life. Since being installed in 1982, the liner has become punctured, torn and ripped throughout the course of its lifespan. Dyke liners are covered with a gravel ballast material to protect the synthetic liners from accelerated deterioration as a result of Ultraviolet Rays. The ballast also serves to protect the liner from damage due to impact from foreign objects. Furthermore vehicular and foot traffic is restricted within the dyke to reduce the risk of damage to the liner. Despite these mitigations, Hydro is concerned that the deterioration of the dyke liner has compromised its ability to fully contain fuel in the event of a spill or leak.

Finally, it was noted, during the 2010 tank inspection, that two of the existing tanks are missing the required ULC Labels. This is a direct violation of the Storage and Handling of Gasoline and Associated Products Regulation (GAP), 2003 Section 27. (5), which states that "Shop fabricated

aboveground horizontal storage tanks shall be constructed and shop tested in accordance with the ULC CAN4-S601, latest edition, and shall bear a ULC label." As these tanks fail to comply with the GAP regulations they must be removed from service.

ULC Certification Bulletin No. 2007-34 states that, "Tank refurbishment by a ULC approved tank manufacturer in accordance with Technical Supplements ULC-S601(A)-2001, ULC-S603(A)-2001, ULC-S615(A)-2002 and ULC-S630(A)-2001, is permitted at the manufacturer's facility only. Listed tank manufacturers must be assessed and deemed acceptable by ULC in order to be authorized to perform this type of work." In short, the tanks would need to be drained, cleaned and shipped to an approved ULC factory if Hydro were to apply for recertification. This would prove to be an extremely costly endeavor.

Operating Regime

The St. Lewis diesel plant is the community's only source of electrical power and, thus, is in continuous operation. The fuel storage tanks in St. Lewis provide the fuel supply for the diesel generating plant.

**Justification:**

This project is required to replace deteriorated equipment in order for Hydro to maintain compliance with legislative and environmental requirements. The St. Lewis fuel storage system has outlived its anticipated service life and fails to comply with applicable regulatory requirements (See Legislative or Regulatory Requirements for further details). Ultrasonic thickness testing, completed in 2010, found that a number of the tanks contained metal thickness readings which failed to meet the requirements of CSA B836-05. The reduction in metal thickness, combined with the age of the existing tanks, raises concerns as to the ability of the tanks to adequately serve Hydro's storage requirements without resulting in fuel spills or leaks.

Given that the St. Lewis diesel plant serves as the community's only source of electrical power, maintaining a safe, dependable fuel storage system is essential.

This project is justified on the requirement to replace deteriorated infrastructure to ensure NL Hydro is equipped to continue the delivery of safe, reliable electrical service to its customers.

Net Present Value

A Net Present Value calculation has not been performed for this project.

Levelized Cost of Energy

As no new generation source is considered, this project has no effect on the levelized cost of electricity.

Cost Benefit Analysis

A cost benefit analysis was completed for two alternatives. The study period for the cost benefit analysis was 20 years, as this is the minimum service life anticipated for the fuel storage tanks.

Alternative 1: Direct replacement of the six fuel storage tanks, thereby, maintaining the 409,140L of site storage.

The material costs for this alternative are significantly higher than those of the remaining alternatives.

Furthermore, the operating and maintenance costs associated with the upkeep of six tanks is proportional to the age and number of tanks. As each fuel tank requires the same routine maintenance work, in accordance with governing regulations, it is assumed that each tank will incur the same operating and maintenance costs. Therefore, the operating and maintenance costs associated with alternative 1 (six tanks) will cost approximately three times those of alternatives 2 and 4 (two tanks). The same conclusion cannot be made for Alternative 3, as reuse of the existing tanks will see maintenance costs higher than those accounted for under alternatives 2 and 3 due to the age of the existing tanks.

Alternative 2: Site storage capacity reduced to 90,000L via two 45,000 litre double wall, horizontal storage tanks

The reduction in onsite storage capacity will require monthly truck delivery to the diesel plant. The changes in the mode and frequency of delivery fall outside the terms of the original contract and will result in an additional cost. As a result, the analysis for this alternative considered a three cent

increase to the current fuel premium. This increase was derived through consultations with the supplier.

The operating and maintenance costs reflect the maintenance costs anticipated for two new storage tanks.

Alternative 3: Reduced site storage capacity through reuse of two of the existing fuel storage tanks.

As with alternative 2, the reduction in onsite storage capacity will require monthly truck delivery to the diesel plant. The changes in the mode and frequency of delivery fall outside the terms of the original contract and will result in an additional cost. As a result, the analysis for this alternative considered a three cent increase to the current fuel premium. This increase was derived through consultations with the supplier.

An internal inspection would first be required to confirm the interior condition of the tanks, prior to proceeding with this alternative. Based on past inspections an investigation of this nature would cost approximately $75,000. With this in mind, should the internal investigation show that the tanks interior were deteriorated beyond repair the reuse of these tanks would be removed no longer be considered as a viable alternative. Given the age of the tanks and the results of the external investigation this is a possibility which warrants consideration.

Furthermore, the synthetic dyke liner has also outlived its anticipated useful service life. Since being installed in 1982, the liner has become punctured, torn and ripped throughout the course of its lifespan. Hydro is concerned that the deterioration of the dyke liner has compromised its ability to fully contain fuel in the event of a spill or leak. Reuse of the existing tanks would require the dyke to be reshaped and fitted with a new synthetic liner. Associated dyke maintenance costs were considered.

Finally, given the age of the tanks and the results of the 2010 external inspection, this alternative will not provide a 20 year service life. The purchase and installation of two new single wall, horizontal storage tanks, within the 20 year analysis period, has been considered for this alternative.

Alternative 4: Reduced site storage capacity via two 45,000 litre, dingle wall, horizontal storage tanks.

The reduction in onsite storage capacity will require monthly truck delivery to the diesel plant. The changes in the mode and frequency of delivery fall outside the terms of the original contract and will result in an additional cost. As a result, the analysis for this alternative considered a three cent increase to the current fuel premium. This increase was derived through consultations with the supplier.

As with alternative 3, this option will require a complete refurbishment of the existing dyke to serve as secondary containment for the single wall storage tanks. Associated dyke maintenance costs were also considered for this alternative.

Alternative 2 is the least cost option and is the recommended alternative. The results of the cost benefit analysis are illustrated in Table 3.

**Table 3: Cost Benefit Analysis Summary Table**

| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2031** | | |
|---|---|---|
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Alternative 1 Direct Replacement - Base Case | 6,313,562 | 228,795 |
| Alternative 2 - Reduced Capacity New Double Wall Tanks | 6,084,767 | 0 |
| Alternative 3 - Reduced Capacity Reuse Existing Tanks | 6,351,110 | 266,342 |
| Alternative 4 - Reduced Capacity Single Wall Tanks | 6,141,185 | 56,418 |

Legislative or Regulatory Requirements

Fuel storage tanks are required to be certified by the ULC. The ULC is an independent product safety testing, certification and inspection organization, which is accredited by the Standards Council of Canada. Fuel tanks fabricated by recognized manufacturer, in accordance with ULC criteria, receive a certification label indicating the same. A 2010 Tank Inspection found that two of the existing tanks are missing the required ULC certification labels. As a result, the tanks do not comply with Section 3.16.1 of ULC-S601-00 which states that, "The following information shall be engraved or stamped on a corrosion resistant metal nameplate permanently attached to the tank and located on one of the heads so as to be readily visible when installed:

a. Name of tank Manufacturer;
b. Metal Thickness, mm;
c. Diameter, mm;
d. Tank Capacity, L;
e. Year of manufacture;
f. Maximum operating pressure, 7 kPa;
g. Maximum operating vacuum, 300 Pa;
h. Required capacity of emergency venting, $m^3$/min; and
i. Label of certifying agency.

This is a direct violation of the Storage and Handling of Gasoline and Associated Products Regulation (GAP), 2003 Section 27. (5), which states that "Shop fabricated aboveground horizontal storage tanks shall be constructed and shop tested in accordance with the U.L.C. CAN4-S601, latest edition, and shall bear a U.L.C. label."

ULC Certification Bulletin No. 2007-34 states that, "Tank refurbishment by a ULC approved tank manufacturer in accordance with Technical Supplements ULC-S601(A)-2001, ULC-S603(A)-2001, ULC-S615(A)-2002 and ULC-S630(A)-2001, is permitted at the manufacturer's facility only. Listed tank manufacturers must be assessed and deemed acceptable by ULC in order to be authorized to perform this type of work." In short, the tanks would need to be drained, cleaned and shipped to an approved ULC factory if Hydro were to apply for recertification. This would prove to be an extremely costly endeavor and given the age of the tanks is not feasible.

Historical Information

There is no historical information related to this project.

Forecast Customer Growth

A load forecast for St. Lewis is produced by the Market Analysis Section of Hydro's System Planning Department. Table 4 presents the Operating Load Forecast (Fall 2010 version) for St. Lewis for the year 2011 to 2016. The associated Diesel Fuel Requirements (Fall 2010 version) can be viewed in Table 5.

**Table 4: St. Lewis Load Forecast (Fall 2010)**

| Year | Gross Peak (kW) | Net Peak (kW) | Gross Energy (MWh) | Net Energy (MWh) | Total Sales (MWh) | Company Use (MWh) |
|---|---|---|---|---|---|---|
| 2011 | 512 | 491 | 1,742 | 1,606 | 1,517 | 0 |
| 2012 | 511 | 490 | 1,742 | 1,606 | 1,516 | 0 |
| 2013 | 511 | 490 | 1,741 | 1,605 | 1,516 | 0 |
| 2014 | 511 | 490 | 1,741 | 1,605 | 1,515 | 0 |
| 2015 | 511 | 490 | 1,740 | 1,604 | 1,515 | 0 |
| 2016 | 511 | 490 | 1,740 | 1,604 | 1,514 | 0 |

**Table 5: St. Lewis Diesel Fuel Requirements**

| Year | Diesel Fuel Requirements (litres) |
|---|---|
| 2011 | 395,000 |
| 2012 | 394,900 |
| 2013 | 394,700 |
| 2014 | 394,600 |
| 2015 | 394,500 |
| 2016 | 394,400 |

Energy consumption and diesel fuel requirements are forecasted to remain relatively stable in St. Lewis for the foreseeable future.

Energy Efficiency Benefits

There are no energy efficiency benefits that can be attributed to this project.

Losses during Construction

There will be no power outages required for this project. The diesel plant will continue to receive fuel from a temporary fuel supply until the new tanks are brought online.

Status Quo

The fuel storage system in St. Lewis has outlived its anticipated useful service life and fails to comply with applicable regulatory requirements.

Ultrasonic thickness testing, completed in 2010, found that a number of the tanks contained metal thickness readings which failed to meet the requirements of CSA B836-05. The reduction in metal thickness, combined with the age of the existing tanks, raises concerns as to the ability of the tanks to adequately serve Hydro's storage requirements without resulting in fuel spills or leaks.

The consequence of not completing this project is the continued reliance on an old, outdated fuel storage system to serve the generation requirements for the Town of St. Lewis.

Alternatives

See Cost Benefit Analysis Section.

**Conclusion:**

The St. Lewis fuel storage system has outlived its anticipated service life and fails to comply with applicable regulatory requirements.

Given that the St. Lewis diesel plant serves as the community's only source of electrical power, maintaining a safe, dependable fuel storage system is essential. It is for this reason that the tanks in St. Lewis need to be replaced.

Project Schedule

The anticipated project schedule is shown in Table 6.

**Table 6: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Discussions with Operations, Design Transmittal, Site Visit, etc. | March 2012 | March 2012 |
| Design | Completion of tender package | April 2012 | April 2012 |
| Procurement | Purchase of Fuel Tanks | May 2012 | June 2012 |
| Construction | Removal of existing tanks and installation of new tanks | July 2012 | July 2012 |
| Commissioning | Fuel system commissioning | August 2012 | August 2012 |
| Closeout | Project Closeout | September 2012 | September 2012 |

**APPENDIX A**

**2010 TANK INSPECTION REPORT**

BMI Job # 2702-A

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

**NO LABEL ON TANK**

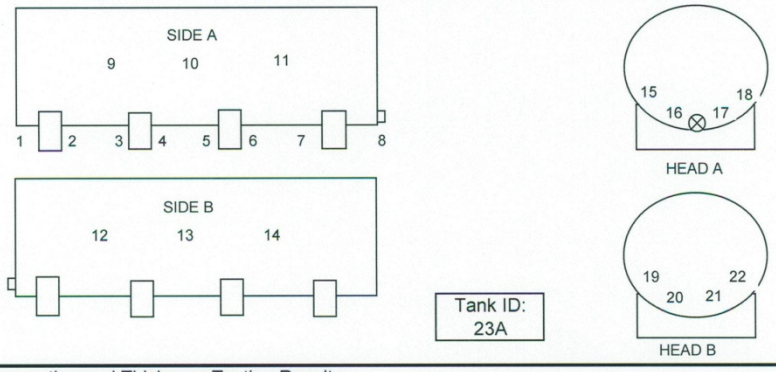
| | | | |
|---|---|---|---|
| Tank Manufacturer: | unknown | | |
| Capacity (L): | 68,190 Litre | Shell Thickness (mm): | unknown |
| Label Serial No.: | unknown | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | unknown |
| Inspection Location: | St. Lewis, Labrador | | |
| Destination: | | | |

2. Tank Cleaning and Purging

Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.287 | x | x | x | |
| 2 | 0.287 | x | x | x | |
| 3 | 0.292 | x | x | x | |
| 4 | 0.296 | x | x | x | |
| 5 | 0.297 | x | x | x | |
| 6 | 0.26 | x | x | x | |
| 7 | 0.257 | x | x | x | |
| 8 | 0.298 | x | x | x | |
| 9 | x | 0.276 | x | x | |
| 10 | x | 0.276 | x | x | |
| 11 | x | 0.283 | x | x | |
| 12 | x | x | 0.267 | x | |
| 13 | x | x | 0.276 | x | |
| 14 | x | x | 0.278 | x | |
| 15 | x | x | x | 0.288 | |
| 16 | x | x | x | 0.278 | |
| 17 | x | x | x | 0.271 | |
| 18 | x | x | x | 0.258 | |
| 19 | x | x | x | x | 0.244 |
| 20 | x | x | x | x | 0.27 |
| 21 | x | x | x | x | 0.282 |
| 22 | x | x | x | x | 0.29 |

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BMI Job # 2702 - A

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.*<br>*Max. general metal loss - tkns. to meet S601 min. rqmt.*<br>*Max. dent depth - 35mm*<br>*Max. dent angle - 30 deg.* | *-4 spots per head (min 2 at bottom edge)*<br>*-6 spots on bottom longitudinals*<br>*-4 spots on each saddle contact area from inside*<br>*-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank is very corroded along tank bottom. Also noted blistering of paint along saddle welds.In reference to other tanks being inspected, this tank is in better condition with regard to paint condition and scaling.

Several tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

There is no label affixed to tank therefore tank is not certified under ULC Standard S601.

9. BMI Sign Off

Report completed by: Rod Cable Date: Aug. 13/10

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BMI Job # 2702 - B

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

**NO LABEL ON TANK**

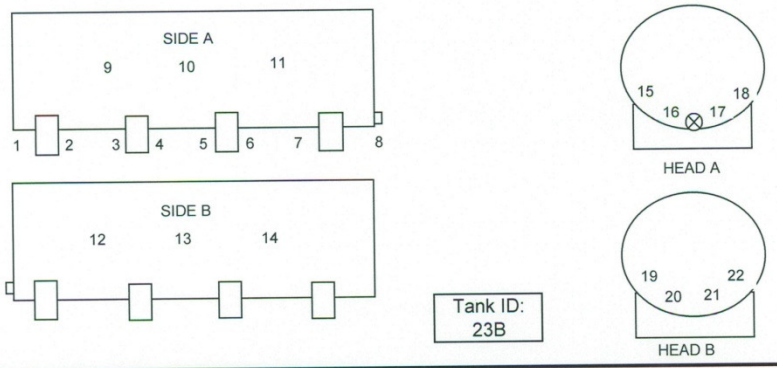
| | | | |
|---|---|---|---|
| Tank Manufacturer: | unknown | | |
| Capacity (L): | 68,190 | Shell Thickness (mm): | unknown |
| Label Serial No.: | unknown | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | unknown |
| Inspection Location: | St.Lewis Labrador | | |
| Destination: | | | |

2. Tank Cleaning and Purging

Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.289 | x | x | x | x |
| 2 | 0.288 | x | x | x | x |
| 3 | 0.279 | x | x | x | x |
| 4 | 0.296 | x | x | x | x |
| 5 | 0.277 | x | x | x | x |
| 6 | 0.286 | x | x | x | x |
| 7 | 0.263 | x | x | x | x |
| 8 | 0.257 | x | x | x | x |
| 9 | x | 0.286 | x | x | x |
| 10 | x | 0.275 | x | x | x |
| 11 | x | 0.272 | x | x | x |
| 12 | x | x | 0.293 | x | x |
| 13 | x | x | 0.272 | x | x |
| 14 | x | x | 0.281 | x | x |
| 15 | x | x | x | 0.261 | x |
| 16 | x | x | x | 0.266 | x |
| 17 | x | x | x | 0.274 | x |
| 18 | x | x | x | 0.273 | x |
| 19 | x | x | x | x | 0.245 |
| 20 | x | x | x | x | 0.283 |
| 21 | x | x | x | x | 0.305 |
| 22 | x | x | x | x | 0.293 |

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BMI Job # 2702 - B

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.*<br>*Max. general metal loss - tkns. to meet S601 min. rqmt.*<br>*Max. dent depth - 35mm*<br>*Max. dent angle - 30 deg.* | *-4 spots per head (min 2 at bottom edge)*<br>*-6 spots on bottom longitudinals*<br>*--4 spots on each saddle contact area from inside*<br>*-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank is very corroded along tank bottom. Also noted blistering of paint along saddle welds.In reference to other tanks being inspected, this tank is in better condition with regard to paint condition and scaling.

Several tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

There is no label affixed to tank therefore tank is not certified under ULC Standard S601.

9. BMI Sign Off

Report completed by: Rod Cable Date: Aug. 13/10

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BMI Job # 2702-C

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

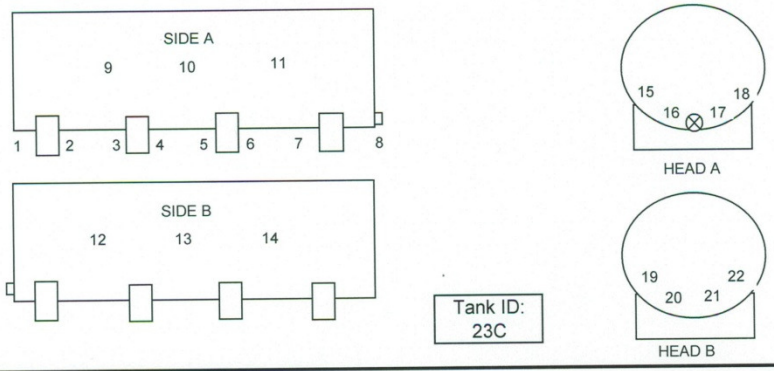
| | | | |
|---|---|---|---|
| Tank Manufacturer: | McNamara Industries | | |
| Capacity (L): | 68,190 | Shell Thickness (mm): | unknown |
| Label Serial No.: | MON1019 | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | 1974 |
| Inspection Location: | St.Lewis Labrador | | |
| Destination: | | | |

2. Tank Cleaning and Purging

Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.263 | x | x | x | x |
| 2 | 0.257 | x | x | x | x |
| 3 | 0.249 | x | x | x | x |
| 4 | 0.291 | x | x | x | x |
| 5 | 0.222 | x | x | x | x |
| 6 | 0.291 | x | x | x | x |
| 7 | 0.246 | x | x | x | x |
| 8 | 0.274 | x | x | x | x |
| 9 | x | 0.294 | x | x | x |
| 10 | x | 0.298 | x | x | x |
| 11 | x | 0.325 | x | x | x |
| 12 | x | x | 0.316 | x | x |
| 13 | x | x | 0.32 | x | x |
| 14 | x | x | 0.324 | x | x |
| 15 | x | x | x | 0.25 | x |
| 16 | x | x | x | 0.25 | x |
| 17 | x | x | x | 0.25 | x |
| 18 | x | x | x | 0.25 | x |
| 19 | x | x | x | x | 0.343 |
| 20 | x | x | x | x | 0.299 |
| 21 | x | x | x | x | 0.251 |
| 22 | x | x | x | x | 0.257 |

BMI Job # 2702 -C

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.*<br>*Max. general metal loss - tkns. to meet S601 min. rqmt.*<br>*Max. dent depth - 35mm*<br>*Max. dent angle - 30 deg.* | *-4 spots per head (min 2 at bottom edge)*<br>*-6 spots on bottom longitudinals*<br>*-4 spots on each saddle contact area from inside*<br>*-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank shows extreme corrosion on tank bottom.Blistering of paint along tank has water trapped between paint & tank, therefore external corrosion evident & likely.

It is suggested that tank to be sandblasted, primed and painted to alleviate further corrosion if the tanks are to remain in service.

Several of tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

9. BMI Sign Off

Report completed by: Rod Cable Date: Aug. 13/10

BMI Job # 2702 - D

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

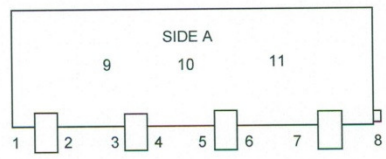
| | | | |
|---|---|---|---|
| Tank Manufacturer: | McNamara Industries | | |
| Capacity (L): | 68,190 | Shell Thickness (mm): | unknown |
| Label Serial No.: | MON1017 | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | 1974 |
| Inspection Location: | St.Lewis Labrador | | |
| Destination: | | | |

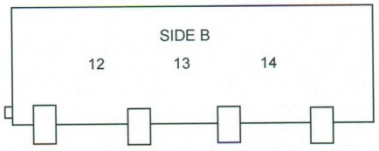
2. Tank Cleaning and Purging

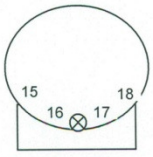
Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

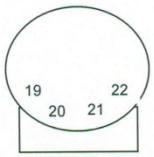
3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




HEAD A




HEAD B

Tank ID: 23D

4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.27 | x | x | x | x |
| 2 | 0.245 | x | x | x | x |
| 3 | 0.277 | x | x | x | x |
| 4 | 0.299 | x | x | x | x |
| 5 | 0.262 | x | x | x | x |
| 6 | 0.272 | x | x | x | x |
| 7 | 0.29 | x | x | x | x |
| 8 | 0.298 | x | x | x | x |
| 9 | x | 0.314 | x | x | x |
| 10 | x | 0.312 | x | x | x |
| 11 | x | 0.301 | x | x | x |
| 12 | x | x | 0.296 | x | x |
| 13 | x | x | 0.266 | x | x |
| 14 | x | x | 0.294 | x | x |
| 15 | x | x | x | 0.248 | x |
| 16 | x | x | x | 0.25 | x |
| 17 | x | x | x | 0.257 | x |
| 18 | x | x | x | 0.25 | x |
| 19 | x | x | x | x | 0.251 |
| 20 | x | x | x | x | 0.248 |
| 21 | x | x | x | x | 0.353 |
| 22 | x | x | x | x | 0.268 |

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BMI Job # 2702 -D

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.* | *-4 spots per head (min 2 at bottom edge)* |
| *Max. general metal loss - tkns. to meet S601 min. rqmt.* | *-6 spots on bottom longitudinals* |
| *Max. dent depth - 35mm* | *-4 spots on each saddle contact area from inside* |
| *Max. dent angle - 30 deg.* | *-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank shows extreme corrosion on tank bottom.Blistering of paint along tank has water trapped between paint & tank, therefore external corrosion evident & likely.

It is suggested that tank to be sandblasted, primed and painted to alleviate further corrosion if the tanks are to remain in service.

Several of tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

9. BMI Sign Off

Report completed by: Rod Cable Date: Aug. 13/10

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BMI Job # 2702-E

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

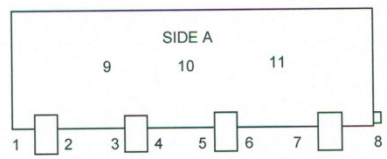
| | | | |
|---|---|---|---|
| Tank Manufacturer: | unknown | | |
| Capacity (L): | 68,190 | Shell Thickness (mm): | unknown |
| Label Serial No.: | unknown | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | 1974 |
| Inspection Location: | St.Lewis Labrador | | |
| Destination: | | | |

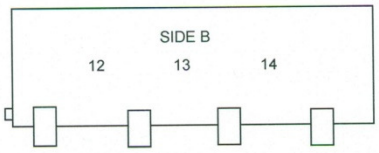
2. Tank Cleaning and Purging

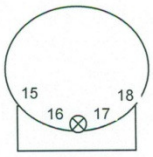
Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

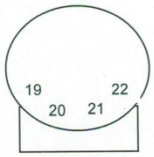
3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




HEAD A




HEAD B

Tank ID: 23E

4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.24 | x | x | x | x |
| 2 | 0.285 | x | x | x | x |
| 3 | 0.275 | x | x | x | x |
| 4 | 0.26 | x | x | x | x |
| 5 | 0.263 | x | x | x | x |
| 6 | 0.294 | x | x | x | x |
| 7 | 0.262 | x | x | x | x |
| 8 | 0.263 | x | x | x | x |
| 9 | x | 0.274 | x | x | x |
| 10 | x | 0.281 | x | x | x |
| 11 | x | 0.274 | x | x | x |
| 12 | x | x | 0.269 | x | x |
| 13 | x | x | 0.275 | x | x |
| 14 | x | x | 0.268 | x | x |
| 15 | x | x | x | 0.251 | x |
| 16 | x | x | x | 0.249 | x |
| 17 | x | x | x | 0.247 | x |
| 18 | x | x | x | 0.25 | x |
| 19 | x | x | x | x | 0.247 |
| 20 | x | x | x | x | 0.247 |
| 21 | x | x | x | x | 0.354 |
| 22 | x | x | x | x | 0.248 |

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BMI Job # 2702-E

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.* | *-4 spots per head (min 2 at bottom edge)* |
| *Max. general metal loss - tkns. to meet S601 min. rqmt.* | *-6 spots on bottom longitudinals* |
| *Max. dent depth - 35mm* | *-4 spots on each saddle contact area from inside* |
| *Max. dent angle - 30 deg.* | *-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank shows extreme corrosion on tank bottom.Blistering of paint along tank has water trapped between paint & tank, therefore external corrosion evident & likely.

It is suggested that tank to be sandblasted, primed and painted to alleviate further corrosion if the tanks are to remain in service.

Several of tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

9. BMI Sign Off

Report completed by: Rod Cable Date: Aug. 13/10

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BMI Job # 2702-F

# S601 Tank Inspection Report

*ref. document BMI-WI-102*

1. Tank and Label Information *(record or attach photo or rubbing of label)*

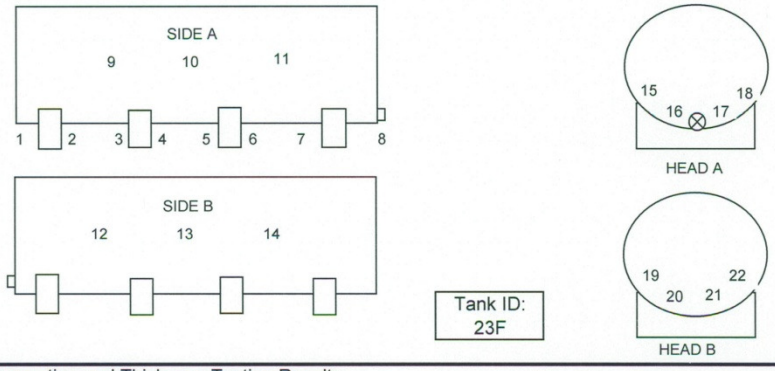
| | | | |
|---|---|---|---|
| Tank Manufacturer: | McNamara Industries | | |
| Capacity (L): | 68,190 | Shell Thickness (mm): | unknown |
| Label Serial No.: | MON1028 | Head Thickness (mm): | unknown |
| Owner/Customer: | NL Hydro | Year of Mfg.: | 1974 |
| Inspection Location: | St.Lewis Labrador | | |
| Destination: | | | |

2. Tank Cleaning and Purging

Tank cleaning and purging of vapours has been completed by: N/A

Copy of the report/certificate is attached if available (initials verifying acceptance):

3. General Arrangement Sketch of Tank *(Show overall dimensions, location of all fittings and attachments)*




4. Exterior Inspection and Thickness Testing Results

*(Number observations and mark corresponding locations on the sketch. Mark all areas on the tank.)*

Test Results:

| Marking #: | Bottom | Side A | Side B | Head A | Head B |
|---|---|---|---|---|---|
| 1 | 0.245 | x | x | x | x |
| 2 | 0.229 | x | x | x | x |
| 3 | 0.272 | x | x | x | x |
| 4 | 0.24 | x | x | x | x |
| 5 | 0.244 | x | x | x | x |
| 6 | 0.221 | x | x | x | x |
| 7 | 0.226 | x | x | x | x |
| 8 | 0.201 | x | x | x | x |
| 9 | x | 0.216 | x | x | x |
| 10 | x | 0.29 | x | x | x |
| 11 | x | 0.249 | x | x | x |
| 12 | x | x | 0.305 | x | x |
| 13 | x | x | 0.316 | x | x |
| 14 | x | x | 0.296 | x | x |
| 15 | x | x | x | 0.251 | x |
| 16 | x | x | x | 0.253 | x |
| 17 | x | x | x | 0.248 | x |
| 18 | x | x | x | 0.251 | x |
| 19 | x | x | x | x | 0.252 |
| 20 | x | x | x | x | 0.254 |
| 21 | x | x | x | x | 0.253 |
| 22 | x | x | x | x | 0.256 |

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BMI Job # 2702-F

| Criteria | General Thickness Survey *(from inside or outside)* |
|---|---|
| *Max. pitting - lesser of 3mm or 50% of orig. tkns.* | *-4 spots per head (min 2 at bottom edge)* |
| *Max. general metal loss - tkns. to meet S601 min. rqmt.* | *-6 spots on bottom longitudinals* |
| *Max. dent depth - 35mm* | *-4 spots on each saddle contact area from inside* |
| *Max. dent angle - 30 deg.* | *-areas of suspected general metal loss* |

5. Internal Inspection and Thickness Testing Results (if applicable)

*(Performed after cleaning. Number observations and mark corresponding locations on the sketch. Mark all areas on the tank. Criteria same as required for exterior inspection.)*

Test Results:

| Marking #: | Saddle A | Saddle B |
|---|---|---|
| 1 | N/A | N/A |
| 2 | N/A | N/A |
| 3 | N/A | N/A |
| 4 | N/A | N/A |

Note: Saddle tests were taken along the interior length of the saddle at equal distances.

6. ULC S601 Compliance Assessment

Year of S601 referenced: 2007

| | Acceptable? | Modification Required |
|---|---|---|
| Head Thickness | 0.264 | |
| Shell Thickness | 0.264 | |
| Lifting Lugs | Y | |
| Fittings/Connections | Y | |
| Venting | Y | |
| Manways | Y | |
| Weld Seams | N/A | |
| Overfill Protection | N/A | |
| Spill Containment | Y | |

*Additional Notes/Details*

7. Decision to Refurbish (if required)

*(Decision by owner based upon inspection and cost estimate.)*

Proceed with refurbishment (circle one)? Yes No Initial:

8. Details of Inspection (ie. findings, notes, suggested modifications & repairs):

Tank shows extreme corrosion on tank bottom.Blistering of paint along tank has water trapped between paint & tank, therefore external corrosion evident & likely.

It is suggested that tank to be sandblasted, primed and painted to alleviate further corrosion if the tanks are to remain in service.

Several of tank metal thickness readings are below the Standard requirements. Also, it must be noted that an internal inspection was not performed, therefore internal corrosion and pitting can not be confirmed. If tanks remain in service an internal inspection is strongly recommended, as internal corrosion seems likely.

9. BMI Sign Off

Report completed by: Rod Cahill Date: Aug. 13/10

Rev. 0 - 1 Feb. 2006 Page 2 of 2 BMI Form WI-102-1

**Project Title:** Replace Instrument Transformers

**Location:** Various Stations

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Other

**Classification:** Mandatory

Project Description

This project is part of an on-going program to replace instrument transformers in the Island Interconnected System. The project involves the purchase and installation of instrument transformers (potential transformers and current transformers) at various terminal stations as maintenance assessments dictate or if failure occurs. Also included in this replacement program are instrument transformers that are determined to be noncompliant with poly chlorinated biphenyls regulations "PCB Regulations SOR/2008-273" (see Appendix B), which require that all equipment with PCB levels greater than 50 mg/kg be taken out of service by 2025. Appendix A provides the list of planned instrument transformer replacements for 2012. This plan is subject to change depending on unforeseen equipment failures that could take priority over planned replacements and operational constraints in scheduling outages. As a result, instrument transformers identified may be deferred to another year and new units added for 2012.

The current project estimate is based on replacing 20 units due to PCB contamination, five units due to condition and three due to age. The age of the 2012 replacements is unknown. In previous budget proposals, only condition and age replacements were considered in the costs for instrument transformers. The project estimate is increased from the 2011 budget estimate in order to accommodate the replacement of instrument transformers suspected to contain PCB levels greater than 50 mg/kg starting in 2012.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 260.0 | 0.0 | 0.0 | 260.0 |
| **Labour** | 116.0 | 0.0 | 0.0 | 116.0 |
| **Consultant** | 17.4 | 0.0 | 0.0 | 17.4 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 20.7 | 0.0 | 0.0 | 20.7 |
| **Contingency** | 38.3 | 0.0 | 0.0 | 38.3 |
| **TOTAL** | **452.4** | **0.0** | **0.0** | **452.4** |

Existing System

Hydro owns approximately 900 instrument transformers on the Island Interconnected System critical to maintaining reliable system operations. Approximately 60 percent of the existing instrument transformers have seen approximately 40 years of service. Units are inspected and tested every 120 days and replaced based on maintenance assessments or in-service failures. The maintenance assessments for instrument transformers include visual inspection and voltage/current checks of the secondary circuits. Of the 900 units, there are 300 instrument transformers, at various voltage classes, that have been identified to contain an unknown quantity of PCBs and as a result have been targeted for replacement. These units typically date back to the 1960's and 1970's when manufacturers were using insulating oil that contained PCBs.

Age of Equipment or System

The instrument transformers on the Island Interconnected System range in age from one to 40 years. The majority of transformers targeted for replacement under this project were manufactured in the late 1960's and 1970's.

Major Work/or Upgrades

There has been no major work or upgrades on terminal station instrument transformers since they were originally installed. Replacements have been made as failures occurred or as a part of the instrument transformer replacement program in which instrument transformers were replaced based on maintenance assessments.

Table 2 shows the instrument transformers that were replaced in the last five years.

**Table 2: Instrument Transformer Replacements**

| Year | Terminal Station Location | Unit Identification |
|---|---|---|
| 2010 | Bay d'Espoir | B9L34 CT, phase C |
| | L'Anse au Loup | LL1-R3 PT |
| | Grand Falls Frequency Converter | T2 PT phases A and B |
| | Western Avalon | B4 PT phases A and C |
| | Holyrood | B1B11 CT phases A,B and C |
| | Oxen Pond | B2 PT phases A,B and C |
| | Stephenville | 405L PT phases A,B and C |
| 2009 | Western Avalon | B4 PT phase B |
| | Bay d'Espoir | B1T2 CT phase B |
| | Hardwoods | B7 PT phases A,B and C |
| | Massey Drive | B1 PT phases A and C |
| 2008 | Bear Cove | TL244 PT phases A and C |
| | Bear Cove | TL256 PT phases B and C |
| | Berry Hill | T1 Secondary PT phase B |
| 2007 | Oxen Pond | T2 PT phases B and C |
| | Bay d'Espoir | B9L34 CT phases A and B |
| | Howley | TL251 PT phase C |
| | Massey Drive | B1L28 CT phase B |
| 2006 | Bottom Brook | 400L PT phases A and C |
| | Cow Head | B1 PT phase C |
| | Cow Head | TL227 PT phase C |
| | Hawke's Bay | B1 PT phases A,B and C |

Anticipated Useful life

Instrument transformers have a typical service life of 30 to 40 years depending on the service environment.

Maintenance History

Normal maintenance for instrument transformers is to replace them upon failure or as maintenance assessments dictate. Table 3 shows the history of maintenance costs for instrument transformers for the period 2006 to 2010.

**Table 3: Five-Year Maintenance History**

| Year | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($ 000) |
|---|---|---|---|
| 2010 | 13.1 | 23.7 | 36.8 |
| 2009 | 28.6 | 65.9 | 94.5 |
| 2008 | 58.9 | 42.5 | 101.4 |
| 2007 | 13.8 | 51.6 | 65.4 |
| 2006 | 60.8 | 18.6 | 79.4 |

The variability in maintenance costs depends on the operating environment of the transformers.

Outage Statistics

Hydro tracks all system outages using industry standard indices System Average Interruption Frequency Index (SAIFI), and System Average Interruption Duration Index (SAIDI). SAIDI and SAIFI are explained as follows:

SAIDI - Indicates the system average interruption duration for customers served per year, or the average length of time a customer is without power in the respective distribution system per year.

SAIFI - Indicates the average of sustained interruptions per customer served per year, or the average number of power outages a customer has experienced in the respective distribution system per year.

Table 4 lists the 2006 to 2010 system average transmission T-SAIFI and T-SAIDI data and the latest Canadian Energy Association (CEA) five year averages (2005 to 2009).

**Table 4: SAIFI/SAIDI Average**

| **Five Year Averages** | | |
|---|---|---|
| | **T-SAIFI** | **T-SAIDI** |
| Hydro System (2006-2010) | 1.08 | 56.07 |
| CEA (2005-2009) | 0.73 | 70.72 |

The statistics do not relate directly to instrument transformer failures but they include instrument transformer and other station equipment failures at the delivery point.

Industry Experience

Hydro, like other Canadian utilities, has aging instrument transformers that are highly corroded with potential for leaking oil that necessitates replacement. Replacements are also required to comply with federal PCB regulations.

Maintenance or Support Arrangements

Normal operation and maintenance work is performed by Hydro personnel. Inspections of terminal stations are done every 120 days during which instrument transformers are visually inspected and voltage/current checks are performed on the secondary circuits. Every six years, during planned outages, each instrument transformer is tested to check the integrity of the high voltage insulation. As this maintenance is performed using internal forces, there is no outside maintenance or support arrangement.

Vendor Recommendations

Vendors, Trench and ABB, recommend replacement of the old instrument transformers after 30 to 40 years of service.

Availability of Replacement Parts

Replacement instrument transformers generally have a delivery period of eight to ten weeks. However, long delivery times may occur depending on the market conditions. Existing transformers do not have parts that can be replaced.

Safety Performance

Instrument transformers do not tend to fail slowly, and in some cases can fail violently. In June 2010 Hydro experienced a failure of a 230 kV ASEA current transformer (CT), manufactured in 1969, at Holyrood Terminal Station that resulted in large pieces of porcelain being projected 50 meters from the original location of the CT. No one was injured in this incident but it had a high potential for serious injury if a person had been in the vicinity of the CT at the time of the explosion.

Environmental Performance

Prior to the early 1980's, many manufacturers of instrument transformers used PCBs in insulating oil. The concentration levels of PCBs vary by manufacturer and also vary within manufacturer by year. This is important in reviewing the latest PCB regulations (Appendix B) as issued by Environment Canada. The regulation in 2009 stated that all equipment containing PCB levels of greater than 500 mg/kg PCB had to be removed by the end of 2009 and any equipment containing greater than 50 mg/kg PCB had to be removed by 2025. The regulations also gave utilities an option to apply for an extension until 2014 to have all equipment containing greater than 500 mg/kg removed. Hydro, like other CEA members, has a significant amount of sealed equipment with unknown levels of PCB. As a result, Hydro applied for and was granted an extension in 2010 and has completed one year of the documented replacement plan, (see Appendix C). Within Hydro's application document it stated that due to the volume of equipment requiring replacement, the plan was a pro forma plan and a more realistic plan would be to extend the replacement to 2025. All CEA members, including Hydro, are actively pursuing this extension. If the extension is not granted, the capital investment required for instrument transformers would be increased significantly for 2013 and 2014. Details of the instrument transformers on Hydro's system that are suspect to contain greater than 500 mg/kg PCB can be found in Appendix C titled "Extension of December 31, 2009 End-Of-Use Date For Equipment And Liquids Containing PCBs Granted Under Subsection 17(2) of the *PCB Regulations"* dated August 23, 2010.

Operating Regime

Instrument transformers operate on a continuous basis.

**Justification:**

Instrument transformers provide critical inputs to protection, control and metering equipment required for the reliable operation and protection of the electrical system. Instrument transformers which fail in-service can result in faults on the electrical system and outages to customers.

The key drivers for the replacement of instrument transformers are as follows:

1. In order for Hydro to meet the latest PCB regulations, 300 sealed units of unknown PCB concentration must be tested for compliance with the PCB regulations. The options available to

determine this are to either sample each unit to obtain the PCB concentration or to replace the units. Sampling is not a practical option due to the duration of outage required, the resources required, and the fact that sampling could increase the probability of failure. Instrument transformers are sealed oil filled units and are not designed for oil testing. Sampling instrument transformers increases the risk of introducing impurities (dirt, water, air) to the oil, increasing the probability of failure. To reduce this risk, specific vacuum oil filtering equipment is used to ensure that each unit is placed in service with filtered oil. The process of removing a unit from service, properly filtering the oil, and returning the unit to service is approximately four days, resulting in extended outages to customers. As a result, Hydro has a replacement plan to remove all instrument transformers suspected of containing PCBs by the end of 2025.

2. Condition assessments of instrument transformers warrant replacement if severe corrosion resulting in leaks is evident or the transformer fails a high voltage insulation test.

3. Instrument transformers that have passed the 30 to 40 years expected life need replacement to avoid potential failures as occurred at Holyrood in June 2010 Therefore, a portion of units will be selected for replacement based upon age.

When instrument transformers fail they are not repairable and require replacement. The normal utility practice in North America is to hold a reserve inventory and replace units as they fail. Table 5 shows Hydro's inventory of instrument transformers.

**Table 5: Inventory of Instrument Transformers**

| Voltage Class | Number of Potential Transformers | Number of Current Transformers |
|---|---|---|
| 230 kV | 2 | 4 |
| 138 kV | 2 | 5 |
| 66/69 kV | 3 | 7 |
| 46 kV | 3 | 1 |
| 25 kV | 1 | 1 |
| 4.16 - 15 kV | 2 | 3 |

Net Present Value

A net present value calculation was not performed in this instance as there is no viable alternative to replacing the instrument transformers.

Levelized Cost of Energy

The capital expenditures for this project will not affect the levelized cost of energy for the system because it does not involve any new sources of generation.

Cost Benefit Analysis

A cost benefit analysis is not required for this project as there are no quantifiable benefits.

Legislative or Regulatory Requirements

The latest federal PCB regulations (see Appendix B) state in Section 16 that the end-of-use date for equipment containing PCBs that are above 500 mg/kg was Dec. 31, 2009. If this date could not be met owners are required to apply for an extension until 2014. Hydro has made application and received the extension to 2014. The regulations also state that equipment with PCB concentrations from 50 mg/kg to 499 mg/kg have to be out of service by 2025.

Hydro, through the CEA, is lobbying Environment Canada to have the extension from 2014 extended further to 2025 for sealed equipment such as instrument transformers and bushings. In fact, Hydro's current budget is based upon receiving an extension to 2025. If this extension is not granted, there will be significant increases in the 2013 and 2014 budget.

Historical Information

Table 6 contains the historical information for instrument transformer replacements for the period 2006 to 2010.

**Table 6: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per Unit ($000) |
|---|---|---|---|---|
| 2011F | 199.1 | | | |
| 2010 | 197.0 | 226.6 | 12 | 18.9 |
| 2009 | 106.6 | 128.3 | 8 | 16.0 |
| 2008 | 73.7 | 75.3 | 7 | 10.8 |
| 2007 | 79.7 | 80.1 | 5 | 16.0 |
| 2006 | 78.0 | 81.4 | 8 | 10.2 |

Per unit cost varies year to year depending on the voltage class of the instrument transformers replaced. Each voltage class has a different unit cost, with 230 kV units being higher cost units in relation to 138 kV and 69 kV units as reflected in the 2010 unit costs.

Forecast Customer Growth

The forecast customer load on the system has no affect on this project.

Energy Efficiency Benefits

There are no issues related to energy efficiencies associated with this project.

Losses during Construction

The replacement of the insulators will be coordinated with the normal outage plans for the system. These outage plans are designed around the system load requirements. Therefore, there will be no production or revenue losses resulting from this project.

Status Quo

The status quo is not an option. The instrument transformers must be replaced to maintain system reliability, a safe working environment, and to conform to new PCB regulations.

Alternatives

There are no viable alternatives to replacing instrument transformers.

**Conclusion:**

Instrument transformers provide critical inputs to protection, control and metering equipment required for the reliable operation and protection of the electrical system. Many instrument transformers on the system have exceeded their useful lives and have been found to have leaks or have to be replaced due to the latest federal PCB regulations. To ensure Hydro is compliant in having all its instrument transformers with a PCB concentration to be less than 50 mg/kg by 2025, Hydro must replace between 15 to 20 units per year. Besides being compliant with federal PCB regulations, there will also be a need to replace an estimated four to six units per year due to their condition and age.

Project Schedule

Table 7 presents the anticipated project schedule.

**Table 7: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Schedules<br>Targeted Replacements | February 2012 | March 2012 |
| Design | Equipment Ordering Tendering | February 2012 | March 2012 |
| Procurement | Equipment Delivery | March 2012 | June 2012 |
| Construction | Equipment Installations<br>Equipment Retirement | June 2012 | November 2012 |
| Commissioning | Equipment in Service | June 2012 | November 2012 |
| Closeout | Project Completion and Closeout | December 2012 | December 2012 |

**APPENDIX A**

**INSTRUMENT TRANSFORMER REPLACEMENTS FOR 2012**

| Terminal Station Location | Voltage Class | Asset Description | Replacement Reason |
|---|---|---|---|
| Berry Hill | 69 kV | PT TL226 Phase B | PCB Reduction |
| Berry Hill | 69 kV | PT TL227 Phase | PCB Reduction |
| Berry Hill | 69 kV | PT T1 SEC Phase B STN SERV | PCB Reduction |
| Deer Lake | 69 kV | PT B2 Phase A | PCB Reduction |
| Deer Lake | 69 kV | PT B2 Phase B | PCB Reduction |
| Deer Lake | 69 kV | PT B2 Phase C | PCB Reduction |
| Oxen Pond | 69 kV | PT T1 Phase B and C | PCB Reduction |
| Western Avalon | 138 kV | PT 64L Phase B PH | PCB Reduction |
| Bay D'Espoir | 230 kV | CT B2B3 Phase A | PCB Reduction |
| Bay D'Espoir | 230 kV | CT B2B3 Phase B | PCB Reduction |
| Bay D'Espoir | 230 kV | CT B2B3 Phase C | PCB Reduction |
| Hardwoods | 69 kV | CT B8B9 Phase A | PCB Reduction |
| Hardwoods | 69 kV | CT B8B9 Phase B | PCB Reduction |
| Hardwoods | 69 kV | CT B8B9 Phase C | PCB Reduction |
| Holyrood | 230 kV | CT B3L18 Phase A | PCB Reduction |
| Holyrood | 230 kV | CT B3L18 Phase B | PCB Reduction |
| Holyrood | 230 kV | CT B3L18 Phase C | PCB Reduction |
| Stony Brook | 138 kV | CT B3T2 Phase A | PCB Reduction |
| Stony Brook | 138 kV | CT B3T2 Phase B | PCB Reduction |
| Stony Brook | 138 kV | CT B3T2 Phase C | PCB Reduction |
| Stony Brook | 230 kV | CT L05L31-1 Phase A | Condition |
| Bear Cove | 69 kV | PT B1 Phase A | Condition |
| Bear Cove | 69 kV | PT B1 Phase B | Condition |
| Bear Cove | 69 kV | PT B1 Phase C | Condition |
| Cat Arm | 230 kV | PT TL247 Phase B | Condition |
| Holyrood | 69 kV | PT B7 Phase A | Age/Condition |
| Holyrood | 69 kV | PT B7 Phase B | Age/Condition |
| Holyrood | 69 kV | PT B7 Phase C | Age/Condition |

**APPENDIX B**

**PCB REGULATIONS**

CANADA

CONSOLIDATION

CODIFICATION

# PCB Regulations

# Règlement sur les BPC

SOR/2008-273

DORS/2008-273

Current to April 19, 2011

À jour au 19 avril 2011

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OFFICIAL STATUS OF CONSOLIDATIONS

Subsections 31(1) and (3) of the *Legislation Revision and Consolidation Act*, in force on June 1, 2009, provide as follows:

Published consolidation is evidence

**31.** (1) Every copy of a consolidated statute or consolidated regulation published by the Minister under this Act in either print or electronic form is evidence of that statute or regulation and of its contents and every copy purporting to be published by the Minister is deemed to be so published, unless the contrary is shown.

...

Inconsistencies in regulations

(3) In the event of an inconsistency between a consolidated regulation published by the Minister under this Act and the original regulation or a subsequent amendment as registered by the Clerk of the Privy Council under the *Statutory Instruments Act*, the original regulation or amendment prevails to the extent of the inconsistency.

CARACTÈRE OFFICIEL DES CODIFICATIONS

Les paragraphes 31(1) et (3) de la *Loi sur la révision et la codification des textes législatifs*, en vigueur le 1er juin 2009, prévoient ce qui suit :

Codifications comme élément de preuve

**31.** (1) Tout exemplaire d'une loi codifiée ou d'un règlement codifié, publié par le ministre en vertu de la présente loi sur support papier ou sur support électronique, fait foi de cette loi ou de ce règlement et de son contenu. Tout exemplaire donné comme publié par le ministre est réputé avoir été ainsi publié, sauf preuve contraire.

[...]

Incompatibilité — règlements

(3) Les dispositions du règlement d'origine avec ses modifications subséquentes enregistrées par le greffier du Conseil privé en vertu de la *Loi sur les textes réglementaires* l'emportent sur les dispositions incompatibles du règlement codifié publié par le ministre en vertu de la présente loi.

Registration
SOR/2008-273 September 5, 2008

CANADIAN ENVIRONMENTAL PROTECTION ACT, 1999

**PCB Regulations**

P.C. 2008-1659 September 5, 2008

Whereas, pursuant to subsection 332(1)[a] of the *Canadian Environmental Protection Act, 1999*[b], the Minister of the Environment published in the *Canada Gazette*, Part I, November 4, 2006, a copy of the proposed *PCB Regulations*, substantially in the annexed form, and persons were given an opportunity to file comments with respect to the proposed Regulations or to file a notice of objection requesting that a board of review be established and stating the reasons for the objection;

Whereas, pursuant to subsection 93(3) of that Act, the National Advisory Committee has been given an opportunity to provide its advice under section 6[c] of that Act;

And whereas, in the opinion of the Governor in Council, pursuant to subsection 93(4) of that Act, the proposed Regulations do not regulate an aspect of a substance that is regulated by or under any other Act of Parliament in a manner that provides, in the opinion of the Governor in Council, sufficient protection to the environment and human health;

Therefore, Her Excellency the Governor General in Council, on the recommendation of the Minister of the Environment and the Minister of Health, pursuant to subsection 93(1) and section 97 of the *Canadian Environmental Protection Act, 1999*[b], hereby makes the annexed *PCB Regulations*.

[a] S.C. 2004, c. 15, s. 31
[b] S.C. 1999, c. 33
[c] S.C. 2002, c. 7, s. 124

Enregistrement
DORS/2008-273 Le 5 septembre 2008

LOI CANADIENNE SUR LA PROTECTION DE L'ENVIRONNEMENT (1999)

**Règlement sur les BPC**

C.P. 2008-1659 Le 5 septembre 2008

Attendu que, conformément au paragraphe 332(1)[a] de la *Loi canadienne sur la protection de l'environnement (1999)*[b], le ministre de l'Environnement a fait publier dans la *Gazette du Canada* Partie I, le 4 novembre 2006, le projet de règlement intitulé *Règlement sur les BPC*, conforme en substance au texte ci-après, et que les intéressés ont ainsi eu la possibilité de présenter leurs observations à cet égard ou un avis d'opposition motivé demandant la constitution d'une commission de révision;

Attendu que, conformément au paragraphe 93(3) de cette loi, le comité consultatif national s'est vu accorder la possibilité de formuler ses conseils dans le cadre de l'article 6[c] de celle-ci;

Attendu que la gouverneure en conseil est d'avis que, aux termes du paragraphe 93(4) de cette loi, le projet de règlement ne vise pas un point déjà réglementé sous le régime d'une autre loi fédérale de manière à offrir une protection suffisante pour l'environnement et la santé humaine,

À ces causes, sur recommandation du ministre de l'Environnement et du ministre de la Santé et en vertu du paragraphe 93(1) et de l'article 97 de la *Loi canadienne sur la protection de l'environnement (1999)*[b], Son Excellence la Gouverneure générale en conseil prend le *Règlement sur les BPC*, ci-après.

[a] L.C. 2004, ch. 15, art. 31
[b] L.C. 1999, ch. 33
[c] L.C. 2002, ch. 7, art. 124

PCB REGULATIONS

PART 1

GENERAL

Definitions

**1.** (1) The following definitions apply in these Regulations.

"Act" « *Loi* »

"Act" means the *Canadian Environmental Protection Act, 1999*.

"authorized facility" « *installation agréée* »

"authorized facility" means a facility, including a transfer site, that is authorized by the authorities of the jurisdiction in which it is located to process PCBs or products containing PCBs or to conduct laboratory analysis or research with PCBs or products containing PCBs.

"National Fire Code" « *Code national de prévention des incendies* »

"National Fire Code" means the National Fire Code of Canada 2005, NRCC No. 47667, issued by the Canadian Commission on Building and Fire Codes, National Research Council of Canada, as amended from time to time.

"PCB" « *BPC* »

"PCB" means any chlorobiphenyl described in item 1 of the List of Toxic Substances in Schedule 1 to the Act.

"process" « *transformer* »

"process" includes to mix with a product.

"product" « *produit* »

"product" includes equipment.

Concentration — several matrices

(2) For the purposes of these Regulations, if a solid or a liquid containing PCBs is composed of several matrices, the concentration of PCBs is based on the mass of the matrix in which the PCBs are located.

Concentration and quantity

(3) For the purposes of these Regulations, the concentration and quantity of PCBs shall be determined

(*a*) by a laboratory

RÈGLEMENT SUR LES BPC

PARTIE 1

GÉNÉRALITÉS

Définitions

**1.** (1) Les définitions qui suivent s'appliquent au présent règlement.

« BPC » "*PCB*"

«BPC» Tout biphényle chloré visé à l'article 1 de la liste des substances toxiques de l'annexe 1 de la Loi.

« Code national de prévention des incendies » "*National Fire Code*"

«Code national de prévention des incendies» Le *Code national de prévention des incendies — Canada 2005*, CNRC 47667F, avec ses modifications successives, publié par la Commission canadienne des codes du bâtiment et de prévention des incendies du Conseil national de recherches du Canada.

« installation agréée » "*authorized facility*"

«installation agréée» Installation — notamment un centre de transfert — qui est autorisée par les autorités de la province ou du territoire où elle est située à transformer des BPC ou des produits qui en contiennent, ou à les utiliser pour des analyses de laboratoire ou des recherches.

« Loi » "*Act*"

«Loi» La *Loi canadienne sur la protection de l'environnement (1999)*.

« produit » "*product*"

«produit» S'entend notamment d'une pièce d'équipement.

« transformer » "*process*"

«transformer» S'entend notamment du fait de mélanger avec tout produit.

Concentration — plusieurs matrices

(2) Pour l'application du présent règlement, lorsqu'un solide ou un liquide qui contient des BPC est composé de plusieurs matrices, la concentration de BPC est basée sur la masse de la matrice dans laquelle les BPC se trouvent.

Concentration et quantité

(3) Pour l'application du présent règlement, la concentration et la quantité de BPC sont déterminées :

*a*) soit par tout laboratoire :

(i) accredited by the Standards Council of Canada (SCC), the Canadian Association for Environmental Analytical Laboratories Inc. (CAEAL), or any other accreditation body that is a signatory to the *International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement*, and the laboratory shall be accredited in accordance with the International Organization for Standardization standard ISO/IEC 17025:2005 entitled *General Requirements for the Competence of Testing and Calibration Laboratories*, as amended from time to time, and

(ii) for which the scope of accreditation shall include the analytical method used to determine the concentration of PCBs in the matrix in which the PCBs are located; or

(*b*) by a laboratory

(i) accredited in accordance with the *Environmental Quality Act*, R.S.Q., c. Q-2, as amended from time to time, and

(ii) for which the scope of accreditation shall include the analytical method used to determine the concentration of PCBs in the matrix in which the PCBs are located.

(i) qui est accrédité à la norme de l'Organisation internationale de normalisation intitulée *Exigences générales concernant la compétence des laboratoires d'étalonnages et d'essais* (ISO/IEC 17025:2005), avec ses modifications successives, par le Conseil canadien des normes (CCN), l'Association canadienne des laboratoires d'analyse environnementale (ACLAE) ou tout autre organisme d'accréditation signataire de l'*International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement*,

(ii) dont la portée d'accréditation couvre la méthode d'analyse utilisée pour déterminer la concentration des BPC dans la matrice dans laquelle les BPC se trouvent;

*b*) soit par tout laboratoire :

(i) qui est accrédité conformément à la *Loi sur la qualité de l'environnement*, L.R.Q., ch. Q-2, avec ses modifications successives,

(ii) dont la portée d'accréditation couvre la méthode d'analyse utilisée pour déterminer la concentration des BPC dans la matrice dans laquelle se trouvent les BPC.

Sampling method

(4) For the purposes of these Regulations, other than section 13, the concentration of PCBs in a matrix is determined using a provincially, nationally or internationally recognized sampling method for PCBs in the matrix in which the PCBs are located.

Méthode d'échantillonnage

(4) Pour l'application du présent règlement, sauf l'article 13, la concentration de BPC se trouvant dans une matrice est déterminée au moyen de toute méthode d'échantillonnage pour les BPC dans cette matrice qui est reconnue à l'échelle provinciale, nationale ou internationale.

Sampling method — bulk solid products

(5) For the purposes of section 13, the concentration of PCBs is determined using

Méthode d'échantillonnage — produits solides en vrac

(5) Pour l'application de l'article 13, la concentration de BPC est déterminée au

a sampling method for bulk solid products, which is set out in either federal or provincial legislation, as amended from time to time, or approved by the United States Environmental Protection Agency for compliance with the *Resource Conservation and Recovery Act* or with the regulations made under that Act, as amended from time to time.

SOR/2010-57, ss. 1(F), 20(F).

moyen de toute méthode d'échantillonnage pour les produits solides en vrac qui est prévue par une loi ou un règlement fédéral ou provincial, avec ses modifications successives, ou qui est approuvée par la United States Environmental Protection Agency pour l'application de la loi des États-Unis intitulée *Resource Conservation and Recovery Act* ou de ses règlements avec leurs modifications successives.

DORS/2010-57, art. 1(F) et 20(F).

Application

**2.** (1) These Regulations apply to PCBs and to any products containing PCBs.

Application

**2.** (1) Le présent règlement s'applique aux BPC et à tout produit qui en contient.

Non-application

(2) These Regulations do not apply to the following:

Exclusion

(2) Il ne s'applique toutefois pas aux activités suivantes :

(*a*) the export and import of PCBs that are hazardous waste or hazardous recyclable material within the meaning of the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* or the export of PCBs that are waste within the meaning of the *PCB Waste Export Regulations, 1996*;

*a*) l'exportation et l'importation de BPC qui sont des déchets dangereux ou des matières recyclables dangereuses au sens du *Règlement sur l'exportation et l'importation de déchets dangereux et de matières recyclables dangereuses* et l'exportation de déchets contenant des BPC au sens du *Règlement sur l'exportation de déchets contenant des BPC (1996)*;

(*b*) the sale, importation or advertising of liquids containing PCBs for use in microscopy, including immersion oils, but not including refractive index oils, which is prohibited under section 4 of the *Hazardous Products Act*; and

*b*) la vente, l'importation ou la publicité des liquides pour usage en microscopie qui contiennent des BPC, y compris les huiles à immersion mais à l'exclusion des huiles à indice de réfraction, interdites par l'article 4 de la *Loi sur les produits dangereux*;

(*c*) the offer for sale, sale and use of land contaminated with PCBs or with products containing PCBs.

*c*) la mise en vente, la vente et l'utilisation de terrains contaminés par des BPC ou des produits qui en contiennent.

Sale of property

**3.** Nothing in these Regulations shall be construed as preventing the sale of

Vente de biens

**3.** Le présent règlement n'a pas pour effet d'empêcher la vente des biens suivants :

(*a*) personal property or movables that contain PCBs, or real property or immovables that have PCBs or products

*a*) tout bien meuble ou personnel qui contient des BPC ou tout bien immeuble ou réel où se trouvent des BPC ou des

containing PCBs, and that form part of the sale of the whole or part of a business, including a manufacturing or a processing business;

(*b*) real property or immovables that have products containing PCBs if the products continue to be used after the sale for the same purpose at the same place and are an integral part of the property or immovable; or

(*c*) real property or immovables on which a PCB storage site is located.

produits qui en contiennent, lesquels biens sont compris dans la vente de tout ou partie d'une entreprise, y compris une entreprise de fabrication ou de transformation;

*b*) tout bien immeuble ou réel dont font partie intégrante les produits qui contiennent des BPC qui s'y trouvent, si les produits continuent d'être utilisés aux mêmes fins et au même endroit après la vente;

*c*) tout bien immeuble ou réel où se trouve un dépôt de BPC.

Compliance

**4.** In addition to the persons who must comply with the requirements set out in these Regulations, a person who owns PCBs or products containing PCBs shall ensure that the requirements of these Regulations with respect to those PCBs or products are met.

Conformité

**4.** En plus des personnes auxquelles il incombe des obligations en vertu du présent règlement, le propriétaire de BPC ou de produits qui en contiennent veille à ce que les exigences du présent règlement concernant ces BPC ou produits soient remplies.

## PART 2

## PROHIBITIONS AND PERMITTED ACTIVITIES

## PARTIE 2

## INTERDICTIONS ET ACTIVITÉS PERMISES

### Prohibitions

### Interdictions

Release into the environment

**5.** (1) No person shall release PCBs into the environment, other than from the equipment referred to in subsection (2), in a concentration of

(*a*) 2 mg/kg or more for a liquid containing PCBs; or

(*b*) 50 mg/kg or more for a solid containing PCBs.

Rejet dans l'environnement

**5.** (1) Il est interdit de rejeter dans l'environnement, autrement qu'à partir d'une pièce d'équipement visée au paragraphe (2), des BPC de l'une ou l'autre des concentrations suivantes :

*a*) dans le cas d'un liquide qui contient des BPC, une concentration égale ou supérieure à 2 mg/kg;

*b*) dans le cas d'un solide qui contient des BPC, une concentration égale ou supérieure à 50 mg/kg.

Release from equipment

(2) No person shall release more than one gram of PCBs into the environment from equipment referred to in section 16

Rejet à partir d'une pièce d'équipement

(2) Il est interdit de rejeter plus d'un gramme de BPC dans l'environnement à partir d'une pièce d'équipement visée à

that is in use or from equipment in use for which an extension has been granted under section 17.

l'article 16 qui est en usage ou d'une pièce d'équipement dont l'usage fait l'objet d'une prolongation en vertu de l'article 17 et qui est en usage.

Prohibited activities

**6.** Except as provided in these Regulations, no person shall

(*a*) manufacture, export or import PCBs or a product containing PCBs in a concentration of 2 mg/kg or more;

(*b*) offer for sale or sell PCBs or a product containing PCBs in a concentration of 50 mg/kg or more; or

(*c*) process or use PCBs or a product containing PCBs.

Activités interdites

**6.** Sauf dans la mesure prévue par le présent règlement, il est interdit :

*a*) de fabriquer, d'exporter ou d'importer des BPC ou tout produit qui en contient en une concentration égale ou supérieure à 2 mg/kg;

*b*) de mettre en vente ou de vendre des BPC ou tout produit qui en contient en une concentration égale ou supérieure à 50 mg/kg;

*c*) de transformer ou d'utiliser des BPC ou tout produit qui en contient.

PERMITTED ACTIVITIES

ACTIVITÉS PERMISES

Laboratory analysis

**7.** A person may manufacture, export, import, offer for sale, sell, process and use PCBs or products containing PCBs for the purpose of laboratory analysis if the analysis is conducted

(*a*) in an authorized facility that is authorized for that purpose; or

(*b*) in a facility that conforms to internationally recognized guidelines on best laboratory practices, if the authorities of the jurisdiction in which the facility is located do not have a mechanism in place to authorize the facility to conduct the analysis.

SOR/2010-57, s. 20(F).

Analyses de laboratoire

**7.** Il est permis de fabriquer, d'exporter, d'importer, de mettre en vente, de vendre, de transformer et d'utiliser des BPC et des produits qui en contiennent pour des analyses de laboratoire, si celles-ci sont effectuées :

*a*) dans toute installation agréée à cette fin;

*b*) dans le cas où les autorités de la province ou du territoire où elle est située ne disposent d'aucun mécanisme l'autorisant à les effectuer, dans toute installation qui est conforme à des lignes directrices, reconnues à l'échelle internationale, sur les pratiques exemplaires en laboratoire.

DORS/2010-57, art. 20(F).

Research

**8.** (1) A person may offer for sale or sell PCBs or products containing PCBs to be processed or used for the purpose of research to determine the effects of those PCBs or products on human health or on

Recherches

**8.** (1) Il est permis de mettre en vente ou de vendre des BPC ou des produits qui en contiennent pour qu'ils soient utilisés ou transformés à des fins de recherche visant à déterminer les effets des BPC ou des pro-

the environment, if the facility in which they are processed or used is

(*a*) an authorized facility that is authorized for that purpose; or

(*b*) a facility that conforms to internationally recognized guidelines on best laboratory practices, if the authorities of the jurisdiction in which the facility is located do not have a mechanism in place to authorize the facility to conduct the research.

duits sur la santé humaine ou l'environnement, si l'installation où ils sont utilisés ou transformés se conforme à l'une ou l'autre des exigences suivantes :

*a*) elle est agréée à cette fin;

*b*) dans le cas où les autorités de la province ou du territoire où elle est située ne disposent d'aucun mécanisme l'autorisant à effectuer des recherches, elle est conforme à des lignes directrices, reconnues à l'échelle internationale, sur les pratiques exemplaires en laboratoire.

Processing and use

(2) A person may process and use the PCBs or products containing PCBs for the purpose of the research referred to in subsection (1) at a facility that meets the requirement set out in paragraph (1)(*a*) or (*b*).

SOR/2010-57, s. 20(F).

Transformation et utilisation

(2) Il est permis de transformer et d'utiliser des BPC et des produits qui en contiennent pour effectuer les recherches visées au paragraphe (1) dans une installation qui se conforme à l'une ou l'autre des exigences prévues à ce paragraphe.

DORS/2010-57, art. 20(F).

Electrical capacitor

**9.** A person may offer for sale, sell and use an electrical capacitor containing PCBs if the electrical capacitor

(*a*) is an integral part of a consumer product;

(*b*) is fusion sealed; and

(*c*) would be rendered inoperable and irreparable if the PCBs were removed from it.

Condensateurs électriques

**9.** Il est permis de mettre en vente, de vendre et d'utiliser tout condensateur électrique qui contient des BPC, si les conditions suivantes sont réunies :

*a*) il fait partie intégrante d'un produit de consommation;

*b*) ses joints sont thermoscellés;

*c*) il ne fonctionnerait plus et serait irréparable si les BPC en étaient extraits.

Aircraft, ships, trains and other vehicles

**10.** A person may export, import, offer for sale, sell and use for transportation purposes aircraft, ships, trains and other vehicles that contain PCBs only in their communication, navigation or electronic control equipment or cables.

Aéronefs, navires, trains et autres véhicules

**10.** Il est permis d'exporter, d'importer, de mettre en vente, de vendre et d'utiliser pour le transport, tout aéronef, navire, train ou autre véhicule dont seuls l'équipement de communication, de navigation ou de commande électronique ou les câbles contiennent des BPC.

Colouring pigment

**11.** (1) A person may manufacture, export, import, offer for sale, sell, process and use a colouring pigment containing

Pigments pour la coloration

**11.** (1) Il est permis de fabriquer, d'exporter, d'importer, de mettre en vente, de vendre, de transformer et d'utiliser des pigments pour la coloration qui contiennent

PCBs produced incidentally if the concentration of the PCBs is less than 50 mg/kg.

des BPC produits par inadvertance en une concentration inférieure à 50 mg/kg.

Annual average concentration

(2) Despite subsection (1), the annual average concentration of PCBs produced incidentally in colouring pigment that a person may manufacture, export, import, offer for sale, sell, process and use shall not exceed 25 mg/kg.

SOR/2010-57, s. 2(F).

(2) Toutefois, la concentration moyenne annuelle de BPC produits par inadvertance dans les pigments pour la coloration fabriqués, exportés, importés, mis en vente, vendus, transformés et utilisés par toute personne ne peut dépasser 25 mg/kg.

DORS/2010-57, art. 2(F).

Moyenne annuelle maximale

Destruction

**12.** A person may process PCBs or products containing PCBs for the purpose of destroying PCBs or recovering PCBs for the purpose of destroying them in an authorized facility that is authorized for that purpose.

SOR/2010-57, s. 3(F).

**12.** Il est permis de transformer des BPC et des produits qui en contiennent pour les détruire dans une installation agréée à cette fin ou pour les récupérer afin de les détruire dans une telle installation.

DORS/2010-57, art. 3(F).

Destruction

Solid products

**13.** (1) A person may manufacture solid products containing PCBs in a concentration of less than 50 mg/kg using bulk solid products containing PCBs in a concentration of less than 50 mg/kg, and may use those solid products.

**13.** (1) Il est permis de fabriquer des produits solides qui contiennent des BPC en une concentration inférieure à 50 mg/kg à partir de produits solides en vrac qui eux-mêmes contiennent des BPC en une concentration inférieure à 50 mg/kg et d'utiliser ces produits solides.

Produits solides

Application

(2) Subsection (1) only applies to the manufacture of the types of products that are manufactured before September 5, 2008.

(2) Le paragraphe (1) ne s'applique qu'aux types de produits qui sont fabriqués avant le 5 septembre 2008.

Application

Exception

(3) No person shall offer for sale or sell the products manufactured in accordance with subsection (1) unless the products are used in the course of a commercial or industrial activity.

SOR/2010-57, s. 4.

(3) Il est interdit de mettre en vente ou de vendre des produits fabriqués conformément au paragraphe (1) pour tout usage en dehors d'une activité commerciale ou industrielle.

DORS/2010-57, art. 4.

Exception

Cables, pipelines, electrical capacitors and other equipment

**14.** (1) A person may use the following products containing PCBs:

(*a*) cables, if they remain in place on September 5, 2008;

(*b*) pipelines that transport natural gas, petroleum or petroleum products and any associated equipment that is in con-

**14.** (1) Il est permis d'utiliser les produits ci-après qui contiennent des BPC :

*a*) tout câble, s'il demeure à l'endroit où il se trouvait le 5 septembre 2008;

*b*) tout pipeline qui transporte du gaz naturel, du pétrole ou des produits pétroliers, ainsi que tout équipement connexe

Câbles, pipelines, condensateurs électriques et pièces d'équipements

tact with the natural gas, petroleum or petroleum products if the pipelines and the equipment remain in place on September 5, 2008;

(*c*) fusion sealed capacitors if they are used in relation to communication equipment or electronic control equipment; and

(*d*) the following equipment containing PCBs in a concentration of less than 50 mg/kg if the equipment is used for the purpose for which it was manufactured:

(i) electrical capacitors, light ballasts, electrical transformers and their auxiliary electrical equipment, including pole-top electrical transformers and their pole-top auxiliary electrical equipment,

(ii) electromagnets that are not used in the handling of food, feed or any additive to food or feed, and

(iii) heat transfer equipment, hydraulic equipment, vapour diffusion pumps and bridge bearings.

qui est en contact avec le gaz naturel, le pétrole ou les produits pétroliers, si le pipeline et l'équipement demeurent à l'endroit où ils se trouvaient le 5 septembre 2008;

*c*) tout condensateur électrique dont les joints sont thermoscellés et qui est utilisé à des fins de communication ou de commande électronique;

*d*) les pièces d'équipement ci-après qui contiennent des BPC en une concentration inférieure à 50 mg/kg et qui sont utilisées aux fins auxquelles elles étaient destinées lors de leur fabrication :

(i) les condensateurs électriques, les ballasts de lampes, les transformateurs électriques et tout équipement électrique connexe, y compris les transformateurs sur poteaux et tout équipement électrique connexe sur poteaux,

(ii) les électroaimants ne servant pas à la manutention des aliments destinés aux humains ou aux animaux, ou de tout additif à ces aliments,

(iii) l'équipement caloporteur, l'équipement hydraulique, les pompes à diffusion de vapeur et les appareils d'appui de pont.

Electrical capacitors

(2) A person may import fusion sealed capacitors containing PCBs for use in relation to communication tactical equipment or electronic control tactical equipment.

SOR/2010-57, ss. 5, 19.

Condensateurs électriques

(2) Il est permis d'importer tout condensateur électrique qui contient des BPC et dont les joints sont thermoscellés pour qu'il soit utilisé à des fins de communication tactique ou de commande électronique tactique.

DORS/2010-57, art. 5 et 19.

Liquids for servicing — concentration less than 2 mg/kg

**15.** (1) A person may use liquids containing PCBs in a concentration of less than 2 mg/kg for the purpose of servicing equipment containing PCBs.

Liquides pour entretien — concentration inférieure à 2 mg/kg

**15.** (1) Il est permis d'utiliser tout liquide qui contient des BPC en une concentration inférieure à 2 mg/kg pour l'entretien de toute pièce d'équipement qui contient des BPC.

Liquids for servicing — concentration of 500 mg/kg or more

(2) A person may use liquids containing PCBs in a concentration of 500 mg/kg or more for the purpose of servicing equipment containing PCBs in a concentration of 500 mg/kg or more until December 31, 2009.

Liquide pour entretien — concentration de 500 mg/kg ou plus

(2) Il est également permis, jusqu'au 31 décembre 2009, d'utiliser tout liquide qui contient des BPC en une concentration égale ou supérieure à 500 mg/kg pour l'entretien de toute pièce d'équipement qui elle-même contient des BPC en une concentration égale ou supérieure à 500 mg/kg.

END-OF-USE DATES AND EXTENSION

UTILISATION — DATES LIMITES ET PROLONGATION

Equipment referred to in subparagraphs 14(1)(*d*)(i) to (iii)

**16.** (1) A person may use the equipment referred to in subparagraphs 14(1)(*d*)(i) to (iii) until the following dates if the equipment is in use on September 5, 2008:

(*a*) in the case of equipment containing PCBs in a concentration of 500 mg/kg or more, December 31, 2009; and

(*b*) in the case of equipment containing PCBs in a concentration of at least 50 mg/kg but less than 500 mg/kg,

(i) December 31, 2009, if the equipment is located at a drinking water treatment plant or food or feed processing plant, in a child care facility, preschool, primary school, secondary school, hospital or senior citizens' care facility or on the property on which the plant or facility is located and within 100 m of it, and

(ii) December 31, 2025, if the equipment is located at any other place.

Pièces d'équipement visées aux sous-alinéas 14(1)*d*)(i) à (iii)

**16.** (1) Il est permis d'utiliser les pièces d'équipement visées aux sous-alinéas 14(1)*d*)(i) à (iii) qui sont en usage le 5 septembre 2008 jusqu'aux dates suivantes :

*a*) si elles contiennent des BPC en une concentration égale ou supérieure à 500 mg/kg, jusqu'au 31 décembre 2009;

*b*) si elles contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg mais inférieure à 500 mg/kg :

(i) jusqu'au 31 décembre 2009, si elles se trouvent dans une usine de traitement d'eau potable ou de transformation des aliments destinés aux humains ou aux animaux, dans une garderie, dans une école — de niveau préscolaire, primaire ou secondaire —, dans un hôpital ou dans une résidence pour personnes âgées ou sur le terrain d'un tel établissement, à 100 m ou moins de celui-ci,

(ii) jusqu'au 31 décembre 2025, si elles se trouvent à tout autre endroit.

Light ballasts and pole-top electrical transformers

(2) A person may use the following equipment containing PCBs in a concentration of 50 mg/kg or more until December 31, 2025, if the equipment is in use on September 5, 2008:

Ballasts de lampes et transformateurs sur poteaux

(2) Il est permis, jusqu'au 31 décembre 2025, d'utiliser les pièces d'équipement ci-après qui sont en usage le 5 septembre 2008 et qui contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg :

(*a*) light ballasts; and

(*b*) pole-top electrical transformers and their pole-top auxiliary electrical equipment.

Liquid — concentration of 2 mg/kg or more

(3) A person may use a liquid containing 2 mg/kg or more of PCBs that is in equipment until the day on which the liquid is removed from the equipment.

SOR/2010-57, s. 19.

*a*) les ballasts de lampes;

*b*) les transformateurs sur poteaux ainsi que tout équipement électrique connexe sur poteaux.

Liquides — concentration de 2 mg/kg ou plus

(3) Il est permis d'utiliser tout liquide qui contient des BPC en une concentration égale ou supérieure à 2 mg/kg dans une pièce d'équipement jusqu'à ce qu'il en soit extrait.

DORS/2010-57, art. 19.

Extension of end-of-use date

**17.** (1) Despite subsection 15(2), paragraph 16(1)(*a*) and subparagraph 16(1)(*b*)(i), a person may use the equipment and the liquids used for servicing that equipment, referred to in those provisions, until the date set out in an extension granted by the Minister under subsection (2) for that equipment and those liquids.

Prolongation de la date de fin d'utilisation

**17.** (1) Malgré le paragraphe 15(2), l'alinéa 16(1)*a*) et le sous-alinéa 16(1)*b*)(i), il est permis d'utiliser les pièces d'équipement et les liquides utilisés pour leur entretien visés à ces dispositions jusqu'à l'expiration de toute prolongation accordée par le ministre en vertu du paragraphe (2) pour ces pièces d'équipement et ces liquides.

Application

(2) The Minister shall, on receiving a written application containing the information set out in subsection (3), grant an extension up to the date applied for but no later than December 31, 2014, if either of the following conditions are met:

(*a*) the equipment is being replaced with equipment that is engineered to order, and

(i) it is not technically feasible to replace the equipment on or before December 31, 2009,

(ii) the applicant is taking all necessary measures to minimize or eliminate any harmful effect of the PCBs in the equipment on the environment and on human health,

(iii) a plan has been prepared, along with timelines, to end the use of the equipment by the date applied for,

Demande

(2) Sur réception d'une demande écrite comportant les renseignements prévus au paragraphe (3), le ministre accorde une prolongation jusqu'à la date prévue dans la demande mais au plus tard jusqu'au 31 décembre 2014, si l'une ou l'autre des conditions suivantes est remplie :

*a*) la pièce d'équipement doit être remplacée par une pièce d'équipement conçue et fabriquée sur mesure et :

(i) il est techniquement impossible de le faire le 31 décembre 2009 ou avant cette date,

(ii) le demandeur prend les mesures nécessaires pour éliminer ou atténuer tout effet nocif des BPC contenus dans la pièce sur l'environnement et la santé humaine,

(iii) un plan, incluant un échéancier, a été dressé afin que l'utilisation de la pièce cesse au plus tard à la date prévue dans la demande,

(iv) a plan has been prepared for inspecting the equipment on a monthly basis for the period of the extension for damage that could lead to the release of PCBs, and

(v) the equipment bears the label required under section 29; or

(*b*) the equipment is located at a facility that is scheduled for permanent closure on or before December 31, 2014, and

(i) the applicant is taking all necessary measures to minimize or eliminate any harmful effect of the PCBs in the equipment on the environment and on human health,

(ii) a plan has been prepared, along with timelines, to end the use of the equipment by the date applied for,

(iii) a plan has been prepared for inspecting the equipment on a monthly basis, for the period of the extension, for damage that could lead to the release of PCBs, and

(iv) the equipment bears the label required under section 29.

(iv) un plan a été dressé pour l'inspection de la pièce une fois par mois durant la prolongation afin que soit décelé tout dommage pouvant mener au rejet de BPC,

(v) la pièce porte l'étiquette exigée par l'article 29;

*b*) la pièce d'équipement se trouve dans une installation dont la fermeture permanente est prévue au plus tard pour le 31 décembre 2014 et :

(i) le demandeur prend les mesures nécessaires pour éliminer ou atténuer tout effet nocif des BPC contenus dans la pièce sur l'environnement et la santé humaine,

(ii) un plan, incluant un échéancier, a été dressé afin que l'utilisation de la pièce cesse au plus tard à la date prévue dans la demande,

(iii) un plan a été dressé pour l'inspection de la pièce une fois par mois durant la prolongation afin que soit décelé tout dommage pouvant mener au rejet de BPC;

(iv) la pièce porte l'étiquette exigée par l'article 29.

Information

(3) The application shall contain the following:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the applicant and of any person authorized to act on the applicant's behalf;

(*b*) a technical description of the equipment which is the subject of the application, including

(i) the type and function of the equipment,

Renseignements

(3) La demande comporte :

*a*) les nom, adresses municipale et postale et numéro de téléphone du demandeur et de toute personne autorisée à agir en son nom et, le cas échéant, leurs numéro de télécopieur et adresse électronique;

*b*) les caractéristiques techniques de la pièce d'équipement qui fait l'objet de la demande, notamment :

(i) son type et sa fonction,

(ii) the quantity of liquid containing PCBs that is in the equipment and the quantity of liquid needed for servicing that equipment, expressed in litres,

(iii) the concentration of PCBs in the liquid, expressed in milligrams of PCBs per kilogram of liquid,

(iv) the quantity of PCBs in the liquid that is in the equipment, expressed in kilograms, and

(v) the name-plate description, if any, and the manufacturer's serial number, if any;

(*c*) the unique identification number that is on the label required under section 29;

(*d*) the name, if any, and civic address of the facility where the equipment is located, or, if there is no civic address, the location using the owner's site identification system, and the function and technical description of the facility;

(*e*) information demonstrating that

(i) it is not technically feasible to replace the equipment on or before December 31, 2009, or

(ii) the facility where the equipment is located is scheduled for permanent closure on or before December 31, 2014;

(*f*) information demonstrating that the applicant is taking all necessary measures to minimize or eliminate any harmful effect of the PCBs that are contained in the equipment on the environment and on human health;

(*g*) the plan, along with timelines, for ending the use of the equipment; and

(ii) la quantité de liquide qui contient des BPC qui s'y trouve et la quantité de liquide nécessaire pour son entretien, exprimées en litres,

(iii) la concentration de BPC dans le liquide, exprimée en milligrammes de BPC par kilogramme de liquide,

(iv) la quantité de BPC dans le liquide qui s'y trouve, exprimée en kilogrammes,

(v) s'il y a lieu, l'information figurant sur la plaque d'identification et le numéro de série de son fabricant;

*c*) le numéro d'identification unique figurant sur l'étiquette en application de l'article 29;

*d*) le nom, s'il y a lieu, et l'adresse municipale de l'installation où se trouve la pièce d'équipement ou, à défaut, l'endroit où elle se trouve d'après le système d'identification de site du propriétaire, et la fonction et les caractéristiques techniques de l'installation;

*e*) les renseignements qui établissent :

(i) soit qu'il est techniquement impossible de remplacer la pièce d'équipement le 31 décembre 2009 ou avant cette date,

(ii) soit que la fermeture permanente de l'installation dans laquelle se trouve la pièce d'équipement est prévue au plus tard pour le 31 décembre 2014;

*f*) les renseignements qui établissent que les mesures nécessaires ont été prises par le demandeur pour éliminer ou atténuer tout effet nocif des BPC contenus dans la pièce d'équipement sur l'environnement et la santé humaine;

(*h*) the plan for inspecting the equipment.

*g*) le plan et l'échéancier qui seront mis en œuvre afin que cesse l'utilisation de la pièce d'équipement;

*h*) le plan d'inspection de la pièce d'équipement.

Notice of change to information

(4) The applicant shall notify the Minister in writing of any change to the information provided under subsection (3) within 30 days after the day on which the change occurs.

(4) Le demandeur est tenu d'aviser le ministre par écrit de tout changement apporté aux renseignements fournis en application du paragraphe (3) dans les trente jours suivant la date du changement.

Avis de changement apporté aux renseignements

False or misleading information

(5) The Minister shall refuse to grant an extension if the Minister has reasonable grounds to believe that the applicant has provided false or misleading information in support of its application.

(5) Le ministre refuse d'accorder une prolongation s'il a des motifs raisonnables de croire que le demandeur a fourni des renseignements faux ou trompeurs au soutien de sa demande.

Renseignements faux ou trompeurs

Revocation

(6) The Minister shall revoke the extension if

(*a*) the requirements set out in subsection (2) are no longer met during the period of the extension; or

(*b*) the Minister has reasonable grounds to believe that the applicant has provided false or misleading information to the Minister in support of its application.

(6) Il révoque la prolongation :

*a*) si, durant la prolongation, les conditions prévues au paragraphe (2), selon le cas, ne sont plus remplies;

*b*) s'il a des motifs raisonnables de croire que le demandeur lui a fourni des renseignements faux ou trompeurs au soutien de sa demande.

Révocation

Reasons for revocation

(7) The Minister shall not revoke the extension unless the Minister provides the applicant with

(*a*) written reasons for the revocation; and

(*b*) an opportunity to be heard, by written representation, in respect of the revocation.

SOR/2010-57, s. 6(F).

(7) Il ne peut toutefois révoquer la prolongation que si, à la fois :

*a*) il a avisé le titulaire par écrit des motifs de la révocation;

*b*) il lui a donné la possibilité de présenter des observations par écrit au sujet de celle-ci.

DORS/2010-57, art. 6(F).

Motifs de révocation

PART 3

STORAGE

PARTIE 3

STOCKAGE

Application — concentration of 50 mg/kg or more

**18.** (1) Subject to subsection (3), this Part applies to a solid or liquid product containing PCBs in a concentration of 50 mg/kg or more

(*a*) that is in an amount equal to or greater than 100 L if the product is a liquid, or in an amount equal to or greater than 100 kg if the product is a solid; or

(*b*) that is in a lesser amount if the product contains 1 kg or more of PCBs.

**18.** (1) Sous réserve du paragraphe (3), la présente partie s'applique aux produits liquides ou solides qui contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg et :

*a*) dont la quantité est égale ou supérieure à 100 L, dans le cas d'un produit liquide, ou à 100 kg, dans le cas d'un produit solide;

*b*) dont la quantité est moindre, si ces produits renferment 1 kg ou plus de BPC.

Application — Concentration égale ou supérieure à 50 mg/kg

Determination of amount

(2) For the purposes of subsection (1), the amount of PCBs or products containing PCBs is the aggregate of all amounts of PCBs and products that are located at a particular site.

(2) Pour l'application du paragraphe (1), la quantité de BPC ou de produits qui en contiennent correspond à la somme de toutes les quantités de BPC et de produits qui se trouvent dans un même emplacement.

Détermination des quantités

Non-application

(3) This Part does not apply in respect of the following products containing PCBs:

(*a*) solid or liquid products that are processed daily or used;

(*b*) pipelines that transport natural gas, petroleum or petroleum products, and any associated equipment that is in contact with the natural gas, petroleum or petroleum products, if they remain in place on September 5, 2008; and

(*c*) cables, if they remain in place on September 5, 2008.

SOR/2010-57, s. 19.

(3) La présente partie ne s'applique pas aux produits ci-après qui contiennent des BPC :

*a*) les produits liquides ou solides qui sont transformés quotidiennement ou utilisés;

*b*) tout pipeline qui transporte du gaz naturel, du pétrole ou des produits pétroliers, ainsi que tout équipement connexe qui est en contact avec le gaz naturel, le pétrole ou les produits pétroliers, si le pipeline et l'équipement demeurent à l'endroit où ils se trouvaient le 5 septembre 2008;

*c*) les câbles, s'ils demeurent à l'endroit où ils se trouvaient le 5 septembre 2008.

DORS/2010-57, art. 19.

Exclusion

Requirement to store

**19.** (1) A person who owns, controls or possesses PCBs or products containing

**19.** (1) Le propriétaire de BPC ou de produits qui en contiennent ou la personne

Obligation de stocker

PCBs shall, within 30 days after the day on which those PCBs or products cease to be processed daily or used or after September 5, 2008, whichever is later, either

(*a*) send them for destruction to an authorized facility that is authorized for that purpose; or

(*b*) store them at a PCB storage site for the period during which they are not processed daily or used.

qui en a la possession ou le contrôle est tenu, dans les trente jours suivant la date où ceux-ci cessent d'être transformés quotidiennement ou utilisés ou suivant le 5 septembre 2008, selon la plus tardive de ces dates :

*a*) soit de les expédier pour qu'ils soient détruits dans une installation agréée à cette fin;

*b*) soit de les stocker dans un dépôt de BPC pendant qu'ils ne sont pas transformés quotidiennement ou utilisés.

Remote from or no access to roadway

(2) Despite subsection (1), if the PCBs or products containing PCBs are remote from a roadway system or if there is no access to a roadway system, the person who owns, controls or possesses the PCBs or products may store them at a PCB storage site as soon as feasible but no later than one year after the day on which they are not processed daily or used or one year after September 5, 2008, whichever is later. That person shall use best management practices for them from the time that they cease to be processed daily or used until the time that they are stored at a PCB storage site.

SOR/2010-57, s. 7.

Endroit éloigné ou inaccessible

(2) Si les BPC ou les produits qui en contiennent sont éloignés de tout système routier ou se trouvent à un endroit où il n'y a pas d'accès à un tel système, le propriétaire ou la personne peut les stocker dans un dépôt de BPC le plus tôt possible, sans toutefois dépasser un an à compter de la date où ils cessent d'être transformés quotidiennement ou utilisés ou du 5 septembre 2008, selon la plus tardive de ces dates. Ils sont tenus d'appliquer des pratiques exemplaires de gestion pour les BPC et les produits dès qu'ils cessent d'être transformés quotidiennement ou utilisés, et ce, jusqu'à leur stockage dans un dépôt de BPC.

DORS/2010-57, art. 7.

Prohibition against storage

**20.** (1) Effective September 5, 2009, no person shall store PCBs or products containing PCBs at the following plants or facilities or on the land on which those plants or facilities are located and within 100 m of them:

(*a*) a drinking water treatment plant or a food or feed processing plant; or

(*b*) a child care facility, preschool, primary school, secondary school, hospital, or senior citizens' care facility.

Interdiction de stocker

**20.** (1) À compter du 5 septembre 2009, il est interdit de stocker des BPC ou des produits qui en contiennent dans l'un des établissements ci-après ou sur le terrain d'un tel établissement, à 100 m ou moins de celui-ci :

*a*) une usine de traitement d'eau potable ou de transformation des aliments destinés aux humains ou aux animaux;

*b*) une garderie, une école — de niveau préscolaire, primaire ou secondaire —,

un hôpital ou une résidence pour personnes âgées.

Light ballasts

(2) Subsection (1) does not apply to light ballasts.

SOR/2010-57, s. 8.

Ballasts de lampes

(2) Le paragraphe (1) ne s'applique pas aux ballasts de lampes.

DORS/2010-57, art. 8.

Maximum storage periods

**21.** (1) Despite any other provision in these Regulations and subject to section 22, no person shall store PCBs or products containing PCBs, other than those referred to in section 23, beyond the following time limits:

(*a*) one year, beginning on the day on which their use is no longer permitted under these Regulations or the day on which they are no longer processed daily or used, whichever is sooner, if the PCBs or products are stored at a facility that is not referred to in paragraph (1)(*b*) or (*c*);

(*b*) one year, if the PCBs or products are stored at an authorized facility that is a transfer site; and

(*c*) two years, if the PCBs or products are stored at an authorized facility that is authorized to destroy them.

Périodes maximales de stockage

**21.** (1) Malgré toute autre disposition du présent règlement mais sous réserve de l'article 22, il est interdit de stocker des BPC et des produits qui en contiennent, autres que ceux visés à l'article 23, au-delà de la période applicable suivante :

*a*) un an à compter du jour où le présent règlement ne permet plus l'utilisation des BPC et des produits ou de celui, s'il est antérieur, où ils ont cessé d'être transformés quotidiennement ou utilisés, s'ils sont stockés à une installation qui n'est pas visée aux alinéas (1)*b*) ou *c*);

*b*) un an, s'ils sont stockés dans une installation agréée qui est un centre de transfert;

*c*) deux ans, s'ils sont stockés dans une installation agréée qui est autorisée à les détruire.

Transfer sites

(2) If the PCBs or products containing PCBs are sent from one transfer site to another, the period referred to in paragraph (1)(*b*) begins when they are received at the first transfer site.

Centres de transfert

(2) Si les BPC et les produits qui en contiennent sont expédiés d'un centre de transfert à un autre, la période prévue à l'alinéa (1)*b*) commence à courir le jour de leur réception au premier centre de transfert.

Destruction

(3) The owner or operator of the facility referred to in paragraph (1)(*a*) or (*b*) shall send the PCBs or products containing PCBs for destruction to an authorized facility that is authorized for that purpose within the time limit set out in those paragraphs.

Destruction

(3) Le propriétaire ou l'exploitant de l'installation visée aux alinéas (1)*a*) ou *b*) est tenu d'expédier, dans le délai prévu à ces alinéas, les BPC ou les produits qui en contiennent pour qu'ils soient détruits dans une installation agréée à cette fin.

Exceptions to maximum storage periods

**22.** (1) Section 21 does not apply to the storage of

(*a*) liquids referred to in subsection 15(2) or for which an extension has been granted under subsection 17; or

(*b*) solids and liquids containing PCBs in a concentration of 50 mg/kg or more resulting from environmental restoration work and stored on site for the duration of the work, if the requirements set out in subsections (2) and (3) are complied with.

Information to be provided

(2) The owner of the land where the solids and liquids referred to in paragraph (1)(*b*) are located shall submit to the Minister at least 30 days before the storage of the solids or liquids or within 30 days after September 5, 2008, whichever is later, the following information:

(*a*) the civic address of the restoration work site or if there is no civic address, the location using the Global Positioning System;

(*b*) the date of commencement of the restoration work;

(*c*) the anticipated date of completion of the restoration work; and

(*d*) the anticipated date of the end of storage of the solids or liquids.

Changes to information

(3) The person referred to in subsection (2) shall notify the Minister in writing of the changes to be made at least 30 days before making any changes to the information provided under that subsection.

SOR/2010-57, s. 9.

Périodes maximales de stockage — exceptions

**22.** (1) L'article 21 ne s'applique pas au stockage :

*a*) des liquides visés au paragraphe 15(2) ou pour lesquels une prolongation a été accordée en vertu de l'article 17;

*b*) des solides et des liquides qui contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg et qui sont issus de travaux de restauration de l'environnement et stockés sur place pendant la durée des travaux, si les exigences prévues aux paragraphes (2) et (3) sont respectées.

Renseignements à fournir

(2) Le propriétaire du terrain où se trouvent les solides ou les liquides visés à l'alinéa (1)*b*) fournit au ministre, au plus tard trente jours avant la date de leur stockage ou trente jours après le 5 septembre 2008, selon la plus tardive de ces dates, les renseignements suivants :

*a*) l'adresse municipale de l'endroit où sont effectués les travaux de restauration ou, à défaut, sa localisation d'après le système mondial de localisation;

*b*) la date de début des travaux de restauration;

*c*) la date prévue pour la fin des travaux de restauration;

*d*) la date prévue pour la cessation du stockage des solides ou des liquides.

Modification des renseignements

(3) Il avise également le ministre par écrit, au moins trente jours à l'avance, de toute modification apportée aux renseignements fournis.

DORS/2010-57, art. 9.

PCBs or products containing PCBs stored on September 5, 2008

**23.** A person who owns, controls or possesses PCBs or products containing PCBs, other than liquids for which an extension has been granted under section 17, that are stored on September 5, 2008 may store them

(*a*) until December 31, 2009 if they are sent by that date for destruction to an authorized facility that is authorized for that purpose; or

(*b*) until December 31, 2011 if the person destroys them by that date, at the location where they are stored, in an authorized facility that is authorized for that purpose.

SOR/2010-57, s. 10.

BPC et produits qui en contiennent stockés le 5 septembre 2008

**23.** Le propriétaire ou la personne qui a la possession ou le contrôle de BPC ou de produits qui en contiennent, autres que des liquides visés par une prolongation au titre de l'article 17, qui sont stockés en date du 5 septembre 2008 est autorisé à les stocker :

*a*) jusqu'au 31 décembre 2009, s'ils sont expédiés, au plus tard à cette date, pour être détruits dans une installation agréée à cette fin;

*b*) jusqu'au 31 décembre 2011, s'ils sont détruits, au plus tard à cette date, dans une installation agréée à cette fin se trouvant à l'emplacement de stockage.

DORS/2010-57, art. 10.

PCB storage site

**24.** PCBs or products containing PCBs shall be stored at a site that is

(*a*) a building, room, shipping container or other enclosed structure; or

(*b*) an area that is enclosed by a woven mesh wire fence or any other fence or wall with similar security characteristics, and the fence or wall shall be at least 1.83 m high.

Dépôt de BPC

**24.** Les BPC et les produits qui en contiennent doivent être stockés dans un dépôt qui est :

*a*) soit un bâtiment, une pièce, un conteneur ou tout autre ouvrage fermé;

*b*) soit un endroit entouré d'une clôture grillagée ou d'un autre genre de clôture ou d'un mur présentant des caractéristiques similaires sur le plan de la sécurité, la clôture ou le mur ayant au moins 1,83 m de haut.

Storage requirements

**25.** The owner or operator of a PCB storage site shall

(*a*) store all PCBs or products containing PCBs that are in liquid form in

(i) sealed containers, other than drums, that are made of steel or other metals that provide sufficient durability and strength to prevent those PCBs or products from being affected by the weather or released, or

(ii) drums that are

Exigences relatives au stockage

**25.** Le propriétaire ou l'exploitant d'un dépôt de BPC :

*a*) stocke les BPC et les produits en contenant qui sont des liquides dans :

(i) soit des contenants étanches, autres que des fûts, faits d'acier ou d'autres métaux offrant une durabilité et une solidité suffisantes pour que ces BPC et ces produits ne soient pas affectés par les conditions climatiques ni rejetés,

(ii) soit des fûts qui, à la fois :

(A) of a capacity not greater than 205 L,

(B) a closed-head double-bung drum made of steel having a gauge of 16 or heavier, and

(C) painted or treated to prevent rusting;

(*b*) store all PCBs or products containing PCBs that are in solid form in

(i) containers, other than drums, that are made of steel or other materials that provide sufficient durability and strength to prevent those PCBs or products from being affected by the weather or released, or

(ii) drums that are

(A) of a capacity not greater than 205 L,

(B) made of steel having a gauge of 18 or heavier,

(C) equipped with a securely attached, removable steel lid and a gasket made of material that is resistant to the PCBs or the products containing PCBs that are stored in the drums, and

(D) painted or treated to prevent rusting;

(*c*) store equipment containing PCB liquids in

(i) containers, other than drums, that are made of steel or other materials that provide sufficient durability and strength to prevent the equipment from being affected by the weather and to prevent any PCB liquid that leaks from the equipment from being released, or

(A) ont une capacité d'au plus 205 L,

(B) sont faits d'acier d'épaisseur minimale 16, ont un dessus non amovible et sont munis de deux bondes,

(C) sont enduits d'une peinture ou d'un revêtement antirouille;

*b*) stocke les BPC et les produits en contenant qui sont des solides dans :

(i) soit des contenants, autres que des fûts, faits d'acier ou d'autres matériaux offrant une durabilité et une solidité suffisantes pour que ces BPC et ces produits ne soient pas affectés par les conditions climatiques ni rejetés,

(ii) soit des fûts qui, à la fois :

(A) ont une capacité d'au plus 205 L,

(B) sont faits d'acier d'épaisseur minimale 18,

(C) sont dotés d'un couvercle d'acier amovible solidement fixé et d'un joint fait d'un matériau résistant aux BPC et aux produits en contenant qui y sont stockés,

(D) sont enduits d'une peinture ou d'un revêtement antirouille;

*c*) stocke les pièces d'équipement qui renferment des liquides contenant des BPC dans :

(i) soit des contenants, autres que des fûts, faits d'acier ou d'autres matériaux offrant une durabilité et une solidité suffisantes pour que les pièces d'équipement ne soient pas affectées par les conditions climatiques et que

(ii) drums described in subparagraph (*b*)(ii);

(*d*) store all equipment that is not in a container, other than drained equipment, if that equipment contains PCB liquid, and all containers of PCB liquid, on a floor or surface that is made of steel, concrete or any other similar durable material and that is constructed with curbing or sides that are capable of containing

(i) if one piece of equipment or one container is being stored, 125% of the volume of the PCB liquid in the equipment or container, and

(ii) if more than one piece of equipment or more than one container is being stored, the greater of twice the volume of the PCB liquid in the largest piece of equipment or the largest container and 25% of the volume of all the PCB liquid stored on the floor or surface;

(*e*) if the material of the floor or surface or the curbing or sides referred to in paragraph (*d*) are capable of absorbing any PCB liquid or other product containing PCBs, seal the floor, surface, curbing or sides with an impervious, durable, PCB-resistant coating;

(*f*) ensure that all floor drains, sumps or other openings in the floor or surface referred to in paragraph (*d*) are

(i) closed and sealed to prevent the release of liquids, or

(ii) connected to a drainage system suitable for liquid dangerous goods that terminates at a location where any spilled liquids will be contained and recovered and where the spilled liquides liquides, s'ils fuient des pièces, ne soient pas rejetés,

(ii) soit des fûts visés au sous-alinéa *b*)(ii);

*d*) stocke les pièces d'équipement — autres que celles contenant des BPC qui ont été vidangées — qui ne sont pas dans un contenant et qui renferment des liquides contenant des BPC, ainsi que tout contenant qui renferme de tels liquides, sur un plancher ou une surface fait d'acier, de béton ou d'un autre matériau durable semblable et entouré d'un rebord ou de côtés capables de retenir :

(i) si une seule pièce d'équipement ou un seul contenant est stocké, 125 % du volume des liquides contenant des BPC que renferme cette pièce d'équipement ou le contenant,

(ii) si plus d'une pièce d'équipement ou plus d'un contenant est stocké, le plus élevé des volumes suivants : le double du volume des liquides contenant des BPC que renferme la plus grosse pièce d'équipement ou le plus grand contenant ou 25 % du volume de l'ensemble des liquides contenant des BPC qui sont stockés sur le plancher ou la surface;

*e*) scelle, au moyen d'un revêtement étanche, durable et résistant aux BPC, le plancher, la surface, le rebord ou les côtés visés à l'alinéa *d*), lorsqu'ils peuvent absorber des liquides ou d'autres produits qui contiennent des BPC;

*f*) veille à ce que les drains de sol, puisards et autres ouvertures dans le plancher ou la surface visés à l'alinéa *d*) soient, selon le cas :

uids will not create a fire hazard or a risk to public health or safety;

(*g*) place on skids or pallets all equipment containing PCBs and containers of PCBs or products containing PCBs that are not permanently secured to the floor or a surface;

(*h*) stack containers of PCBs and products containing PCBs, other than drums, only if the containers are designed for stacking, and stack containers of PCB liquid not more than two containers high;

(*i*) if drums containing PCBs or products containing PCBs are stacked, separate the drums from each other with pallets and, in the case of drums of PCB liquid, stack the drums not more than two drums high;

(*j*) store equipment containing PCBs, and containers of PCBs or products containing PCBs, in a manner that makes them accessible for inspection;

(*k*) store PCBs or products containing PCBs in a manner that prevents them from catching fire or being released;

(*l*) store PCBs or products containing PCBs together, and separate them from other stored materials;

(*m*) if reasonably practicable, equip any indoor PCB storage site having a mechanical exhaust system with heat or smoke sensory controls that stop the fan and close the intake and exhaust dampers in the event of a fire;

(*n*) if equipment or containers of PCB liquid are stored outdoors, cover all PCB equipment that is not in a container, other than drained equipment, if that equipment contains PCB liquid, and all con-

(i) obturés et scellés pour empêcher le rejet de liquides,

(ii) reliés à un réseau de drainage convenant aux marchandises dangereuses liquides, qui se jette dans un lieu où les liquides déversés seront confinés et récupérés et où ils ne constitueront pas un risque d'incendie ni un risque pour la santé et la sécurité publiques;

*g*) place sur des patins ou des palettes les pièces d'équipement contenant des BPC et les contenants renfermant des BPC ou des produits en contenant qui ne sont pas fixés de façon permanente à un plancher ou à une surface;

*h*) empile les contenants de BPC et de produits qui en contiennent, autres que les fûts, seulement s'ils sont conçus à cette fin et, dans le cas des contenants renfermant des liquides qui contiennent des BPC, ne les empile pas à plus de deux contenants de haut;

*i*) s'ils sont empilés, sépare les fûts de BPC et de produits qui en contiennent les uns des autres avec des palettes et, dans le cas des fûts renfermant des liquides qui contiennent des BPC, ne les empile pas à plus de deux fûts de haut;

*j*) stocke les pièces d'équipement qui contiennent des BPC et les contenants renfermant des BPC ou des produits qui en contiennent de manière à ce qu'ils soient accessibles à des fins d'inspection;

*k*) stocke les BPC et les produits qui en contiennent de façon à empêcher leur inflammation ou leur rejet;

tainers of PCB liquid, with a weatherproof roof or barrier that protects the equipment and containers and prevents rain or snow from entering the curbing and the sides of the floor and the surface under them; and

(*o*) ensure that all drained PCB equipment and all containers of any PCB solid or PCB equipment are structurally sound and weatherproof if stored outdoors.

*l*) stocke les BPC et les produits qui en contiennent ensemble, à l'écart des autres matériaux stockés;

*m*) dans la mesure du possible, munit tout dépôt de BPC intérieur ayant un dispositif mécanique de ventilation de commandes sensibles à la chaleur ou à la fumée qui, en cas d'incendie, arrêtent le ventilateur et ferment les registres d'admission et d'évacuation d'air;

*n*) s'ils sont stockés dehors, couvre les pièces d'équipement — autres que celles contenant des BPC qui ont été vidangées — qui ne sont pas dans un contenant et qui renferment des liquides contenant des BPC, ainsi que tout contenant qui renferme de tels liquides, d'une toiture ou d'un écran à l'épreuve des intempéries qui les protège et empêche la pluie et la neige de pénétrer à l'intérieur du rebord et des côtés du plancher et de la surface sur lesquels ils sont posés;

*o*) s'ils sont stockés dehors, veille à ce que les pièces d'équipement contenant des BPC qui ont été vidangées et tout contenant qui renferme des solides ou des pièces d'équipement contenant des BPC aient une structure en bon état et soient à l'épreuve des intempéries.

Access to PCB storage site

**26.** The owner or operator of a PCB storage site shall keep all points of access to the PCB storage site locked or guarded.

**26.** Le propriétaire ou l'exploitant d'un dépôt de BPC tient chaque point d'accès au dépôt verrouillé ou veille à ce qu'il soit gardé.

Accès au dépôt de BPC

Inspection and maintenance of a PCB storage site

**27.** The owner or operator of a PCB storage site shall

(*a*) inspect all floors, curbing, sides, drains, drainage systems, weatherproof roofs and barriers, fences and walls of the PCB storage site, any fire alarm system, fire extinguishers and fire suppres-

**27.** Le propriétaire ou l'exploitant d'un dépôt de BPC :

*a*) en inspecte les planchers, les rebords, les côtés, les drains, les réseaux de drainage, les toitures et écrans à l'épreuve des intempéries, les clôtures, les murs, le système d'alarme-incendie, les extinc-

Inspection et entretien des dépôts de BPC

sion system and all equipment containing PCBs, containers used for the storage of PCBs or products containing PCBs and materials for clean-up at the PCB storage site

(i) each month,

(ii) at intervals of more than one month, if the Minister, on the written request of the owner or operator, determines that it is not reasonably practicable to inspect the site each month, due to its remote location, or

(iii) at intervals of less than one month, if more frequent inspections are necessary for the safe operation of the site; and

(*b*) keep in good condition and, if damaged, immediately repair or replace the floors, curbing, sides, drains, drainage systems, weatherproof roofs or barriers, fences, walls, fire alarm system, fire extinguishers, fire suppression system, equipment containing PCBs and containers and immediately clean up any contaminated area.

teurs et le réseau d'extinction automatique, ainsi que les pièces d'équipement qui contiennent des BPC, les contenants servant au stockage des BPC ou des produits qui en contiennent et les agents de nettoyage qui s'y trouvent :

(i) tous les mois,

(ii) à des intervalles de plus d'un mois, si le ministre, à la demande écrite du propriétaire ou de l'exploitant, détermine qu'il est en pratique impossible d'inspecter le dépôt tous les mois en raison de son isolement,

(iii) à des intervalles de moins d'un mois, si l'exploitation du dépôt en toute sécurité exige des inspections plus fréquentes;

*b*) les garde en bon état et, en cas de dommage, les répare ou les remplace immédiatement et nettoie sur-le-champ les aires contaminées.

Fire protection and emergency procedures

**28.** (1) The owner or operator of a PCB storage site shall

(*a*) develop and implement at the PCB storage site a fire protection and emergency procedures plan and shall

(i) update and test the plan once per year,

(ii) keep a written copy of the latest plan at the PCB storage site and another at their principal place of business, and

(iii) make the latest plan readily available to persons who implement the plan and to the local fire depart-

Protection contre les incendies et mesures d'urgence

**28.** (1) Le propriétaire ou l'exploitant d'un dépôt de BPC :

*a*) élabore et met en œuvre un plan d'intervention d'urgence et de lutte contre les incendies et :

(i) le met à jour et le vérifie annuellement,

(ii) en conserve une copie écrite à jour au dépôt et à son établissement principal,

(iii) en rend une copie à jour facilement accessible à toute personne qui participe à sa mise en œuvre et au service d'incendie local ou, à défaut, au

ment or to the local officer appointed by the provincial Fire Marshall if there is no local fire department or to any other local authority responsible for fire protection;

(*b*) ensure that all employees who are authorized to enter the PCB storage site are familiar with the contents of the latest plan;

(*c*) equip the indoor PCB storage site with a fully operative fire alarm system that is maintained, inspected and tested in accordance with articles 6.3.1.1 and 6.3.1.2 of the National Fire Code and with

(i) portable fire extinguishers that are selected and installed in accordance with article 2.1.5.1 of the National Fire Code and maintained, inspected and tested in accordance with article 6.2.1.1 of that Code, or

(ii) an automatic fire suppression system that meets the requirements of article 3.2.7.9 of the National Fire Code, if required;

(*d*) keep a copy of the records referred to in sections 43 and 44 at the PCB storage site and make a copy readily available to the local fire department and, if there is no local fire department, to the local officer appointed by the provincial Fire Marshall or to any other local authority responsible for fire protection;

(*e*) ensure that all employees who are authorized to enter the PCB storage site are made aware of the hazards of PCBs and are familiar with the use of protective equipment and clothing and the clean-up procedures referred to in the *Guidelines for the Management of*

fonctionnaire local nommé par le commissaire provincial aux incendies ou à toute autre autorité locale chargée de la protection contre les incendies;

*b*) veille à ce que tous les employés autorisés à entrer dans le dépôt connaissent bien le contenu du plan à jour;

*c*) s'agissant d'un dépôt intérieur, le munit d'un système d'alarme-incendie en état de fonctionnement qui est entretenu, inspecté et mis à l'essai conformément aux exigences des articles 6.3.1.1 et 6.3.1.2 du Code national de prévention des incendies, ainsi que :

(i) soit d'extincteurs portatifs qui sont choisis et installés conformément à l'article 2.1.5.1 de ce code et qui sont entretenus, inspectés et mis à l'essai conformément aux exigences de l'article 6.2.1.1 de ce code,

(ii) soit d'un réseau d'extinction automatique conforme aux exigences de l'article 3.2.7.9 du même code, si celles-ci s'appliquent;

*d*) conserve au dépôt une copie des documents et registres visés aux articles 43 et 44 respectivement et en rend une facilement accessible au service d'incendie local ou, à défaut, au fonctionnaire local nommé par le commissaire provincial aux incendies ou à toute autre autorité locale chargée de la protection contre les incendies;

*e*) veille à ce que tous les employés autorisés à entrer dans le dépôt soient informés des dangers que présentent les BPC et connaissent bien l'utilisation du matériel et des vêtements de protection et les méthodes de nettoyage mention-

*Wastes Containing Polychlorinated Biphenyls (PCBs)*, CCME-TS/WM-TRE008, September 1989, as amended from time to time, issued by the Canadian Council of Ministers of the Environment; and

(*f*) store absorbent materials for clean-up near the PCB storage site.

Shipping containers

(2) Despite paragraph (1)(*c*), if the indoor PCB storage site is a shipping container, the owner or operator of the site does not have to equip that site with a fire alarm system.

SOR/2010-57, s. 11(F).

nées dans le *Guide pour la gestion des déchets contenant des biphényles polychlorés (BPC)* CCME-TS/WM-TRE008, septembre 1989, avec ses modifications successives, publié par le Conseil canadien des ministres de l'environnement;

*f*) garde les matériaux absorbants servant au nettoyage près du dépôt.

Conteneur

(2) Malgré l'alinéa (1)*c*), le propriétaire ou l'exploitant d'un dépôt de BPC intérieur qui est un conteneur n'est pas tenu de le munir d'un système d'alarme-incendie.

DORS/2010-57, art. 11(F).

## PART 4

## LABELLING, REPORTS AND RECORDS

### Labelling

Equipment and liquids used for their servicing

**29.** (1) The owner of equipment referred to in section 16, other than equipment for which an extension has been applied for under section 17, or of a liquid used in its servicing referred to in subsection 15(2) shall affix a label in a readily visible location on the equipment or on the container of the liquid, no later than 30 days after the day on which it ceases to be used.

Equipment for which extension applied for

(2) The owner of equipment for which an extension has been applied under section 17 shall affix a label in a readily visible location on the equipment.

Exceptions

(3) Subsection (1) does not apply to

(*a*) equipment or containers of liquids that bear a label on September 5, 2008 that indicates the presence of PCBs; and

## PARTIE 4

## ÉTIQUETAGE, RAPPORTS ET DOSSIERS

### Étiquetage

Pièces d'équipement et liquides pour leur entretien

**29.** (1) Le propriétaire d'une pièce d'équipement visée à l'article 16, autre qu'une pièce d'équipement qui fait l'objet d'une demande de prolongation en vertu de l'article 17, ou de tout liquide utilisé pour l'entretien visé au paragraphe 15(2) est tenu d'apposer une étiquette, à un endroit bien en vue sur la pièce d'équipement ou le contenant du liquide, au plus tard trente jours après que la pièce ou le contenant cesse d'être utilisé.

Équipement faisant l'objet d'une demande de prolongation

(2) Le propriétaire d'une pièce d'équipement qui fait l'objet d'une demande de prolongation en vertu de l'article 17 est tenu d'y apposer une étiquette à un endroit bien en vue.

Exceptions

(3) Le paragraphe (1) ne s'applique pas :

*a*) aux pièces d'équipement et aux contenants de liquide qui portent, le

(*b*) equipment that is too small, including light ballasts, to bear the label referred to in subsection (4).

5 septembre 2008, une étiquette qui indique la présence de BPC;

*b*) aux pièces d'équipement qui sont trop petites, y compris les ballasts de lampes, pour que l'étiquette visée au paragraphe (4) y soit apposée.

Containers for small equipment

(3.1) The owner of the equipment referred to in paragraph (3)(*b*) that is stored shall affix the label referred to in subsection (4) in a readily visible location on the container in which the equipment is stored.

(3.1) Le propriétaire des pièces d'équipement visées à l'alinéa (3)*b*) qui sont stockées appose l'étiquette visée au paragraphe (4) à un endroit bien en vue sur leur contenant de stockage.

Contenants de pièces d'équipement trop petites

Description

(4) The label must

(*a*) state "ATTENTION — contains 50 mg/kg or more of PCBs / contient 50 mg/kg ou plus de BPC" in black lettering on a white background, in a font size of no less than 36 points;

(*b*) measure at least 150 mm by 150 mm or at least 76 mm by 76 mm in the case of capacitors; and

(*c*) in the case of equipment for which an extension is applied for under section 17, state a unique identification number.

SOR/2010-57, ss. 12, 19.

(4) L'étiquette doit :

*a*) porter la mention « ATTENTION — contains 50 mg/kg or more of PCBs / contient 50 mg/kg ou plus de BPC », inscrite en caractères d'au moins 36 points, en noir sur fond blanc;

*b*) être d'une dimension minimale de 150 mm sur 150 mm ou, dans le cas d'un condensateur, 76 mm sur 76 mm;

*c*) dans le cas d'une pièce d'équipement qui fait l'objet d'une demande de prolongation en vertu de l'article 17, porter un numéro d'identification unique.

DORS/2010-57, art. 12 et 19.

Description

Cables and pipelines

**30.** (1) The owner of a cable, a pipeline or equipment associated with a pipeline, referred to in paragraphs 14(1)(*a*) and (*b*), containing PCBs in a concentration of 50 mg/kg or more that is in a room, a tunnel or a facility shall either

(*a*) affix the label in the form set out in subsection 29(4) in a readily visible location on a part of the cable, pipeline or associated equipment that is accessible; or

(*b*) place a notice in a readily visible location at the entrance of the room, tunnel or facility that states the information set

**30.** (1) Le propriétaire de câbles, de pipelines ou d'équipement connexe visés aux alinéas 14(1)(*a*) et (*b*) qui contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg et se trouvent dans une pièce, un tunnel ou une installation est tenu :

Câbles et pipelines

*a*) soit d'apposer une étiquette conforme au paragraphe 29(4) à un endroit bien en vue sur toute partie accessible du câble, pipeline ou équipement connexe;

*b*) soit de placer à l'entrée de la pièce, du tunnel ou de l'installation à un endroit bien en vue une affiche d'une di-

out in paragraph 29(4)(*a*) and measures at least 150 mm by 150 mm.

mension minimale de 150 mm sur 150 mm portant la mention prévue à l'alinéa 29(4)*a*).

If dismantled

(2) If a part of the cable, pipeline or associated equipment is dismantled, the owner of the cable, pipeline or associated equipment shall affix on each dismantled part the label in the form set out in subsection 29(4), no later than 30 days after the day on which it is dismantled.

Désassemblage

(2) En cas de désassemblage d'une partie du câble, du pipeline ou de l'équipement connexe, le propriétaire de ceux-ci est tenu, dans les trente jours suivant le désassemblage, d'apposer une étiquette conforme au paragraphe 29(4) sur chaque partie désassemblée du câble, du pipeline ou de l'équipement connexe.

A facility other than transfer site or destruction facility

**31.** (1) The owner or operator of a PCB storage site, other than the PCB storage site of an authorized facility that is a transfer site or that is authorized to destroy PCBs, shall affix a label in a readily visible location on any product containing PCBs in a concentration of 50 mg/kg or more and that are stored at the PCB storage site, which

(*a*) is in the form referred to in subsection 29(4); and

(*b*) states "Date of Commencement of Storage / Date de début de stockage" and the date on which the storage begins.

Installation autre qu'un centre de transfert ou de destruction

**31.** (1) Le propriétaire ou l'exploitant d'un dépôt de BPC d'une installation autre qu'une installation agréée qui est un centre de transfert ou qui est autorisée à détruire des BPC est tenu d'apposer une étiquette à un endroit bien en vue sur tout produit en contenant qui y sont stockés et qui contiennent des BPC en une concentration égale ou supérieure à 50 mg/kg; l'étiquette

*a*) est conforme au paragraphe 29(4);

*b*) porte la mention « Date de début de stockage / Date of Commencement of Storage » et la date de début de stockage.

Transfer site or destruction facility

(2) The owner or operator of the PCB storage site of an authorized facility that is a transfer site or that is authorized to destroy PCBs shall affix a label in the form set out in subsection 29(4) in a readily visible location on any container that is a fixed tank and that is used at the facility for the storage of PCBs or products containing PCBs in a concentration of 50 mg/kg or more.

Centre de transfert ou de destruction

(2) Le propriétaire ou l'exploitant d'un dépôt de BPC d'une installation agréée qui est un centre de transfert ou qui est autorisée à détruire des BPC est tenu d'apposer une étiquette conforme au paragraphe 29(4) à un endroit bien en vue sur tout contenant qui est un réservoir fixe utilisé pour stocker des BPC à l'installation ou des produits qui en contiennent en une concentration égale ou supérieure à 50 mg/kg.

Notice

(3) The owner or operator of a PCB storage site shall place a notice in a readily visible location at the entrance of the site that states the information set out in para-

Affiche

(3) Le propriétaire ou l'exploitant d'un dépôt de BPC place à l'entrée du dépôt à un endroit bien en vue une affiche d'une dimension minimale de 150 mm sur 150

graph 29(4)(*a*) and that measures at least 150 mm by 150 mm.

Non-application

(4) Subsections (1) and (2) do not apply in respect of a product or container stored on September 5, 2008, if the product or the container

(*a*) bore a label on September 5, 2008 that indicated the presence of PCBs and that stated "Date of Commencement of Storage" and the date on which the storage began; and

(*b*) bears a label that states "Date of Commencement of Storage / Date de début de stockage" and the date on which the storage began.

SOR/2010-57, s. 13.

Retention of labels

**32.** The person who is required to affix a label on a product or container in accordance with sections 29 to 31 shall ensure that it bears that label for the duration that the person possesses the product or container.

REPORTS

End of use of equipment and liquids — 2009

**33.** (1) The owner of the equipment referred to in paragraph 16(1)(*a*) and subparagraph 16(1)(*b*)(i), other than the equipment for which an extension is granted by the Minister in accordance with section 17, or the liquids referred to in subsection 15(2) shall prepare a report that is current to December 31 of each calendar year in which the person owns the equipment or the liquids and that contains the following information:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the owner and any person authorized to act on the owner's behalf;

mm portant la mention prévue à l'alinéa 29(4)*a*).

Non application

(4) Les paragraphes (1) et (2) ne s'appliquent pas au produit ou au contenant stocké en date du 5 septembre 2008, s'il respecte les conditions suivantes :

*a*) en date du 5 septembre 2008, il portait une étiquette indiquant la présence de BPC, la mention « Date de début de stockage » et la date de début de stockage;

*b*) il porte une étiquette portant la mention « Date de début de stockage / Date of Commencement of Storage » et la date de début de stockage.

DORS/2010-57, art. 13.

Conservation des étiquettes

**32.** La personne qui a l'obligation d'apposer une étiquette sur un produit ou un contenant en application des articles 29 à 31 veille à ce que le produit ou le contenant la porte en tout temps pendant qu'il est en sa possession.

RAPPORTS

Date de fin d'utilisation des pièces d'équipement et des liquides — 2009

**33.** (1) Le propriétaire des pièces d'équipement visées à l'alinéa 16(1)*a*) ou au sous-alinéa 16(1)*b*)(i), autres que celles pour lesquelles une prolongation a été accordée par le ministre en vertu de l'article 17, ou des liquides visés au paragraphe 15(2) est tenu de préparer un rapport, au 31 décembre de chaque année civile durant laquelle il en est propriétaire, comportant les renseignements suivants :

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

(*b*) the civic addresses of the facilities where the equipment and liquids are located or, if there is no civic address, their location using the owner's site identification system;

(*c*) the quantity of liquids containing PCBs in the equipment and of liquids, expressed in litres, the quantity of solids containing PCBs in the equipment, expressed in kilograms, and the concentration of PCBs in the liquids and solids, expressed in mg/kg,

(i) that are in use on December 31,

(ii) that are stored on December 31 at the person's PCB storage site,

(iii) that are sent, in that calendar year, to an authorized facility that is a transfer site,

(iv) that are sent, in that calendar year, to an authorized facility that is authorized to destroy them, or

(v) that are destroyed in that calendar year; and

(*d*) a certification that the information is accurate and complete and that is dated and signed by the owner or by a person authorized to act on the owner's behalf.

*b*) l'adresse municipale des installations où se trouvent les pièces d'équipement et les liquides ou, à défaut, l'endroit où ils se trouvent d'après le système d'identification de site du propriétaire;

*c*) la quantité, exprimée en litres, de liquides qui contiennent des BPC dans les pièces d'équipement et de liquides, la quantité de solides qui contiennent des BPC dans les pièces d'équipement, exprimée en kilogrammes, et la concentration de BPC dans les liquides ou les solides, exprimée en mg/kg :

(i) en usage le 31 décembre,

(ii) stockés à son dépôt le 31 décembre,

(iii) expédiés, au cours de l'année civile, à une installation agréée qui est un centre de transfert,

(iv) expédiés, au cours de l'année civile, à une installation agréée qui est autorisée à les détruire,

(v) détruits au cours de l'année civile;

*d*) une attestation, datée et signée par lui ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

Equipment and liquids for which extension granted

(2) The owner of the equipment referred to in paragraph 16(1)(*a*) and subparagraph 16(1)(*b*)(i) or the liquids referred to in subsection 15(2) for which an extension is granted by the Minister in accordance with section 17 shall prepare a report that is current to December 31 of each calendar year in which the person owns the equipment or the liquids and that contains the following information for each piece of equipment or container of liquid:

Pièces d'équipement et liquides pour lesquels une prolongation a été accordée

(2) Le propriétaire des pièces d'équipement visées à l'alinéa 16(1)*a*) ou au sous-alinéa 16(1)*b*)(i) ou des liquides visés au paragraphe 15(2) pour lesquels une prolongation a été accordée par le ministre en vertu de l'article 17 est tenu de préparer un rapport, au 31 décembre de chaque année civile durant laquelle il en est propriétaire, comportant les renseignements suivants pour chaque pièce d'équipement et contenant de liquides :

(*a*) the information required under paragraphs (1)(*a*) and (*d*);

(*b*) the unique identification number that is on the label referred to in paragraph 29(4)(*c*);

(*c*) the civic address, function and technical description of the facility where the equipment or container of liquid is located or, if there is no civic address, its location using the owner's site identification system;

(*d*) the progress on the plan's implementation and the timelines for ending the use of the equipment;

(*e*) the measures taken to minimize or eliminate any harmful effect of the PCBs in the equipment on the environment and on human health; and

(*f*) the findings of the inspections of the equipment.

*a*) les renseignements prévus aux alinéas (1)*a*) et *d*);

*b*) le numéro d'identification unique figurant sur l'étiquette conformément à l'alinéa 29(4)*c*);

*c*) l'adresse municipale, la fonction et les caractéristiques techniques de l'installation où se trouvent la pièce d'équipement ou le contenant des liquides ou, à défaut, l'endroit où ils se trouvent d'après le système d'identification de site du propriétaire;

*d*) le progrès accompli dans la mise en œuvre du plan et de l'échéancier dressé en vue de la cessation de l'utilisation de la pièce d'équipement;

*e*) les mesures prises pour éliminer ou atténuer tout effet nocif des BPC contenus dans la pièce d'équipement sur l'environnement et la santé humaine;

*f*) les résultats des inspections de la pièce d'équipement.

End of use of equipment — 2025

(3) The owner of the equipment referred to in subparagraph 16(1)(*b*)(ii) and subsection 16(2) shall prepare a report that is current to December 31 of each calendar year in which the person owns the equipment and that contains the following information:

(*a*) the information required under paragraphs (1)(*a*), (*b*) and (*d*); and

(*b*) the quantity of liquids containing PCBs in the equipment, expressed in litres, the quantity of solids containing PCBs in the equipment, expressed in kilograms, and the concentration of PCBs in the liquids and the solids, expressed in mg/kg,

Date de fin d'utilisation des pièces d'équipement — 2025

(3) Le propriétaire des pièces d'équipement visées au sous-alinéa 16(1)*b*)(ii) ou au paragraphe 16(2) est tenu de préparer un rapport, au 31 décembre de chaque année civile durant laquelle il en est propriétaire, comportant les renseignements suivants :

*a*) les renseignements prévus aux alinéas (1)*a*), *b*) et *d*);

*b*) la quantité de liquides qui contiennent des BPC dans les pièces d'équipement, exprimée en litres, la quantité de solides qui contiennent des BPC dans les pièces d'équipement, exprimée en kilogrammes, et la concentration de BPC dans les liquides ou les solides, exprimée en mg/kg :

(i) that are stored on December 31 at the person's PCB storage site,

(ii) that are sent, in that calendar year, to an authorized facility that is a transfer site,

(iii) that are sent, in that calendar year, to an authorized facility that is authorized to destroy them, or

(iv) that are destroyed in that calendar year.

SOR/2010-57, s. 14.

(i) stockés à son dépôt de BPC le 31 décembre,

(ii) expédiés, au cours de l'année civile, à une installation agréée qui est un centre de transfert,

(iii) expédiés, au cours de l'année civile, à une installation agréée qui est autorisée à les détruire,

(iv) détruits au cours de l'année civile.

DORS/2010-57, art. 14.

Research

**34.** The person who offers for sale, sells, processes or uses PCBs or products containing PCBs for the purpose of research in accordance with section 8 shall prepare a report that is current to December 31 in each calendar year in which the person offers for sale, sells, processes or uses those PCBs or products and that contains the following information:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the person and of any person authorized to act on that person's behalf;

(*b*) an indication of whether the person offers for sale, sells, processes or uses the PCBs or products;

(*c*) the quantity of the PCBs or of the products containing PCBs that are offered for sale, sold, processed or used in that calendar year; and

(*d*) a certification that the information is accurate and complete and that is dated and signed by the person or by a person authorized to act on their behalf.

Recherches

**34.** La personne qui met en vente, vend, transforme ou utilise des BPC ou des produits qui en contiennent en vue d'effectuer des recherches conformément à l'article 8 est tenue de préparer un rapport, au 31 décembre de chaque année civile durant laquelle elle les a mis en vente, vendus, utilisés ou transformés, comportant les renseignements suivants :

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

*b*) une mention indiquant si elle les a mis en vente, vendus, transformés ou utilisés;

*c*) la quantité de BPC ou de produits qui ont été mis en vente, vendus, transformés ou utilisés durant l'année civile;

*d*) une attestation, datée et signée par elle ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

Colouring pigment

**35.** The person who manufactures, exports or imports colouring pigment in accordance with section 11 shall prepare a re-

Pigments pour la coloration

**35.** La personne qui fabrique, exporte ou importe, conformément à l'article 11, des pigments pour la coloration est tenue

port that is current to December 31 in each calendar year in which the person manufactures, imports or exports the colouring pigment and that contains the following information:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the person and of any person authorized to act on that person's behalf;

(*b*) an indication of whether the person manufactures, exports or imports colouring pigment;

(*c*) the quantity of colouring pigment, expressed in kilograms, the maximum concentration of PCBs in the colouring pigment, expressed in mg/kg, and the average annual concentration of PCBs in the colouring pigment, expressed in mg/kg, that is manufactured, imported or exported in that calendar year;

(*d*) in the case of importing, the name, telephone number and civic and mailing addresses of the person from whom the colouring pigment is imported and, in the case of exporting, the name, telephone number and civic and mailing addresses of the person to whom the colouring pigment is exported; and

(*e*) a certification that the information is accurate and complete and that is dated and signed by the person or by a person authorized to act on their behalf.

de préparer un rapport, au 31 décembre de chaque année civile durant laquelle elle les fabrique, exporte ou importe, comportant les renseignements suivants :

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

*b*) une mention indiquant si elle les a fabriqués, exportés ou importés;

*c*) la quantité, exprimée en kilogrammes, de pigments qui ont été fabriqués, exportés ou importés durant l'année civile ainsi que la concentration moyenne annuelle et la concentration maximale en BPC de ces pigments, exprimée en mg/kg;

*d*) les nom, adresses municipale et postal et numéro de téléphone de la personne de qui proviennent les pigments, dans le cas où ils sont importés, ou à qui ils sont expédiés, dans le cas où ils sont exportés;

*e*) une attestation, datée et signée par elle ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

Solid products containing PCBs

**36.** The person who manufactures solid products containing PCBs in accordance with section 13 shall prepare a report that is current to December 31 in each calendar year in which the person manufactures the products and that contains the following information:

Produits solides qui contiennent des BPC

**36.** La personne qui fabrique, conformément à l'article 13, des produits solides qui contiennent des BPC est tenue de préparer un rapport, au 31 décembre de chaque année civile durant laquelle elle les fabrique, comportant les renseignements suivants :

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the person and of any person authorized to act on that person's behalf;

(*b*) the quantity of solid products manufactured in that calendar year, expressed in kilograms, and the maximum concentration and average concentration of PCBs in the solid products, expressed in mg/kg, for that calendar year;

(*c*) the name, telephone number and civic and mailing addresses of the person to whom the manufacturer sells the products; and

(*d*) a certification that the information is accurate and complete and that is dated and signed by the person or by a person authorized to act on their behalf.

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

*b*) la quantité, exprimée en kilogrammes, de produits qui ont été fabriqués durant l'année civile ainsi que la concentration moyenne et la concentration maximale en BPC de ces produits, exprimée en mg/kg, pour cette année civile;

*c*) les nom, adresse municipale et postale et numéro de téléphone de la personne à qui elle a vendu les produits;

*d*) une attestation, datée et signée par elle ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

Stored PCBs or products — PCB concentration of 50 mg/kg or more

**37.** The person who owns and stores PCBs or products containing PCBs in a concentration of 50 mg/kg or more, other than the equipment and liquids referred to in section 33, and the owner of a facility who stores PCBs or products containing PCBs in a concentration of 50 mg/kg or more, other than the person referred to in section 38, shall each prepare a report that is current to December 31 in each calendar year in which the person stores the PCBs or products at their PCB storage site and that contains the following information:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the owner and of any person authorized to act on the owner's behalf;

(*b*) the civic addresses of the PCB storage sites where the PCBs or products are

BPC ou produits stockés — concentration de BPC de 50 mg/kg ou plus

**37.** Le propriétaire de BPC ou de produits qui en contiennent en une concentration égale ou supérieure à 50 mg/kg, autres que les pièces d'équipement ou les liquides visés à l'article 33, et le propriétaire d'une installation, autre que celui visé à l'article 38, qui stockent à leur dépôt de BPC des BPC ou des produits qui en contiennent en cette concentration sont chacun tenus de préparer un rapport, au 31 décembre de chaque année civile durant laquelle ils les stockent ainsi, comportant les renseignements suivants :

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

located, or if there is no civic address, their location using the owner's site identification system;

(*c*) the quantity of liquids containing PCBs in the products, expressed in litres, and the quantity of solids containing PCBs in the products, expressed in kilograms, and the concentration of PCBs in the liquids and the solids, expressed in mg/kg

(i) that are stored on December 31 at the person's PCB storage site,

(ii) that are sent, in that calendar year, to an authorized facility that is a transfer site,

(iii) that are sent, in that calendar year, to an authorized facility that is authorized to destroy them, or

(iv) that are destroyed in that calendar year; and

(*d*) a certification that the information is accurate and complete and that is dated and signed by the owner of the PCBs or products containing PCBs or by a person authorized to act on the owner's behalf.

SOR/2010-57, s. 15.

*b*) l'adresse municipale des dépôts où sont stockés les BPC et les produits ou, à défaut, l'endroit où ils se trouvent d'après le système d'identification de site du propriétaire;

*c*) la quantité de liquides qui contiennent des BPC dans les produits, exprimée en litres, la quantité de solides qui contiennent des BPC dans les produits, exprimée en kilogrammes, et la concentration de BPC dans les liquides ou les solides, exprimée en mg/kg :

(i) stockés à son dépôt de BPC le 31 décembre,

(ii) expédiés, au cours de l'année civile, à une installation agréée qui est un centre de transfert,

(iii) expédiés, au cours de l'année civile, à une installation agréée qui est autorisée à les détruire,

(iv) détruits au cours de l'année civile,

*d*) une attestation, datée et signée par lui ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

DORS/2010-57, art. 15.

Stored PCBs or products — transfer site or destruction facility

**38.** The owner of an authorized facility that is a transfer site or that is authorized to destroy PCBs or products containing PCBs and who stores them at their PCB storage site, other than the owner referred to in section 37, shall prepare a report that is current to December 31 in each calendar year and that contains the following information:

(*a*) the name, civic and mailing addresses, telephone number, fax number, if any, and e-mail address, if any, of the

BPC ou produits stockés — Centre de transfert ou de destruction

**38.** Le propriétaire d'une installation agréée qui est un centre de transfert ou qui est autorisée à détruire des BPC et des produits qui en contiennent, autre que le propriétaire visé à l'article 37, et qui les stocke à son dépôt de BPC est tenu de préparer un rapport, au 31 décembre de chaque année civile durant laquelle il les transforme ou les détruit, comportant les renseignements suivants :

*a*) ses nom, adresses municipale et postale, numéro de téléphone et, le cas échéant, numéro de télécopieur et

owner and of any person authorized to act on the owner's behalf;

(*b*) the civic addresses of the sites where the PCBs or products containing PCBs are stored, or if there is no civic address, the location of the sites using the owner's site identification system;

(*c*) the quantity of liquids containing PCBs in the products, expressed in litres, or the quantity of solids containing PCBs in the products, expressed in kilograms, and the concentration of the PCBs in the liquids and the solids, expressed in mg/kg

(i) that are stored on December 31 at the owner's PCB storage site,

(ii) that are sent, in that calendar year, to an authorized facility that is a transfer site,

(iii) that are sent, in that calendar year, to an authorized facility that is authorized to destroy them, or

(iv) that are destroyed in that calendar year; and

(*d*) a certification that the information is accurate and complete and that is dated and signed by the owner of the authorized facility or by a person authorized to act on the owner's behalf.

adresse électronique, ainsi que ceux de toute personne autorisée à agir en son nom;

*b*) l'adresse municipale des dépôts où sont stockés les BPC et les produits ou, à défaut, l'endroit où ils se trouvent d'après le système d'identification de site du propriétaire;

*c*) la quantité de liquides qui contiennent des BPC dans les produits, exprimée en litres, la quantité de solides qui contiennent des BPC dans les produits, exprimée en kilogrammes, et la concentration de BPC dans les liquides ou les solides, exprimée en mg/kg :

(i) stockés à son dépôt de BPC le 31 décembre,

(ii) expédiés, au cours de l'année civile, à une installation agréée qui est un centre de transfert,

(iii) expédiés, au cours de l'année civile, à une installation agréée qui est autorisée à les détruire,

(iv) détruits au cours de l'année civile,

*d*) une attestation, datée et signée par lui ou par toute personne autorisée à agir en son nom, portant que les renseignements sont complets et exacts.

Date of submission of report

**39.** (1) The person who is required to prepare a report in accordance with subsection 33(1) or (2) and with any of sections 34 to 38 shall submit it to the Minister on or before March 31 of the year following the calendar year for which the report is made.

**39.** (1) La personne qui est tenue de préparer tout rapport visé aux paragraphes 33(1) ou (2) ou à l'un des articles 34 à 38 le présente au ministre au plus tard le 31 mars de l'année civile qui suit celle pour laquelle il est établi.

Date de présentation des rapports

Report made under subsection 33(3)

(2) The person who is required to prepare a report in accordance with subsection 33(3) shall submit it to the Minister

(2) Celle qui est tenue de préparer le rapport visé au paragraphe 33(3) le présente au ministre :

Rapport visé au paragraphe 33(3)

(*a*) on or before March 31, 2010 for reports that are current to December 31 of the year that these Regulations come into force up to the year 2009;

(*b*) on or before March 31, 2014 for reports that are current to December 31 of each of the years 2010 to 2013;

(*c*) on or before March 31, 2018 for reports that are current to December 31 of each of the years 2014 to 2017;

(*d*) on or before March 31, 2022 for reports that are current to December 31 of each of the years 2018 to 2021;

(*e*) on or before March 31, 2026 for reports that are current to December 31 of each of the years 2022 to 2025;

(*f*) on or before March 31, 2027 for reports that are current to December 31 of the year 2026; and

(*g*) on or before March 31, 2030 for reports that are current to December 31 of each of the years 2027 to 2029.

SOR/2010-57, s. 16(F).

*a*) au plus tard le 31 mars 2010, s'il porte sur toute année civile suivant l'entrée en vigueur du présent règlement jusqu'à l'année 2009;

*b*) au plus tard le 31 mars 2014, s'il porte sur l'une ou l'autre des années 2010 à 2013;

*c*) au plus tard le 31 mars 2018, s'il porte sur l'une ou l'autre des années 2014 à 2017;

*d*) au plus tard le 31 mars 2022, s'il porte sur l'une ou l'autre des années 2018 à 2021;

*e*) au plus tard le 31 mars 2026, s'il porte sur l'une ou l'autre des années 2022 à 2025;

*f*) au plus tard le 31 mars 2027, s'il porte sur l'année 2026;

*g*) au plus tard le 31 mars 2030, s'il porte sur l'une ou l'autre des années 2027 à 2029.

DORS/2010-57, art. 16(F).

Release into the environment

**40.** (1) For the purposes of paragraph 95(1)(*a*) of the Act, where there occurs or is a likelihood of a release into the environment of PCBs in contravention of section 5, the person who is designated to be provided with a written report is the Regional Director, Environmental Enforcement Division, Enforcement Branch of the Department of the Environment in the region where the release occurs or is likely to occur.

Rejets dans l'environnement

**40.** (1) Pour l'application de l'alinéa 95(1)*a*) de la Loi, en cas de rejet dans l'environnement — effectif ou probable — de BPC en violation de l'article 5, la personne désignée pour recevoir le rapport écrit est le directeur régional, Division de l'application de la loi en environnement, Direction générale de l'application de la loi du ministère de l'Environnement, dans la région où a lieu le rejet — effectif ou probable.

Contents

(2) The report shall include the following information:

(*a*) the name, civic and mailing addresses and telephone number of the person who owns or has the charge, manage-

Contenu

(2) Le rapport comporte les renseignements suivants :

*a*) les nom, adresses municipale et postale et numéro de téléphone de la personne qui a toute autorité sur les BPC

ment or control of the PCBs that are released into the environment;

(*b*) the date, time and location of the release;

(*c*) a description of the source of the release; and

(*d*) the quantity of liquids containing PCBs released, expressed in litres, the quantity of solids containing PCBs released, expressed in kilograms, and the concentration of PCBs in the liquids and the solids that are released, expressed in mg/kg.

SOR/2010-57, s. 17.

qui ont été rejetés dans l'environnement ou qui en est propriétaire;

*b*) les date, heure et lieu du rejet;

*c*) une description de la source du rejet;

*d*) la quantité de liquides qui contiennent des BPC rejetés, exprimée en litres, la quantité de solides qui contiennent des BPC rejetés, exprimée kilogrammes, et la concentration de BPC dans les liquides ou les solides rejetés, exprimée en mg/kg.

DORS/2010-57, art. 17.

Retention

**41.** Any person who is required to submit a report under these Regulations shall keep a copy of the report at their principal place of business in Canada for at least five years after the day on which the report is submitted.

Conservation

**41.** Toute personne qui est tenue de présenter un rapport en application du présent règlement en conserve une copie à son établissement principal au Canada pendant au moins cinq ans après la date de sa présentation.

Method of submission

**42.** Each report referred to in sections 33 to 38 shall be submitted electronically in the format provided by the Department of the Environment, but the report shall be submitted in writing if

(*a*) no such format is provided; or

(*b*) it is, owing to circumstances beyond the control of the person required to submit the report, impracticable to submit the report electronically in the format provided.

Méthode de présentation

**42.** Les rapports visés aux articles 33 à 38 sont présentés sous forme électronique selon le modèle établi par le ministère de l'Environnement. Ils sont toutefois présentés par écrit dans les cas suivants :

*a*) aucun modèle n'a été établi par le ministère;

*b*) il est pratiquement impossible, pour des raisons indépendantes de la volonté de la personne tenue de les présenter, de le faire sous forme électronique selon le modèle établi.

RECORDS

DOCUMENTS ET REGISTRES

Records for permitted activities

**43.** The following persons shall maintain records that demonstrate that they manufacture, process, use, sell, offer for sale, store, import or export PCBs or products containing PCBs in accordance with the Act and these Regulations:

Documents concernant les activités permises

**43.** Les personnes ci-après conservent les documents établissant que des BPC ou des produits qui en contiennent ont été fabriqués, transformés, utilisés, mis en vente, vendus, stockés, importés ou exportés

(*a*) the owner of PCBs or products containing PCBs;

(*b*) the person who is engaged in any of these activities; and

(*c*) the owner or operator of a PCB storage site.

conformément à la Loi et au présent règlement :

*a*) le propriétaire des BPC ou des produits;

*b*) la personne qui exerce l'activité;

*c*) le propriétaire ou l'exploitant du dépôt de BPC.

Inspection record

**44.** (1) The owner or operator of a PCB storage site shall maintain a record of all inspections conducted at the PCB storage site under paragraph 27(*a*)

(*a*) listing all items that are inspected;

(*b*) describing any deficiency found;

(*c*) setting out the measures taken to remedy the deficiency; and

(*d*) specifying the dates of the inspections and the names of the inspectors.

Registres d'inspections

**44.** (1) Le propriétaire ou l'exploitant d'un dépôt de BPC tient un registre de toutes les inspections effectuées au dépôt de BPC en application de l'alinéa 27*a*), lequel fait état :

*a*) de tous les points inspectés;

*b*) de toutes les lacunes relevées;

*c*) des mesures prises pour y remédier;

*d*) de la date de l'inspection et du nom de l'inspecteur.

Owner of equipment — extension

(2) The owner of equipment for which an extension of the end-of-use date is applied under section 17 shall maintain a record of all inspections conducted on the equipment that contains the information set out in paragraphs (1)(*a*) to (*d*).

SOR/2010-57, s. 18(F).

Propriétaire d'une pièce d'équipement — prolongation

(2) Le propriétaire d'une pièce d'équipement dont l'utilisation fait l'objet d'une prolongation en vertu de l'article 17 tient un registre de toutes les inspections de la pièce d'équipement qui ont été effectuées, lequel fait état des renseignements prévus aux alinéas (1)*a*) à *d*).

DORS/2010-57, art. 18(F).

Retention of records

**45.** The person who is required to maintain a record under sections 43 and 44 shall retain it at their principal place of business in Canada or at the place where they conduct the activity for at least five years

(*a*) after the destruction of the PCBs or the products containing PCBs that are the subject of the record, in the case of the owner of PCBs or products containing PCBs or the owner or operator of the PCB storage site where the PCBs or products containing PCBs are stored; or

Conservation des dossiers

**45.** Toute personne qui est tenue de conserver des documents ou de tenir un registre en application des articles 43 et 44 respectivement les conserve à son établissement principal au Canada ou à l'établissement où l'activité est exercée pendant au moins cinq ans après :

*a*) dans le cas du propriétaire de BPC ou de produits qui en contiennent ou du propriétaire ou de l'exploitant d'un dépôt de BPC où sont stockés des BPC ou des produits qui en contiennent, la date de destruction des BPC ou des produits

(*b*) after the completion of an activity referred to in section 43, in the case of the person who is engaged in that activity.

qui en contiennent visés par le document ou le registre;

*b*) dans le cas de la personne qui exerce une activité visée à l'article 43, la date de la fin de l'activité.

PART 5

REPEALS AND COMING INTO FORCE

PARTIE 5

ABROGATIONS ET ENTRÉE EN VIGUEUR

**Repeals**

**46.** [Repeal]

**47.** [Repeal]

**Abrogation**

**46.** [Abrogation]

**47.** [Abrogation]

**Coming into Force**

Coming into force

**48. These Regulations come into force on the day on which they are registered.**

**Entrée en vigueur**

Entrée en vigueur

**48. Le présent règlement entre en vigueur à la date de son enregistrement.**

**APPENDIX C**
**REPLACEMENT PLAN**

Environment Canada Environnement Canada

Newfoundland and Labrador Hydro, a Nalcor Energy Company
P.O. Box 2002
Bishop's Falls, Newfoundland, Canada A0H 1C0

23 August 2010 / 23 août 2010

**EXTENSION OF DECEMBER 31, 2009 END-OF-USE DATE FOR EQUIPMENT AND LIQUIDS CONTAINING PCBs** Granted Under Subsection 17(2) of the *PCB Regulations*

**PROLONGATION DE LA DATE DE FIN D'UTILISATION DU 31 DÉCEMBRE 2009 POUR DES PIÈCES D'ÉQUIPEMENT ET DES LIQUIDES QUI CONTIENNENT DES BPC** Accordée en vertu du paragraphe 17(2) du *Règlement sur les BPC*

**File Number / No. de dossier : 09/061.1/EXT**

The Department of the Environment grants Newfoundland and Labrador Hydro, Bishop's Falls, the extension requested in its application. The end-of-use date of the equipment and liquids used for their servicing described below is extended from December 31, 2009 to the dates indicated in the table below.

This extension is granted in accordance with subsection 17(2) of the *PCB Regulations*. The condition specified in subparagraph 17(2)(*a*)(i) of the Regulations and referred to in the application is met.

Le ministère de l'Environnement accorde à Newfoundland and Labrador Hydro, Bishop's Falls, la prolongation exigée dans sa demande. La date de fin d'utilisation des pièces d'équipement et des liquides nécessaires à leur entretien décrits ci-dessous est reportée du 31 décembre 2009 aux dates indiquées au tableau ci-dessous.

Cette prolongation est accordée en vertu du paragraphe 17(2) du *Règlement sur les BPC*. La condition énoncée au sous-alinéa 17(2)*a*)(i) du Règlement et invoquée dans la demande est remplie.

| Number of pieces of equipment / Nombre de pièces d'équipement | Extension date/Date de prolongation |
|---|---|
| 37<br>(24 transformers bushings in service, 4 current transformers in service, 9 potential transformers in service) | 31 December 2010 |
| 34<br>( 21 transformers bushings in service, 6 current transformers in service, 7 potential transformers in service | 31 December 2011 |

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| | |
|---|---|
| 31<br>( 18 transformers bushings in service, 5 current transformers in service,<br>8 potential transformers in service) | 31 December 2012 |
| 48<br>(28 transformers bushings in service, 6 current transformers in service,<br>14 potential transformers in service) | 31 December 2013 |
| 1,067<br>(551 transformers bushings in service, 276 breaker bushings in service,<br>122 current transformers in service,<br>118 potential transformers in service) | 31 December 2014 |
| **Total – 1,217** | |

**Condition referred to in the application for an extension / Condition invoquée dans la demande de prolongation**

The equipment is being replaced with equipment that is engineered to order, and it is not technically feasible to replace the equipment on or before December 31, 2009.

La pièce d'équipement doit être remplacée par une pièce d'équipement conçue et fabriquée sur mesure et il est techniquement impossible de le faire le 31 décembre 2009 ou avant cette date.

**Applicant and person authorized to act on applicant's behalf Demandeur et personne autorisée à agir en son nom**

**Applicant/ Demandeur, 17(3)(a)**
Newfoundland and Labrador Hydro, a Nalcor Energy Company
P.O. Box 2002
Bishop's Falls, Newfoundland, Canada A0H 1C0

**Person authorized to act on applicant's behalf/ Personne autorisée à agir au nom du demandeur, 17(3)(a)**
Facility/Technical Contact:
Hughie Ireland, P.Eng
Manager Generation and Terminals.
TRO Central
Tel: (709) 258-2367
Fax: (709) 258-2346
Email: hireland@nlh.nl.ca

**Owner of equipment containing PCBs/ Propriétaire des pièces d'équipement contenant des BPC, 17(1)**
Same as applicant above.



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Environment Canada Environnement Canada

**Description and location of equipment and liquids needed for their servicing / Description et emplacement des pièces d'équipement et des liquides nécessaires à leur entretien**

**See attached list of equipment for details, this list is part of the authorization / Voir la liste des pièces d'équipements annexée pour le détail, cette liste fait partie intégrante de l'autorisation**

**Type and function of the equipment/ Type et fonction de l'équipement, 17(3)(b)(i):** 1,217 pieces of equipment in service at the utility Transmission an Rural Operations Terminal Stations and potentially containing PCBs in a concentration greater than 500 mg/kg as manufactured in 1985 or earlier. Details indicated in attached Tables for: 642 power transformer bushings in service in Table 1, 276 breaker bushings in service (oil circuit breaker bushings) indicated in Table 2, 143 current transformers in service indicated in Table 3, and 156 potential transformers in service indicated in Table 4.

**Quantity of liquid (litres) containing PCBs in the equipment/ Quantité de liquide (litres) contenant des BPC dans la pièce d'équipement, 17(3)(b)(ii)**: An estimated total of 23,805 Litres of liquid for all 1,217 pieces of equipment. See Tables attached for details on each piece of equipment.

**Quantity of liquid (litres) containing PCBs needed for its servicing/ Quantité de liquide (litres) contenant des BPC nécessaire à son entretien, 17(3)(b)(ii)**: No additional liquids are kept for the purpose of servicing the working equipment.

**Concentration of PCBs (mg/kg) in the liquid/ Concentration de BPC (mg/kg) dans le liquide, 17(3)(b)(iii)**: Estimated average PCB concentration of 550 mg/kg is used for all 1,217 pieces of equipment.

**Quantity of PCBs (kg) in the liquid/ Quantité de BPC (kg) dans le liquide/, 17(3)(b)(iv)**: An estimated total of 11,783.48 kg of PCBs in the liquid for all 1,217 pieces of equipment. See attached Tables for details on each piece of equipment.

**Name-plate description, manufacturer's serial number/ Plaque d'identification et numéro de série, 17(3)(b)(v) :** See attached Tables for details on each piece of equipment.

**Unique identification number on the label required under section 29/ Numéro d'identification unique sur l'étiquette conformément à l'article 29, 17(3)(c ):** Labels will be placed on equipment listed in attached tables once they are tested and confirmed to contain PCBs in a concentration greater than 500 mg/kg.

**Place where the equipment is located/ Endroit où se trouve la pièce d'équipement, 17(3)(d):** The equipment is located outdoors at Transmission and Rural Operations (TRO) Terminal Stations indicated in attached Tables. All of the stations are locked and fenced. There

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is no specific address for the stations in which the equipment is located. Newfoundland and Labrador Hydro's site identification system is used for the identification of their location.

**Information demonstrating that it is not technically feasible to replace the equipment with equipment that is engineered to order on or before December 31, 2009/ Renseignements qui établissent qu'il est techniquement impossible de remplacer la pièce d'équipement conçue et fabriquée sur mesure le 31 décembre 2009 ou avant cette date, 17(3)(e):** The information provided in the application for an extension in accordance with this section indicate that the applicant is meeting the condition specified in subparagraph 17(2)*a*)(i).

**Necessary measures taken to minimize or eliminate any harmful effect of the PCBs that are contained in the equipment on the environment and human health/ Mesures nécessaires prises pour éliminer ou atténuer tout effet nocif des BPC contenus dans la pièce d'équipement sur l'environnement et la santé humaine, 17(3)(f):** The measures are indicated in the application for an extension.

**Plan for ending the use of equipment by the end of the extension along with timelines/ Plan et échéancier mis en oeuvre afin que l'utilisation de la pièce d'équipement cesse à la fin de la prolongation, 17(3)(g):** Provided in the application for an extension. The equipment will be removed by the specific end-of-use dates indicated in the attached Tables.

**Plan for inspecting equipment/ Plan d'inspection de la pièce d'équipement, 17(3)(h)**: Monthly inspections will be conducted for the period of the extension for damage that could lead to the release of PCBs for equipment confirmed to contain PCBs in a concentration greater than 500 mg/kg.

Please take note that it is your responsibility as the owner or the person who controls or possesses the equipment and liquids containing PCBs to ensure that the requirements set out in the *PCB Regulations* made pursuant to CEPA 1999 are complied with at all time.

Veuillez noter qu'en tant que propriétaire ou personne qui contrôle ou possède les pièces d'équipement et des liquides contenant des BPC il vous incombe de veiller à ce que les exigences établies dans le *Règlement sur les BPC* et dans la LCPE (1999) soient remplies en tout temps.



Canada

Environment Canada Environnement Canada

Signed for and on behalf of the Minister of the Environment /
Signé au nom du ministre de l'Environnement



Tim Gardiner
Director / Directeur
Waste Reduction & Management / Réduction et gestion des déchets
Public and Resources Sectors / Secteurs publics et des ressources
Environment Canada / Environnement Canada



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**Table 1 – Transformer Bushings in Service**

| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c) &29) | Quantity of Liquid containing PCBs (L) per equipment (17(3)(b)(ii)) | Total Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid per equipment (kg) (17(3)(b)(iv)) | Total Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer, if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(vi)) | End-of-Use Date | Bushing Type | Number in Service | Associated Asset Type | Associated Asset Mfg | Associated Asset Year | Associated Asset Serial Number | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BDE | Bay D'Espoir | T7 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 3 | Transformer | CGE | 1977 | 288926 | 196 | 600 | TROC | All liquid volumes are estimated. |
| BDE | Bay D'Espoir | T7 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2010 | LC | 3 | Transformer | CGE | 1977 | 288926 | 15 | 8000 | TROC | |
| BDE | Bay D'Espoir | T7 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2010 | D | 1 | Transformer | CGE | 1977 | 288926 | 15 | 1200 | TROC | |
| BDE | Bay D'Espoir | T6 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2010 | RS-10 | 3 | Transformer | WESTINGHOUSE | 1969 | A-357764 | 15 | 3000 | TROC | |
| MDR | Massey Drive | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 3 | Transformer | CGE | 1970 | 287527 | 196 | 600 | TROC | |
| MDR | Massey Drive | T2 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 3 | Transformer | CGE | 1970 | 287527 | 69 | 1200 | TROC | |
| MDR | Massey Drive | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2010 | D | 1 | Transformer | CGE | 1970 | 287527 | 15 | 400 | TROC | |
| WAV | Western Avalon | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 3 | Transformer | CGE | 1973 | 286101 | 196 | 400 | TROC | |
| WAV | Western Avalon | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 3 | Transformer | CGE | 1973 | 286101 | 69 | 400 | TROC | |
| WAV | Western Avalon | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2010 | U | 1 | Transformer | CGE | 1973 | 286101 | 15 | 400 | TROC | |
| BDE | Bay D'Espoir | T4 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2011 | U | 3 | Transformer | CGE | 1968 | 286669 | 196 | 400 | TROC | |
| BDE | Bay D'Espoir | T4 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2011 | DSU | 3 | Transformer | CGE | 1968 | 286669 | 15 | 4000 | TROC | |
| BDE | Bay D'Espoir | T4 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2011 | DSU | 1 | Transformer | CGE | 1968 | 286669 | 15 | 400 | TROC | |
| BBK | Bottom Brook | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2011 | U | 3 | Transformer | CGE | 1967 | 286625 | 196 | 400 | TROC | |
| BBK | Bottom Brook | T1 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2011 | U | 3 | Transformer | CGE | 1967 | 286625 | 115 | 400 | TROC | |
| BBK | Bottom Brook | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2011 | D | 1 | Transformer | CGE | 1967 | 286625 | 15 | 400 | TROC | |
| OPD | Oxen Pond | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2011 | O | 3 | Transformer | WESTINGHOUSE | 1967 | 293314 | 196 | 400 | TROC | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OPD | Oxen Pond | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2011 | ON | 3 | Transformer | WESTINGHOUSE | 1967 | 293314 | 69 | 1200 | TROC | |
| OPD | Oxen Pond | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2011 | 544C638G03 | 1 | Transformer | WESTINGHOUSE | 1967 | 293314 | 15 | 400 | TROC | |
| BDE | Bay D'Espoir | T6 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2012 | O | 3 | Transformer | WESTINGHOUSE | 1969 | A-357764 | 196 | 400 | TROC | |
| BDE | Bay D'Espoir | T6 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2012 | 544C638G03 | 1 | Transformer | WESTINGHOUSE | 1969 | A-357764 | 15 | 400 | TROC | |
| MDR | Massey Drive | T3 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2012 | GK | 3 | Transformer | WESTINGHOUSE | 1981 | A-3-S-5316 | 69 | 1200 | TROC | |
| MDR | Massey Drive | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2012 | GK | 1 | Transformer | WESTINGHOUSE | 1981 | A-3-S-5316 | 15 | 400 | TROC | |
| MDR | Massie Drive | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2012 | U | 3 | Transformer | WESTINGHOUSE | 1981 | A-3-S-5316 | 230 | 600 | TROC | |
| OPD | Oxen Pond | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2012 | T-25 | 3 | Transformer | WESTINGHOUSE | 1977 | A-3-S-7857 | 196 | 600 | TROC | |
| OPD | Oxen Pond | T3 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2012 | T-10 | 3 | Transformer | WESTINGHOUSE | 1977 | A-3-S-7857 | 69 | 1200 | TROC | |
| OPD | Oxen Pond | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2012 | T-10 | 1 | Transformer | WESTINGHOUSE | 1977 | A-3-S-7857 | 15 | 400 | TROC | |
| BDE | Bay D'Espoir | T5 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2013 | O | 3 | Transformer | WESTINGHOUSE | 1968 | A-357757 | 196 | 400 | TROC | |
| BDE | Bay D'Espoir | T5 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2013 | 544C638G03 | 1 | Transformer | WESTINGHOUSE | 1968 | A-357757 | 15 | 400 | TROC | |
| BDE | Bay D'Espoir | T5 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2013 | RS-10 | 3 | Transformer | WESTINGHOUSE | 1968 | A-357757 | 15 | 3000 | TROC | |
| BBK | Bottom Brook | T2 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | WEST | Unknown | 31-Dec-2013 | O | 3 | Transformer | WESTINGHOUSE | 1967 | 293692 | 115 | 400 | TROC | |
| BBK | Bottom Brook | T2 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2013 | ON | 3 | Transformer | WESTINGHOUSE | 1967 | 293692 | 69 | 400 | TROC | |
| BBK | Bottom Brook | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2013 | O | 1 | Transformer | WESTINGHOUSE | 1967 | 293692 | 15 | 400 | TROC | |
| BUC | Buchans | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2013 | O | 3 | Transformer | WESTINGHOUSE | 1967 | 293315 | 196 | 400 | TROC | |
| BUC | Buchans | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2013 | ON | 3 | Transformer | WESTINGHOUSE | 1967 | 293315 | 69 | 120 | TROC | |
| BUC | Buchans | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2013 | 544C638G03 | 1 | Transformer | WESTINGHOUSE | 1967 | 293315 | 15 | 400 | TROC | |
| CBC | Come By Chance | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2013 | OSF | 3 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-A | 230 | 600 | TROC | |
| CBC | Come By Chance | T1 LOW | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2013 | T10 | 3 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-A | 0.6 | 2400 | TROC | |
| CBC | Come By Chance | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2013 | T10 | 1 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-A | 15 | 2000 | TROC | |
| BRT | Bartlett | T1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6270 | 46 | Unknown | | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BRT | Bartlett | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6270 | 4.16 | Unknown | | | |
| BRT | Bartlett | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | Unknown | A-3S-6270 | 4.16 | Unknown | | | |
| BRT | Bartlett | T2 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6192 | 46 | Unknown | | | |
| BRT | Bartlett | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6192 | 46 | Unknown | | | |
| BRT | Bartlett | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | Unknown | A-3S-6192 | 4.16 | Unknown | | | |
| BDE | Bay D'Espoir | SST3 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1977 | 1085443 | 13.8 | Unknown | | | |
| BDE | Bay D'Espoir | SST3 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1977 | 1085443 | 0.575 | Unknown | | | |
| BDE | Bay D'Espoir | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | RS-10 | 3 | Transformer | WESTINGHOUSE | 1966 | 293267 | 15 | 3000 | TROC | | |
| BDE | Bay D'Espoir | T3 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | RS-10 | 3 | Transformer | WESTINGHOUSE | 1967 | 293456 | 15 | 3000 | TROC | | |
| BDE | Bay D'Espoir | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | RS-10 | 3 | Transformer | WESTINGHOUSE | 1966 | 293266 | 15 | 3000 | TROC | | |
| BDE | Bay D'Espoir | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293267 | 196 | 400 | TROC | | |
| BDE | Bay D'Espoir | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | 544C638G03 | 1 | Transformer | WESTINGHOUSE | 1966 | 293267 | 15 | 400 | TROC | | |
| BDE | Bay D'Espoir | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1967 | 293456 | 196 | 400 | TROC | | |
| BDE | Bay D'Espoir | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 1 | Transformer | WESTINGHOUSE | 1967 | 293456 | 15 | 400 | TROC | | |
| BDE | Bay D'Espoir | T11 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 3 | Transformer | WESTINGHOUSE | 1970 | A-3-S-7203 | 69 | Unknown | | | |
| BDE | Bay D'Espoir | T11 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1970 | A-3-S-7203 | 25 | Unknown | | | |
| BDE | Bay D'Espoir | T11 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | D | 1 | Transformer | WESTINGHOUSE | 1970 | A-3-S-7203 | 15 | Unknown | | | |
| BDE | Bay D'Espoir | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293266 | 196 | 400 | TROC | | |
| BDE | Bay D'Espoir | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 1 | Transformer | WESTINGHOUSE | 1966 | 293266 | 15 | 400 | TROC | | |
| BDE | Bay D'Espoir | T10 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7380 | 196 | 600 | TROC | | |
| BDE | Bay D'Espoir | T10 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7380 | 69 | 400 | TROC | | |
| BDE | Bay D'Espoir | T10 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 1 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7380 | 35 | 400 | TROC | | |
| BDE | Bay D'Espoir | SST1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1966 | 293286 | 13.8 | Unknown | | | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BDE | Bay D'Espoir | SST1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1966 | 293286 | 0.575 | Unknown | | | |
| BDE | Bay D'Espoir | SST2 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1966 | 293285 | 13.8 | Unknown | | | |
| BDE | Bay D'Espoir | SST2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1966 | 293285 | 0.575 | Unknown | | | |
| BDE | Bay D'Espoir | SST1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | WESTINGHOUSE | 1966 | 293286 | 15 | Unknown | | | |
| BDE | Bay D'Espoir | SST2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | WESTINGHOUSE | 1966 | 293285 | 15 | Unknown | | | |
| BDE | Bay D'Espoir | SST3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | CGE | 1977 | 1085443 | 15 | Unknown | | | |
| BIF | Bishop's Falls | P235 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | COB | Unknown | 31-Dec-2014 | GK-40 | 3 | Transformer | MOLONEY ELECTRIC | 1973 | 268343 | 115 | 600 | TROC | | |
| BIF | Bishop's Falls | P235 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transformer | MOLONEY ELECTRIC | 1973 | 268343 | 69 | 400 | TROC | | |
| BIF | Bishop's Falls | P235 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | GK-15 | 1 | Transformer | MOLONEY ELECTRIC | 1973 | 268343 | 25 | 1200 | TROC | | |
| BIF | Bishop's Falls | P235 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R-10 | 1 | Transformer | MOLONEY ELECTRIC | 1973 | 268343 | 15 | 400 | TROC | | |
| BUC | Buchans | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | COB | Unknown | 31-Dec-2014 | GK-40 | 3 | Transformer | FERRANTI PACKARD | 1983 | 293315 | 115 | 600 | TROC | | |
| BUC | Buchans | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FERRANTI PACKARD | 1966 | 1-2718 | 69 | Unknown | | | |
| BUC | Buchans | GT1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FERRANTI PACKARD | 1966 | 1-2718 | 13.8 | Unknown | | | |
| CAT | Cat Arm | SST1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0111-1 | 13.8 | Unknown | | | |
| CAT | Cat Arm | SST1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0111-1 | 0.6 | Unknown | | | |
| CAT | Cat Arm | SST2 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0111-2 | 13.8 | Unknown | | | |
| CAT | Cat Arm | SST2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0111-2 | 0.6 | Unknown | | | |
| CAT | Cat Arm | SST3 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0995:1 | 12.5 | Unknown | | | |
| CAT | Cat Arm | SST3 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CARTE ELECTRIC | 1984 | L0995:1 | 0.6 | Unknown | | | |
| CBC | Come By Chance | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-B | 230 | 600 | TROC | | |
| CBC | Come By Chance | T2 LOW | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | T10 | 3 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-B | 0.6 | 2400 | TROC | | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CBC | Come By Chance | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | T10 | 1 | Transformer | WESTINGHOUSE | 1972 | 3-S-7548-B | 15 | 2000 | TROC |
| CRV | Conne River | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FEDERAL PIONEER | 1976 | 305960 | 69 | Unknown | |
| CRV | Conne River | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FEDERAL PIONEER | 1976 | 305960 | 12.5 | Unknown | |
| CBF | Corner Brook | T2 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transformer | MOLONEY ELECTRIC | 1966 | 230814 | 69 | 400 | TROC |
| CBF | Corner Brook | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | R5 | 3 | Transformer | MOLONEY ELECTRIC | 1966 | 230814 | 8.7 | 3000 | TROC |
| CBF | Corner Brook | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R10 | 1 | Transformer | MOLONEY ELECTRIC | 1966 | 230814 | 15 | 400 | TROC |
| CHD | Cow Head | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transformer | MOLONEY ELECTRIC | 1978 | 3674-1 | 69 | 400 | TRON |
| CHD | Cow Head | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | GK-20 | 3 | Transformer | MOLONEY ELECTRIC | 1978 | 3674-1 | 34.5 | 400 | TRON |
| CHD | Cow Head | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R10 | 1 | Transformer | MOLONEY ELECTRIC | 1978 | 3674-1 | 15 | 400 | TRON |
| DHR | Daniels Harbour | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 3 | Transformer | WESTINGHOUSE | 1970 | B-3-S-6118 | 69 | 400 | TRON |
| DHR | Daniels Harbour | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | T10 | 3 | Transformer | WESTINGHOUSE | 1970 | B-3-S-6118 | 25 | 400 | TRON |
| DHR | Daniels Harbour | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 1 | Transformer | WESTINGHOUSE | 1970 | B-3-S-6118 | 8.7 | 400 | TRON |
| DHR | Daniels Harbour | T2 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 3 | Transformer | WESTINGHOUSE | 1970 | A-3-S-6118 | 69 | 400 | TRON |
| DHR | Daniels Harbour | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | T10 | 3 | Transformer | WESTINGHOUSE | 1970 | A-3-S-6118 | 25 | 400 | TRON |
| DHR | Daniels Harbour | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 1 | Transformer | WESTINGHOUSE | 1970 | A-3-S-6118 | 8.7 | 400 | TRON |
| DLK | Deer Lake | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1980 | 66310 | 138 | 600 | TROC |
| DLK | Deer Lake | T1 LOW | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1980 | 66310 | 69 | 1200 | TROC |
| DLK | Deer Lake | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FERRANTI PACKARD | 1983 | 42511 | 230 | 600 | TROC |
| DLK | Deer Lake | T2 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FERRANTI PACKARD | 1983 | 42511 | 145 | 600 | TROC |
| DLK | Deer Lake | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R-10 | 1 | Transformer | FERRANTI PACKARD | 1983 | 42511 | 15 | 400 | TROC |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DLK | Deer Lake | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R-5 | 1 | Transformer | FERRANTI PACKARD | 1983 | 42511 | 8.7 | 2000 | TROC |
| DLK | Deer Lake | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | FEDERAL PIONEER | 1980 | 66310 | 15 | Unknown | |
| EHW | English Harbour West | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transformer | FEDERAL PIONEER | 1980 | T-60127-1 | 69 | 400 | TROC |
| EHW | English Harbour West | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | GK-15 | 3 | Transformer | FEDERAL PIONEER | 1980 | T-60127-1 | 25 | 400 | TROC |
| EHW | English Harbour West | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | FEDERAL PIONEER | 1980 | T-60127-1 | 15 | Unknown | |
| GLB | Glenburnie | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 3 | Transformer | WESTINGHOUSE | 1969 | 3-S-6116 | 69 | 400 | TRON |
| GLB | Glenburnie | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 3 | Transformer | WESTINGHOUSE | 1969 | 3-S-6116 | 25 | 400 | TRON |
| GLB | Glenburnie | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 1 | Transformer | WESTINGHOUSE | 1969 | 3-S-6116 | 8.7 | 400 | TRON |
| GFC | Grand Falls | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293247 | 196 | 400 | TROC |
| GFC | Grand Falls | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293247 | 15 | 5000 | TROC |
| GFC | Grand Falls | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 1 | Transformer | WESTINGHOUSE | 1966 | 293247 | 15 | 400 | TROC |
| GFC | Grand Falls | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293246 | 196 | 400 | TROC |
| GFC | Grand Falls | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1966 | 293246 | 15 | 5000 | TROC |
| GFC | Grand Falls | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 1 | Transformer | WESTINGHOUSE | 1966 | 293246 | 15 | 400 | TROC |
| HDN | Hampden | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1981 | T-60508 | 69 | 400 | TROC |
| HDN | Hampden | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | GK-20 | 3 | Transformer | FEDERAL PIONEER | 1981 | T-60508 | 34.5 | 400 | TROC |
| HDN | Hampden | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | GK-15 | 1 | Transformer | FEDERAL PIONEER | 1981 | T-60508 | 25 | 400 | TROC |
| HVY | Happy Valley | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1977 | 60013-101-01 | 138 | 600 | TROL |
| HVY | Happy Valley | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 3 | Transformer | CGE | 1977 | 60013-101-01 | 25 | 1200 | TROL |
| HVY | Happy Valley | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1977 | 60013-101-01 | 15 | 400 | TROL |
| HVY | Happy Valley | T2 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1977 | 289067 | 138 | 600 | TROL |
| HVY | Happy Valley | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 3 | Transformer | CGE | 1977 | 289067 | 25 | 1200 | TROL |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HVY | Happy Valley | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1977 | 289067 | 15 | Unknown | | | |
| HWD | Hardwoods | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1972 | 287959 | 196 | 600 | TROC | | |
| HWD | Hardwoods | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1972 | 287959 | 69 | 1200 | TROC | | |
| HWD | Hardwoods | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1972 | 287959 | 15 | 400 | TROC | | |
| HWD | Hardwoods | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 286852 | 196 | 600 | TROC | | |
| HWD | Hardwoods | T3 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 286852 | 69 | 1200 | TROC | | |
| HWD | Hardwoods | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1968 | 286852 | 15 | 400 | TROC | | |
| HWD | Hardwoods | T5 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7430 | 69 | 1200 | TROC | | |
| HWD | Hardwoods | T5 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7430 | 15 | 4000 | TROC | | |
| HWD | Hardwoods | T5 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 1 | Transformer | WESTINGHOUSE | 1976 | A-3-S-7430 | 25 | 400 | TROC | | |
| HWD | Hardwoods | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1976 | A-3S-7561 | 230 | Unknown | | | |
| HWD | Hardwoods | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1976 | A-3S-7561 | 66 | Unknown | | | |
| HWD | Hardwoods | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1976 | 289112 | 66 | Unknown | | | |
| HWD | Hardwoods | GT1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1976 | 289112 | 0.6 | Unknown | | | |
| HRL | Harrie Lake | T1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | 1960 | 291212 | 46 | Unknown | | | |
| HRL | Harrie Lake | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | 1960 | 291212 | 4.16 | Unknown | | | |
| HRL | Harrie Lake | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | 1960 | 291212 | 4.16 | Unknown | | | |
| HBY | Hawks Bay | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transformer | H.K. PORTER CO. | 1976 | 22340 | 69 | 400 | TRON | | |
| HBY | Hawks Bay | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | R-15 | 3 | Transformer | H.K. PORTER CO. | 1976 | 22340 | 25 | 400 | TRON | | |
| HBY | Hawks Bay | T2 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 3 | Transformer | WESTINGHOUSE | 1969 | A3-S-6119 | 69 | 400 | TRON | | |
| HBY | Hawks Bay | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 3 | Transformer | WESTINGHOUSE | 1969 | A3-S-6119 | 25 | 400 | TRON | | |
| HBY | Hawks Bay | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | ON | 1 | Transformer | WESTINGHOUSE | 1969 | A3-S-6119 | 8.7 | 400 | TRON | | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HBY | Hawks Bay | T3 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | R-15 | 3 | Transformer | PIONEER ELECTRIC | 1971 | T-4400-1 | 25 | 400 | TRON | | |
| HBY | Hawks Bay | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | R-15 | 1 | Transformer | PIONEER ELECTRIC | 1971 | T-4400-1 | 25 | 400 | TRON | | |
| HBY | Hawks Bay | T3 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1971 | T-4400-1 | 4.16 | Unknown | | | |
| HLK | Hinds Lake | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FERRANTI PACKARD | 1980 | 1-4227 | 115 | 600 | TROC | | |
| HLK | Hinds Lake | T2 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FERRANTI PACKARD | 1980 | 1-4227 | 115 | 600 | TROC | | |
| HLK | Hinds Lake | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R-10 | 1 | Transformer | FERRANTI PACKARD | 1980 | 1-4227 | 15 | 400 | TROC | | |
| HLK | Hinds Lake | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | R-10 | 1 | Transformer | FERRANTI PACKARD | 1980 | 1-4228 | 15 | 400 | TROC | | |
| HLK | Hinds Lake | SS1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FEDERAL PIONEER | 1980 | G5710-1 | 13.8 | Unknown | | | |
| HLK | Hinds Lake | SS1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FEDERAL PIONEER | 1980 | G5710-1 | 0.6 | Unknown | | | |
| HLK | Hinds Lake | SSI NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | FEDERAL PIONEER | 1980 | G5710-1 | 15 | Unknown | | | |
| HRD | Holyrood | T6 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1966 | 286167 | 196 | 400 | TROC | | |
| HRD | Holyrood | T6 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1966 | 286167 | 115 | 400 | TROC | | |
| HRD | Holyrood | T6 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1966 | 286167 | 15 | 400 | TROC | | |
| HRD | Holyrood | T7 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1969 | 287064 | 196 | 400 | TROC | | |
| HRD | Holyrood | T7 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1969 | 287064 | 115 | 400 | TROC | | |
| HRD | Holyrood | T7 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1969 | 287064 | 15 | 400 | TROC | | |
| HRD | Holyrood | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1970 | 287198 | 230 | 400 | TROC | | |
| HRD | Holyrood | T3 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 3 | Transformer | CGE | 1970 | 287198 | 25 | 7000 | TROC | | |
| HRD | Holyrood | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 1 | Transformer | CGE | 1970 | 287198 | 15 | 1200 | TROC | | |
| HRD | Holyrood | SST3,4 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK | 3 | Transformer | WESTINGHOUSE | 1978 | A-3-S-7608 | 69 | 400 | TROC | | |
| HRD | Holyrood | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | FELTEN & GUILLEAUME | Unknown | 31-Dec-2014 | EKTF | 3 | Transformer | TRAFO UNION | 1978 | 303236 | 230 | 600 | TROC | | |
| HRD | Holyrood | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | FELTEN & GUILLEAUME | Unknown | 31-Dec-2014 | | 3 | Transformer | TRAFO UNION | 1978 | 303236 | 13.8 | 8000 | TROC | | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HRD | Holyrood | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | FELTEN & GUILLEAUME | Unknown | 31-Dec-2014 | ESKTF | 1 | Transformer | TRAFO UNION | 1978 | 303236 | 15 | 1200 | TROC | |
| HRD | Holyrood | SST3,4 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | 5333D73G04 | 3 | Transformer | WESTINGHOUSE | 1978 | A-3-S-7608 | 5 | 2900 | TROC | |
| HRD | Holyrood | SST3,4 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | 544C639G04 | 1 | Transformer | WESTINGHOUSE | 1978 | A-3-S-7608 | 8.7 | 2000 | TROC | |
| HRD | Holyrood | T5 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1969 | A-3-S-7520 | 230 | 400 | TROC | |
| HRD | Holyrood | T5 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | WEST | Unknown | 31-Dec-2014 | O | 3 | Transformer | WESTINGHOUSE | 1969 | A-3-S-7520 | 115 | 400 | TROC | |
| HRD | Holyrood | T5 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 1 | Transformer | WESTINGHOUSE | 1969 | A-3-S-7520 | 25 | 400 | TROC | |
| HRD | Holyrood | SST1,2 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1969 | WT-1976-1 | 69 | Unknown | | |
| HRD | Holyrood | SST1,2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1969 | WT-1976-1 | 4.16 | Unknown | | |
| HRD | Holyrood | SST1,2 NEUT | 5 | 10 | 550 | 2.48 | 4.95 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 2 | Transformer | PIONEER ELECTRIC | 1969 | WT-1976-1 | 15 | Unknown | | |
| HRD | Holyrood | T9 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1970 | WT-1977-1 | 13.8 | Unknown | | |
| HRD | Holyrood | T9 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1970 | WT-1977-1 | 4.16 | Unknown | | |
| HRD | Holyrood | T9 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | PIONEER ELECTRIC | 1970 | WT-1977-1 | 15 | Unknown | | |
| HLY | Howley | T2 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1981 | T60513 | 138 | 800 | TROC | |
| HLY | Howley | T2 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1981 | T60513 | 69 | 400 | TROC | |
| HLY | Howley | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | GK-20 | 1 | Transformer | FEDERAL PIONEER | 1981 | T60513 | 34.5 | 400 | TROC | |
| HUD | Hudson | T1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6352 | 46 | Unknown | | |
| HUD | Hudson | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3S-6352 | 4.16 | Unknown | | |
| HUD | Hudson | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | Unknown | A-3S-6352 | 4.16 | Unknown | | |
| HUD | Hudson | T2 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | 284305 | 46 | Unknown | | |
| HUD | Hudson | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | 284305 | 4.16 | Unknown | | |
| HUD | Hudson | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | Unknown | 284305 | 4.16 | Unknown | | |
| JAM | Jacksons Arm | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1981 | T-60509 | 69 | 400 | TROC | |
| JAM | Jacksons Arm | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | GK-20 | 3 | Transformer | FEDERAL PIONEER | 1981 | T-60509 | 34.5 | 1200 | TROC | |



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| JAM | Jacksons Arm | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | COB | Unknown | 31-Dec-2014 | GK-25 | 1 | Transformer | FEDERAL PIONEER | 1981 | T-60509 | 25 | 1200 | TROC | |
| LHR | Long Harbour | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 286670 | 230 | 600 | TROC | |
| LHR | Long Harbour | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 286670 | 69 | 1200 | TROC | |
| LHR | Long Harbour | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1968 | 286670 | 15 | 1200 | TROC | |
| MDR | Massey Drive | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1966 | 2755-1 | 66 | Unknown | | |
| MDR | Massey Drive | GT1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1966 | 2755-1 | 69 | Unknown | | |
| MDR | Massey Drive | GT1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | PIONEER ELECTRIC | 1966 | 2755-1 | 15 | Unknown | | |
| MFA | Muskrat Falls | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | WEST | Unknown | 31-Dec-2014 | U | 3 | Transformer | FEDERAL PIONEER | 1982 | T-60559 | 138 | 1200 | TROL | |
| MFA | Muskrat Falls | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FEDERAL PIONEER | 1982 | T-60559 | 34.5 | 400 | TROL | |
| MFA | Muskrat Falls | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | FEDERAL PIONEER | 1982 | T-60559 | 34.5 | 1200 | TROL | |
| OPD | Oxen Pond | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | T1 NEUT | 1966 | 2755-2 | 66 | Unknown | | |
| OPD | Oxen Pond | GT1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | PIONEER ELECTRIC | 1966 | 2755-2 | 6.9 | Unknown | | |
| OPD | Oxen Pond | GT1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | PIONEER ELECTRIC | 1966 | 2755-2 | 15 | Unknown | | |
| PPD | Parsons Pond | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1972 | 288026 | 69 | 400 | TRON | |
| PPD | Parsons Pond | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 3 | Transformer | CGE | 1972 | 288026 | 25 | 400 | TRON | |
| PPD | Parsons Pond | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | CGE | 1972 | 288026 | 15 | Unknown | | |
| PBN | Peter' Barren | SST HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1972 | 287987 | 69 | Unknown | | |
| PBN | Peter' Barren | SST LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1972 | 287987 | 0.6 | Unknown | | |
| PBN | Peter' Barren | SST NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | CGE | 1972 | 287987 | 15 | Unknown | | |
| RHR | Rocky Harbour | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FERRANTI PACKARD | 1983 | 2-350432 | 66 | Unknown | | |
| RHR | Rocky Harbour | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | FERRANTI PACKARD | 1983 | 2-350432 | 25 | Unknown | | |
| RHR | Rocky Harbour | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | FERRANTI PACKARD | 1983 | 2-350432 | 15 | Unknown | | |
| SOK | South Brook | T1 HIGH | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1967 | 286450 | 138 | 600 | TROC | |



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| SOK | South Brook | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 3 | Transformer | CGE | 1967 | 286450 | 25 | 400 | TROC | |
| SOK | South Brook | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1967 | 286450 | 8.7 | 400 | TROC | |
| SVL | Stephenville | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1975 | B-3-S-7561 | 196 | 600 | TROC | |
| SVL | Stephenville | T3 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1975 | B-3-S-7561 | 69 | 1200 | TROC | |
| SVL | Stephenville | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 1 | Transformer | WESTINGHOUSE | 1975 | B-3-S-7561 | 15 | 400 | TROC | |
| SVL | Stephenville | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1975 | A-3-S-7381 | 69 | 1200 | TROC | |
| SVL | Stephenville | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | OSF | 3 | Transformer | WESTINGHOUSE | 1975 | A-3-S-7381 | 15 | 4000 | TROC | |
| SVL | Stephenville | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | T-10 | 1 | Transformer | WESTINGHOUSE | 1975 | A-3-S-7381 | 25 | 400 | TROC | |
| SVL | Stephenville | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1975 | A-3-S-4593 | 66 | Unknown | | |
| SVL | Stephenville | GT1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1975 | A-3-S-4593 | 0.6 | Unknown | | |
| SVL | Stephenville | GT1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | WESTINGHOUSE | 1975 | A-3-S-4593 | 15 | Unknown | | |
| STB | Stony Brook | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288894 | 196 | 600 | TROC | |
| STB | Stony Brook | T1 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288894 | 115 | 800 | TROC | |
| STB | Stony Brook | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 1 | Transformer | CGE | 1976 | 288894 | 15 | 1200 | TROC | |
| STB | Stony Brook | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288839 | 196 | 600 | TROC | |
| STB | Stony Brook | T2 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288839 | 115 | 800 | TROC | |
| STB | Stony Brook | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 1 | Transformer | CGE | 1976 | 288839 | 15 | 1200 | TROC | |
| SSD | Sunnyside | T4 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288838 | 196 | 600 | TROC | |
| SSD | Sunnyside | T4 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1976 | 288838 | 115 | 800 | TROC | |
| SSD | Sunnyside | T4 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 1 | Transformer | CGE | 1976 | 288838 | 15 | 1200 | TROC | |
| SSD | Sunnyside | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1978 | 289147 | 196 | 600 | TROC | |
| SSD | Sunnyside | T1 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1978 | 289147 | 115 | 800 | TROC | |
| SSD | Sunnyside | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 1 | Transformer | CGE | 1978 | 289147 | 15 | 1200 | TROC | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USL | Upper Salmon | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1982 | 289479 | 245 | 600 | TROC | |
| USL | Upper Salmon | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 3 | Transformer | CGE | 1982 | 289479 | 15 | 4000 | TROC | |
| USL | Upper Salmon | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 1 | Transformer | CGE | 1982 | 289479 | 15 | 400 | TROC | |
| USL | Upper Salmon | SS1 Neut | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1982 | T.60548 | 25 | Unknown | | |
| USL | Upper Salmon | SS1 High | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | CGE | Unknown | 31-Dec-2014 | R-10 | 3 | Transformer | CGE | 1982 | T.60548 | 25 | Unknown | | |
| USL | Upper Salmon | T2 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | WEST | Unknown | 31-Dec-2014 | 545C7 40G05 | 3 | Transformer | WESTINGHOUSE | 1966 | 293234 | 25 | Unknown | | |
| USL | Upper Salmon | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | WEST | Unknown | 31-Dec-2014 | 545C7 40G05 | 1 | Transformer | WESTINGHOUSE | 1966 | 293234 | 25 | Unknown | | |
| USL | Upper Salmon | SS1 Low | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | CGE | 1982 | T.60548 | 0.6 | Unknown | | |
| USL | Upper Salmon | T2 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | WESTINGHOUSE | 1966 | 293234 | 13.8 | Unknown | | |
| VAN | Vanier | T1 HIGH | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3-S-6397 | 46 | Unknown | | |
| VAN | Vanier | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 3 | Transformer | Unknown | Unknown | A-3-S-6397 | 4.16 | Unknown | | |
| VAN | Vanier | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unknown | 1 | Transformer | Unknown | Unknown | A-3-S-6397 | 4.16 | Unknown | | |
| WAB | Wabush | T1 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 292003 | 230 | 600 | TROL | |
| WAB | Wabush | T1 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 292003 | 69 | 1200 | TROL | |
| WAB | Wabush | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1968 | 292003 | 15 | 400 | TROL | |
| WAB | Wabush | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 292004 | 230 | 600 | TROL | |
| WAB | Wabush | T2 LOW | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1968 | 292004 | 69 | 1200 | TROL | |
| WAB | Wabush | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | D | 1 | Transformer | CGE | 1968 | 292004 | 15 | 400 | TROL | |
| WAV | Western Avalon | T4 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1969 | 287065 | 196 | 400 | TROC | |
| WAV | Western Avalon | T4 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1969 | 287065 | 115 | 400 | TROC | |
| WAV | Western Avalon | T4 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 1 | Transformer | CGE | 1969 | 287065 | 15 | 400 | TROC | |
| WAV | Western Avalon | T3 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1967 | 286626 | 196 | 400 | TROC | |
| WAV | Western Avalon | T3 LOW | 30 | 90 | 550 | 14.85 | 44.55 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transformer | CGE | 1967 | 286626 | 115 | 400 | TROC | |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WAV | Western Avalon | T3 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 1 | Transforme r | CGE | 1967 | 286626 | 15 | 400 | TROC | |
| WAV | Western Avalon | T2 HIGH | 60 | 180 | 550 | 29.70 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 3 | Transforme r | CGE | 1973 | 288178 | 196 | 400 | TROC | |
| WAV | Western Avalon | T2 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 1 | Transforme r | CGE | 1973 | 288178 | 15 | 400 | TROC | |
| WAV | Western Avalon | GT1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkno wn | 3 | Transforme r | PIONEER ELECTRIC | 1966 | 2755-3 | 66 | Unknown | | |
| WAV | Western Avalon | GT1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkno wn | 3 | Transforme r | PIONEER ELECTRIC | 1966 | 2755-3 | 6.9 | Unknown | | |
| WAV | Western Avalon | GT1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkno wn | 1 | Transforme r | PIONEER ELECTRIC | 1966 | 2755-3 | 15 | Unknown | | |
| WDL | Wilton Dale | T1 NEUT | 5 | 5 | 550 | 2.48 | 2.48 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkno wn | 1 | Transforme r | FEDERAL PIONEER | Unknown | 285537 | 15 | Unknown | | |
| WDL | Wiltondale | T1 HIGH | 10 | 30 | 550 | 4.95 | 14.85 | Bushing | COB | Unknown | 31-Dec-2014 | GK-30 | 3 | Transforme r | FEDERAL PIONEER | Unknown | 285537 | 69 | 400 | TRON | |
| WDL | Wiltondale | T1 LOW | 5 | 15 | 550 | 2.48 | 7.43 | Bushing | COB | Unknown | 31-Dec-2014 | GK-10 | 3 | Transforme r | FEDERAL PIONEER | Unknown | 285537 | 15 | 400 | TRON | |
| | | | **Totals** | **12750** | | | **6311.25** | | | | | | **642** | **pieces of equipment** | | | | | | | |



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**Table 2 – Breaker Bushings in Service**

| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)& 29) | Quantity of Liquid containing PCBs (L) per equipment (17(3)(b)(iii)) | Total Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCBs (mg/kg) (17(3)(b)(iii)) | Quantity of PCBs in the liquid (kg) per equipment (17(3)(b)(iv)) | Total Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Number In Service | Associated Asset Type | Associated Asset Manuf. | Associated Asset Year | Voltage Class (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BBK | Bottom Brook | B2L14 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 138 | 1200 | TROC | All liquid volumes are estimated. |
| BBK | Bottom Brook | L400T2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 69 | 1200 | TROC | |
| BDE | Bay D'Espoir | B13L20 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| BDE | Bay D'Espoir | B13T11 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| BHL | Berry Hill | L26L27 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1968 | 69 | 1200 | TRON | |
| BHL | Berry Hill | L27T1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 69 | 1200 | TRON | |
| CBF | Corner Brook | 152T | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1966 | 69 | 1200 | TROC | |
| CHD | Cow Head | B1L26 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 69 | 1200 | TRON | |
| DHL | Daniels Harbour | B1L27 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 69 | 1200 | TRON | |
| DLK | Deer Lake | B2L26 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | Unknown | 72.5 | 1250 | TROC | |
| DLK | Deer Lake | B2T1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1980 | 69 | 1200 | TROC | |
| DLS | Doyles | B1L15 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 69 | 1200 | TROC | |
| HBY | Hawks Bay | L21VR1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1970 | 69 | 1200 | TRON | |
| HRD | Holyrood | B6L3 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1978 | 69 | 1200 | TROC | |
| HRD | Holyrood | B7L2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1969 | 69 | 1200 | TROC | |
| HRD | Holyrood | B7L38 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1969 | 69 | 1200 | TROC | |
| HRD | Holyrood | B8L39 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1978 | 138 | 1200 | TROC | |
| HVY | Happy Valley | 13-1 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1976 | 138 | 1200 | TROL | |
| HVY | Happy | HV15-CB1 | 5 | 30 | 550 | 2.48 | 14.85 | Bushing | Unknown | Unknown | 31-Dec- | Unkn | 6 | Breaker | CGE FKP | 1982 | 25 | Unkn | TROL | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)& 29) | Quantity of Liquid containing PCBs (L) per equipment (17(3)(b)(ii)) | Total Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCBs (mg/kg) (17(3)(b)(iii)) | Quantity of PCBs in the liquid (kg) per equipment (17(3)(b)(iv)) | Total Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Number In Service | Associated Asset Type | Associated Asset Manuf. | Associated Asset Year | Voltage Class (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Valley | | | | | | | | | | 2014 | own | | | | | | own | | |
| HVY | Happy Valley | HV17-CB1 | 5 | 30 | 550 | 2.48 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | CGE FKP | 1976 | 25 | Unkn own | TROL | |
| HVY | Happy Valley | T1B12 | 5 | 30 | 550 | 2.48 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | CGE FKP | 1976 | 25 | Unkn own | TROL | |
| HVY | Happy Valley | T2B12 | 5 | 30 | 550 | 2.48 | 14.85 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | CGE FKP | 1982 | 25 | Unkn own | TROL | |
| HWD | Hardwoods | B7B8 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1971 | 69 | 1200 | TROC | |
| HWD | Hardwoods | B7T2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| HWD | Hardwoods | B7T5 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1976 | 69 | 1200 | TROC | |
| HWD | Hardwoods | B8T3 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1986 | 72.5 | 2000 | TROC | |
| LBC | Labrador City | TS9-CB1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1972 | 72.5 | 1600 | TROL | |
| LBC | Labrador City | TS9-CB2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1977 | 72.5 | 1600 | TROL | |
| LBC | Labrador City | TS10-CB1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1972 | 72.5 | 1600 | TROL | |
| LBC | Labrador City | TS11-CB1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1972 | 72.5 | 1600 | TROL | |
| LHR | Long Harbour | B3T1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | LC | 6 | Breaker | CGE KSO | 1967 | 46 | 1200 | TROC | |
| MDR | Massey Drive | B2T2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1970 | 69 | 1200 | TROC | |
| MDR | Massey Drive | B3T2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| OPD | Oxen Pond | B2B5 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1977 | 69 | 1200 | TROC | |
| OPD | Oxen Pond | B5T3 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1977 | 69 | 1200 | TROC | |
| OPD | Oxen Pond | B2T2 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1986 | 72.5 | 2000 | TROC | |
| SPL | Springdale | B1L22 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 138 | 1200 | TROC | |
| SPL | Springdale | B1L23 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1967 | 138 | 1200 | TROC | |
| SVL | Stephenville | B2L405 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| SVL | Stephenvil | B2T3 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec- | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)& 29) | Quantity of Liquid containing PCBs (L) per equipment (17(3)(b)(ii)) | Total Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCBs (mg/kg) (17(3)(b)(iii)) | Quantity of PCBs in the liquid (kg) per equipment (17(3)(b)(iv)) | Total Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Number In Service | Associated Asset Type | Associated Asset Manuf. | Associated Asset Year | Voltage Class (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | le | | | | | | | | | | 2014 | | | | | | | | | |
| SVL | Stephenville | L405T4 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1975 | 69 | 1200 | TROC | |
| SVL | Stephenville | L09L38 | 60 | 360 | 550 | 29.70 | 178.20 | Bushing | unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLR | 1975 | 245 | | TROC | |
| WAB | Wabush | WA1-CB1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | Unknown | Unknown | 31-Dec-2014 | Unkn own | 6 | Breaker | ASEA HLC | 1986 | 72.5 | 2000 | TROL | |
| WAV | Western Avalon | B2T1 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1967 | 69 | 1200 | TROC | |
| WAV | Western Avalon | B1L64 | 30 | 180 | 550 | 14.85 | 89.10 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE KSO | 1977 | 138 | 1200 | TROC | |
| WDL | Wiltondale | B1L29 | 10 | 60 | 550 | 4.95 | 29.70 | Bushing | CGE | Unknown | 31-Dec-2014 | U | 6 | Breaker | CGE FKP | 1967 | 69 | 1200 | TRON | |
| | | Totals | 3660 | | | | 1811.70 | | | | | | 276 | pieces of equipment | | | | | | |



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**Table 3 – Current Transformers in Service**

| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BDETS2 | Bay D'Espoir | CT B9L34 C PH,BDE TS2 | 60 | 550 | 29.70 | Current Transformer | WES | LG50495 | 31-Dec-2010 | OPC-230 | Unknown | 230 | 1200 | TROC | All liquid volumes are estimated. |
| SVL | Stephenville | CT L405 A PH,SVL TS | 10 | 550 | 4.95 | Current Transformer | FPT | 2-402847 | 31-Dec-2010 | K-69 | 1975 | 66 | 400 | TROC | |
| SVL | Stephenville | CT L405 B PH,SVL TS | 10 | 550 | 4.95 | Current Transformer | FPT | 2-402848 | 31-Dec-2010 | K-69 | 1975 | 66 | 400 | TROC | |
| SVL | Stephenville | CT L09L38 A PH,SVL TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50711 | 31-Dec-2010 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| STB | Stoney Brook | CT B3L10 A PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60307 | 31-Dec-2011 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3L10 B PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60308 | 31-Dec-2011 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3L10 C PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60309 | 31-Dec-2011 | OPC-138 | 1976 | 138 | 800 | TROC | |
| HVY | Happy Valley | CT T2B13 A PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2011 | Unknown | 1978 | 138 | Unknown | TROL | |
| HVY | Happy Valley | CT T2B13 B PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2011 | Unknown | 1978 | 138 | Unknown | TROL | |
| HVY | Happy Valley | CT T2B13 C PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2011 | Unknown | 1978 | 138 | Unknown | TROL | |
| HRD | Holyrood | CT B3L18 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50529 | 31-Dec-2012 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B3L18 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50538 | 31-Dec-2012 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B3L18 C PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50531 | 31-Dec-2012 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| BDETS69KV | Bay D'Espoir | CT TL 220 A PH,BDE TS69 | 10 | 550 | 4.95 | Current Transformer | CGE | Unknown | 31-Dec-2012 | K69 | Unknown | 69 | Unknown | TROC | |
| BDETS69KV | Bay D'Espoir | CT TL 220 C PH,BDE TS69 | 10 | 550 | 4.95 | Current Transformer | CGE | Unknown | 31-Dec-2012 | K69 | Unknown | 69 | Unknown | TROC | |
| HWD | Hardwoods | CT B8 A PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | CGE | 819049 | 31-Dec-2013 | IC-69 | 1970 | 69 | 1200 | TROC | |
| HWD | Hardwoods | CT B8 B PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | CGE | 819048 | 31-Dec-2013 | IC-69 | 1970 | 69 | 1200 | TROC | |
| HWD | Hardwoods | CT B8 C PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | CGE | 819050 | 31-Dec-2013 | IC-69 | 1970 | 69 | 1200 | TROC | |
| BDETS1 | Bay D'Espoir | CT B2B3 A PH,BDE TS1 | 60 | 550 | 29.70 | Current Transformer | WES | LB60936 | 31-Dec-2013 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BDETS1 | Bay D'Espoir | CT B2B3 B PH,BDE TS1 | 60 | 550 | 29.70 | Current Transformer | WES | LB60935 | 31-Dec-2013 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BDETS1 | Bay D'Espoir | CT B2B3 C PH,BDE TS1 | 60 | 550 | 29.70 | Current | WES | LB60934 | 31-Dec- | OPC-230 | Unknown | 230 | 1200 | TROC | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2013 | | | | | | |
| BDETS1 | Bay D'Espoir | CT B1T2 A PH,BDE TS1 | 60 | 550 | 29.70 | Current Transformer | WES | 560281 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BDETS1 | Bay D'Espoir | CT B1T2 B PH,BDE TS1 | 60 | 550 | 29.70 | Current Transformer | WES | 560282 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BDETS1 | Bay D'Espoir | CT B1T2 C PH,BDE TS1 | 60 | 550 | 29.70 | Current Transformer | WES | 560280 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BBK | Bottom Brook | CT L11L33 A PH,BBK TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50309 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BBK | Bottom Brook | CT L11L33 B PH,BBK TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50310 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BBK | Bottom Brook | CT L11L33 C PH,BBK TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50308 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BBK | Bottom Brook | CT L09L33 B PH,BBK TS | 60 | 550 | 29.70 | Current Transformer | WES | 696804 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BBK | Bottom Brook | CT L09L33 C PH,BBK TS | 60 | 550 | 29.70 | Current Transformer | WES | 696805 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| BUC | Buchans | CT L32L33 A PH,BUC TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50714 | 31-Dec-2014 | OPC-230 | 1981 | 230 | 1200 | TROC | |
| BUC | Buchans | CT L32L33 B PH,BUC TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50713 | 31-Dec-2014 | OPC-230 | 1981 | 230 | 1200 | TROC | |
| BUC | Buchans | CT L32L33 C PH,BUC TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50708 | 31-Dec-2014 | OPC-230 | 1981 | 230 | 1200 | TROC | |
| CAT | Cat Arm | CT TL 247 A PH,CAT TS | 60 | 550 | 29.70 | Current Transformer | MIT | J089778/J08977 9 | 31-Dec-2014 | BS | Unknown | 230 | Unknown | TROC | |
| CAT | Cat Arm | CT TL 247 B PH,CAT TS | 60 | 550 | 29.70 | Current Transformer | MIT | J089780/J08978 1 | 31-Dec-2014 | BS | Unknown | 230 | Unknown | TROC | |
| CAT | Cat Arm | CT TL 247 C PH,CAT TS | 60 | 550 | 29.70 | Current Transformer | MIT | J089782/J08978 3 | 31-Dec-2014 | BS | Unknown | 230 | Unknown | TROC | |
| FHDDIST110 | Fogo | 25KV LINE CT'S, FGO SS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | Unknown | TROC | |
| FHDDIST110 | Fogo | CT A PH, FGO SS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | Unknown | TROC | |
| FHDDIST110 | Fogo | CT B PH, FGO SS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | Unknown | TROC | |
| FHDDIST110 | Fogo | CT C PH, FGO SS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | Unknown | TROC | |
| GFC | Grand Falls | CT 229TB-1 A PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | Unknown | TROC | |
| GFC | Grand Falls | CT 229TB-1 B PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | Unknown | TROC | |
| GFC | Grand Falls | CT 229TB-1 C PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | Unknown | TROC | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GFC | Grand Falls | CT 229TB-2 A PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | Unknown | TROC | |
| GFC | Grand Falls | CT 229TB-2 B PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | Unknown | TROC | |
| GFC | Grand Falls | CT 229TB-2 C PH,GFC TS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | Unknown | TROC | |
| HVY | Happy Valley | CT B11B12-11 A PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B11B12-11 B PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B11B12-11 C PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B11B12-12 A PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B11B12-12 B PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B11B12-12 C PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-12 A PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-12 B PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-12 C PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-T3 A PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-T3 B PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT B12T3-T3 C PH, HVY TS | 5 | 550 | 2.48 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED1 | Happy Valley | CT HV1-R1 B PH, HVY FEEDER 1 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138061 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED1 | Happy Valley | CT HV1-R1 C PH, HVY FEEDER 1 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138062 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED7 | Happy Valley | CT HV7-R1 A PH, HVY FEEDER 7 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138063 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED7 | Happy Valley | CT HV7-R1 B PH, HVY FEEDER 7 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138064 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED7 | Happy Valley | CT HV7-R1 C PH, HVY FEEDER 7 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138065 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED8 | Happy Valley | CT HV8-R1 A PH, HVY FEEDER 8 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138066 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED8 | Happy Valley | CT HV8-R1 B PH, HVY FEEDER 8 | 5 | 550 | 2.48 | Current | FPT | NR9138067 | 31-Dec- | Unknown | 1978 | 25 | Unknown | TROL | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2014 | | | | | | |
| HVYFEED8 | Happy Valley | CT HV8-R1 C PH, HVY FEEDER 8 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138068 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED10 | Happy Valley | CT HV10-R1 A PH, HVY FEEDER 10 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138069 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED10 | Happy Valley | CT HV10-R1 B PH, HVY FEEDER 10 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138070 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED10 | Happy Valley | CT HV10-R1 C PH, HVY FEEDER 10 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138071 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED16 | Happy Valley | CT HV16-R1 A PH, HVY FEEDER 16 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138072 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED16 | Happy Valley | CT HV16-R1 B PH, HVY FEEDER 16 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138073 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVYFEED16 | Happy Valley | CT HV16-R1 C PH, HVY FEEDER 16 | 5 | 550 | 2.48 | Current Transformer | FPT | NR9138074 | 31-Dec-2014 | Unknown | 1978 | 25 | Unknown | TROL | |
| HVY | Happy Valley | CT T1B13 B PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 138 | Unknown | TROL | |
| HVY | Happy Valley | CT T1B13 C PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1978 | 138 | Unknown | TROL | |
| HVY | Happy Valley | CT T1B13 A PH, HVY TS | 30 | 550 | 14.85 | Current Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | Unknown | TROL | |
| HWD | Hardwoods | CT B7 A PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | MUG | 850612/1 | 31-Dec-2014 | CTE-72E | 1985 | 69 | 2000 | TROC | |
| HWD | Hardwoods | CT B7 B PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | MUG | 850612/2 | 31-Dec-2014 | CTE-72E | 1985 | 69 | 2000 | TROC | |
| HWD | Hardwoods | CT B7 C PH,HWD TS | 10 | 550 | 4.95 | Current Transformer | MUG | 850612/3 | 31-Dec-2014 | CTE-72E | 1985 | 69 | 2000 | TROC | |
| HWD | Hardwoods | CT B1L01 A PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761622 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B1L01 B PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761623 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B1L01 C PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761624 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B1L36 A PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761625 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B1L36 B PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761626 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B1L36 C PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | WES | 761627 | 31-Dec-2014 | OPC-230 | 1972 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B2L42 A PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/03 | 31-Dec-2014 | QD-245 | 1981 | 230 | 1200 | TROC | |
| HWD | Hardwoods | CT B2L42 B PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/01 | 31-Dec-2014 | QD-245 | 1981 | 230 | 1200 | TROC | |



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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HWD | Hardwoods | CT B2L42 C PH,HWD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/02 | 31-Dec-2014 | QD-245 | 1981 | 230 | 1200 | TROC | |
| HRD | Holyrood | CT B8L39 A PH,HRD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60091 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| HRD | Holyrood | CT B8L39 B PH,HRD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60089 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| HRD | Holyrood | CT B8L39 C PH,HRD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60093 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| HRD | Holyrood | CT B3B13 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50537 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B3B13 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50532 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B3B13 C PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50530 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B12B15 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50534 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B12B15 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50539 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B12B15 C PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50535 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B12L42 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50528 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B12L42 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LC50533 | 31-Dec-2014 | OPC-230 | 1978 | 230 | 2000 | TROC | |
| HRD | Holyrood | CT B13B15 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LG50499 | 31-Dec-2014 | OPC-230 | 1981 | 230 | 1200 | TROC | |
| HRD | Holyrood | CT B13B15 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | WES | LG50498 | 31-Dec-2014 | OPC-230 | 1981 | 230 | 1200 | TROC | |
| HRD | Holyrood | CT B12L18 A PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/06 | 31-Dec-2014 | QDR-245 | Unknown | 230 | Unknown | TROC | |
| HRD | Holyrood | CT B12L18 B PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/04 | 31-Dec-2014 | QDR-245 | Unknown | 230 | Unknown | TROC | |
| HRD | Holyrood | CT B12L18 C PH,HRD TS | 60 | 550 | 29.70 | Current Transformer | BAL | 81/52431/05 | 31-Dec-2014 | QDR-245 | Unknown | 230 | Unknown | TROC | |
| LHR | Long Harbour | CT'S CAP BANK B PH,LHR TS | 10 | 550 | 4.95 | Current Transformer | CGE | 673698 | 31-Dec-2014 | IS-69 | Unknown | 46 | 100 | TROC | |
| LHR | Long Harbour | CT'S CAP BANK C PH,LHR TS | 10 | 550 | 4.95 | Current Transformer | CGE | 673697 | 31-Dec-2014 | IS-69 | Unknown | 46 | 100 | TROC | |
| MKSDIST112 | Monkstown | CT L1,PRV SS | 5 | 550 | 2.48 | Current Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | Unknown | TROC | |
| OPD | Oxen Pond | CT B2B3 A PH,OPD TS | 10 | 550 | 4.95 | Current Transformer | WES | LB60615 | 31-Dec-2014 | OPC-69 | Unknown | 66 | 2000 | TROC | |
| OPD | Oxen Pond | CT B2B3 B PH,OPD TS | 10 | 550 | 4.95 | Current | WES | LB60611 | 31-Dec- | OPC-69 | Unknown | 66 | 2000 | TROC | |



Canada

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| Station Name (if any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2014 | | | | | | |
| OPD | Oxen Pond | CT B2B3 C PH,OPD TS | 10 | 550 | 4.95 | Current Transformer | WES | LB60613 | 31-Dec-2014 | OPC-69 | Unknown | 66 | 2000 | TROC | |
| OPD | Oxen Pond | CT B4B5 A PH,OPD TS | 10 | 550 | 4.95 | Current Transformer | WES | LB60612 | 31-Dec-2014 | OPC-69 | Unknown | 66 | Unknown | TROC | |
| OPD | Oxen Pond | CT B4B5 B PH,OPD TS | 10 | 550 | 4.95 | Current Transformer | WES | LB60614 | 31-Dec-2014 | OPC-69 | Unknown | 66 | Unknown | TROC | |
| OPD | Oxen Pond | CT B4B5 C PH,OPD TS | 10 | 550 | 4.95 | Current Transformer | WES | LB60616 | 31-Dec-2014 | OPC-69 | Unknown | 66 | Unknown | TROC | |
| SVL | Stephenville | CT L09L38 B PH,SVL TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50710 | 31-Dec-2014 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| SVL | Stephenville | CT L09L38 C PH,SVL TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50712 | 31-Dec-2014 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| STB | Stoney Brook | CT B3L130 A PHSTB TS | 30 | 550 | 14.85 | Current Transformer | CGE | 861677 | 31-Dec-2014 | KG-138 | 1969 | 138 | 400 | TROC | |
| STB | Stoney Brook | CT B3L130 B PH,STB TS | 30 | 550 | 14.85 | Current Transformer | CGE | 861678 | 31-Dec-2014 | KG-138 | 1969 | 138 | 400 | TROC | |
| STB | Stoney Brook | CT B3L130 C PH,STB TS | 30 | 550 | 14.85 | Current Transformer | CGE | 861679 | 31-Dec-2014 | KG-138 | 1969 | 138 | 400 | TROC | |
| STB | Stoney Brook | CT B3T1 A PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60302 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3T1 B PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60301 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3T1 C PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60306 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3T2 A PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60303 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3T2 B PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60304 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3T2 C PH,STB TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60305 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| STB | Stoney Brook | CT B3L22 A PH,STB TS | 30 | 550 | 14.85 | Current Transformer | CGE | 630630 | 31-Dec-2014 | IC-138 | Unknown | 138 | Unknown | TROC | |
| STB | Stoney Brook | CT B1L32 A PH,STB TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50715 | 31-Dec-2014 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| STB | Stoney Brook | CT B1L32 B PH,STB TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50709 | 31-Dec-2014 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| STB | Stoney Brook | CT B1L32 C PH,STB TS | 60 | 550 | 29.70 | Current Transformer | WES | LF50716 | 31-Dec-2014 | OPC-230 | 1980 | 230 | 1200 | TROC | |
| STB | Stoney Brook | CT L05L31(TL205)A PH,STB TS | 60 | 550 | 29.70 | Current Transformer | BOV | Unknown | 31-Dec-2014 | Unknown | Unknown | 230 | Unknown | TROC | |
| STB | Stoney Brook | CT L05L31(TL205)B PH,STB TS | 60 | 550 | 29.70 | Current Transformer | BOV | Unknown | 31-Dec-2014 | Unknown | Unknown | 230 | Unknown | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), If any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Calss (KV) | Amps | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STB | Stoney Brook | CT L05L31(TL205)C PH,STB TS | 60 | 550 | 29.70 | Current Transformer | BOV | Unknown | 31-Dec-2014 | Unknown | Unknown | 230 | Unknown | TROC | |
| SSD | Sunnyside | CT B3T4 A PH,SSD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60090 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| SSD | Sunnyside | CT B3T4 B PH,SSD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60092 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| SSD | Sunnyside | CT B3T4 C PH,SSD TS | 30 | 550 | 14.85 | Current Transformer | WES | LB60088 | 31-Dec-2014 | OPC-138 | 1976 | 138 | 800 | TROC | |
| SSD | Sunnyside | CT L06L07 A PH,SSD TS | 60 | 550 | 29.70 | Current Transformer | WES | 560292 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| SSD | Sunnyside | CT L06L07 B PH,SSD TS | 60 | 550 | 29.70 | Current Transformer | WES | 560291 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| SSD | Sunnyside | CT L06L07 C PH,SSD TS | 60 | 550 | 29.70 | Current Transformer | WES | 560290 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| WAV | Western Avalon | CT B1B3 A PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | LB60671 | 31-Dec-2014 | OPC-230 | 1977 | 230 | 600 | TROC | |
| WAV | Western Avalon | CT B1B3 B PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | LB60670 | 31-Dec-2014 | OPC-230 | 1977 | 230 | 600 | TROC | |
| WAV | Western Avalon | CT B1B3 C PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | LB60669 | 31-Dec-2014 | OPC-230 | 1977 | 230 | 600 | TROC | |
| WAV | Western Avalon | CT B1L37 A PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | 560287 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| WAV | Western Avalon | CT B1L37 B PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | 560286 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| WAV | Western Avalon | CT B1L37 C PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | 560289 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| WAV | Western Avalon | CT B1L08 A PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | 560284 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| WAV | Western Avalon | CT B1L08 C PH,WAV TS | 60 | 550 | 29.70 | Current Transformer | WES | 560285 | 31-Dec-2014 | OPC-230 | Unknown | 230 | 1200 | TROC | |
| | | Totals | 4895 | | 2423.03 | | | | | 143 | pieces of equipment | | | | |



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**Table 4 – Potential Transformers in Service**

| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GFC | Grand Falls | PT 2 S2 3PH, GFC | 5 | 550 | 2.48 | Potential Transformer | WEST | Unknown | 31-Dec-2010 | Unknown | Unknown | 13.8 | TROC | All liquid volumes are estimated. |
| OPD | Oxen Pond | PT B2 A PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514303 | 31-Dec-2010 | APT-69 | Unknown | 66 | TROC | |
| OPD | Oxen Pond | PT B2 B PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514302 | 31-Dec-2010 | APT-69 | Unknown | 66 | TROC | |
| OPD | Oxen Pond | PT B2 C PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514304 | 31-Dec-2010 | APT-69 | Unknown | 66 | TROC | |
| SVL | Stephenville | PT 405L A PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978827 | 31-Dec-2010 | ES-69 | Unknown | 66 | TROC | |
| SVL | Stephenville | PT 405L B PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978826 | 31-Dec-2010 | ES-69 | Unknown | 66 | TROC | |
| SVL | Stephenville | PT 405L C PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978825 | 31-Dec-2010 | ES-69 | Unknown | 66 | TROC | |
| WAV | Western Avalon | PT B4 A PH,WAV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 10276 | 31-Dec-2010 | EWC-650 | 1977 | 138 | TROC | |
| WAV | Western Avalon | PT B4 C PH,WAV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 10298 | 31-Dec-2010 | EWC-650 | 1977 | 138 | TROC | |
| BDETS69KV | Bay D'Espoir | PT B13 A-B PH,BDE TS69 | 10 | 550 | 4.95 | Potential Transformer | CGE | 976511 | 31-Dec-2011 | ET-69 | Unknown | 69 | TROC | |
| BDETS69KV | Bay D'Espoir | PT B13 B-C PH,BDE TS69 | 10 | 550 | 4.95 | Potential Transformer | CGE | 976512 | 31-Dec-2011 | ET-69 | Unknown | 69 | TROC | |
| DLK | Deer Lake | PT B2(T1) SYNC A-C PH,DLK TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 488598 | 31-Dec-2011 | ET-69 | Unknown | 66 | TROC | |
| DLS | Doyles | PT TL 215 B PH,DLS TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 708033 | 31-Dec-2011 | ES-69 | Unknown | 69 | TROC | |
| HWD | Hardwoods | PT T1 B-C PH,HWD TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 818771 | 31-Dec-2011 | ET-69 | 1972 | 69 | TROC | |
| HWD | Hardwoods | PT T2 B-C PH,HWD TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 976500 | 31-Dec-2011 | ET-69 | 1972 | 69 | TROC | |
| WAV | Western Avalon | PT 64L B PH,WAV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 10275 | 31-Dec-2011 | EWC-650 | 1977 | 138 | TROC | |
| BHL | Berry Hill | B PHASE PT, TL226, BHL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 2-494906-1 | 31-Dec-2012 | Unknown | Unknown | 66 | TRON | |
| BHL | Berry Hill | B PHASE PT, TL227, BHL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 2-494906 | 31-Dec-2012 | Unknown | Unknown | 66 | TRON | |
| BHL | Berry Hill | B PHASE PT, T1 SEC, STN SERV, | 10 | 550 | 4.95 | Potential Transformer | WEST | 514308-1 | 31-Dec-2012 | APT-69 | Unknown | 66 | TRON | |
| DLK | Deer lake | PT B2 A PH,DLK TS | 10 | 550 | 4.95 | Potential Transformer | WES | 654873 | 31-Dec-2012 | APT | Unknown | 66 | TROC | |
| DLK | Deer lake | PT B2 B PH,DLK TS | 10 | 550 | 4.95 | Potential | WES | 1450660 | 31-Dec- | APT | Unknown | 66 | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(iii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2012 | | | | | |
| DLK | Deer lake | PT B2 C PH,DLK TS | 10 | 550 | 4.95 | Potential Transformer | WES | 654872 | 31-Dec-2012 | APT | Unknown | 66 | TROC | |
| WAV | Western Avalon | PT T1 B-C PH,WAV TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 872799 | 31-Dec-2012 | ET-69 | Unknown | 66 | TROC | |
| WAV | Western Avalon | PT T2 B-C PH,WAV TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 872798 | 31-Dec-2012 | ET-69 | Unknown | 66 | TROC | |
| GBA | Grand Bay | PT B1 A PH,GBY TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 539309 | 31-Dec-2013 | APT-69 | Unknown | 66 | TROC | |
| GBA | Grand Bay | PT B1 B PH,GBY TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 525212 | 31-Dec-2013 | APT-69 | Unknown | 66 | TROC | |
| GBA | Grand Bay | PT B1 C PH,GBY TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514311 | 31-Dec-2013 | APT-69 | Unknown | 66 | TROC | |
| GBA | Grand Bay | PT C1 NEUT,GBY TS | 10 | 550 | 4.95 | Potential Transformer | WEST | LK50401 | 31-Dec-2013 | APT-69 | Unknown | 66 | TROC | |
| HWD | Hardwoods | PT T3 B-C PH,HWDTS | 10 | 550 | 4.95 | Potential Transformer | CGE | 1039005 | 31-Dec-2013 | JVT-350 | Unknown | 69 | TROC | |
| IRV | Indian River | PT B1 A PH,IRV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 551500 | 31-Dec-2013 | ES-138 | Unknown | 138 | TROC | |
| IRV | Indian River | PT B1 B PH,IRV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 695250 | 31-Dec-2013 | ES-138 | Unknown | 138 | TROC | |
| IRV | Indian River | PT B1 C PH,IRV TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 551501 | 31-Dec-2013 | ES-138 | Unknown | 138 | TROC | |
| STATSDSLPLT | St Anthony | A PHASE PT, BUSS 1, SDP T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2013 | Unknown | Unknown | 25 | TRON | |
| STATSDSLPLT | St Anthony | B PHASE PT, BUSS 1, SDP T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2013 | Unknown | Unknown | 25 | TRON | |
| STATSDSLPLT | St Anthony | C PHASE PT, BUSS 1, SDP T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2013 | Unknown | Unknown | 25 | TRON | |
| STATSDSLPLT | St Anthony | B PHASE PT, T1 SEC., SDP T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2013 | Unknown | Unknown | 25 | TRON | |
| STATSDSLPLT | St Anthony | B PHASE PT, TL 261, SDP T.S. | 10 | 550 | 4.95 | Potential Transformer | RIT | Unknown | 31-Dec-2013 | Unknown | Unknown | 69 | TRON | |
| STATSDSLPLT | St Anthony | C PHASE PT, TL 261, SDP T.S. | 10 | 550 | 4.95 | Potential Transformer | RIT | Unknown | 31-Dec-2013 | Unknown | Unknown | 69 | TRON | |
| BDETS1 | Bay D'Espoir | PT B2 B PH,BDE TS1 | 60 | 550 | 29.70 | Potential Transformer | HT | 967352004 | 31-Dec-2014 | TEMP-230 | Unknown | 230 | TROC | |
| BDETS69KV | Bay D'Espoir | B14,PT A PHASE | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BDETS69KV | Bay D'Espoir | B14,PT B PHASE | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BDETS69KV | Bay D'Espoir | B14,PT C PHASE | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(iii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BWTDIST102 | Bottom Waters | PT B1,A PH,BWT TS | 5 | 550 | 2.48 | Potential Transformer | ART | 892908/3 | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BWTDIST102 | Bottom Waters | PT B1,B PH,BWT TS | 5 | 550 | 2.48 | Potential Transformer | ART | 892908/1 | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BWTDIST102 | Bottom Waters | PT B1,C PH,BWT TS | 5 | 550 | 2.48 | Potential Transformer | ART | 892908/2 | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BWTDIST102 | Bottom Waters | PT L3,A & C PH,SAM TAP | 5 | 550 | 2.48 | Potential Transformer | ART | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| BWTDIST102 | Bottom Waters | PT L3,B PH,BWT TS | 5 | 550 | 2.48 | Potential Transformer | ART | 892908/4 | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| LALDIST308 | Lanse-Au-loup | POTENTIAL TRANSFORMER | 5 | 550 | 2.48 | Potential Transformer | Unknown | 5869792 | 31-Dec-2014 | Unknown | Unknown | 25 | TRON | |
| LALDIST308 | Lanse-Au-loup | POTENTIAL TRANSFORMER | 5 | 550 | 2.48 | Potential Transformer | Unknown | 5871623 | 31-Dec-2014 | Unknown | Unknown | 25 | TRON | |
| MKSDIST112 | Monkstown | PT L1,PRV SS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| MKSDIST112 | Monkstown | PT TL258 B PH, PRV SS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROC | |
| RWCTSWCHIP | Roddickton | B PHASE PT, BUSS 3, RWC T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 4.16 | TRON | |
| RWCTSWCHIP | Roddickton | B PHASE PT, BUSS 3, RWC T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 4.16 | TRON | |
| RWCTSWCHIP | Roddickton | B PHASE PT, BUSS 3, RWC T.S. | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 4.16 | TRON | |
| BCV | Bear Cove | A PHASE PT, TL244 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029315 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | C PHASE PT, TL244 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029316 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | B PHASE PT, TL256 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029321 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | C PHASE PT, TL256 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029314 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | A PHASE PT, BUSS 1 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029308 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | B PHASE PT, BUSS 1 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029302 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BCV | Bear Cove | C PHASE PT, BUSS 1 | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029304 | 31-Dec-2014 | SCHI_145 | Unknown | 138 | TRON | |
| BUC | Buchans | PT B3 A PH,BUC TS | 5 | 550 | 2.48 | Potential Transformer | CGE | 873935 | 31-Dec-2014 | E-235 | Unknown | 25 | TROC | |
| BUC | Buchans | PT B3 B PH,BUC TS | 5 | 550 | 2.48 | Potential Transformer | CGE | 873937 | 31-Dec-2014 | E-235 | Unknown | 25 | TROC | |
| BUC | Buchans | PT B3 C PH,BUC TS | 5 | 550 | 2.48 | Potential | CGE | 873936 | 31-Dec- | E-235 | Unknown | 25 | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2014 | | | | | |
| BUC | Buchans | PT T1 B-C PH,BUC TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 1033566 | 31-Dec-2014 | JVT-350 | Unknown | 66 | TROC | |
| CAT | Cat Arm | PT TL247 A PH,CAT TS | 60 | 550 | 29.70 | Potential Transformer | MIT | 311777 | 31-Dec-2014 | GV-201 | Unknown | 230 | TROC | |
| CAT | Cat Arm | PT TL247 B PH,CAT TS | 60 | 550 | 29.70 | Potential Transformer | MIT | 311778 | 31-Dec-2014 | GV-201 | Unknown | 230 | TROC | |
| CAT | Cat Arm | PT TL247 C PH,CAT TS | 60 | 550 | 29.70 | Potential Transformer | MIT | 311779 | 31-Dec-2014 | GV-201 | Unknown | 230 | TROC | |
| DHR | Daniel's Harbour | A PHASE PT, BUS2, DHR TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 850611/2 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| DHR | Daniel's Harbour | C PHASE PT, BUS2, DHR TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 850611/1 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| DHR | Daniel's Harbour | PT, TL227 A PH, DHR TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 850611/9 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| DHR | Daniels Habour | B PHASE PT, BUS2, DHR TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 850611/6 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| DLS | Doyles | PT B1 A PH,DLS T.S. | 10 | 550 | 4.95 | Potential Transformer | MUG | 850611/7 | 31-Dec-2014 | UTE-72E | 1985 | 69 | TROC | |
| DLS | Doyles | PT B1 B PH,DLS TS | 10 | 550 | 4.95 | Potential Transformer | MUG | 850611/5 | 31-Dec-2014 | UTE-72E | 1985 | 69 | TROC | |
| DLS | Doyles | PT B1 C PH,DLS TS | 10 | 550 | 4.95 | Potential Transformer | MUG | 850611/10 | 31-Dec-2014 | UTE-72E | 1985 | 69 | TROC | |
| FGO | Fogo | PT,A PHASE,FGO SS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 12.5 | TROC | |
| FGO | Fogo | PT,B PHASE,FGO SS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 12.5 | TROC | |
| FGO | Fogo | PT,C PHASE,FGO SS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 12.5 | TROC | |
| HRD | Holyrood | PT 39L B PH,HRD TS | 30 | 550 | 14.85 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | MG-138 | Unknown | 138 | TROC | |
| HRD | Holyrood | PT B8 A PH,HRD TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-419361 | 31-Dec-2014 | MG-138 | Unknown | 138 | TROC | |
| HRD | Holyrood | PT B8 B PH,HRD TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-419364 | 31-Dec-2014 | MG-138 | Unknown | 138 | TROC | |
| HRD | Holyrood | PT B8 C PH,HRD TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-419362 | 31-Dec-2014 | MG-138 | Unknown | 138 | TROC | |
| HVY | Happy Valley | PT1, PH A to PH B, HVYGT | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 13.8 | TROL | |
| HVY | Happy Valley | PT1, PH B to PH C, HVYGT | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 13.8 | TROL | |
| HVY | Happy Valley | PT B12 A PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 25 | TROL | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HVY | Happy Valley | PT B12 B PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 25 | TROL | |
| HVY | Happy Valley | PT B12 C PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 25 | TROL | |
| HVY | Happy Valley | PT T1 LV C PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 25 | TROL | |
| HVY | Happy Valley | PT T2 LV C PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 25 | TROL | |
| HVY | Happy Valley | PT B13 A PH, HVY TS | 30 | 550 | 14.85 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 138 | TROL | |
| HVY | Happy Valley | PT B13 B PH, HVY TS | 30 | 550 | 14.85 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 138 | TROL | |
| HVY | Happy Valley | PT B13 C PH, HVY TS | 30 | 550 | 14.85 | Potential Transformer | FPT | Unknown | 31-Dec-2014 | Unknown | 1975 | 138 | TROL | |
| HVY | Happy Valley | PT B14 A PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROL | |
| HVY | Happy Valley | PT B14 B PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROL | |
| HVY | Happy Valley | PT B14 C PH, HVY TS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 25 | TROL | |
| HVY | Happy Valley | PT2 A PH, HVYGT | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | TROL | |
| HVY | Happy Valley | PT2 B PH, HVYGT | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | TROL | |
| HVY | Happy Valley | PT2 C PH, HVYGT | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 13.8 | TROL | |
| HVY | Happy Valley | PT TL240 A PH, HVY | 30 | 550 | 14.85 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | TROL | |
| HVY | Happy Valley | PT TL240 B PH, HVY | 30 | 550 | 14.85 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | TROL | |
| HWD | Hardwoods | PT C1 (NEUT),HWD TS | 10 | 550 | 4.95 | Potential Transformer | S & C | 990488 | 31-Dec-2014 | 81576R1 | Unknown | 69 | TROC | |
| IRV | Indian River | PT TL223 A PH, IRVTS | 30 | 550 | 14.85 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | TROC | |
| IRV | Indian River | PT TL223 A PH, IRVTS | 30 | 550 | 14.85 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | TROC | |
| LBC | Labrador City | POTENTIAL TRANSFORMER, TOWNSI | 10 | 550 | 4.95 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 46 | TROL | |
| LBC | Labrador City | WESTINGHOUSE POTENTIAL TRANFOR | 10 | 550 | 4.95 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 46 | TROL | |
| LLK | Linton Lake | PT A PH,METERING,LLK TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-513781 | 31-Dec-2014 | MG-138 | 1983 | 138 | TROC | |
| LLK | Linton Lake | PT B PH,METERING,LLK TS | 30 | 550 | 14.85 | Potential | FPT | 2-513779 | 31-Dec- | MG-138 | 1983 | 138 | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(iii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2014 | | | | | |
| LLK | Linton Lake | PT C PH,METERING,LLK TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-513783 | 31-Dec-2014 | MG-138 | 1983 | 138 | TROC | |
| LLK | Linton Lake | PT TL212 B PH,LLK TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-513778 | 31-Dec-2014 | MG-138 | 1983 | 138 | TROC | |
| MDR | Massie Drive | PT T3 A-B PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | FPT | 2-500632 | 31-Dec-2014 | M-69 | 1981 | 66 | TROC | |
| MDR | Massey Drive | PT T1 A-B PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | FPT | 2-2202205 | 31-Dec-2014 | M-69 | Unknown | 66 | TROC | |
| MDR | Massey Drive | PT T2 A-B PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | FPT | 2-245299 | 31-Dec-2014 | M-69 | Unknown | 66 | TROC | |
| MDR | Massey Drive | PT B2 A PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514310 | 31-Dec-2014 | APT-69 | Unknown | 66 | TROC | |
| MDR | Massey Drive | PT B2 B PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514309 | 31-Dec-2014 | APT-69 | Unknown | 66 | TROC | |
| MDR | Massey Drive | PT B2 C PH,MDR TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 514307 | 31-Dec-2014 | APT-69 | Unknown | 66 | TROC | |
| OPD | Oxen Pond | PT B5 A PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | LB60618 | 31-Dec-2014 | APT-69 | 1977 | 66 | TROC | |
| OPD | Oxen Pond | PT B5 B PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | LB60619 | 31-Dec-2014 | APT-69 | 1977 | 66 | TROC | |
| OPD | Oxen Pond | PT B5 C PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | LB60617 | 31-Dec-2014 | APT-69 | 1977 | 66 | TROC | |
| OPD | Oxen Pond | PT T3 B-C PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | FPT | 2-427610 | 31-Dec-2014 | M-69 | Unknown | 66 | M-69 | |
| OPD | Oxen Pond | PT C1(NEUT),OPD TS | 10 | 550 | 4.95 | Potential Transformer | S & C | 990518 | 31-Dec-2014 | 81576R1 | Unknown | 66 | TROC | |
| OPD | Oxen Pond | PT C2(NEUT),OPD TS | 10 | 550 | 4.95 | Potential Transformer | S & C | 990486 | 31-Dec-2014 | 81576R1 | Unknown | 66 | TROC | |
| OPD | Oxen Pond | PT T1 B-C PH,OPD TS | 10 | 550 | 4.95 | Potential Transformer | WEST | 595119 | 31-Dec-2014 | APT-69 | Unknown | 66 | APT-69 | |
| PBN | Peter's Barren | B PHASE PT, TL221, PBN TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 90289402 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| PBN | Peter's Barren | B PHASE PT, TL262, PBN TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 90289403 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| PBN | Peter's Barren | A PHASE PT, BUS 2, PBN TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 892907/1 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| PBN | Peter's Barren | B PHASE PT, BUSS 2, PBN TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 892907/3 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| PBN | Peter's Barren | C PHASE PT, BUSS 2, PBN TS | 10 | 550 | 4.95 | Potential Transformer | Unknown | 892907/2 | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |
| PBN | Peter's Barren | B PHASE PT, T1 SECONDARY, PBN | 10 | 550 | 4.95 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 66 | TRON | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(iii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PBN | Peter's Barren | A PHASE PT & WAVETRAP, TL241, | 30 | 550 | 14.85 | Potential Transformer | Unknown | 11029310 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | C PHASE PT & WAVETRAP, TL241, | 30 | 550 | 14.85 | Potential Transformer | Unknown | 11029312 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | A PHASE PT & WAVETRAP, TL259, | 30 | 550 | 14.85 | Potential Transformer | Unknown | 11029317 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | B PHASE PT & WAVETRAP, TL259, | 30 | 550 | 14.85 | Potential Transformer | Unknown | 11029318 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | A PHASE PT , BUS1 , PBN TS | 30 | 550 | 14.85 | Potential Transformer | Unknown | 90289206 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | B PHASE PT , BUS1, PBN TS | 30 | 550 | 14.85 | Potential Transformer | Unknown | 90289204 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PBN | Peter's Barren | C PHASE PT, BUSS1, PBN TS | 30 | 550 | 14.85 | Potential Transformer | Unknown | 11029307 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | A PHASE PT, BUSS 2, PPTTS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 12.5 | TRON | |
| PPT | Plum Point | A PHASE PT, TL241, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029313 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | C PHASE PT, TL241, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | Unknown | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | A PHASE PT, TL244, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029319 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | C PHASE PT, TL244, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029309 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | A PHASE PT, BUS1, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029311 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | B PHASE PT, BUS1, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029305 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| PPT | Plum Point | C PHASE PT, BUS1, PPT TS | 30 | 550 | 14.85 | Potential Transformer | RIT | 11029301 | 31-Dec-2014 | Unknown | Unknown | 138 | TRON | |
| SPL | Springdale | PT B1 A PH,SPL TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 631654 | 31-Dec-2014 | VCM-138 | Unknown | 138 | TROC | |
| SPL | Springdale | PT B1 B PH,SPL TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 630862 | 31-Dec-2014 | VCM-138 | Unknown | 138 | TROC | |
| SPL | Springdale | PT B1 C PH,SPL TS | 30 | 550 | 14.85 | Potential Transformer | CGE | 630861 | 31-Dec-2014 | VCM-138 | Unknown | 138 | TROC | |
| SSD | Sunnyside | PT T1 B-C PH,SSD TS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | TROC | |
| SSD | Sunnyside | PT T4 B-C PH,SSD TS | 5 | 550 | 2.48 | Potential Transformer | Unknown | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | TROC | |
| SSD | Sunnyside | PT B2 B PH,SSD TS | 30 | 550 | 14.85 | Potential Transformer | CGE | Dec 31, 20100477 | 31-Dec-2014 | Unknown | No Nameplate | 138 | TROC | |
| SSD | Sunnyside | PT B2 C PH,SSD TS | 30 | 550 | 14.85 | Potential | CGE | 2-100476 | 31-Dec- | Unknown | No | 138 | TROC | |



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| Station Name (If any) | Location (17(3)(d)) | Unique Identification Number (Labels) (17(3)(c)&29) | Quantity of Liquid containing PCBs (L) (17(3)(b)(ii)) | Concentration of PCB (mg/kg) (17(3)(b)(iii)) | Quantity of PCB in the liquid (kg) (17(3)(b)(iv)) | Type and function of equipment (17(3)(b)(i)) | Name-Plate description (Manufacturer), if any (17(3)(b)(v)) | Manufacturer's serial number, if any (17(3)(b)(v)) | End-of-Use Date | Type | Year of Mfgr | Voltage Class | Region | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Transformer | | | 2014 | | Nameplate | | | |
| STB | Stony Brook | PT TL210 B PH,STB TS | 30 | 550 | 14.85 | Potential Transformer | FPT | 2-426725 | 31-Dec-2014 | MG-138 | Unknown | 138 | TROC | |
| STB | Stony Brook | PT T1 SYNC,STB TS | 5 | 550 | 2.48 | Potential Transformer | CGE | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | TROC | |
| STB | Stony Brook | PT T2 SYNC,STB TS | 5 | 550 | 2.48 | Potential Transformer | CGE | Unknown | 31-Dec-2014 | Unknown | Unknown | 6.9 | TROC | |
| SVL | Stephenville | PT B2 A PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978824 | 31-Dec-2014 | ES-69 | Unknown | 66 | TROC | |
| SVL | Stephenville | PT B2 B PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978823 | 31-Dec-2014 | ES-69 | Unknown | 66 | TROC | |
| SVL | Stephenville | PT B2 C PH,SVL TS | 10 | 550 | 4.95 | Potential Transformer | CGE | 978822 | 31-Dec-2014 | ES-69 | Unknown | 66 | TROC | |
| | | **Totals** | 2500 | | 1237.50 | | | | | | | **156** | | pieces of equipment |

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**Project Title:** Replace Insulators

**Location:** Various Terminal Stations

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

This project consists of the purchase and installation of 230, 138 and 69 kV station post and suspension insulators at various high voltage terminal stations on the Island Interconnected System. This project is part of a multi-year program for replacement of insulators which started in 2003. The insulators will be purchased in bulk and delivered to Hydro's central maintenance facility at Bishop's Falls. As outages are scheduled, the insulators will be shipped from this central location for installation in the particular stations. The 2012 budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 195.0 | 0.0 | 0.0 | 195.0 |
| **Labour** | 126.0 | 0.0 | 0.0 | 126.0 |
| **Consultant** | 15.5 | 0.0 | 0.0 | 15.5 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 21.0 | 0.0 | 0.0 | 21.0 |
| **Interest and Escalation** | 18.3 | 0.0 | 0.0 | 18.3 |
| **Contingency** | 35.8 | 0.0 | 0.0 | 35.8 |
| **TOTAL** | **411.6** | **0.0** | **0.0** | **411.6** |

Existing System

Insulators are an integral part of the transmission system. They support and insulate the energized portions of the system from the structures and grounded areas. Terminal Stations contain post-type insulators, cap and pin-top insulators, mulitcone design insulators, and suspension type insulators. As the cement in these insulators age, it grows and cracks. As the cement growth progresses, it exerts increased pressure on the porcelain part of the insulator such that the porcelain cracks and causes the insulator to fail.

Age of Equipment or System

The insulators in use on the Island Interconnected System range in age from one to 42 years. The insulators targeted for replacement under this project were manufactured before the mid 1970's.

There are approximately 47 percent left to be replaced.

Major Work/or Upgrades

There has been no major work or upgrades on terminal station insulators since they were installed. Replacements have only been made as failures occurred or as part of this insulator replacement program.

Anticipated Useful life

The anticipated service life of the new insulators is 40 years; however, this may vary depending on the service environment.

Maintenance History

Normal maintenance for insulators is to replace them upon failure.

Outage Statistics

Hydro tracks all system outages using industry standard indexes System Average Interruption Frequency Index (SAIFI), and System Average Interruption Duration Index (SAIDI). SAIDI and SAIFI are explained as follows:

SAIDI - Indicates the system average interruption duration for customers served per year, or the average length of time a customer is without power in the respective distribution system per year.

SAIFI - Indicates the average of sustained interruptions per customer served per year, or the average number of power outages a customer has experienced in the respective distribution system per year.

Table 2 lists the 2006 to 2010 system average transmission (T) T-SAIFI and T-SAIDI data and the latest CEA five year averages (2005 to 2009).

**Table 2: SAIFI/SAIDI Average**

| **Five Year Averages** | | |
|---|---|---|
| | **T-SAIFI** | **T-SAIDI** |
| Hydro System (2006-2010) | 1.08 | 56.07 |
| CEA (2005-2009) | 0.73 | 70.72 |

The statistics do not relate directly to insulator failures but they include insulator and other station equipment failures at the delivery point.

Industry Experience

The industry experience of cement growth and cracking with insulators manufactured prior to the mid 1970's is the same as Hydro's.

Maintenance or Support Arrangements

Normal operation and maintenance work is performed by Hydro personnel. A visual inspection of the terminal stations is done every ninety days during which insulators are checked for cracks or chips.

Vendor Recommendations

Hydro maintains regular contact with other major utilities and equipment manufacturers on matters related to the operation and maintenance of its equipment. Current insulator manufacturers have identified and researched the cement growth problems and have developed more sophisticated cement compounds to eliminate the cement growth problem. The manufacturers recommend that the older insulators manufactured before the mid 1970's be replaced.

Availability of Replacement Parts

Replacement insulators are generally readily available within six to eight weeks of an order. However, long delivery times may occur depending on the market conditions.

Safety Performance

In general terms, the safety performance of the insulators is good. However, in situations where the insulators are under structural stress, the cement growth condition will lead to a failure of the

insulator. This failure creates a safety hazard for operations personnel when broken insulator parts fall to the ground.

Environmental Performance

There are no specific environmental issues relating to insulators other than the proper disposal of the retired insulators.

Operating Regime

The insulators are in continuous use.

**Justification:**

This project is justified on the requirement for Hydro to provide safe and reliable power and a safe working environment for its staff. Insulators provide electrical insulation between energized equipment and ground. When insulators fail, a short circuit to ground is created and loose and falling parts can result. Both create system outages and safety hazards to personnel. In service failures have occurred while maintenance personnel were working on the equipment. To prevent such failures from occurring Hydro proposes and plans to replace deteriorated post, suspension and multi-cone type insulators.

The manufacturers have identified and researched the cement growth problems and have developed more sophisticated cement compounds to eliminate the problem in the future. For existing installations, the manufacturers recommend that the older insulators be replaced.

Net Present Value

A net present value calculation was not performed in this instance as there is no viable alternative to replacing the insulators.

Levelized Cost of Energy

The capital expenditures for this project will not affect the levelized cost of energy for the system.

Cost Benefit Analysis

A cost benefit analysis is not required for this project proposal as there are no quantifiable financial benefits.

Legislative or Regulatory Requirements

There are no applicable legislative or regulatory requirements.

Historical Information

Table 3 contains the historical information for insulator replacements for the period 2006 to 2011. Hydro expects to have its insulator replacement plan completed by the end of 2013.

**Table 3: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit ($000) |
|---|---|---|---|---|
| 2011F | 401.3 | | | |
| 2010 | 399.0 | 323.9 | 3,041 | 0.1 |
| 2009 | 390.9 | 426.9 | 1,521 | 0.3 |
| 2008 | 294.3 | 324.0 | 1,963 | 0.2 |
| 2007 | 323.0 | 297.5 | 2,140 | 0.1 |
| 2006 | 306.8 | 256.2 | 1,140 | 0.2 |

The unit cost for insulators varies with voltage class. For example, a 230 kV station post insulator will cost approximately $900, a 138 kV will cost approximately $400, a 69 kV will cost approximately $300 and a suspension insulator will cost approximately $25. As a result, in any given year, the quantities of units replaced vary and as a result, the annual average cost can be considerably different.

Forecast Customer Growth

The forecast customer load on the system has no affect on this project.

Energy Efficiency Benefits

There are no issues related to energy efficiencies associated with this project.

Losses during Construction

The replacement of the insulators will be coordinated with the normal outage plans for the system. These outage plans are designed around the system load requirements. Therefore, there are no production or revenue losses resulting from this project.

Status Quo

The status quo is not an option. The insulators must be replaced to maintain system reliability and a safe working environment.

Alternatives

There are no alternative solutions to the problem described with the insulators other than direct replacements.

**Conclusion:**

When insulators fail they create a short circuit to ground and result in loose and falling parts. This creates safety hazards to personnel and results in system outages. To prevent such failures from occurring, Hydro proposes to replace all post, suspension and multi-cone type insulators manufactured by Canadian Ohio Brass.

Project Schedule

Project milestones and schedule are shown in Table 4.

**Table 4: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Schedule<br>Target Replacement | January 2012 | February 2012 |
| Design | Equipment Ordering Tendering | February 2012 | March 2012 |
| Procurement | Equipment Delivery | March 2012 | July 2012 |
| Construction | Equipment Installations | March 2012 | November 2012 |
| Commissioning | Installations in service | February 2012 | November 2012 |
| Closeout | Project Completion | December 2012 | December 2012 |

Future Plans

Insulator replacements are planned until 2013 as shown in the five year capital plan (2012 Capital Plan Tab, Appendix A).

**Project Title:** Replace Light-Duty Mobile Equipment

**Location:** Various Sites

**Category:** Transmission and Rural Operations – Tools and Equipment

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project proposes the replacement of six snowmobiles, nine all-terrain vehicles, 11 light-duty trailers, eight heavy-duty trailers, two salt spreaders and one forklift in accordance with the established replacement criteria as follows:

- Snowmobiles/All-Terrain Vehicles: Transmission Line crews 3-5 years
- Snowmobiles/All-Terrain Vehicles: Other 5-7 years
- Light-Duty Trailers 6-8 years
- Heavy-Duty Trailers 12-15 years

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 364.0 | 0.0 | 0.0 | 364.0 |
| **Labour** | 3.5 | 0.0 | 0.0 | 3.5 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 14.7 | 0.0 | 0.0 | 14.7 |
| **Contingency** | 18.4 | 0.0 | 0.0 | 18.4 |
| **TOTAL** | **400.6** | **0.0** | **0.0** | **400.6** |

**Existing System:**

Newfoundland and Labrador Hydro (Hydro) operates a fleet of light-duty mobile equipment comprised of approximately 120 snowmobiles, 70 all-terrain vehicles, 120 trailers, 10 forklifts and ten miscellaneous attachments (for example, lawn mowers, backhoes, salt spreaders, snow plows).

The mobile equipment fleet is strategically distributed across Hydro's operating areas throughout the Province and is utilized on a daily basis to support staff engaged in the maintenance and repair

of the electrical system.

The Transportation Department of Hydro maintains a close liaison with other Canadian Utilities through participation on the Canadian Utility Fleet Council and has established mobile equipment replacement guidelines, which consider the age and operating conditions for the equipment.

As this project is for the replacement of light-duty mobile equipment, there is no relevant information for the following:

- Outage Statistics;
- Safety Performance; and
- Operating Regime.

Age of Equipment or System

Please see Appendix A for a detailed listing of the age of the assets being replaced under this system.

Major Work/or Upgrades

There have been no major upgrades since purchase.

Anticipated Useful life

The estimated service life for all-terrain vehicles, snowmobiles, trailers and attachments is as follows:

- Snowmobiles/All-Terrain Vehicles: Transmission Line crews 3-5 years
- Snowmobiles/All-Terrain Vehicles: Other 5-7 years
- Trailers: Light-Duty 6-8 years
- Trailers: Heavy-Duty 12-15 years

Maintenance History

Hydro does not maintain maintenance records for this type of equipment to this level of detail.

Industry Experience

Light-duty mobile equipment replacement scheduling varies dependent on location, exposure to harsh environmental conditions, and the severity of the service use for the equipment.

Maintenance or Support Arrangements

The Hydro fleet of light-duty mobile equipment is maintained by external service garages.

Vendor Recommendations

There are no vendor recommendations in regards to this project.

Availability of Replacement Parts

Replacements parts are usually available for all of the equipment being replaced in this proposal.

Environmental Performance

Hydro complies with the Canadian Environmental Protection Act, Section 160, which applies to engines and vehicles of 2008 and later model years emissions requirements.

**Justification:**

Hydro operates in many diverse locations across the province, and it is critical that employees are provided with safe and reliable equipment in order to provide economical and reliable electricity.

As this proposal provides for the normal replacement of mobile equipment in accordance with established criteria, there is no relevant information related to:

- Levelized Cost of Energy;
- Forecast Customer Growth;
- Energy Efficiency Benefits; and
- Losses During Construction.

Net Present Value

A net present value calculation was not performed in this instance as there is no viable alternative to replacing light-duty mobile equipment.

Cost Benefit Analysis

As this project relates to the replacement of mobile equipment, a cost benefit analysis has not been performed.

Legislative or Regulatory Requirements

Hydro complies with the environmental requirements stipulated in the following:

- Canadian Environmental Protection Act
- Marine Spark-Ignition Engine and Off-Road Recreational Vehicle Emission Regulations

Historical Information

Table 2 provides a history of light-duty mobile equipment purchases.

**Table 2: Mobile Equipment Less than $50,000**

| Year | Units Purchased | | | | | Budget ($000) | Actual ($000) |
|---|---|---|---|---|---|---|---|
| | All Terrain Vehicles | Snowmobiles | Trailers | Forklifts | Attachments | | |
| 2011F | 14 | 12 | 29 | 1 | 0 | 757.0 | |
| 2010 | 15 | 18 | 17 | 0 | 0 | 553.6 | 519.0 |
| 2009 | 15 | 26 | 14 | 1 | 0 | 561.2 | 529.9 |
| 2008 | 20 | 24 | 9 | 1 | 2 | 522.2 | 454.4 |
| 2007 | 15 | 19 | 0 | 0 | 0 | 241.0 | 243.5 |
| 2006 | 15 | 17 | 4 | 0 | 0 | 249.2 | 243.3 |

Status Quo

Failure to replace units in accordance with the replacement policy will lead to increasing maintenance costs and less reliable vehicles. Employees maintain the electrical system 24 hours a day, seven days a week, and require dependable and safe vehicles for their work. As equipment ages, it experiences increasing downtime, which could negatively affect response times for emergency outages or planned maintenance.

Alternatives

Purchase of this equipment is the only viable option. This project provides for the normal replacement of light-duty mobile equipment which is at the end of its useful life and is no longer dependable. Purchase of this equipment is the only viable option to support the maintenance of Hydro's assets.

Project Schedule

This project is to be completed by December 31, 2012.

**APPENDIX A**
**ASSETS TO BE REPLACED IN 2012**

| Unit # | Type | Age at retire | Expected Life | AGE | KMS | Condition | L-T-D Maint ($000) |
|---|---|---|---|---|---|---|---|
| V7089 | ATV | 5.1 | 5 | X | | | 2.1 |
| V7095 | ATV | 5.1 | 5 | X | | | 1.1 |
| V7098 | ATV | 5.1 | 5 | X | | | 1.8 |
| V7099 | ATV | 5.1 | 5 | X | | | 1.4 |
| V7119 | ATV | 4.2 | 4 | X | | | 2.0 |
| V7122 | ATV | 4.0 | 4 | X | | | 1.6 |
| V7124 | ATV | 4.0 | 4 | X | | | 1.8 |
| V7125 | ATV | 4.0 | 4 | X | | | 0.9 |
| V7127 | ATV | 4.0 | 4 | X | | | 0.8 |
| V9785 | Forklift | 24.2 | 20 | X | | | 13.0 |
| V9620 | Salt Spreader | 10.3 | 10 | X | | | 1.0 |
| V9625 | Salt Spreader | 10.0 | 10 | X | | | 19.5 |
| V8886 | HD Trl | 32.0 | 10 | X | | | 1.1 |
| V8756 | HD Trl | 24.2 | 12 | X | | | 6.4 |
| V8816 | HD Trl | 12.4 | 12 | X | | | 25.4 |
| V8842 | HD Trl | 12.4 | 12 | X | | | 12.4 |
| V8843 | HD Trl | 12.4 | 12 | X | | | 11.0 |
| V8844 | HD Trl | 12.4 | 12 | X | | | 40.4 |
| V8845 | HD Trl | 12.4 | 12 | X | | | 27.4 |
| V8846 | HD Trl | 11.8 | 12 | X | | | 10.2 |
| V7955 | LD Trl | 14.2 | 10 | X | | | 7.8 |
| V8698 | LD Trl | 11.8 | 6 | X | | | 3.5 |
| V8699 | LD Trl | 11.8 | 6 | X | | | 2.7 |
| V8700 | LD Trl | 11.8 | 6 | X | | | 1.7 |
| V8731 | LD Trl | 11.8 | 6 | X | | | 2.4 |
| V8732 | LD Trl | 11.8 | 6 | X | | | 20.7 |
| V8837 | LD Trl | 19.6 | 10 | X | | | 0.7 |
| V8858 | LD Trl | 10.3 | 6 | X | | | 4.8 |
| V8859 | LD Trl | 10.3 | 6 | X | | | 2.9 |
| V8882 | LD Trl | 5.6 | 6 | X | | | 1.1 |
| V8883 | LD Trl | 5.6 | 6 | X | | | 1.9 |
| V7069 | Snowmobile | 5.2 | 4 | X | | | 1.1 |
| V7070 | Snowmobile | 5.2 | 4 | X | | | 1.0 |
| V7080 | Snowmobile | 5.2 | 5 | X | | | 1.2 |
| V7081 | Snowmobile | 5.2 | 5 | X | | | 1.0 |
| V7611 | Snowmobile | 4.1 | 4 | X | | | 1.4 |
| V7645 | Snowmobile | 6.0 | 5 | X | | | 1.2 |

**Project Title:** Replace Disconnects

**Location:** Various Terminal Stations

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Clustered

**Classification:** Normal

**Project Description:**

This project is an ongoing program to replace aging 69 kV, 138 kV and 230 kV disconnect switches in Hydro's terminal stations on the Island Interconnected System. The condition of the disconnects is defined in terms of age, history of failures, availability of spare parts, and corrosion. The priority of replacements is a function of the condition of a disconnect; where it is located in the system; availability of outage time for repairs; availability of spare parts and manufacturer servicing. These criteria are considered collectively to determine the order of repairs or replacements. Table 1 lists the disconnect switches planned for replacement in 2012.

**Table 1: Disconnect Switches to be replaced in 2012**

| Location | Number of Units | Disconnect Switch | Voltage (kV) |
|---|---|---|---|
| Barchoix | 3 | L20T1,L20G, T1AG | 69 |
| Coney Arm | 1 | T1 Fuses | 69 |
| Holyrood | 2 | T1B1-1, T1B1-2 | 69 |
| Holyrood | 4 | B3L18-2,L18G, B1T1,T1G | 230 |
| Bottom Brook | 1 | B1T1 | 230 |
| Western Avalon | 2 | B1L08-1, L03L17-2 | 230 |

A mobile substation will be required for the replacement of disconnect switches at Barachoix Terminal Station in order to continue electrical service to approximately 1,350 customers on the Barachoix Distribution System. Other replacements do not require temporary transformation or generation and will be completed during scheduled equipment outages and will not affect customer service.

The budget estimate for this project is shown in Table 2.

**Table 2: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 180.0 | 0.0 | 0.0 | 180.0 |
| **Labour** | 74.0 | 0.0 | 0.0 | 74.0 |
| **Consultant** | 12.5 | 0.0 | 0.0 | 12.5 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 35.0 | 0.0 | 0.0 | 35.0 |
| **Interest and Escalation** | 20.2 | 0.0 | 0.0 | 20.2 |
| **Contingency** | 30.1 | 0.0 | 0.0 | 30.1 |
| **TOTAL** | **351.8** | **0.0** | **0.0** | **351.8** |

The new disconnects will have improved technology compared with the existing disconnects. For vertically mounted disconnects, the insulator part will be upgraded to high strength material to reduce the risk of the insulators breaking and falling. The new disconnects to be mounted on the wood pole structures will also have a more rigid support frame to maintain the alignment of the switches.

The disconnect switches for this program will be bought under a multi year contract. This will improve the delivery time and price from the manufacturer.

Existing System

Disconnect switches are an integral part of the power system. The disconnects are used to isolate a piece of equipment such as a breaker, transformer or transmission line for maintenance or repair. Also, they are used to bypass equipment to prevent customer outages while work is being performed on the equipment.

The basic components of a disconnect switch are the blade, insulators, switch base and operating mechanism. The blade is the main current carrying component in the switch and it moves to open and close the switch. The insulators are made of porcelain and insulate the switch base from the current carrying parts . The switch base supports the insulators and is mounted to a metal frame for wood pole structures or on a steel tower structure. The switches are operated either manually using a handle at ground level to open and close the blade or automatically by a motor operated device.

The disconnect switches that are being replaced in 2012 under this program operate at either 230 kV or 69kV and are a combination of motor operated and manually operated switches. Figure 1

shows a typical arrangement of a disconnect switch on each of the three phases of a 69 kV wood pole structure. The arrows in the diagram point to the operating blades that open and close to control current flow.




**Figure 1 – Typical 69 kV Disconnect Switch**

Age of Equipment or System

The disconnect switches on the Island Interconnected System range in age from one to 45-years. The switches that are scheduled to be replaced are between 20 and 40 years old and have had recurring safety and reliability problems.

Major Work/or Upgrades

There have been no major replacements of terminal station disconnect switches since they were installed. Repairs have been made on a piecemeal basis as failures occurred. The maintenance history of these disconnects involves repair or replacement of insulators, control systems, drive motors, gearboxes, auxiliary contact cams, brakes, heaters, motor contactors, control arms, jaws, springs, blades, couplings, and hinges. This history is summarized in Table 3. The hot spot data

shown in the table refers to events where operations staff had to respond to overheating conditions resulting from the failure of mechanical and current carrying parts.

**Table 3: Work History Summary**

| Work History Summary (2000 to 2010) | | | | |
|---|---|---|---|---|
| **kV Class** | **Replace Insulators** | **Repair Controls** | **Hardware And Mechanical Issues** | **Hot Spots and Emergencies** |
| 230 | 16 | 105 | 124 | 18 |
| 138 | 10 | 19 | 26 | 6 |
| 69 | 13 | 7 | 44 | 19 |
| Total | 39 | 131 | 194 | 44 |

Anticipated Useful life

Disconnect switches have an anticipated service life of 30 to 40 years, depending on the service environment.

Maintenance History

Table 4 shows the history of maintenance costs for disconnect switches for the period 2006 to 2010.

**Table 4: Five-Year Maintenance History**

| Year | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($000) |
|---|---|---|---|
| 2010 | 24.3 | 28.9 | 53.2 |
| 2009 | 6.8 | 16.0 | 22.8 |
| 2008 | 13.6 | 22.4 | 36.0 |
| 2007 | 8.8 | 23.1 | 31.9 |
| 2006 | 26.0 | 32.9 | 58.9 |

Below is a brief discussion of problems experienced with various disconnect switches. The age of the switches and in some cases environmental conditions have been the main cause of problems. The supply of spare parts for these disconnects has been exhausted.

1) Farewell Head L54G

The original switch is 20 years old. The switch is hard to operate and efforts to adjust the mechanism for easier operation have proven unsuccessful. There is concern the mechanism will

break because of the force required to operate it. This disconnect switch will be replaced in 2014.

2) Holyrood T1B1-1

The original switch is 30 years old. The switch is currently inoperative due to misalignment of arms and jaws. Several attempts have been made to correct and realign the disconnect switch. Each time it has been repaired it fails on the next operation. This disconnect switch will be replaced in 2012.

3) Bottom Brook B1T1

The original switch is 39 years old. The gear box for this switch has failed and the repairs are not permanent. New parts are not available. Failure during operation could result in extensive damage to transformer T1 and associated equipment and extended outages. This disconnect switch will be replaced in 2012.

4.) Oxen Pond B2B5-1 and B2B5-2 and Hardwoods B8C2-1

In 2010 hot spots were identified on all three of these disconnects. This resulted in disconnects B2B5-2 at Oxen Pond Terminal Station and B8C2-1 at Hardwoods Terminal Station having to be bypassed and are planned for replacement in 2011. Disconnect B2B5-1 at Oxen Pond also had repairs completed in 2010 due to less severe damage.

<u>Outage Statistics</u>

Hydro does not track outage statistics directly related to failures of disconnect switches. Disconnect switches are a sub-component of major terminal station equipment such as circuit breakers, transformers and station power buses. Outage statistics for the major terminal station equipment reflect disconnect failures but the performance of disconnect switches is not directly measured.

Table 5 lists the 2006 to 2010 average T-SAIFI and T-SAIDI data by region and the Hydro corporate value. The table also lists the latest CEA five year averages (2005 to 2009).

**Table 5: Outage Statistics**

**Five Year Averages (2006-2010) Forced Outages Only**

| Delivery Point Affected | T-SAIFI | T-SAIDI |
|---|---|---|
| Central Region | 0.47 | 49.38 |
| Northern Region | 2.90 | 76.28 |
| Labrador Region | 6.60 | 114.60 |
| Hydro System | 1.08 | 56.07 |
| CEA (2005-2009) | 0.73 | 70.72 |

SAIDI- indicates the System Average Interruption Duration Index for customers served per year, or the average length of time a customer is without power in the respective distribution system per year.

SAIFI - is the System Average Interruption Frequency Index per year which indicates the average of sustained interruptions per customer served per year or the average number of power outages a customer has experienced in the respective distribution system per year.

Industry Experience

Hydro has experienced operational problems with the older disconnects such as misalignment of switch blades, broken insulators falling off structures, corrosion and seizing of moving parts.

Maintenance or Support Arrangements

Maintenance on the disconnect switches is performed by Hydro personnel.

Vendor Recommendations

The vendor recommends replacement of the old disconnects after 30 years in service.

Availability of Replacement Parts

Due to the age of this equipment, original manufacturers are no longer in business and spare parts are unavailable. Hydro's inventory of spare parts has now been depleted.

Safety Performance

Malfunctioning disconnects create safety hazards due to insulator failures in which parts break off and could potentially fall on personnel working on them or around the pole structure supporting the disconnects. Insulator failures on disconnect switches have occurred three times, at Bay d'Espoir, Barachoix, and Conne River Terminal Stations. Hydro has revised its engineering standard for disconnect switches so that new insulators for the disconnect switches should have a higher cantilever strength in an effort to reduce the risk of parts breaking and falling.

Environmental Performance

There are no environmental concerns related to this project.

Operating Regime

Disconnect switches operate on a continuous basis.

**Justification:**

The disconnect switches are used to isolate equipment either for maintenance activities or system operations and controls. Proper operation of the switches is essential to a safe work environment and for reliable and secure system operation. Faulty and/or malfunctioning disconnect switches do not operate properly when required and as such prevent reliable and secure system operation and create a safety hazard. The switches that are being replaced have problems such as misalignment of switch blades, broken insulators falling off structures, corrosion, and seizing of moving parts. In addition, the switches are obsolete and replacement parts are not available.

The condition of the disconnects has deteriorated such that continued piecemeal repair is not an effective solution for eliminating the safety hazards and ensuring reliable operation. Complete replacement of the disconnects in an orderly, prioritized replacement program is required.

Net Present Value

A net present value calculation was not performed as only one viable alternative exists and that is to replace deteriorated disconnect switches.

Levelized Cost of Energy

This project does not affect the levelized cost of energy because it does not involve any new sources of generation.

Cost Benefit Analysis

A cost benefit analysis is not required for this project as there are no quantifiable benefits.

Legislative or Regulatory Requirements

There are no legislative or regulatory requirements for this project.

Historical Information

Table 6 provides a recent history of disconnect switch replacements.

**Table 6: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit ($000) | Comments |
|---|---|---|---|---|---|
| 2011F | 295.0 | | 7 | | Replacement of Switches at Holyrood and on TL-225. Also replaced switches at English Harbour West, Conne River, Corner Brook Frequency Converter which was originally planned for 2010 |
| 2010 | 199.0 | 96.5* | 5 | 19.3 | Planned replacement of switches at English Harbour West, Conne River, and Corner Brook Frequency Converter |
| 2008 | 367.6 | 568.4 | 16 | 35.5 | Replacement of switches at Cow Head and Daniels Harbour |

* Targeted work for 2010 was not completed; the remainder of the budget ($102,500) was carried over to 2011. The work was not completed because the planned outage was missed due to late delivery of equipment. The planned replacements not completed in 2010 will be completed with the scheduled replacements for 2011.

Forecast Customer Growth

Customer load growth does not affect this project.

Energy Efficiency Benefits

There are no energy efficiency benefits associated with this project.

Losses during Construction

The replacement of the disconnect switches will be coordinated with the normal planned outage schedule for the transmission system. Therefore, there will be no production or revenue losses resulting from this project.

Status Quo

The status quo is not an acceptable alternative. The disconnect switches are old and present safety and reliability issues.

Alternatives

There are no viable alternatives to replacing the disconnect switches.

**Conclusion:**

Reliable operation of the disconnect switches is essential to a safe work environment and for reliable and secure system operation. Many of the disconnect switches on the system have exceeded their useful life and have problems related to reliable operation and safety. An orderly, prioritized replacement of the most problematic disconnects is required.

Project Schedule

The anticipated project schedule is shown in Table 7.

**Table 7: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Schedule<br>Target Plan | January 2012 | February 2012 |
| Design | Equipment Ordering Tendering | February 2012 | March 2012 |
| Procurement | Equipment Delivery | March 2012 | August 2012 |
| Construction | Equipment Removal<br>Equipment Installations | August 2012 | November 2012 |
| Commissioning | Installations in service | August 2012 | November 2012 |
| Closeout | Project Completion | December 2012 | December 2012 |

Future Plans

Each year a review of the prioritized list for the replacement of disconnect switches will be made. Based on the condition of the disconnect switches combined with their location on the Island Interconnected System and the availability of outages, the priority of the replacements may change from year to year. Table 8 provides the list of disconnect switches planned for replacement in 2013 to 2016.

**Table 8: Future Disconnect Switch Replacements**

| Year | Location | Number of Units | Disconnect Switch | Voltage (kV) |
|---|---|---|---|---|
| 2013 | Come By Chance | 6 | B1L07, B2L37, B1T1, B2T2, B1B2-1, B1B2-2 | 230 |
| 2013 | Bay d'Espoir | 1 | B3B4-1 | 230 |
| 2013 | Holyrood | 2 | B2T2/T2G | 230 |
| 2014 | Holyrood | 2 | B3T3/T3G | 230 |
| 2014 | English Harbor West | 3 | L20-1, L20G | 69 |
| 2014 | Conne River Tap | 1 | L20-1 | 69 |
| 2014 | Farewell Head | 1 | L54G, L54T1, T1AG | 69 |
| 2015 | Bay d'Espoir | 7 | B13L20-1, B13L20BP, B13T11-1, B13T10, B13T12, B13L20-2, L20G | 69 |
| 2016 | Sunnyside | 1 | L06L07-2 | 230 |
| 2016 | Doyles | 1 | B1L15-2 | 69 |
| 2016 | Bottom Brook | 3 | B1L11-1, B1L11-2, L11G | 230 |
| 2016 | Bottom Brook | 4 | B2L14-2, L14G, B2T1, B2T2 | 138 |
| 2016 | Hampden Tap | 4 | L51-1, L51G, L52-1, L52G | 69 |
| 2016 | Massey Drive | 3 | B2B4-1, B4T1-1, B2T2-1 | 69 |

**Project Title:** Upgrade Transmission Line Access Trails

**Location:** Stoney Brook to Springdale

**Category:** Transmission and Rural Operations - Transmission

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is the first year of a program starting in 2012 to improve the condition of Hydro's transmission line access trail system on the island interconnected system. Labrador has one transmission line, TL-240 which is currently not a priority for access trail upgrades. Upgrade work will involve the widening of existing trails to a minimum of four meters. All side hill slopes will be reduced to 37 percent incline or less. All approach and exit slopes will be reduced to 51 percent incline or less, and all slope inclines/declines will be reduced to 58 percent or less (on portions of each trail Hydro has some deficiencies that do not conform to the new standard.) In addition, all trails will be clearly marked to ensure that travel is limited to a single route along the surveyed right-of-way. This work is required to bring the condition of the trails up to current Hydro safety and environmental standards (See Appendix A). Percent slope is the ratio of rise (height) to run (length) of the slope. It is a general practice when constructing roads, highways, etc., that grades are expressed as a percentage. These angles make up part of Hydro's access trail standard found in appendix A of this proposal.

The anticipated work plan for upgrading access trails is shown in Table 1 and the length of upgrade will be dependent upon the condition assessment conducted prior to the work being executed.

**Table 1: Work Plan**

| Year | Line | Location | Area Upgraded |
|---|---|---|---|
| 2012 | TL-222 | Stony Brook - Springdale | From Structures 01 to 440 |
| 2013 | TL-233 | Buchans - Bottom Brook | From Structures 251 to 577 |
| 2014 | TL-229 | Wiltondale - Glenburnie | From Structures 01 to 279 |
| 2014 | TL-241 | Peter's Barren - Plum Point | From Structures 01 to 530 |
| 2015 | TL-210 | Stony Brook - Cobb's Pond | From Structures 01 to 328 |
| 2016 | TL-212 | Sunnyside - Linton Lake | From Structures 01 to 609 |

The budget estimate for this project is shown in Table 2.

**Table 2: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **2016** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 32.0 | 0.0 | 0.0 | 32.0 |
| **Consultant** | 11.2 | 0.0 | 0.0 | 11.2 |
| **Contract Work** | 224.0 | 0.0 | 0.0 | 224.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 19.0 | 0.0 | 0.0 | 19.0 |
| **Contingency** | 26.8 | 0.0 | 0.0 | 26.8 |
| **TOTAL** | **313.0** | **0.0** | **0.0** | **313.0** |

**Existing System:**

Access trails are routes that lead from public highways or forestry roads to and along transmission line right of ways. All access trails used by Hydro employees are identified on transmission line sensitivity mapping. See Appendix B for access trails on TL-222 which will receive priority for upgrades in 2012. The access trails are on Crown owned land that Hydro is permitted to use.

In order to provide reliable service to its customers, Hydro must be able to respond to maintenance issues and emergencies in a safe, environmentally friendly and efficient manner. Heavy equipment accessing transmission lines use government approved trails which originate along adjacent highways. Motorized Snow Vehicles and All-Terrain Vehicles Regulations, 1996 under the Motorized Snow Vehicles and All-Terrain Vehicles Act, 1990 apply. Also, Environmental Guidelines for Stream Crossing by All-Terrain Vehicles (ATV's) 1994 and as well, the Department of Environment in 1997 issued a Policy Directive: P.D. W.R. 97-2 – Policy for Development in Wetlands.

As this project is for major upgrades of existing access trails, the following items do not apply to this project:

- Outage Statistics;
- Industry Experience;
- Maintenance or Support Arrangements;
- Vendor Recommendations;
- Availability of Replacements Parts; and
- Operating Regime.

Safety Performance

In 2004, a line worker from TRO Central was injured and required an off work recovery period of six months due to an ATV incident. The injury was to the right shoulder and was reported through Hydro's Safe Work Observation Program (SWOP) as SWOP 2004097666. There were nine near miss ATV incidents over a four year period, 2006 to 2009; three occurred in 2006, four in 2007, one in 2008 and one in 2009. In 2008 a line worker in the TRO Northern region suffered a lost time incident of eight months before return to work due to a fractured left femur, see SWOP 2008003449. High percentage slopes on access trails contributes to the number of roll over incidents that have been recorded. Table 3 is a list of ATV and snowmobile incidents related to access trail conditions since 2003:

**Table 3: ATV and Snowmobile Incidents Since 2003**

| Incident | Frequency |
|---|---|
| ATV roll overs | 18 |
| ATV damage from stumps and rocks | 5 |
| ATV indicated bad trail | 3 |
| ATV sank in holes | 2 |
| Snowmobile struck stump or rock | 24 |
| Snowmobile hit drifts | 2 |
| Snowmobile indicated bad trail | 6 |

Age of Equipment

Access trails are the same age as the transmission lines and range from three to 44 years.

Anticipated Useful Life

Access trails are expected to remain for the full life of the transmission line.

Major Work/Upgrades

Operating projects were carried out in 2008, 2009, and 2010 to address immediate safety concerns in areas of planned maintenance activities. The work was done on TL-210, TL-215, TL-219, TL-220, TL-222, TL-231, TL-232, TL-233, TL-241, TL-252, TL-253, TL-254 and TL-259. The upgrades addressed issues such as vegetation growth, washouts, ruts, and potholes in areas where Hydro had planned maintenance on the lines. The work in this project covers TL-210, TL-212, TL-222, TL-229, TL-233, and TL-241. The work will improve upon the original condition of the trails in order to conform to

the new trail standard. In 2008, 2009, and 2010, the actual expenditures were $93,658, $137,521, and $136,728 respectively. The operating budget for 2011 for access trail maintenance is $160,000.

Maintenance History

Historically access trails were maintained by Hydro, but the ground maintenance crews have been phased out and the work has since been conducted by temporary employees and contractors. Recent incidents with ATVs require that sections of trails be upgraded to the standard in Appendix A. Once brought to standard the preventive maintenance program will ensure the trails are kept to standard. Maintenance work involves bringing a trail back to its original condition by clearing vegetation, repairing washouts, potholes and ruts. The capital funding will be used to improve a trail beyond its original condition such that it conforms to the new standard.

Environmental Performance

Please see Appendix A for discussion of environmental issues.

**Justification:**

In 2010, an access trail standard was developed in an effort to improve safety and reduce the number of ATV and snowmobile incidents on access trails. The purpose of this document is to ensure that a safe and environmentally sound design be applied when constructing and/or upgrading access trails. Hydro has observed over the past years that ATV incidents involving personal injury have increased. Therefore, from a safety perspective, it is critical that a program be started to improve upon the original condition of the access trail system as provided for in the new trail standard. From an environmental perspective, properly constructed trails on wetlands and bogs will minimize the damage currently caused by heavy equipment and ATVs.

Net Present Value

A net present value calculation was not performed as there are no viable alternatives.

Levelized Cost of Energy

The levelized cost of energy is a high level means to compare the costs of developing two or more alternative generating sources. Therefore, the levelized cost of energy is not applicable in this case.

Cost Benefit Analysis

As there are no quantifiable benefits, a cost benefit analysis has not been performed.

Legislative or Regulatory Requirements

Legislative requirements are included in the standard in Appendix A. Motorized Snow Vehicles and All-Terrain Vehicles Regulations, 1996 under the Motorized Snow Vehicles and All-Terrain Vehicles Act, 1990 apply. Also, Environmental Guidelines for Stream Crossing by All-Terrain Vehicles (ATV's) 1994 and as well, the Department of Environment in 1997 issued a Policy Directive: P.D. W.R. 97-2 – Policy for Development in Wetlands. Hydro is in violation of single route of travel and of avoidance of steep slopes which are currently in place on some access trails.

Historical Information

There is no applicable historical information available.

Forecast Customer Growth

Customer load growth does not affect this project.

Energy Efficiency Benefits

There are no energy efficiency benefits that can be attributed to the construction of transmission line equipment off-loading areas.

Losses during Construction

This project will have no effect on normal operations of generating facilities and will not cause any interruptions or system outages. Therefore, there will be no losses during construction.

Status Quo

Status Quo is not an option due to safety performance and environmental legislative requirements.

Alternatives

There are no viable alternatives available to the major upgrading of transmission line access trails.

**Conclusion:**

Transmission line access trails are necessary to provide safe, environmentally friendly and efficient access for line crews maintaining and troubleshooting transmission lines. This project will improve sections of access trails that do not meet Hydro's safety and environmental standard for access trails found in Appendix A.

Project Schedule

Table 4 provides the anticipated project schedule.

**Table 4: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Project Initiation | January 2012 | February 2012 |
| Design | Design plan and prioritize work | February 2012 | May 2012 |
| Procurement | Tender work for contracts | May 2012 | July 2012 |
| Construction | Upgrade trails | July 2012 | October 2012 |
| Closeout | Close out and documentation | October 2012 | November 2012 |

Future Plans:

Other access trail upgrades will be proposed in future capital budget applications. See five year capital plan (2012 Capital Plan Tab, Appendix A).

APPENDIX A

ACCESS TRAIL STANDARD

**NL Hydro Standards for Creating and Using an Access Trail**

**Permits and Requirements**

Vehicle and driver related procedures and guidelines as to use of access trail or road in the province are regulated by:

1. The Motorized Snow Vehicles and All-Terrain Vehicles Regulations under the Motorized Snow Vehicles and All-Terrain Vehicles Act (O.C. 96-240) and;

2. The Occupational Health and Safety Regulations under the Occupational Health and Safety Act.

A Permit to Occupy is required to establish an ATV trail. You can apply to the Department of Environment and Conservation, Lands Branch.

Permits and authorizations required for new line construction and upgrades include:

(a) Certificate of Approval to Ford a Watercourse from the Provincial Department of Environment and Conservation and from the Federal Department of Fisheries and Oceans;

(b) Certificate of approval for any work within 15 metres of a water body (Federal and Provincial);

(c) Letter of authorization from a municipality or operator to work within the boundary of a protected water supply;

(d) Certificate of Approval for Development Activity within a Protected Water Supply Area;

(e) Operating and Cutting Permits from Provincial Department of Natural Resources - Forestry Division for operations on forested lands during the forest fire season and the removal of brush and trees;

(f) Certificate of approval from the Department of Environment and Conservation for the temporary storage of drummed fuel in a remote location;

(g) Letter of authorization from Parks Canada or Environment Canada for work on protected federal lands or where federal funding is involved;

(h) Letter of authorization from private park owner is needed;

(i) Authorization from Coast Guard/DFO for Registration under the Navigable Waters Protection Act, if a bridge is required.

(j) Permits to carry out an activity on protected habitat under the endangered species legislation;

(k) Authorization for work within an Ecological Reserve or Protected Area.

(l) Consultation with the Department of Natural Resources - Wildlife for any changes that might occur.

**NL Hydro Environmental Services Department (ESD)**

The specific permit required is determined based on the type of activity to be undertaken and the sensitivity of the work location. Land use information and site assessment is used to determine if work is located in an area of particular sensitivity. Legislation and regulations are designed to protect such areas from adverse environmental impacts during any construction or other human activity therefore, whenever feasible sensitive areas should be avoided. Trails that were used to construct the provincial transmission grid may not be suited for use by heavy equipment or ATV's, based on today's standards.

ESD may reject previously approved trails upon review. They can also reject the use of the proposed access route if there is an alternative existing access within a reasonable distance or if there is a potential alternative access route that is less environmentally sensitive within a reasonable distance. ESD retains the right to restrict activity on any access route, if unacceptable terrain disturbance should occur. Upgrade work may be required if deemed necessary by ESD.

**Permits are not required**

In many areas of the province, there are no restrictions on the use of ATV's. Areas where ATV use is approved without restriction include:

- forested lands underlain by mineral soil (hard ground)
- properly constructed and licensed trails
- beaches unless otherwise prohibited by the Minister
- abandoned railway corridors and highways
- forest access roads and a variety of resource roads
- privately owned lands of less than 10 hectares (25 acres)
- any lands when snow-covered and frozen below the ground surface
- lands in Labrador north of 54$^{th}$ parallel

The individual or group to whom the licence is issued is responsible for the upkeep of the licensed trail. The license may be withdrawn if the licence holder does not maintain the trail.

1) **Existing Power Lines:**

a) All trails currently in use are required to be identified on appropriate mapping (usually 1:50,000) and supplied to the Government Services Department by the Hydro Companies.

b) Appropriate signs are to be supplied and erected by the Hydro Companies to identify the beginning and end of trails.

c) Approval of all stream crossings is required from the Department of Environment.

2) **Applications for New Power Lines:**

a) All conditions outlined in (1) above are applicable.

b) All ancillary trails and access roads are required to be identified during the review process.

c) "Approved areas" will be designated upon issuance of the power line easement.

Please note that duplicate copies of mapping are required with the application, i.e. one copy to be sent to the appropriate Regional Lands Office, and the other copy to the Crown Lands Record Division, Howley Building, St. John's.

**Access Trail Standards**

Travel shall be limited to a single route along the surveyed right-of-way. Travel outside the route shall only occur if conditions warrant it and is monitored and maintained to keep travel confined to this route.

The trail shall be clearly marked to offer proper and clear direction along the trail route with marked distances to give safe direction, especially in the winter months. This will include trail identification, direction, ford and non-fording sites etc.

The temporary route will be marked, such as flagging with surveyor's tape, in advance of construction, when necessary as to avoid sensitive areas.

Excavation and stump removal to accommodate equipment access along the right-of-way shall be kept to a minimum. Regular maintenance occurs as required.

Brush clearing shall be undertaken only in the approved and along approved access trails. The removal of trees and brush with machinery shall not be permitted. All cuttings and slash shall be piled along the edge of the right-of-way.

Trails should be cleared to the width of the vehicles that will use the trail, usually 4.0 meters with some extra clearing to allow for turnabouts.

Slope limits for access trails are as follows; Maximum side hill angle of 20° or 37%. Maximum approach and exit angle of 27° or 51%. Maximum trail slope incline or decline of 30° or 58%.

**Areas to Avoid**

- Limestone barrens
- Wetlands
- Environmental sensitivity areas such as water bodies, bogs, areas of potential slope instability, erodible soils and areas of high aesthetic value.
- Habitat where Species at Risk Act encompasses and park and reserve areas are involved, as determined by the Department of Environment and Conservation.

- Federal parks, historic sites and conservation areas.
- Protected water supply areas
- Private properties or any areas used and /or owned by municipal and government agencies

**Buffer Zones**

- Buffer zones must be maintained along water bodies for erosion control. The width of the buffer depends primarily on type of soil and slope.

  12 meters + (1.5 meters x slope (%))

  Where the slope is greater than 30 %,

  20 meters + (1.5 meters x slope (%))

- Specific widths of vegetated buffer zones must be maintained in a protected water supply area and other recreational areas (Table 1a & b).

- Clearing is not to occur within 800 meters of an active osprey or eagle nest during the nesting period (May 15 to July 31) and 200 meters outside of the breeding season.

- Hardwoods within 30 meters of waters occupied by beaver shall be left standing. A buffer shall be preserved a minimum of 30 meters from the waters edge at known waterfowl staging areas, with at least 20m of forest shall be established.

- At a known black bear denning site (winter) or those encountered during construction, a 50 meter no cut treed buffer will be maintained.

- Harvesting is also not permitted within caribou calving areas from May 15 - June 15 (calving period), and post calving areas from June 15 - July 31.

**Table 1 a. Vegetated Buffer Zone to be Maintained in a Protected Water Supply Area**

| Body of Water | Width of Buffer Zone to be Maintained |
|---|---|
| River Intake | 150 meters for 1.0 km upstream and 100 meters downstream |
| Intake (Pond/Lake) | 150 meters |
| Main River Channel | 75 meters |
| Main tributary/lakes/ponds | 50 meters |
| Other water bodies | 30 meters |

**Table 1b. Vegetated Buffer Zone to be Maintained in Respect to Department of Tourism and Recreation Requirements**

| Trials and Rivers | Width of Buffer Zone to be Maintained |
|---|---|
| Main Stem of Salmon River | 100 meters |
| Major tributaries | 50 meters |
| Approved Snowmobile Trails | 30 meters |
| Approved Hiking Trails | 20 meters |
| Provincial Trailway | 100 meters |

**Environmental Guidelines for Stream Crossing by All-Terrain Vehicles (ATVs) 1994.**

**Introduction**

The purpose of these guidelines are to outline the manner for crossing small streams or any other body of water with ATVs on licensed trails or any other approved area.

**Selection of Route and crossing sites**

1. ATV trails should be planned so that the route has the least amount of impact on all water resources.

   Routes should be selected to:

   minimize the number of watercourse crossings,

   avoid steep slopes and other sensitive areas,

   avoid wetlands and floodplain areas,

   reduce travel and access through Protected Water Supply Areas, and

   maintain substantial buffer strips of 15 meters on all bodies of water.

2. Where there is a choice between alternative crossing sites on the same watercourse the crossing should be located:

   where the stream is straight, unobstructed, and well defined,

   on an existing right of way if one exists,

   where stable geological and soil conditions are present,

   where a minimum of scour, deposition, or displacement of sediments are expected to occur at or near a crossing,

   where possible effects on existing bridges and hydraulic structures can be avoided,

   where it is possible to minimize the risk of damage from environmental hazards such as floods, mudslides, or fires,

   where conditions are favourable, and

   away and preferably downstream from such areas as fish spawning sites or water intakes.

3. Much of the information required for selecting a site and for deciding the best method of crossing is obtained from a site inspection. Other necessary information includes:

   Physical measurements of the stream including width at top and bottom, the depth of channel and water and its flow velocity.

   type and grading of bed material,

   existence of shoals and their composition,

   the type of material forming the stream banks,

   type and density of vegetation on the banks,

   steepness of banks and evidence of erosion,

   debris marks on shrubs, trees, or banks which may indicate the level of recent floods, and

   elevation of ice scars which may indicate ice jam elevations.

**Fording and or Bridge Construction**

There are a number of environmental factors and criteria should be followed when deciding whether to ford a watercourse or to provide a structure such as a bridge or culvert.

If a location with stable channel bed and banks has been identified, the flow is not too deep, and very infrequent use is anticipated, fording may be an acceptable alternative to the installation of a bridge or culvert. In some cases the installation of a bridge or culvert and its subsequent removal would result in greater channel disruption than preparing a fording site. Appropriate standards and guidelines are to be followed when dealing with watercourse crossing activities (i.e.: "Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador").

**Applying for Environmental Approval for Stream Crossings**

1. All stream crossings must be approved in writing by the Minister before the crossings takes place or before beginning the construction of a bridge. In addition to this requirement under the *Environment Act* other jurisdictions may require that the project be approved under their own legislation. A common example is the possible need to obtain a permit under *The Fisheries Act* if fish habitat is involved.

2. While these guidelines apply to any watercourse crossing no matter how small, written approval for each crossing need only be obtained for those stream crossings that appear on 1:50,000 scale topographic maps. One application must be completed for each type of stream crossing on each trail.

3. Applicants for licensed trails can apply for environmental approval for the necessary bridges either after the location of the trail is approved in principle by Crown Lands or at the same time. A recommendation that a trail will be eligible to be licensed must be made by Crown Lands before any certificate of approval is issued. Stream crossings on private land or any land that is not Crown Land must be approved under Section 27 but there is no need to have a licence for that trail. In such cases, proof of title or land ownership will be required before any written approval is issued.

4. In actually filling out the application form, it is important that the details be provided accurately and completely. Incomplete applications cannot be properly evaluated and they will be returned. Obviously, this will cause delays in getting approvals issued.

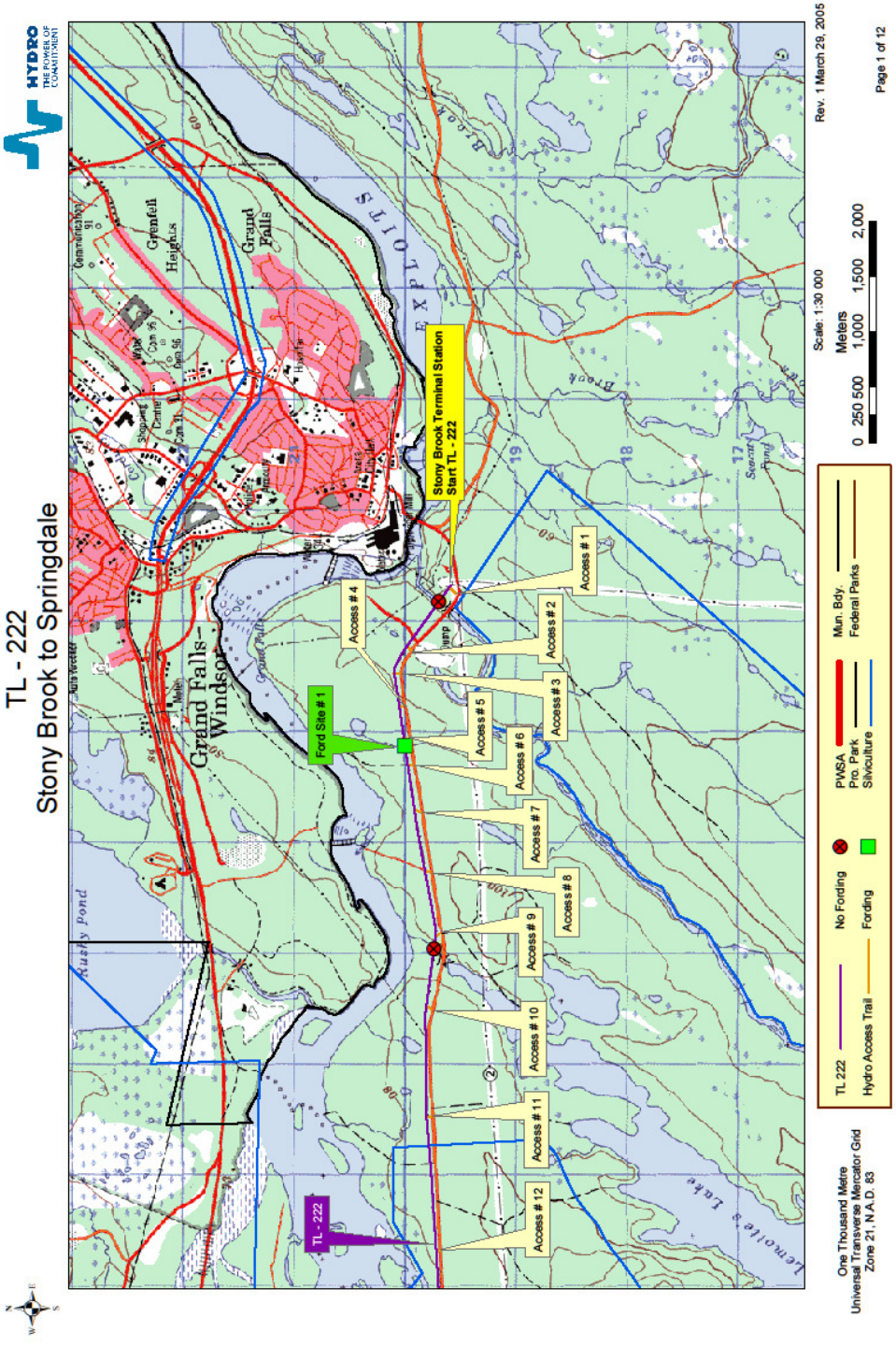
5. Each application will be evaluated to determine if the crossing is likely to avoid causing any impact on water resources.

6. The certificate of environmental approval will be subject to terms and conditions specifying such details as the location, size, materials, methods of construction, site preparation and restoration, and methods to control silt. These terms and conditions must be adhered to strictly.

7. Applicants for approvals should note that it takes about 3 to 6 weeks to process an application for approval beginning from the time that it is received by the Water Resources Division.

**APPENDIX B**

**ACCESS TRAIL MAPS**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HYDRO
THE POWER OF COMMITMENT
Grand Falls-Windsor
Grand Falls
Grenfell Heights
Stony Brook Terminal Station
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Access # 1
Access # 2
Access # 3
Access # 4
Access # 5
Access # 6
Access # 7
Access # 8
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Access # 10
Access # 11
Access # 12
TL - 222
Lemotte's Lake
Rushy Pond
Scale: 1:30 000
Meters
0 250 500 1,000 1,500 2,000
Rev. 1 March 29, 2005
Page 1 of 12
TL 222
Hydro Access Trail
No Fording
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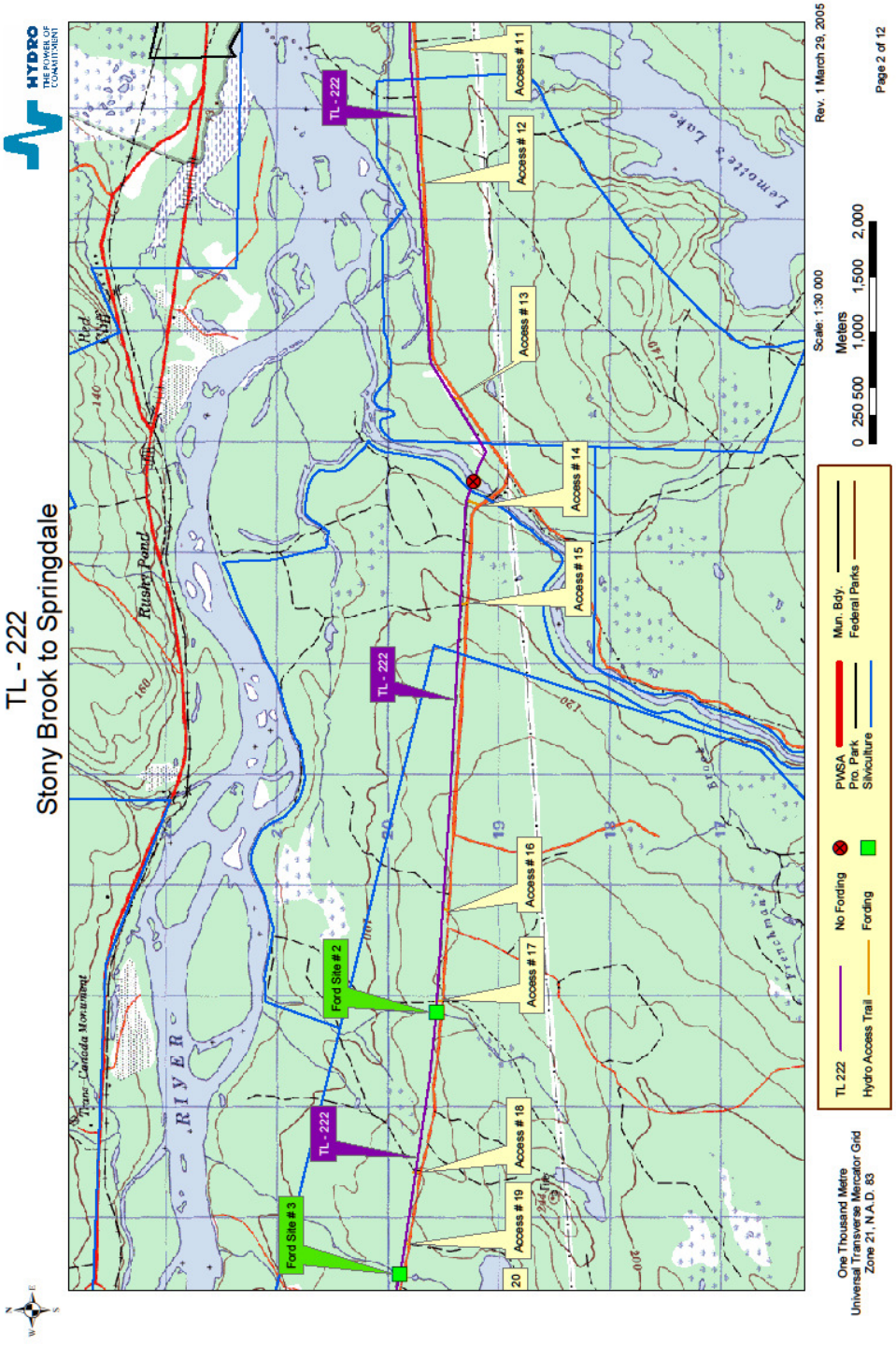
Pro. Park
Silviculture
Mun. Bdy.
Federal Parks
One Thousand Metre
Universal Transverse Mercator Grid
Zone 21, N.A.D. 83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Rev. 1 March 29, 2005
Page 2 of 12
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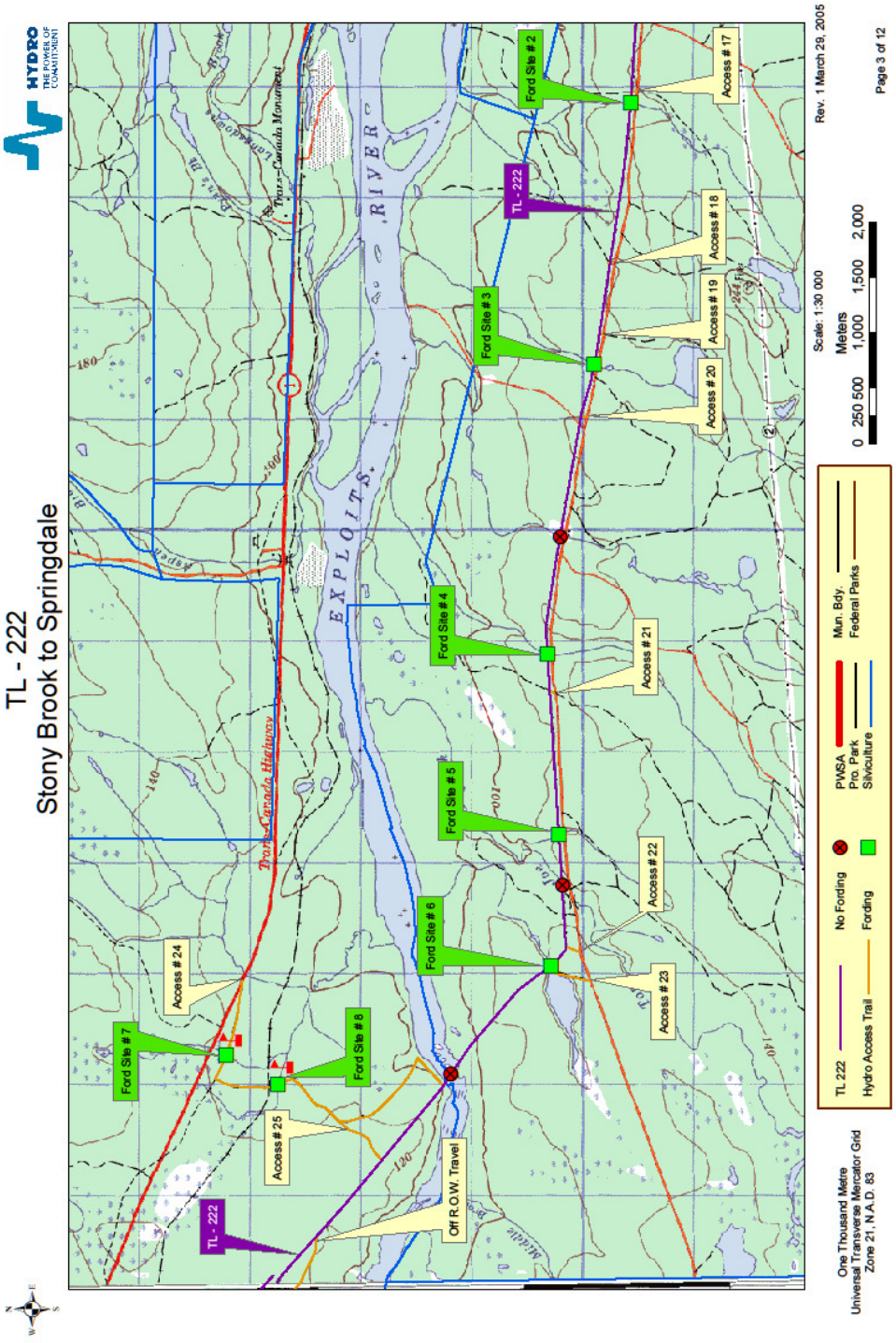
Pro. Park
Silviculture
Mun. Bdy.
Federal Parks
One Thousand Metre
Universal Transverse Mercator Grid
Zone 21, N.A.D. 83
Access # 11
Access # 12
Access # 13
Access # 14
Access # 15
Access # 16
Access # 17
Access # 18
Access # 19
Ford Site # 2
Ford Site # 3
Lemolite's Lake
Rushy Pond
RIVER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Trans-Canada Highway
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Ford Site # 5
Ford Site # 6
Ford Site # 7
Ford Site # 8
Access # 17
Access # 18
Access # 19
Access # 20
Access # 21
Access # 22
Access # 23
Access # 24
Access # 25
TL - 222
TL - 222
Off R.O.W. Travel
Rev. 1 March 29, 2005
Page 3 of 12
Scale: 1:30 000
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One Thousand Metre
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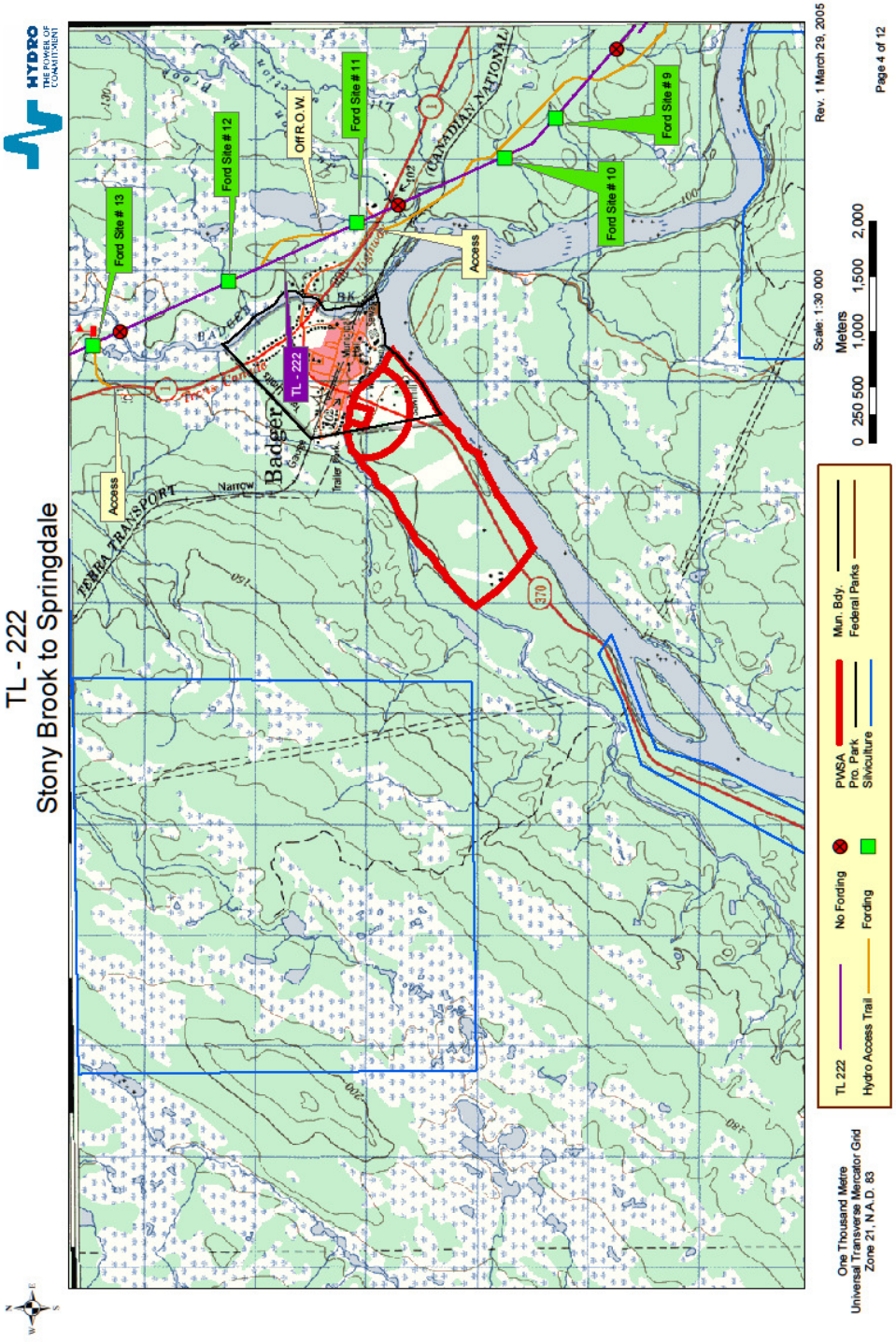
Zone 21, N.A.D. 83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Rev. 1 March 29, 2005
Page 4 of 12
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Ford Site # 13
Ford Site # 12
Ford Site # 11
Ford Site # 10
Ford Site # 9
Off R.O.W
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TL - 222
Badger
BADGER
TERRA TRANSPORT
CANADIAN NATIONAL
370
TL 222
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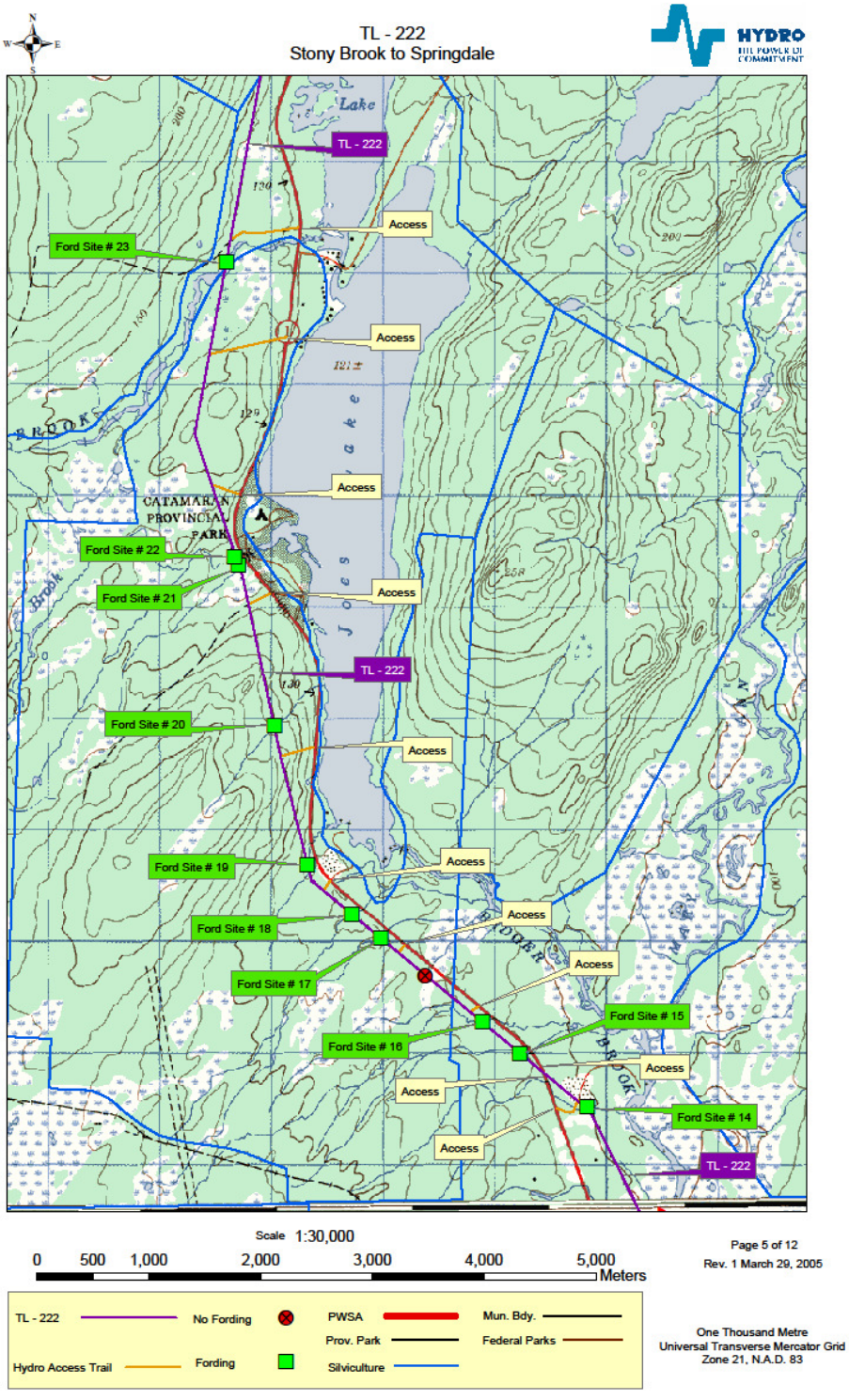
Universal Transverse Mercator Grid
Zone 21, N.A.D. 83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HYDRO
Lake
TL - 222
Access
Ford Site # 23
Access
Access
CATAMARAN PROVINCIAL PARK
Ford Site # 22
Ford Site # 21
Access
TL - 222
Ford Site # 20
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Ford Site # 19
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Ford Site # 18
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Ford Site # 14
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Page 5 of 12
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One Thousand Metre
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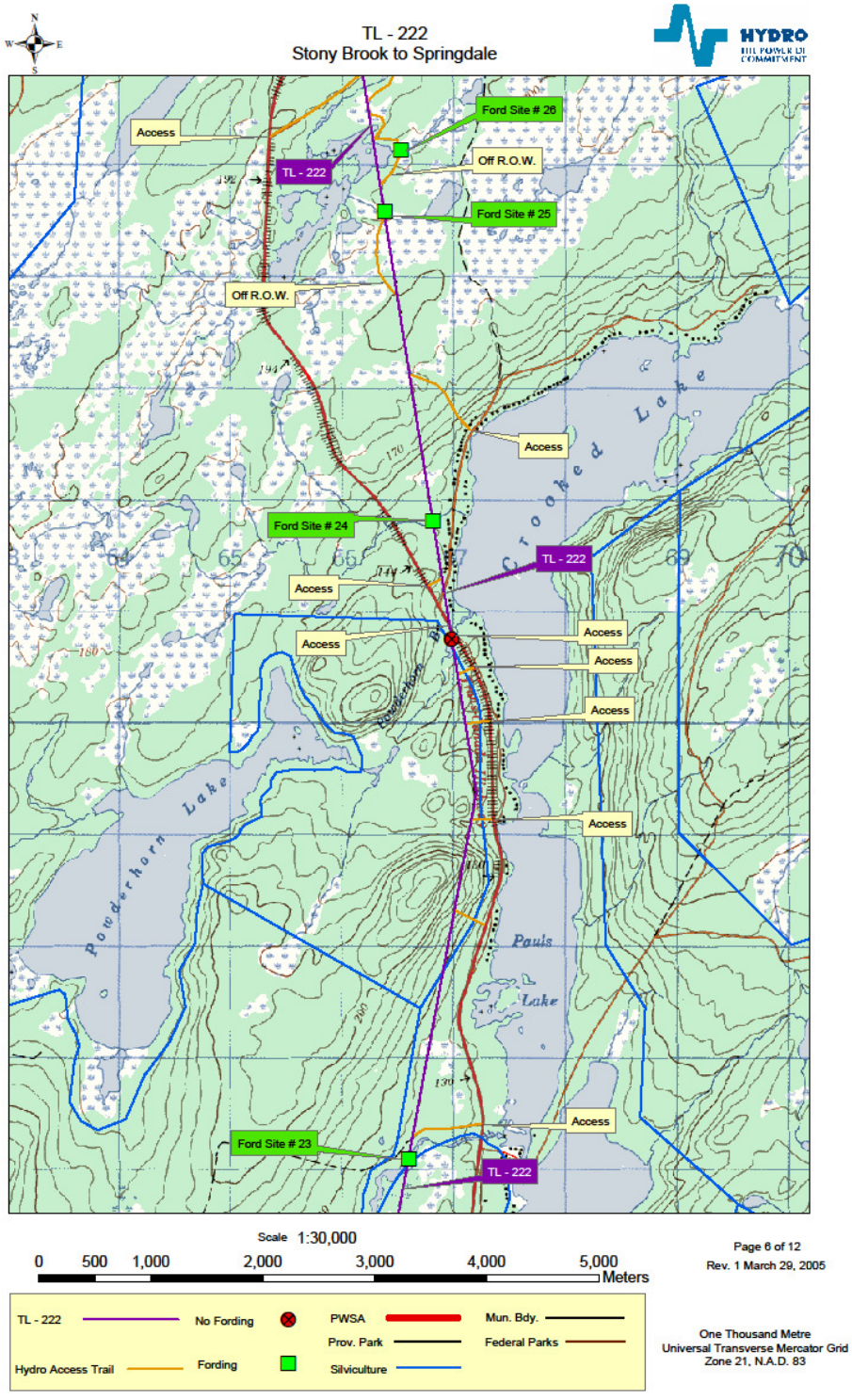
Zone 21, N.A.D. 83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HYDRO
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TL - 222
Off R.O.W.
Ford Site # 26
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Off R.O.W.
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Ford Site # 24
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Access
Access
Ford Site # 23
TL - 222
Crooked Lake
Powderhorn Lake
Pauls Lake
Scale 1:30,000
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Page 6 of 12
Rev. 1 March 29, 2005
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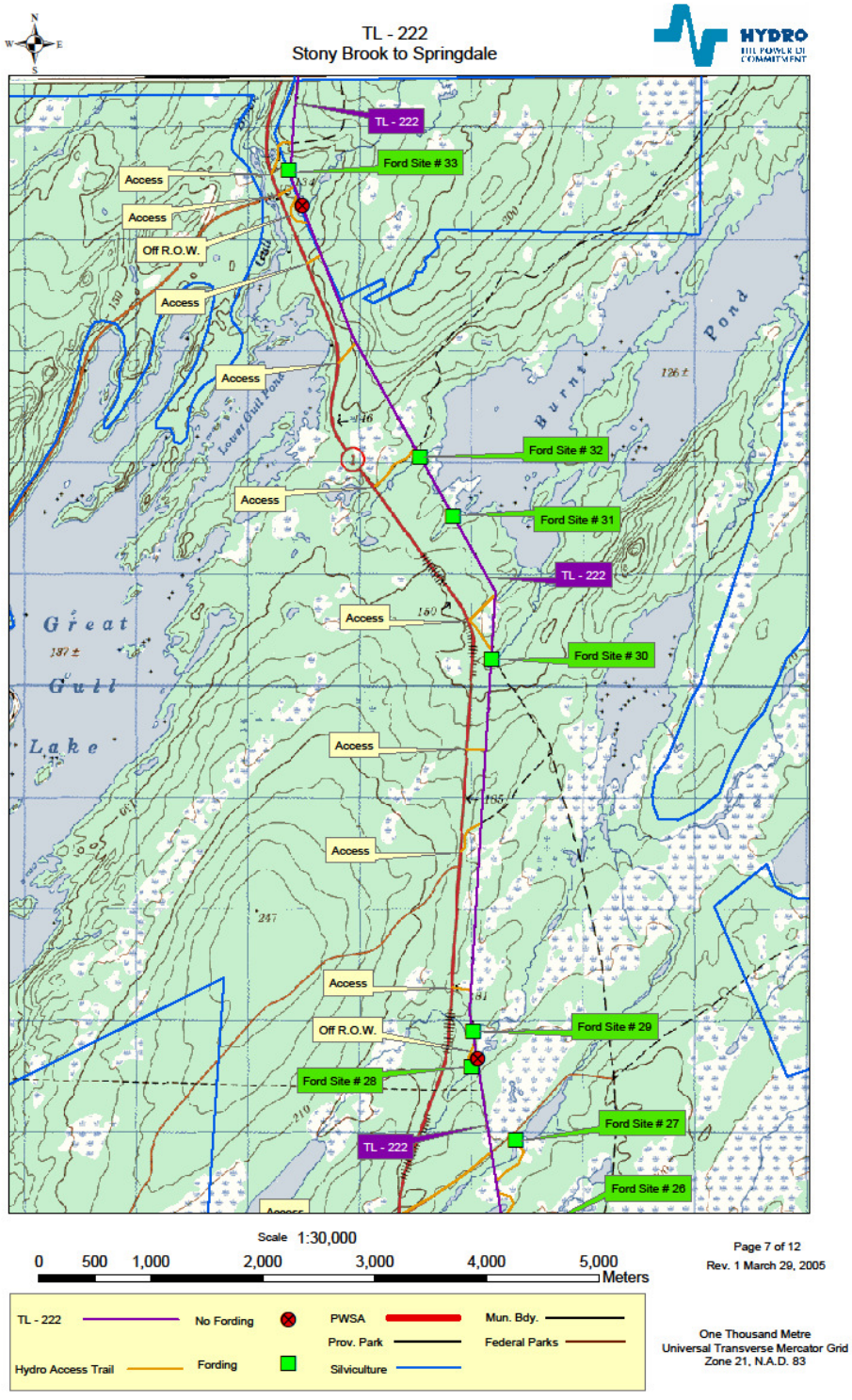
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Off R.O.W.
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Ford Site # 32
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Ford Site # 31
TL - 222
Access
Ford Site # 30
Access
Access
Access
Off R.O.W.
Ford Site # 29
Ford Site # 28
Ford Site # 27
TL - 222
Ford Site # 26
Great Gull Lake
Burnt Pond
Lower Gull Pond
Scale 1:30,000
0 500 1,000 2,000 3,000 4,000 5,000 Meters
Page 7 of 12
Rev. 1 March 29, 2005
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Hydro Access Trail
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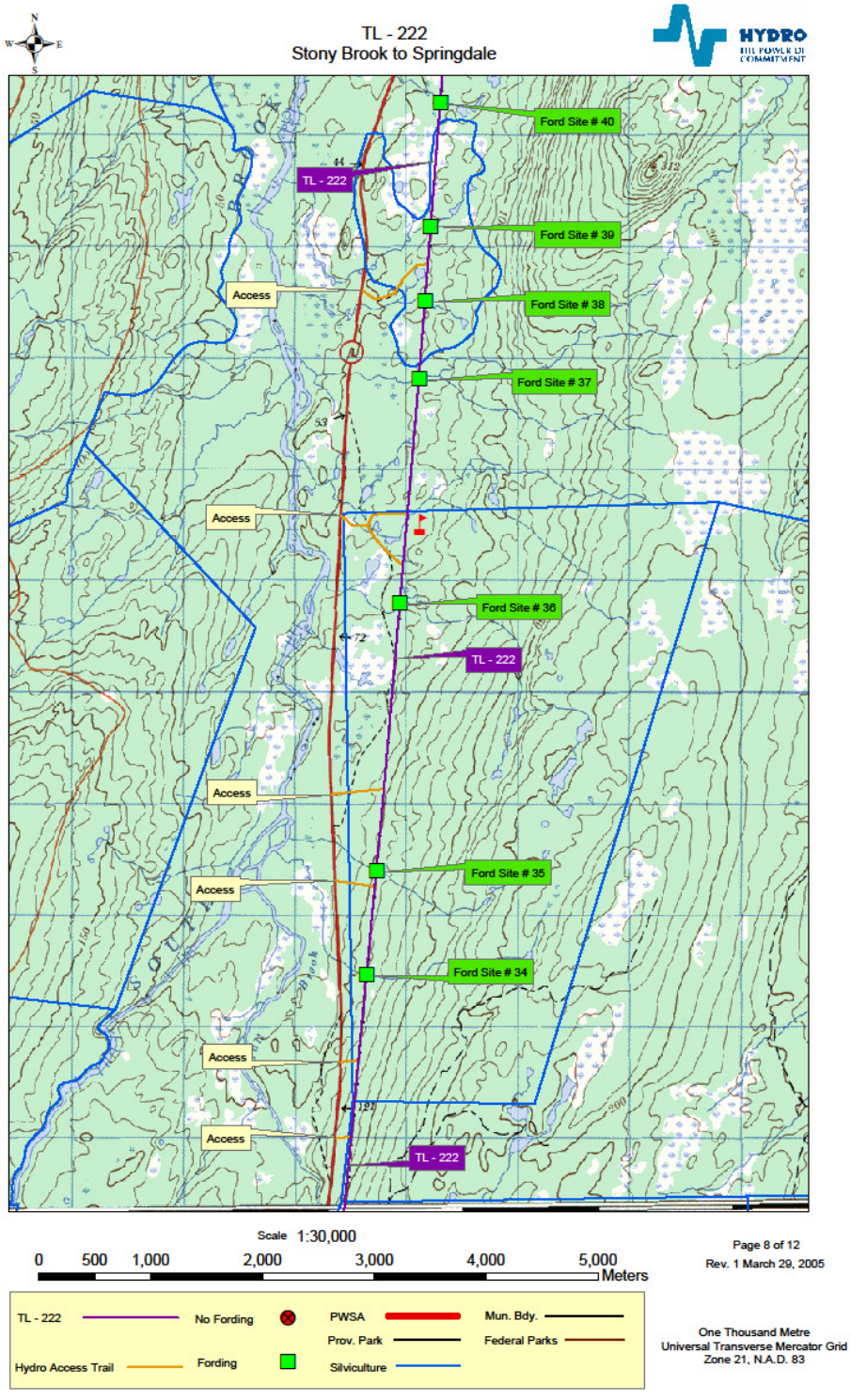
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Page 8 of 12
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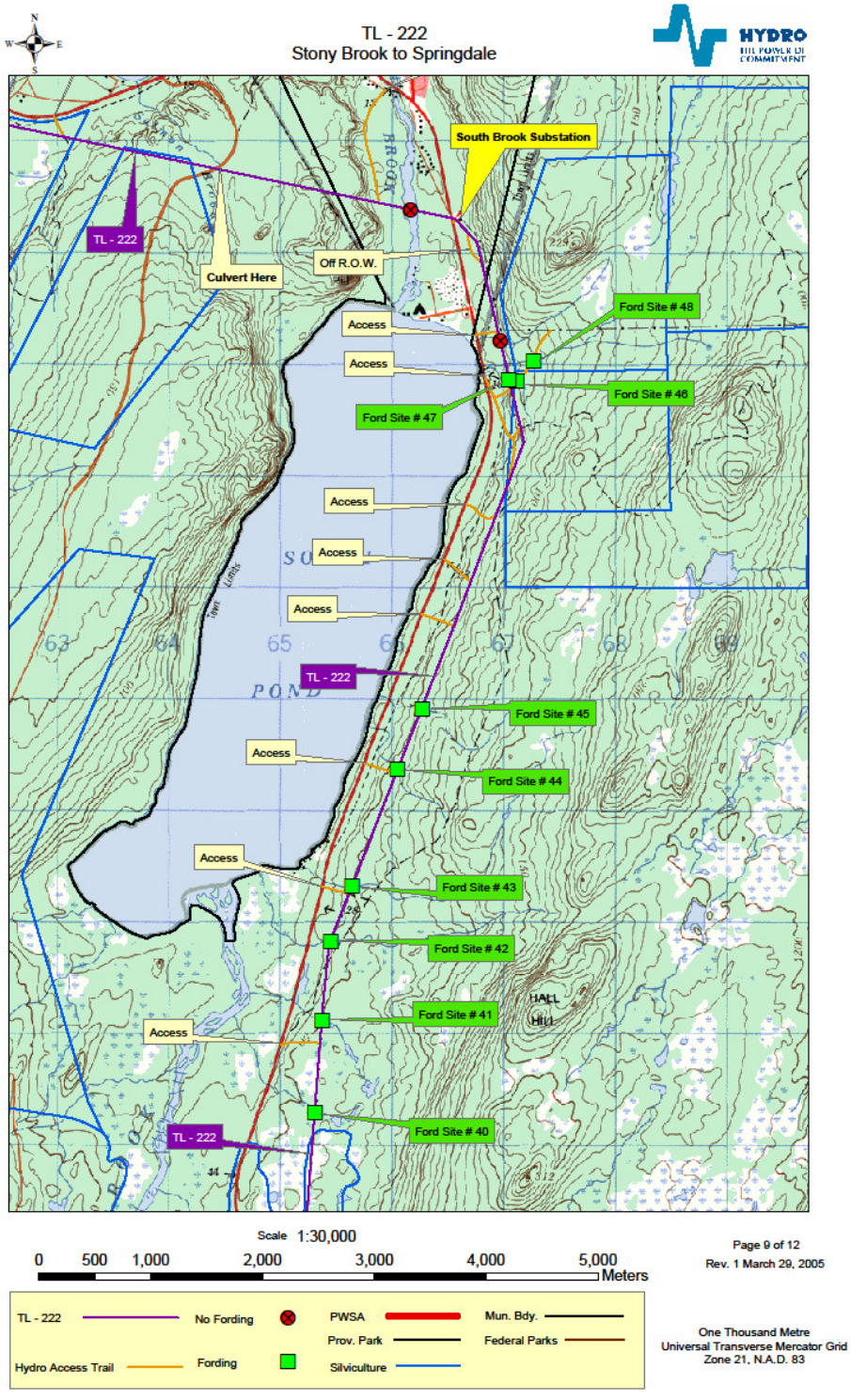
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Stony Brook to Springdale
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South Brook Substation
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Ford Site # 41
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Ford Site # 40
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Page 9 of 12
Rev. 1 March 29, 2005
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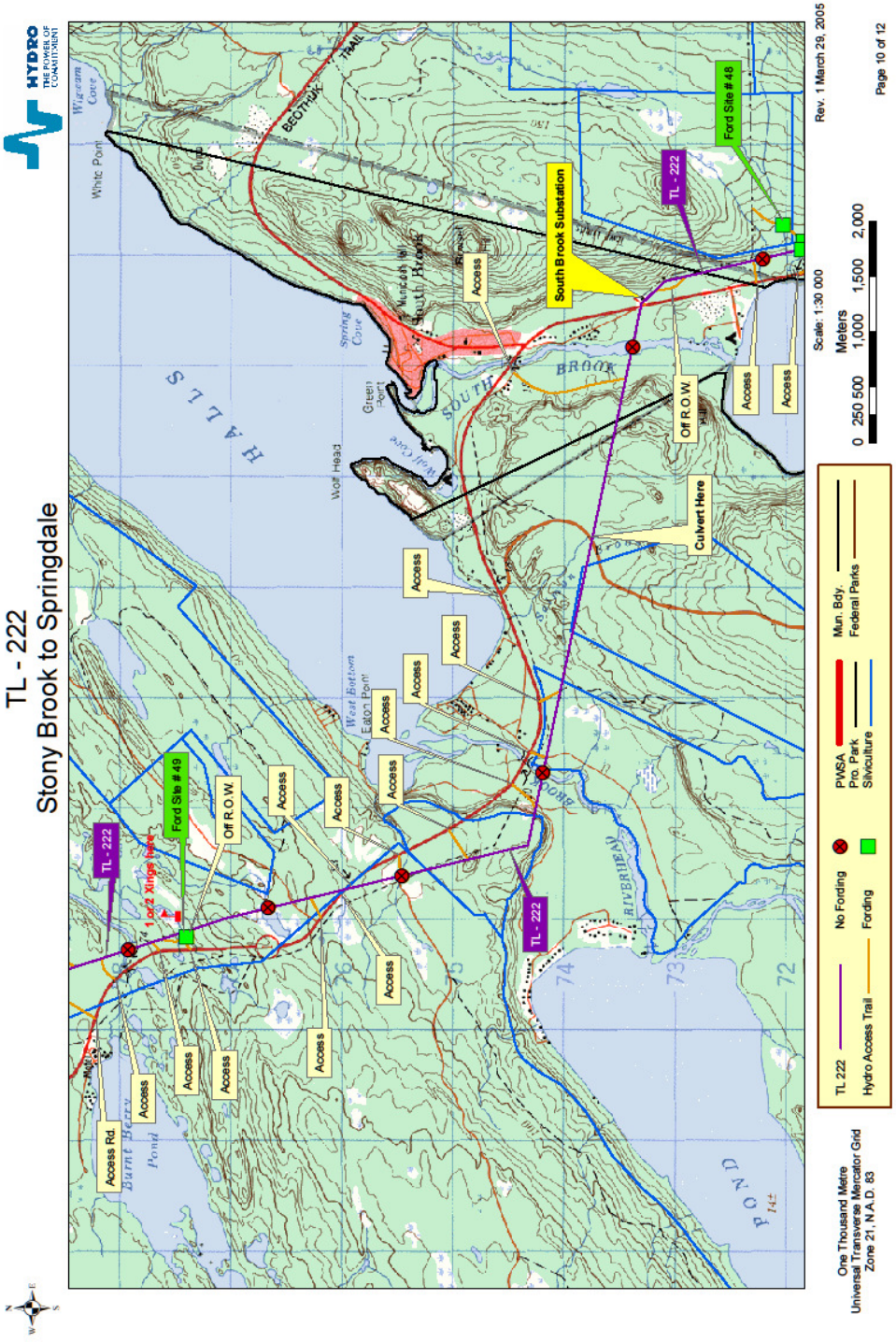
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Stony Brook to Springdale
Rev. 1 March 29, 2005
Page 10 of 12
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South Brook Substation
Ford Site #48
Ford Site #49
Culvert Here
Off R.O.W.
Access
Access Rd.
TL - 222
No Fording
Fording
PWSA
Pro. Park
Silviculture
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Federal Parks
TL 222
Hydro Access Trail
One Thousand Metre
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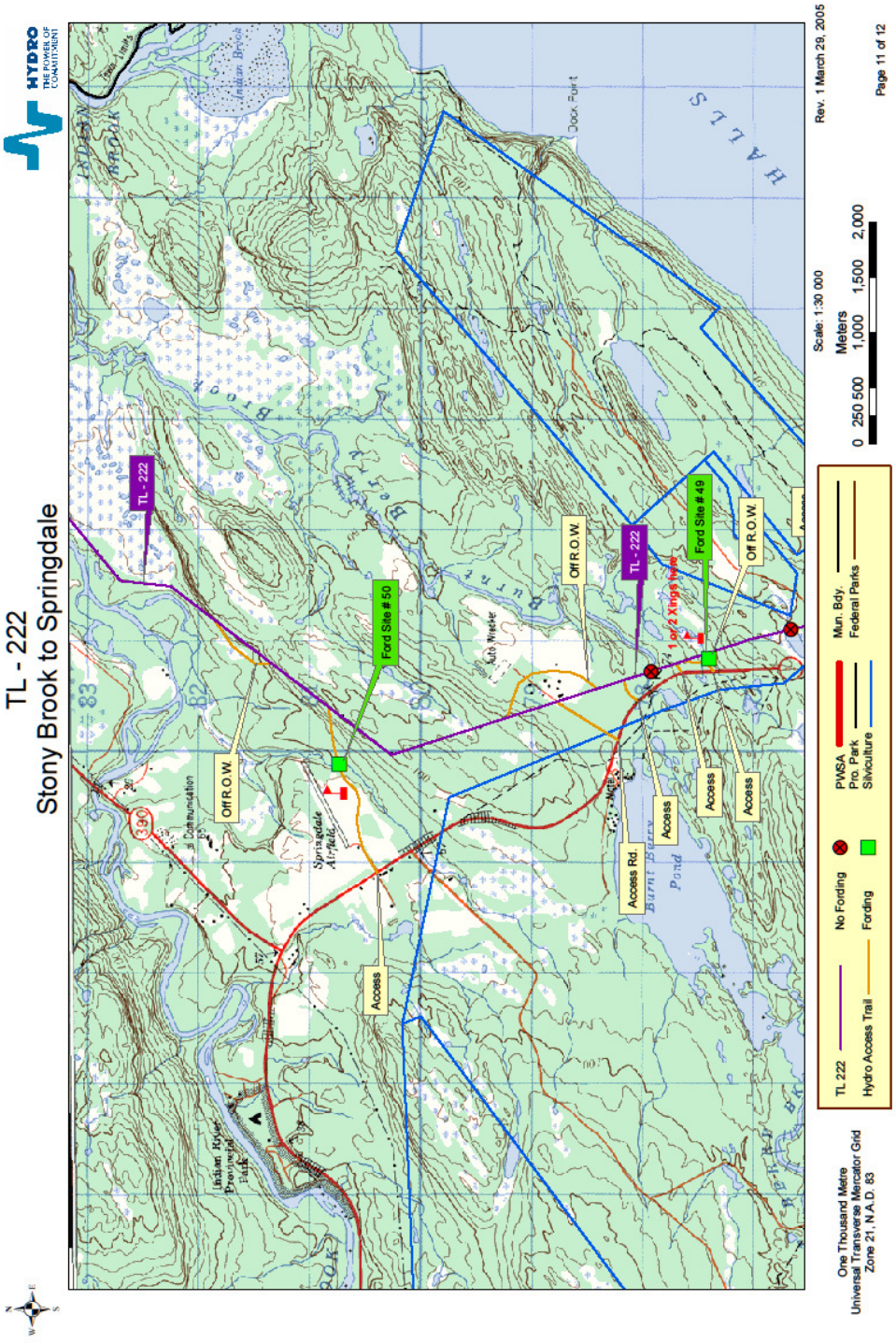
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THE POWER OF COMMITMENT
Rev. 1 March 29, 2005
Page 11 of 12
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Ford Site # 50
Ford Site # 49
1 or 2 Xings here
Access
Access Rd.
Springdale Airfield
Indian River Provincial Park
Burnt Berry Pond
Auto Wrecker
Dock Point
HALLS
TL 222
Hydro Access Trail
No Fording
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Silviculture
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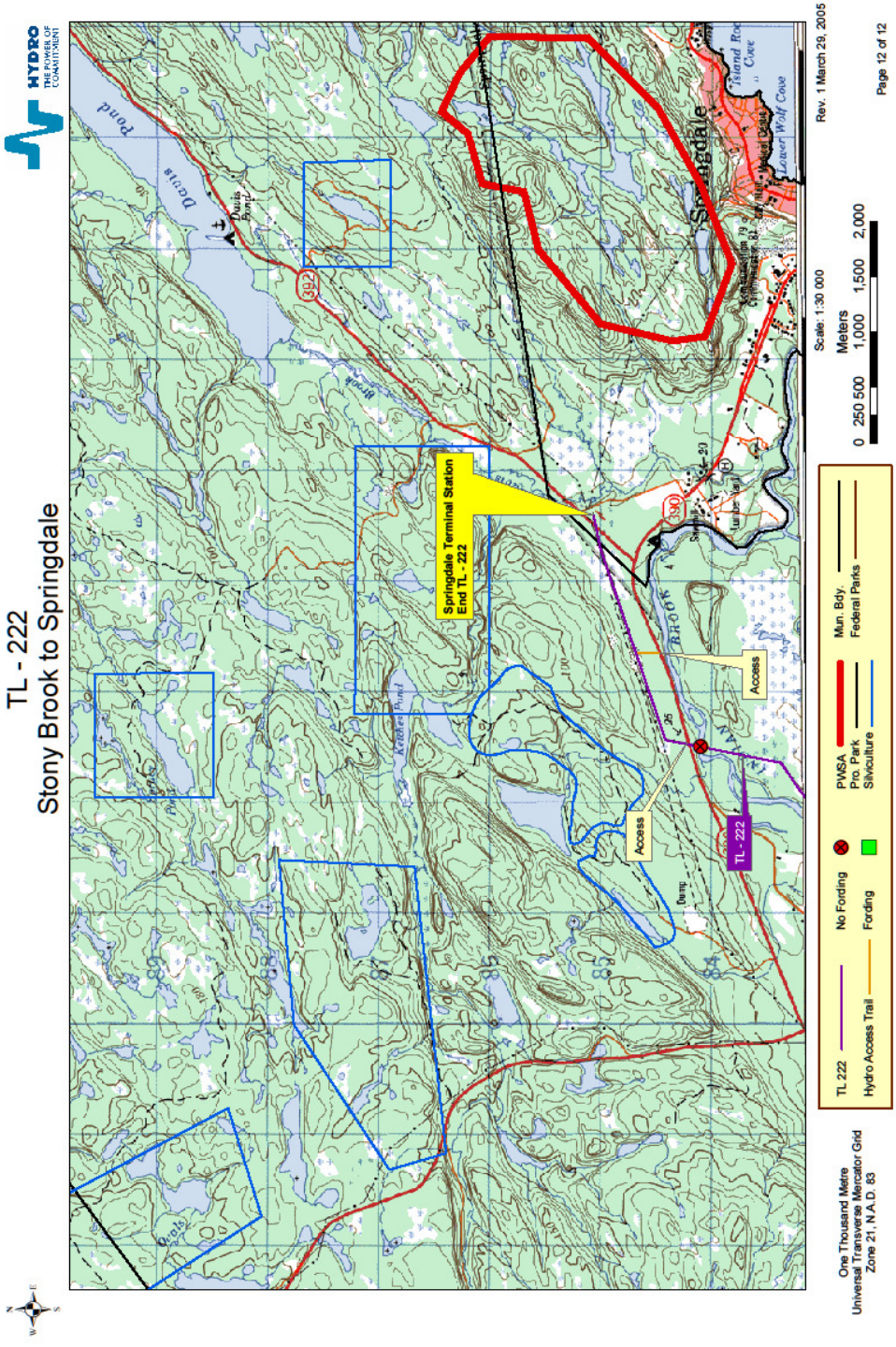
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Stony Brook to Springdale
Springdale Terminal Station
End TL - 222
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TL - 222
Springdale
Scale: 1:30 000
Meters
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Rev. 1 March 29, 2005
Page 12 of 12
TL 222
Hydro Access Trail
No Fording
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PWSA
Pro. Park
Silviculture
Mun. Bdy.
Federal Parks
One Thousand Metre
Universal Transverse Mercator Grid
Zone 21, N.A.D. 83

**Project Title:** Replace Compressed Air Piping and Install Dew Point Monitor

**Location:** Buchans

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Other

**Classification:** Normal

**Project Description:**

The aging compressed air distribution piping at the Buchans Terminal Station will be replaced under this project. A new compressed air dew point monitoring system and back-up compressed air dryer will also be installed. This will improve the quality of compressed air supplied to critical equipment in the terminal station, namely the four air-blast circuit breakers. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 26.5 | 0.0 | 26.5 |
| **Labour** | 20.0 | 47.0 | 0.0 | 67.0 |
| **Consultant** | 1.0 | 10.5 | 0.0 | 11.5 |
| **Contract Work** | 0.0 | 125.0 | 0.0 | 125.0 |
| **Other Direct Costs** | 5.0 | 18.4 | 0.0 | 23. |
| **Interest and Escalation** | 2.5 | 25.6 | 0.0 | 28.1 |
| **Contingency** | 0.0 | 25.3 | 0.0 | 25.3 |
| **TOTAL** | **28.4** | **278.3** | **0.0** | **306.8** |

**Existing System:**

The Buchans Terminal Station has been in service since 1973. The 69 kV transmission line, TL-280, originating from the Star Lake hydroelectric plant, terminates at the station. A 69/230 kV transformer steps up the voltage to 230 kV to transmit power to terminal stations at Stoney Brook, Bottom Brook and Massey Drive. Also, a 66/12.5 kV transformer steps down the voltage for distribution to Buchans and Millertown. The station's eight circuit breakers protect sections of the Island Interconnected System by interrupting power whenever faults such as short circuits or overload currents are detected. Of the eight circuit breakers, four operate using sulphur hexafluoride gas ($SF_6$) while the remaining four are air-blast type and require a supply of clean, dry compressed air to operate.

Compressed air for the air-blast circuit breakers at the Buchans Terminal Station is produced by two air compressors located inside the control building. Moisture contained in the compressed air is removed by the air dryer. Once sufficiently dry, the compressed air is piped outdoors to either the compressed air storage vessels or the distribution piping system. Branch lines off of the piping system supply compressed air directly to each air-blast circuit breaker.

The compressed air distribution piping at the Buchans Terminal Station is fabricated from flexible rubber hose with the trade name Synflex. The hose is laid in cable trenches extending from the control building to the air-blast circuit breakers. Over the past five years, there have been 15 leaks that have occurred in the hose. Air leaks cause the compressors and air dryer to operate excessively as the system attempts to replenish the compressed air that was lost through the leaks. This not only wastes energy, but also causes unnecessary wear and tear on the equipment. In addition to the problems associated with leaks, Hydro has also discovered that moisture will permeate the Synflex hose and migrate into the compressed air. This has a detrimental effect on the successful operation of the air-blast circuit breakers. Stainless steel pipe has become Hydro's preferred material for terminal station compressed air systems. Hydro no longer installs flexible rubber hose in compressed air installations at terminal stations.

The Buchans Terminal Station has one compressed air dryer that removes vapour from the compressed air until the desired dew point is met. The dew point is the temperature at which water vapour starts to condense into liquid water or form ice when the temperature is below zero degrees Celsius, for a given volume of air at a constant pressure. Removing moisture from the compressed air supply is critical because it can be detrimental to the operation and safety of air-blast circuit breakers. It is possible that the air-blast circuit breakers will fail to operate if moisture is present in the compressed air supply. At worst case, the breaker may experience a fault and possibly explode. Over the last five years, undesirable dew points were measured manually on ten occasions at the Buchans Terminal Station. Automatic dew point monitoring equipment is not currently installed at this station.

Due to the detrimental effects that moisture in the compressed air system can cause, Hydro has adopted the strategy of installing a second air dryer and dew point monitoring systems in terminal

stations undergoing compressed air system replacements. The second air dryer will serve as a back-up to the primary air dryer. The dew point monitor will continuously measure the moisture content of the compressed air to ensure that its dew point meets recommended levels. The dew point monitor will communicate with Hydro's SCADA system by sending alarms to the Energy Control Centre (ECC) if undesirable dew point levels are measured. The Buchans Terminal Station does not yet have a back-up air dryer or a dew point monitoring system.

To date there have been no major failures or outages as a result of the compressed air quality at the Buchans Terminal Station. However, in 2004, a moisture problem with compressed air at the Stony Brook Terminal Station caused a fault in an air-blast circuit breaker resulting in major repairs to the breaker. A similar event also occurred at the Hardwoods Terminal Station in 2002. Failures of this type not only present a risk to equipment, but also pose a significant safety risk for employees that may be in the vicinity when a failure occurs.

Age of Equipment or System

The compressed air piping system at the Buchans Terminal Station was installed in 1973 and has been in service since that time.

Major Work/or Upgrades

There have been no major upgrades on the compressed air piping system.

Anticipated Useful life

The compressed air piping system, back-up compressed air dryer and dew point monitor has an anticipated service life of 15 years.

Maintenance History

The five-year maintenance history for the compressed air piping system is shown in Table 2.

**Table 2: Five-Year Maintenance History**

| Year | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($000) |
|---|---|---|---|
| 2010 | 9.0 | 7.3 | 16.3 |
| 2009 | 3.2 | 10.7 | 13.9 |
| 2008 | 2.9 | 1.6 | 4.5 |
| 2007 | 2.5 | 13.5 | 16.0 |
| 2006 | 3.6 | 0.9 | 4.5 |

Outage Statistics

There have been no forced outages of the air blast circuit breakers attributed to problems or failures with the compressed air system.

Industry Experience

Hydro participates in a discussion forum managed by Doble Engineering, a company that helps clients in the electric power industry improve operations and optimize system performance. Utilizing this forum, in 2008 Hydro posted a questionnaire to similar utilities to gain an understanding of whether they have encountered moisture problems in compressed air systems supplying air-blast circuit breakers. A Canadian utility responded that moisture can penetrate Synflex hose and that its associated fittings tend to rust and fail. This utility experienced one failure which resulted in a near miss incident on a compressed air system that used Synflex. As a result, they replaced the Synflex with stainless steel piping at multiple terminal stations. This reduced the hazard and resulted in immediate correction of moisture problems which greatly improved the compressed air's dew point temperature.

Maintenance or Support Arrangements

The compressed air system is maintained by Hydro personnel.

Vendor Recommendations

ASEA Brown Boveri (ABB), a manufacturer of air-blast circuit breakers, has recommended to Hydro that Synflex hose should not be used for the compressed air systems supplying compressed air to

air-blast circuit breakers. This is because of Synflex's propensity to absorb moisture and transfer it to the compressed air.

Availability of Replacement Parts

Replacement parts are readily available for all components of the compressed air system.

Safety Performance

There is a possibility of catastrophic failure of any of the air-blast circuit breakers at the Buchans Terminal Station if the moisture problems associated with the compressed air system are not eliminated. A failure of this type could result in metal shrapnel being violently thrown from the circuit breaker, possibly causing injury or death to personnel in the area at the time of failure. Hydro has experienced two such failures at other terminal stations, as described in the *Existing System* section of this report. Adequate drying of the compressed air and continually monitoring its dew point temperature will reduce this risk.

Failure of the existing Synflex hose may result in a near miss incident similar to the one noted by another Canadian utility. In the incident, the hose broke and thrashed around with enough force to lift the cover from the cable tray in which the hose was laid. An incident such as this could result in both personal injury and asset damage. Given that the compressed air distribution piping at the Buchans Terminal Station is fabricated from Synflex hose, an incident similar to the one experienced by the other Canadian utility is possible.

Environmental Performance

There are no environmental concerns that justify this project.

Operating Regime

The compressed air system operates continuously.

**Justification:**

This project is justified as a normal requirement to ensure that the Buchans Terminal Station has a reliable supply of dry compressed air to safely operate the station's four air-blast circuit breakers. A

reliable supply of dry compressed air can only be guaranteed through the replacement of the existing compressed air distribution piping, the addition of a second compressed air dryer, and the installation of a new dew point monitoring system. A manufacturer (ABB) of air-blast circuit breakers has advised that the existing compressed air distribution piping (Synflex) is not recommended for use with air-blast circuit breakers due to its propensity to permit the ingress of moisture into the compressed air. The addition of a second compressed air dryer will provide a back-up system in the event that the primary air dryer fails or is taken out of service for maintenance. The installation of a new dew point monitoring system will send an alarm to the ECC in the event of an undesirable dew point measurement on the compressed air system. Receiving an alarm notification will permit Hydro to address problems with the system in a timely fashion which will improve the ability of the air-blast circuit breakers to operate successfully when called upon.

Net Present Value

The net present values for two alternatives were evaluated. See Cost Benefit Analysis section below for details.

Levelized Cost of Energy

Levelized cost of energy is not applicable to this project.

Cost Benefit Analysis

A cost benefit analysis (see Table 3) was performed on two alternatives.

**Table 3: Cost Benefit Analysis**

| **Replace Compressed Air Piping and Install Dew Point Monitor** | | |
|---|---|---|
| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2051** | | |
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Alternative 1 Refurbish Compressed Air Piping, Install Back-up Air Dryer and Dew Point Monitor | 1,549,736 | 0 |
| Alternative 2 Replace Air-Blast Breakers with SF6 Breakers and Remove Compressed Air System | 1,787,309 | 237,573 |

Alternative 1: Refurbish the existing compressed air system by replacing the distribution piping, adding a back-up air dryer, and installing a dew point monitoring system.

Capital cost: $306,800 (2-year project – 2012-2013)

O&M cost: $18,200 annually (2012-2013) and increases to $21,200 annually (2014-2027) due to second air dryer;

Other: a) $75,000 in compressed air storage tank upgrades required in 2018;

b) $120,000 annually from 2013 to 2016 to overhaul existing air- blast circuit breakers; and

c) One air-blast circuit breaker to be replaced annually beginning in 2025 at a cost of $508,500 each. Replacement breakers will be $SF_6$ and will not require compressed air. Compressed air system will be retired in 2028 as it will no longer be required. $SF_6$ breakers will be overhauled after 20 years of service at a cost of $50,000 per breaker beginning in 2046.

Alternative 2: Replace the four air-blast circuit breakers with $SF_6$ breakers at the rate of one per year. Upon implementation of this alternative, the compressed air system at the Buchans Terminal Station could be removed as it would no longer be required.

Capital cost: $2,102,500 (4-year project – 2012-2015)

O&M cost: $2,200 annually

Other: Breakers will be overhauled after 20 years of service beginning in 2033 at the rate of one per year. Cost per overhaul is $50,000.

At the end of the 40 year study period for the cost benefit analysis, the $SF_6$ breakers installed under Alternative 1 will have 14 to 18 years of service life remaining. By that time, those installed under Alternative 2 will be at the end of their useful life and will require replacement.

Legislative or Regulatory Requirements

There are no legislative or regulatory requirements that justify this project.

Historical Information

Similar upgrades at the Holyrood Terminal Station have been approved by the Board of Commissions of Public Utilities and are scheduled to be completed in 2011. Table 4 shows details on this project.

**Table 4: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Comments |
|---|---|---|---|
| 2010 -2011 | 496.0 | Still in progress | Holyrood Terminal Station has 9 air-blast circuit breakers |

Forecast Customer Growth

This project is not required to accommodate customer growth.

Energy Efficiency Benefits

Since the compressed air system will be free of leaks as a result of this project, energy efficiency benefits will be realized because the operating hours on the air compressors will be reduced. Leaks in the existing system cause the compressors to operate longer and more often to maintain system pressure by replenishing the air lost through the leaks. While the benefit cannot be quantified because the quantity of air lost through leaks has not been measured, it is safe to say that the compressors will operate less frequently in a leak free system resulting in energy savings.

Losses during Construction

There will be no losses during construction.

Status Quo

If the status quo is maintained, the integrity and reliability of the compressed air system and thus the circuit breakers and ultimately the Island Interconnected System will continue to be compromised and the safety risk will remain unacceptably high.

Alternatives

An alternative to replacing the compressed air distribution piping, adding a back-up air dryer, and installing dew point monitoring at the Buchans Terminal Station is to remove the requirement for the compressed air system by replacing the four air-blast circuit breakers with $SF_6$ breakers. Under this alternative, the compressed air system could be completely removed since $SF_6$ breakers do not require compressed air to operate. A cost benefit analysis proved that this is not the least cost option.

**Conclusion:**

The air-blast circuit breakers installed at the Buchans Terminal Station require a supply of clean, dry compressed air to operate successfully. Synflex hose, used throughout the compressed air distribution system at this station, is not recommended for use by ABB due to its tendency to permit the ingress of moisture. Therefore, it must be replaced with a suitable material such as stainless steel pipe. Due to the critical requirement that compressed air supplied to air-blast circuit breakers

be dry, it is recommended that a back-up air dryer be installed at this station. This will allow the station to switch to the back-up air dryer upon failure of the primary dryer. As well, the dew point of the compressed air should be continually monitored so that the ECC is notified when undesired levels of moisture are detected. This will be accomplished through the installation of a dew point monitoring system. These enhancements to the compressed air system will improve the safety of the air-blast circuit breakers at this station by removing the risk associated with catastrophic failure caused by inadequate compressed air dryness. Stainless steel distribution piping, a back-up air dryer, and dew point monitoring system have become Hydro's standard equipment for terminal stations undergoing a refurbishment of its compressed air system.

Project Schedule

The anticipated project schedule is shown in Table 5.

**Table 5: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Initiate project | January 2012 | March 2012 |
| Design | Complete design | March 2012 | August 2012 |
| Procurement | Tender construction package and Owner-supplied order equipment | September 2012 | October 2012 |
| Construction | Construction and installation | July 2013 | August 2013 |
| Commissioning | Testing, commissioning and sign off | September 2012 | October 2013 |
| Closeout | Complete project close-out, documentation and close project | October 2012 | December 2013 |

**Project Title:** Replace Recloser Control Panels

**Location:** Various Terminal Stations

**Category:** Transmission and Rural Operations - Distribution

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

The Recloser Control Panel Replacement Project is required to replace 36 aging recloser control panels. This is the third year of a five-year program. In 2012, five recloser control panels will be replaced. The existing control panels are housed in steel enclosures which have deteriorated due to the environment. To prevent future deterioration of the new panels due to weather, the Recloser Control Panel Replacement Project uses rack mounted control panels inside control buildings where applicable and control panels located inside stainless steel enclosures where no building exists. The new recloser control panel will also have remote control capability should a future telecommunications network be established at these sites. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 67.0 | 0.0 | 0.0 | 67.0 |
| **Labour** | 74.0 | 0.0 | 0.0 | 74.0 |
| **Consultant** | 7.8 | 0.0 | 0.0 | 7.8 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 23.2 | 0.0 | 0.0 | 23.2 |
| **Interest and Escalation** | 13.4 | 0.0 | 0.0 | 13.4 |
| **Contingency** | 16.9 | 0.0 | 0.0 | 16.9 |
| **TOTAL** | **202.3** | **0.0** | **0.0** | **202.3** |

In 2012, four rack mounted panels and one pole mounted control panel will be installed as shown in Table 2. For a complete list of the recloser control panels to be replaced under this program see Appendix A.

**Table 2: 2012 Recloser Control Panel Replacements**

| Location | Type | Recloser ID | Installation Year |
|---|---|---|---|
| Cow Head | Rack Mounted | CH1-R1 | 1981 |
| Cook 's Harbour | Rack Mounted | CH7-R1 | 1975 |
| Daniels Harbour | Rack Mounted | DH1-R1 | 1981 |
| Hawke's Bay | Rack Mounted | HB3-R1 | 1971 |
| Parsons Pond | Pole Mounted | PP1-R1 | 1981 |

These recloser control panels have been identified for replacement based on condition and age. The pole mounted unit listed in Table 2 will be replaced with stainless steel enclosures while rack mounted units will be mounted inside the available control building and need no further enclosure. Both these measures will reduce the effect of salt corrosion which is a known factor in these areas.

**Existing System:**

Newfoundland and Labrador Hydro (Hydro) operates distribution systems throughout Newfoundland and Labrador and supplies power to approximately 36,000 metered customers. A key component of the distribution systems is the distribution automatic recloser. It is the primary fault protective device on distribution feeders. A distribution recloser is set to detect faults on the feeders and to open if a fault occurs. The feeder is put back in service automatically by the recloser and if the fault has been cleared, the feeder will stay in service, minimizing the outage to customers.

This project is to replace aging and weathered distribution recloser control panels on distribution feeders to ensure fault protection reliability is not compromised. Photos of rusted recloser control panels are shown in Figures 1 and 2.



**Figure 1: Hawkes Bay Recloser HB3-R1 Control Cabinet**



**Figure 2: Parson Pond Recloser PP1-R1 Control Cabinet**

The existing recloser control panels, manufactured by Cooper Power Systems, are housed in a painted steel compartment which has been exposed to a highly corrosive coastal environment for many of the recloser locations.

Age of Equipment or System

Refer to Appendix A for a listing of the age of the assets being replaced.

Major Work/ or Upgrades

Refer to Appendix B for a list of major work and upgrades on various reclosers.

Anticipated Useful life

The recloser control panel has an anticipated useful life of 20 years.

Maintenance History

Table 3 shows the five-year maintenance history for the reclosers being replaced in 2012. Refer to Appendix C for the five-year maintenance history for all reclosers to be replaced under the program.

**Table 3: Five Year Maintenance History**

| Year | Recloser | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($000) |
|---|---|---|---|---|
| 2010 | Hawke's Bay Recloser HB3-R1 | 3.0 | 0.0 | 3.0 |
| 2008 | Cow Head Recloser CH1-R1 | 0.3 | 0.0 | 0.3 |
| 2008 | Daniels Harbour Recloser DH1-R1 | 0.0 | 0.4 | 0.4 |
| 2008 | Parson's Pond Recloser PP1-R1 | 0.0 | 0.8 | 0.8 |
| 2007 | Hawke's Bay Recloser HB3-R1 | 0.0 | 1.2 | 1.2 |
| 2007 | Hawke's Bay Recloser HB3-R1 | 0.0 | 1.2 | 1.2 |
| 2007 | Daniels Harbour Recloser DH1-R1 | 0.4 | 0.0 | 0.4 |
| 2006 | Hawke's Bay Recloser HB3-R1 | 0.0 | 2.0 | 2.0 |

Outage Statistics

Hydro tracks all distribution system outages using industry standard indexes, SAIFI and SAIDI which are explained as follows:

SAIDI- indicates the System Average Interruption Duration for customers served per year, or the average length of time a customer is without power in the respective distribution system per year.

SAIFI - Indicates the average of sustained interruptions per customer served per year or the average number of power outages a customer has experienced in the respective distribution system per year.

Table 4 lists the 2006 to 2010 average SAIFI and SAIDI data by feeder and distribution system where the upgrades are proposed. The table also lists the 2006 to 2010 corporate value and the latest Canadian Electrical Association (CEA) five year average (2005 to 2009) for comparison.

**Table 4: Outage Statistics**

Five Year averages (2006 to 2010)

| SYSTEM | All Causes SAIFI | All Causes SAIDI | Defective Equipment SAIFI | Defective Equipment SAIDI |
|---|---|---|---|---|
| **Central Interconnected** | 3.32 | 8.64 | 0.36 | 0.74 |
| **Northern Interconnected** | 4.24 | 7.05 | 0.38 | 0.77 |
| **Northern Isolated** | 6.82 | 6.48 | 0.24 | 0.40 |
| **Cow Head Feeder 1** | 1.75 | 4.38 | 0.15 | 0.09 |
| **Daniel's Harbour Feeder 1** | 2.05 | 4.66 | 0.24 | 0.81 |
| **Hawke's Bay System** | 5.17 | 7.52 | 0.16 | 0.20 |
| Hawke's Bay Feeder 3 | 5.31 | 7.10 | 0.22 | 0.25 |
| **Parson's Pond Feeder 1** | 3.16 | 4.33 | 0.00 | 0.01 |
| **St. Anthony System** | 5.63 | 9.46 | 0.77 | 2.34 |
| St. Anthony Feeder 1 | 4.92 | 7.47 | 1.11 | 2.09 |
| St. Anthony Feeder 2 | 4.93 | 6.47 | 0.22 | 0.03 |
| St. Anthony Feeder 3 | 4.89 | 6.75 | 0.35 | 0.35 |
| Cook's Harbour Feeder 7 | 7.72 | 14.88 | 1.42 | 3.09 |
| **L'Anse au Loup System** | 4.52 | 5.51 | 0.23 | 0.32 |
| L'Anse au Loup Feeder 1 | 4.38 | 4.90 | 0.22 | 0.42 |
| L'Anse au Loup Feeder 2 | 4.62 | 5.92 | 0.24 | 0.26 |
| **Mary's Harbour System** | 13.42 | 9.55 | 0.39 | 0.72 |
| **Port Hope Simpson System** | 7.45 | 5.03 | 0.21 | 0.05 |
| **Hydro Corporate** | 5.43 | 9.43 | 0.39 | 0.88 |
| **CEA Region 2 (2005-2009)** | 2.65 | 7.71 | 0.48 | 1.27 |

Hydro's present system for collecting outage information does not record equipment failures by distribution equipment components such as recloser panels. Outages due to recloser control panels along with other defective equipment would be included in the general defective equipment category. The data provided in the table lists the outage statistics for all causes and defective equipment.

Defective equipment is defined by the CEA, Service Continuity Reliability Committee as:
*Customer interruptions resulting from equipment failures due to deterioration from age, incorrect maintenance, or imminent failures detected by maintenance.*

The CEA statistics do not include planned outages to repair defective equipment.

Industry Experience

The stainless steel enclosure for the control panel or the rack mounted control panel is recommended for installations subject to severe weather or salt contamination.

Maintenance or Support Arrangements

There are no maintenance or support agreements with the manufacturers. Maintenance and support are provided by Hydro in-house resources.

Vendor Recommendations

Peter Dennis from R L Dennis Associates Ltd, the representative for Cooper Power Systems verbally advised Hydro, in 2009, that the solution to the severe rust contamination on the recloser control panels is replacement with the latest digital control which is available in a stainless steel panel enclosure, as well as in rack mount configuration. The vendor has also confirmed that the existing recloser itself does not require change out and that only its sensing current transformers (CT) require replacement in order to be compatible with the accuracy of the new digital control.

Availability of Replacement Parts

Hydro has been advised by Cooper Power Systems that circuit boards and plug-in cards have delivery times of 12-20 weeks, as can be seen below in an excerpt from their email:

> ”The existing F3 controls are from 1960's technologies. As many of these devices still exist at Utilities all over the world, Cooper had strategically found new components suppliers in the 80's, had stock-piled required boards and components to support the devices. I am still amazed that we can still obtain parts, as many of the old original manufacturers have long since moved on to more current technologies. I would expect within the next 5-10 years that we may have great difficulty obtaining replacement parts for these old devices. The replacement parts business could be terminated at any time - although Cooper does not have any set

time at present. To the best of my knowledge, most of the control boards are still available, but on a 12-20 week delivery basis."

Safety Performance

During a fault, electrical energy enters the earth. These electronic reclosers sense the fault condition and break the electrical path feeding the fault. This quickly limits the electrical energy entering the earth greatly reducing the electrocution hazard.

Environmental Performance

This multi-year project does not have any environmental impact.

Operating Regime

All distribution reclosers listed for upgrade are in continuous operating mode.

**Justification:**

The distribution recloser is a key protective device for detection of various types of system faults and the automatic restoration of power when these line faults are only temporary in nature. It also enables isolation of the faulted line section should the system fault be permanent. Therefore, the operating integrity of this key protective device must not be compromised by the failure of an internal electronic component due to severe rusting of the recloser control panel.

Net Present Value

A net present value calculation was not performed in this instance, as there are no viable alternatives to replacing the control panels.

Levelized Cost of Energy

This project will have no effect on the levelized cost of electricity.

Cost Benefit Analysis

A cost benefit analysis is not required as there are no quantifiable benefits.

Legislative or Regulatory Requirements

There are no legislative or regulatory requirements with this project.

Historical Information

Eight recloser control panel replacements were completed in 2008. These consisted of reclosers at the Change Islands Substation (CH2-R1 and CH3-R1), Fogo Island Substation (FO4-R1, FO5-R1, and FO6-R1), and the Bottom Waters Terminal Station (BW1-R1, BW2-R1 and BW3-R1).

Five recloser control panel replacements were completed in 2009. These consisted of reclosers at the Burgeo Substation (BU2-R1, BU3-R1 and BU4-R1) and at the Bottom Waters Terminal Station (BW2-R3 and BW4-R1).

Of the sixteen recloser control panels that were budgeted to be replaced in 2010, eleven recloser control panels were completed. These were located at South Brook (SB7-R2), English Hr. West (EH1-R1 and EH1-R2), Jackson's Arm (JA1-R1 and JA2-R1), Hampden (HA1-R1), Happy Valley-Goose Bay (HV1-R1, HV7-R1, HV8-R1, HV10-R1 and HV16-R1). The remaining five were tested and installed, but will be commissioned in July 2011. These were Bear Cove (BC6-R2, BC4-R1 and BC6-R1), and Plum Point (PP1-R1 and PP2-R1).

Table 5 contains the historical information for these replacements.

**Table 5: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit ($000) | Comments |
|---|---|---|---|---|---|
| 2011F | 231.9 | | 7 | | |
| 2010 | 603.1 | | 16 | | Project in progress. Resource issues in Rural Operations has pushed the schedule of 5 recloser panels into 2011 |
| 2009 | 132.4 | 107.3 | 5 | 21.46 | Completed with approved change order[2] |
| 2008 | 222.5 | 133.9 | 8 | 16.74 | Completed with approved change order[3] |

Forecast Customer Growth

Customer load growth does not affect this project.

Energy Efficiency Benefits

There are no energy efficiency benefits associated with this type of project.

Losses During Construction

There may be planned power outages involving the reclosers that require current transformer (CT) replacements. The reclosers will have to be temporarily removed from service.

Status Quo

Maintaining the status quo will result in prolonged outages and by-passed protective devices due to the availability of replacement parts for the existing recloser controls. This could also cause

[2] A change order to revise the 2009 budget was issued as the amount of field work by operations crew was less than originally estimated. Operations crews retrofitted each recloser and pre-commissioned it at the terminals maintenance repair facility in Bishop's Falls. This project was completed in conjunction with other work in the region during the same time and thus reduced travel and accommodations costs. The total reduction on the change order was $25,100.

[3] A change order to revise the 2008 budget was issued as the cost for the recloser controls was less than originally estimated and several of the recloser structure modifications were not required as originally anticipated. The amount of field work by operations crews was also significantly reduced by retrofitting each recloser and pre-commissioning it with its new electronic controls in the Hydro terminals maintenance repair facility at Bishop's Falls, thereby reducing operations crews overtime and travel time. The total reduction on the change order was $88,961.

unnecessary outages. If a recloser did not operate because it was in bypass mode or simply didn't operate due to age, an upstream protective device would operate and by doing so, increase the number of customers affected.

Alternatives

There is no viable alternative to replacement of the control panels for the distribution reclosers listed in Appendix A. Many of the original electronic components for these control panels have long lead times as noted in the "Availability of Parts" section of this document.

**Conclusion:**

Replacing each panel with a more modern digital control panel with stainless steel enclosure or rack mounted panels located in a control building is the only option.

Project Schedule

The anticipated project schedule is shown in Table 6.

**Table 6: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Project Initiation | January 2012 | January 2012 |
| Design | Project Design | February 2012 | April 2012 |
| Procurement | Equipment Ordering | February 2012 | April 2012 |
| Construction | Field Construction and Installations | May 2012 | October 2012 |
| Commissioning | Commissioning after Installation | May 2012 | October 2012 |
| Closeout | Project Completion and Closeout | November 2012 | November 2012 |

**Future Plans:**

Future replacements will be proposed in future capital budget applications for 2013 and 2014. See five year capital plan (Capital Plan 2011 Tab, Appendix A).

**APPENDIX A**

**RECLOSER CONTROL PANELS TO BE REPLACED**

| Location | Recloser ID | Asset # | Year Installed | Year Scheduled/Replaced |
|---|---|---|---|---|
| Barachoix | BA1-R1 | 41774 | 1979 | 2011 |
| Barachoix | BA4-R1 | 41806 | 1979 | 2011 |
| Roddickton | RO1-R3 | 107301 | 1981 | 2011 |
| Roddickton | R04-R1 | 106298 | 1984 | 2011 |
| Roddickton | RO1-R2 | 103587 | 1985 | 2011 |
| Roddickton | RO3-R2 | 106299 | 1985 | 2011 |
| Main Brook | MB1-R2 | 101958 | 1989 | 2011 |
| Hawke's Bay | HB3-R1 | 58178 | 1971 | 2012 |
| Cow Head | CH1-R1 | 58187 | 1981 | 2012 |
| Cow Head | CH7-R1 | 80051 | 1975 | 2012 |
| Daniels Harbour | DH1-R1 | 58184 | 1981 | 2012 |
| Parsons Pond | PP1-R1 | 159132 | 1999 | 2012 |
| Cooks Harbour | CH7-R1 | 80051 | 1975 | 2013 |
| St. Anthony | SA1-R3 | 80042 | 1975 | 2013 |
| St. Anthony | SA2-R1 | 107289 | 1980 | 2013 |
| St. Anthony | SA3-R1 | 99273 | 1985 | 2013 |
| St. Anthony | SA1-R1 | 97367 | 1986 | 2013 |
| L'Anse au Loup | LL2-R1 | 95688 | 1968 | 2014 |
| L'Anse au Loup | LL1-R1 | 99933 | 1975 | 2014 |
| Mary's Harbour | MH1-R1 | 80037 | 1970 | 2014 |
| Port Hope- Simpson | PH1-R1 | 80031 | 1970 | 2014 |

**APPENDIX B**

**MAJOR UPGRADES**

**Major Work/Upgrades**

| Date | Recloser | Major Work/Upgrade | Cost |
|---|---|---|---|
| September 2009 | Parson's Pond Recloser PP1-R1 | Replace power cable | $463 |
| March 2006 | Hawke's Bay Recloser HB3-R1 | Recloser Control Panel Repaired | $2,086 |
| March 2006 | St. Anthony Recloser SA3-R1 | Recloser Control Panel Repaired | $2,086 |
| December 2005 | St. Anthony Recloser SA3-R1 | Reloser Control Panel Failure To Trip | $806 |
| May 2005 | Glenburnie Recloser GL2-R1 | Replace CT | $407 |
| August 2004 | L'Anse au Loup Recloser LL2-R1 | Install Sequence Coordination Accessory | $904 |
| July 2004 | Roddickton Recloser RO4-R1 | Install Sequence Coordination Accessory | $830 |

**APPENDIX C**

**MAINTENANCE HISTORY**

**Maintenance History**

| Year | Recloser | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($000) |
|---|---|---|---|---|
| 2010 | Parson 's Pond PP1-R1 | 0.9 | 0.0 | 0.9 |
| 2010 | Recloser Battery | 0.7 | 0.0 | 0.7 |
| | **Total 2010** | 1.6 | 0.0 | 1.6 |
| 2009 | Barachoix Recloser BA4-R1 | 1.3 | 0.0 | 1.3 |
| 2009 | Glenburnie Recloser GL2-R1 | 0.0 | 0.1 | 0.1 |
| | **Total 2009** | **1.3** | **0.1** | **1.4** |
| 2008 | Barachoix Recloser BA1-R1 | 0.6 | 0.0 | 0.6 |
| 2008 | Cow Head Recloser CH1-R1 | 0.3 | 0.0 | 0.3 |
| 2008 | Daniels Harbour Recloser DH1-R1 | 0.0 | 0.4 | 0.4 |
| 2008 | Roddickton Recloser RO4-R1 | 0.0 | 0.1 | 0.1 |
| 2008 | St. Anthony Recloser SA3-R1 | 0.5 | 1.2 | 1.7 |
| 2008 | Parson's Pond Recloser PP1-R1 | 0.0 | 0.8 | 0.8 |
| | **Total 2008** | **1.4** | **2.5** | **3.9** |
| 2007 | L'Anse au Loup Recloser LL2-R1 | 0.9 | 0.0 | 0.9 |
| 2007 | Port Hope Simpson Recloser PH1-R1 | 0.4 | 0.3 | 0.7 |
| 2007 | Hawke's Bay Recloser HB3-R1 | 0.0 | 1.2 | 1.2 |
| 2007 | L'Anse au Loup Recloser LL1-R1 | 0.7 | 0.0 | 0.7 |
| 2007 | Cooks Harbour Recloser CH7-R1 | 0.0 | 0.2 | 0.2 |
| 2007 | Daniels Harbour Recloser DH1-R1 | 0.4 | 0.0 | 0.4 |
| 2007 | Glenburnie Recloser GL2-R1 | 0.4 | 1.1 | 1.5 |
| 2007 | St. Anthony Recloser SA3-R1 | 0.0 | 1.4 | 1.4 |
| | **Total 2007** | **2.8** | **4.2** | **7.0** |

| Year | Recloser | Preventive Maintenance ($000) | Corrective Maintenance ($000) | Total Maintenance ($000) |
|---|---|---|---|---|
| 2006 | Port Hope Simpson Recloser PH1-R1 | 0.4 | 0.0 | 0.4 |
| 2006 | Hawke's Bay Recloser HB3-R1 | 0.0 | 2.0 | 2.0 |
| 2006 | St. Anthony Recloser SA1-R3 | 0.0 | 0.1 | 0.1 |
| 2006 | Barachoix Recloser BA1-R1 | 0.0 | 0.8 | 0.8 |
| 2006 | Glenburnie Recloser GL2-R1 | 0.0 | 0.6 | 0.6 |
| 2006 | Roddickton Recloser RO1-R2 | 0.3 | 0.0 | 0.3 |
| 2006 | Roddickton Recloser RO4-R1 | 0.3 | 0.8 | 1.1 |
| 2006 | Roddickton Recloser RO1-R3 | 0.0 | 0.2 | 0.2 |
| 2006 | St. Anthony Recloser SA1-R1 | 0.0 | 5.1 | 5.1 |
| | **Total 2006** | **1.0** | **9.6** | **10.6** |

**Project Title:** Replace Personal Computers

**Location:** Various Sites

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

The PC Replacement program is an on-going program required to enhance the efficiency of Newfoundland and Labrador Hydro (Hydro) employees by replacing the personal computers (PCs) used for their day to day requirements.

This project will enable Hydro to replace 183 personal computers that were deployed in 2007 and 2008. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 308.8 | 0.0 | 0.0 | 308.8 |
| **Labour** | 40.0 | 0.0 | 0.0 | 40.0 |
| **Consultant** | 82.5 | 0.0 | 0.0 | 82.5 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 16.2 | 0.0 | 0.0 | 16.2 |
| **Contingency** | 43.1 | 0.0 | 0.0 | 43.1 |
| **TOTAL** | **490.6** | **0.0** | **0.0** | **490.6** |

**Existing System:**

Hydro has over 1000 end-user personal computers in service. It is important to refresh this equipment on a regular cycle to keep the technology current to maintain a reliable, efficient and productive workforce. Refreshing is the replacement of end user equipment, such as desktops, laptops and thin clients, on a life cycle depending on the type of device.

Minimum specifications for replacement of personal computers are reviewed on an annual basis to ensure that the PCs in service continue to remain effective. Industry best practices, technology and application trends are taken into consideration when specifications for

computer devices are decided for the current year. The annual review continues the replacement life cycle for laptops of every four years and desktops every five years.

As this budget proposal is for the routine replacement of computing hardware based on a corporate standard consistent with industry practice the following items under the existing system section are not relevant to the proposal:

- Major Work/Upgrades;
- Maintenance History;
- Outage Statistics;
- Safety Performance;
- Vendor recommendation
- Environmental Performance; and
- Operating Regime.

Age of Equipment or System

The existing PCs that are to be replaced under this project will have been in service between four and five years depending on the hardware platform used.

Anticipated Useful life

According to Gartner[4], the useful life for a laptop is three years while a desktop is four to five years. The North American industry standard life cycle for end-user devices is three years for laptops and five years for desktops. Hydro has adopted a four to five year life cycle and utilizes extended warranties to ensure reliable operation.

Industry Experience

Hydro has a similar life cycle plan for computer equipment as other companies in the utility industry, including Newfoundland Power.

[4] Gartner Inc. provides research and analysis on the global Information Technology industry. They assist companies in making informed technology and business decisions by providing in-depth analysis and advice on virtually all aspects of technology.

Maintenance or Support Arrangements

Hydro has purchased maintenance agreements with Lenovo Corporation, the manufacturer, that cover laptops for four years and desktops for five years.

Availability of Replacement Parts

Replacement parts are readily available for the duration of the maintenance agreements. Once the maintenance agreement has expired there is no guarantee that replacement parts can be obtained.

**Justification:**

Hydro must keep computers current in order to adequately support and protect the Information Technology applications and information required to operate its business. The replacement and addition of PC components to achieve this goal requires investment over the life cycle of the computers.

The refresh program makes it possible for computers to be replaced in a planned and consistent manner. This allows for even distribution of budgets and ensures that the computers are available and reliable to support the user's applications. Continued review of the computer life cycle allows Hydro to adjust plans based on performance, technology changes and new business requirements.

In addition, the computers to be replaced under this project are approaching the end of their useful lives and failures can be expected. The maintenance agreements for these computers will have expired and replacement parts can no longer be guaranteed.

As this budget proposal is for the routine replacement of computing hardware based on a corporate standard consistent with industry practice the following items are not relevant to the justification of this proposal:

- Levelized Cost of Energy;
- Legislative or Regulatory Requirements;
- Forecast Customer Growth;

- Energy Efficiency Benefits; and
- Losses during Construction.

Net Present Value

A net present value calculation was not performed as there are no viable alternatives.

Cost Benefit Analysis

This project is subject to a lease or purchase cost benefit analysis to determine the lowest cost alternative. The cost benefit analysis is done in the year of replacement to ensure consideration of incentives or other benefits that may be offered by the providers.

Historical Information

Historical information on computer replacement over the last five years is presented in Table 2.

**Table 2: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit ($000) | Comments |
|---|---|---|---|---|---|
| 2011F | 403.5 | | 142 | | Laptops only replaced |
| 2010 | 406.6 | 403.6 | 215 | 1.9 | |
| 2009 | 491.4 | 489.7 | 230 | 2.1 | |
| 2008 | 451.4 | 456.7 | 215 | 2.1 | |
| 2007 | 395.0 | 393.7 | 102 | 3.9 | Laptops only replaced |

Status Quo

If the end user infrastructure is not kept current the following scenarios could potentially occur:

- New applications may not run on the old hardware platform;
- Decreased speed may result in lost production;
- Failure rates will exceed 50 percent;
- Maintenance agreements will not be offered by vendor; and
- Operating systems may be unsupported.

Alternatives

The only alternative is to consider leasing the equipment. However, this has been done in the past and has proven to be more expensive and difficult to manage.

**Conclusion:**

The PC Replacement Program as proposed in this project is the preferred solution for the following reasons:

- It enables the end user equipment to remain current.
- It improves workforce efficiency by providing reliable hardware.
- It allows for a predictable annual budget.

Project Schedule

The project is scheduled to start in March 2012 and be completed before December 31, 2012.

**Future Plans:**

Future replacements will be proposed in future capital budget applications. Computer replacements are planned for the next four years as shown in the five year plan (2012 Capital Plan Tab, Appendix A).

**Project Title:** Replace Peripheral Infrastructure

**Location:** Various Sites

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

The Peripheral Infrastructure Replacement Project is an ongoing program to replace the printers, copiers, fax machines and video conference equipment used in the day to day operation of the business. For the year 2012, this project will consist of the replacement of seven Multi-Function Devices (MFDs) used for printing, copying, faxing and scanning, as well as 93 Laser Printers and smaller multi-purpose units. Six MFDs are to be replaced at St. John's and one at Holyrood. The location of the laser printers to be replaced are as follows: 31 in Hydro Place; one in Deer Lake, nine in Holyrood, nine in Bay d'Espoir, seven in Happy Valley-Goose Bay, five in St. Anthony, one in Wabush, three in Port Saunders, two in Bishop's Falls and two in Stephenville. There will also be replacement for 23 smaller devices used by individual meter readers located across the Province. In addition, this budget includes funds for expanding the Video Conferencing Bridge[5] in order to accommodate the increased number of Video end-points.

The budget estimate for this project is shown in Table 1.

[5] A video conference bridge is an adaptation of the telephone conference bridge that became common in the 1980s. Able to converge multiple streams into a single, interactive video feed, a video conference bridge allows businesses to appear "virtually" in any market at any time without the need for travel delays or expensive airline tickets.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 268.3 | 0.0 | 0.0 | 268.3 |
| **Labour** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 10.4 | 0.0 | 0.0 | 10.4 |
| **Contingency** | 28.8 | 0.0 | 0.0 | 28.8 |
| **TOTAL** | **327.5** | **0.0** | **0.0** | **327.5** |

**Existing System:**

The units scheduled for replacement have been in service for five years or more and normal maintenance contracts have expired. As the devices age, they require increasing maintenance and service time resulting in loss of reliability and productivity. If these units are kept in service until failure occurs, then the availability of scanning, coping, faxing or high volume printing services is limited. Depending on the location of the unit it may take four to five weeks to replace. Table 2 has a count of Newfoundland and Labrador Hydro's Peripheral devices.

**Table 2: Peripheral Devices in Service**

| Office Location | Number of Printers | Number of Employees | Buildings Per Location |
|---|---|---|---|
| Hydro Place | 84 | 350 | 1 |
| Bay d'Espoir | 22 | 90 | 4 |
| Happy Valley/Goose Bay | 7 | 34 | 2 |
| Springdale | 2 | 10 | 1 |
| St. Anthony | 6 | 21 | 2 |
| Stephenville | 4 | 22 | 2 |
| Deer Lake | 2 | 6 | 1 |
| Wabush | 3 | 12 | 2 |
| Whitbourne | 2 | 25 | 2 |
| Bishop's Falls | 18 | 80 | 3 |
| Holyrood | 24 | 102 | 4 |
| Port Saunders | 4 | 22 | 1 |

There is no relevant information for:

- Safety Performance;
- Environmental Performance; or
- Operating Regime.

Major Work/Upgrades

There have been no major upgrades since installation.

Age of Equipment or System

The units scheduled for replacement have been in service for over five years.

The decision when to replace a printer or MFD is based on many criteria, including:

- Vendor's product roadmap (new features like secure print and scanning will not be supported on older equipment);
- Users' printing requirements (color need, print volumes and speed);
- Number of users supported by the equipment;
- Availability of alternate printing;
- Available support for the equipment; and
- Age of equipment.

Anticipated Useful life

According to Gartner[6], the useful life for a color printer is three years while a black/white printer is between three and five years. The average age of Hydro's is around seven years.

Maintenance History

Please refer to the Outage Statistics section.

Outage Statistics

An average of 7.4 service calls over a 12 month period (52 total) has been made on each of the seven multi-functional printers being replaced. Each service call results from the printer being out of service.

[6] Gartner Inc. provides research and analysis on the global Information Technology industry. They assist companies in making informed technology and business decisions by providing in-depth analysis and advice on virtually all aspects of technology.

Industry Experience

Industry best practices indicate that the typical service life for a peripheral device is four to five years. Hydro has a similar life cycle plan for peripheral devices as other companies in the utility industry.

Maintenance or Support Arrangements

Hydro has purchased a maintenance agreement with a supplier (Xerox) that covers the larger Multi-Function Devices for five years. Smaller laser printers have only a manufacturer's warranty of one to three years duration.

Vendor Recommendations

The vendor (Xerox) recommends a maximum lifespan of five years. Other major vendors have not stated their recommended lifespan.

Availability of Replacement Parts

Replacement parts are readily available for the duration of the maintenance agreements and warranties. Once these agreements and warranties have expired replacement parts may or may not be available.

**Justification:**

This is the continuation of the Peripheral Infrastructure Replacement Project to replace peripheral devices as they reach the end of their useful lives. The units scheduled for replacement in 2012 have all been in service for five years or more and maintenance contracts and warranties have expired. While the manufacturer will provide extended maintenance (at an increased cost) they will not guarantee the performance of these devices after five years. In this case Hydro would have to incur an unbudgeted capital expense in order to replace the device and could take several weeks before the unit is replaced. Smaller area offices only have a single MFD and would have no services during this time.

Hydro must keep its peripheral infrastructure current in order to adequately support the needs of its business. This project makes it possible for such equipment to be replaced in a planned

and consistent manner. This allows for even distribution of expenditures and ensures that these peripherals are available and reliable to support the user's needs. Continued review of the products lifecycle allows Hydro to adjust plans based on performance, technology changes and new business requirements.

Net Present Value

A net present value calculation was not performed in this instance as there is no viable alternative to the planned replacement of peripheral infrastructure.

Cost Benefit Analysis

A cost benefit analysis was not performed as there are no quantifiable benefits.

As this budget proposal is for the routine replacement of computer peripherals based on industry accepted standards, the following items are not relevant to the justification of this proposal:

- Levelized Cost of Energy;
- Legislative or Regulatory Requirements;
- Forecast Customer Growth;
- Energy Efficiency Benefits; and
- Losses during Construction.

Historical Information

Table 3 contains a five-year history of the Peripheral Infrastructure Replacement Project.

**Table 3: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit [(1)] ($000) |
|---|---|---|---|---|
| 2011F | 258.2 | | | |
| 2010 | 222.0 | 227.0 | 34 | 6.5 |
| 2009 | 161.1 | 160.9 | 34 | 4.7 |
| 2008 | 159.0 | 158.8 | 32 | 5.0 |
| 2007 | 139.0 | 139.0 | 10 | 13.9 |
| 2006 | 199.0 | 196.0 | 8 | 24.5 |

(1) The variability in unit costs are due to specifications of the printers being replaced such as pages per minute, memory, fax and scanning capability.

Status Quo

If the peripheral infrastructure is not kept current, there is a risk of increase in failure rates and lack of maintenance agreements offered by vendor.

Alternatives

The only alternative is to consider leasing the equipment. The lease versus buy decision will be evaluated during the tendering process.

**Conclusion:**

The ongoing program involves a coordinated effort to keep Hydro's peripheral infrastructure in good working order and use current technologies while delivering a cost effective solution to the end-user.

Project Schedule

The project is scheduled to start in March 2012 and be completed before December 31, 2012.

**Future Plans:**

Future replacements will be proposed in future capital budget applications. See five-year Capital Plan (2012 Capital Plan Tab, Appendix A).

**Project Title:** Remove Safety Hazards

**Location:** Various Sites

**Category:** General Properties - Administrative

**Definition:** Other

**Classification:** Mandatory

**Project Description:**

This project is required to ensure adequate capital funding is available to quickly address capital-related safety hazards as they are identified. In an effort to avoid injury and/or fatality, Newfoundland and Labrador Hydro (Hydro) has initiated a Safe Work Observation Program (SWOP). This program trains employees in the importance of identifying and reporting conditions that can potentially lead to an incident or an accident. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 112.0 | 0.0 | 0.0 | 112.0 |
| **Labour** | 56.0 | 0.0 | 0.0 | 56.0 |
| **Consultant** | 10.0 | 0.0 | 0.0 | 10.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 56.0 | 0.0 | 0.0 | 56.0 |
| **O/H, AFUDC &Escln.** | 15.1 | 0.0 | 0.0 | 15.1 |
| **Contingency** | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL** | **249.1** | **0.0** | **0.0** | **249.1** |

**Existing System:**

In Hydro's 2010 Capital Budget Application, the Board of Commissioners of Public Utilities (Board) approved a budget of $252,400 to address safety hazards in the workplace. Several potential safety hazards were identified through our SWOP program. Table 2 lists the projects completed in 2010 having a total expenditure of $207,782.

**Table 2: Projects Completed**

| Location | Project | Costs |
|---|---|---|
| Holyrood | Arc flash remediation | $56,157 |
| Bay d'Espoir | Install spherical valve platforms at units 1, 2, 3 and 4 | $5,869 |
| Holyrood | Replace Emergency Ladders on stacks | $145,756 |
| **Total** | | $207,782 |

A large portion of the budget was spent replacing the emergency ladders on the three stacks in Holyrood. These emergency ladders were identified as safety hazards by employees via our company SWOP system and needed immediate replacement. A portion of the "Remove Safety Hazards" budget was therefore used to address this safety issue.

As this is an on-going program, safety hazards will be identified as they arise in 2011. Hydro plans to continue to identify and remove safety hazards on an annual basis.

As this project involves removing safety hazards as they are identified at various sites through the SWOP system, there is no relevant data related to:

- Age of Equipment or System;
- Major Work/or Upgrades;
- Anticipated Useful life;
- Maintenance History;
- Outage Statistics;
- Industry Experience;
- Maintenance or Support Arrangements;
- Vendor Recommendations;
- Availability of Replacement Parts; and
- Operating Regime.

<u>Safety Performance</u>

Hydro must comply with the Newfoundland and Labrador Occupational Health and Safety Regulations. Hydro aims to create a safe work environment so that nobody gets hurt.

Environmental Performance

There are no known environmental issues.

**Justification:**

This project is required to provide a safe work environment for Hydro employees, contractors, visitors and the general public in compliance with Hydro's policies and the Occupational Health and Safety Regulations. Criteria for the selection of acceptable projects include SWOP identification. The SWOP program involves workers actively looking for safety hazards and problems that may otherwise go unnoticed, which could lead to serious health and/or safety issues for Hydro customers, employees, contractors, and the general public. This project provides Hydro with the budget to address unsafe situations where capital work is identified as the solution, and enables Hydro to respond quickly to address unsafe conditions rather than waiting for the normal capital budget process. These deficiencies need to be immediately corrected to provide a safe work environment.

Net Present Value

The net present value is not applicable for this project as it is a general proposal to remove safety hazards from the workplace. As each unsafe situation is identified, if more than one alternative exists to correct the problem, a net present value calculation will be done to determine the least cost solution.

Levelized Cost of Energy

The levelized cost of energy is a high level means to compare costs of developing two or more alternative generating sources. Therefore, the levelized cost of energy is not applicable.

Cost Benefit Analysis

As there are no quantifiable benefits, a cost benefit analysis has not been performed.

Legislative or Regulatory Requirements

Hydro must comply with the Newfoundland and Labrador Occupational Health and Safety Regulations. Each situation identified as a safety hazard will be corrected to comply with current

legislative and regulatory requirements.

Historical Information

Hydro removed safety hazards under a capital project in 2008 as well as in 2010. In 2010, $207,782 of the budgeted $252,400 was spent. A capital project for 2011 with a budget of $252,400 is ongoing.

Forecast Customer Growth

Customer load growth does not affect this project.

Energy Efficiency Benefits

There are no energy efficiency benefits that can be attributed to removing safety hazards.

Losses during Construction

This project will have no effect on normal plant operations and will not cause any interruptions or system outages. Therefore, there will be no losses during construction.

Status Quo

The status quo is not acceptable since there are safety hazards to be identified and corrected for the safety of Hydro employees, customers, contractors and the general public.

Alternatives

This project is a general proposal to correct various identified safety hazards in the workplace.

**Conclusion:**

Hydro must remove safety hazards at all of its facilities.

Project Schedule

As this budget relates to unanticipated safety issues, no schedule is available.

**Future Plans:**

Future Safety Hazards Removal projects will be proposed in future capital budget applications.

Also see five-year capital plan (2012 Capital Plan Tab, Appendix A).

**Project Title:** Upgrade Enterprise Storage Capacity

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is to provide an additional five Terabytes of disk storage to the Storage Area Network (SAN) to serve the Intel Enterprise Servers. The DS4800 SAN was installed in 2008 and an additional Storage System was installed in 2011 to provide the efficient management and growth of the disk storage for the Intel Servers. This project will also replace two Raid Storage Arrays in the Energy Systems and one in the Backup Control Center at Holyrood with current SAN Technology and also replace three Tape Backup Units in Energy Systems. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 220.0 | 0.0 | 0.0 | 220.0 |
| **Labour** | 24.8 | 0.0 | 0.0 | 24.8 |
| **Consultant** | 25.0 | 0.0 | 0.0 | 25.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 9.5 | 0.0 | 0.0 | 9.5 |
| **Contingency** | 27.0 | 0.0 | 0.0 | 27.0 |
| **Subtotal** | 306.3 | 0.0 | 0.0 | 306.3 |
| **Cost Recoveries** | (104.1) | 0.0 | 0.0 | (104.1) |
| **TOTAL** | **202.2** | **0.0** | **0.0** | **202.2** |

**Operating Experience:**

Disk capacity has grown at a rate of approximately 30 percent per year over the last five years and is projected to grow at this rate into the future. This is slightly below the industry standard growth rates (50-70 percent per year). Storage Resource Management Tools, installed in 2007, allow Hydro to effectively manage data and disk usage.

As this budget involves the upgrade of an existing piece of software the following items are not considered relevant to the proposal:

- Outage Statistics;
- Industry Experience;
- Vendor Recommendations;
- Availability of Replacement Parts;
- Safety Performance;
- Environmental Performance; and
- Operating Regime.

Age of Equipment or System

The Disk Arrays and Tape Backup Units to be replaced are currently seven years old.

Major Work/or Upgrades

The upgrades listed in Table 2 have occurred since installation. Costs associated with these upgrades are shown in Table 3 of the Historical Information section of this report.

**Table 2: Major Work and Upgrades**

| Year | Major Work/Upgrade | Comments |
|---|---|---|
| 2011 | Additional DS5100 SAN Installed | New Controller and capacity installed. |
| 2008 | Additional SAN Storage installed | Additional disk storage space installed. |
| 2007 | Tivoli Productivity Center (TPC) installed | A storage management toolset was purchased and installed to allow better management of the SAN. |

Anticipated Useful life

The SAN Technology Tape Backup Units to replace the Arrays and Tape Units has an estimated service life of six years. The disk capacity expansion for the Storage System will have an estimated service life of six years also.

Maintenance or Support Arrangements

The new SAN and Tape Technology for the replacement of the Arrays/Tape Units and the

Expansion Shelves for the New Storage System will be covered by the current maintenance agreement with IBM. The maintenance agreement will cover hardware failures.

**Justification:**

The existing Disk Arrays and Tape Drives have been active for the past seven years and are now near capacity limits. The new SAN and Tape Technology will provide the ability for the existing servers to attach to storage that is much faster and has the ability to be increased in capacity as the need arises.

The servers that are attached to the SAN are used by Hydro employees in running the business on a daily basis. A reduction in the performance of these servers due to disk space unavailability would have a negative effect on employee productivity and customer service. The additional disk capacity added to the Storage System will provide for the efficient management and growth of the disk storage for the Intel Server Infrastructure.

As this budget proposal is for an upgrade for an existing piece of software the following items are not relevant to the justification of this proposal:

- Levelized Cost of Energy;
- Energy Efficiency Benefits; and
- Losses during Construction.

Legislative or Regulatory Requirements

The Management of Information Act and Statute of Limitations Act require Hydro to retain relevant data for a six year period. This requires systems to be backed up regularly onto tapes for off-site storage. Hydro's policy is to retain this data for a period of seven years.

Forecast Growth

The projected data growth for the storage system is approximately 30 percent per year with data remaining at current anticipated levels.

Net Present Value

A net present value calculation was not performed as there are no viable alternatives.

Cost Benefit Analysis

As there are no quantifiable benefits, a cost benefit analysis has not been performed.

Historical Information

Table 3 shows the historical costs of the Storage Area Network.

**Table 3: Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Comments |
|---|---|---|---|
| 2011F | 154.1 | | Added capacity and installed new Storage System Unit |
| 2010 | 241.4 | 240.6 | Five TB capacity increase and replace eight LTO-4 Tape Drives |
| 2009 | | | No capacity increase required |
| 2008 | 261.7 | 260.8 | Installed DS4800 SAN |
| 2007 | 148.6 | 148.6 | Management Tool Set |
| 2006 | | | No capacity increase required |

Status Quo

The consequences of not completing this project is that the time it takes to complete a backup increases as the amount of storage increases. The systems are required during the night as well as during business hours and Hydro must insure that the computer system is available.

If the Disk capacity of the Storage System is not increased Hydro could run into disk space limits which would degrade the performance of the system and the productivity of employees.

Alternatives

There are no viable alternatives that will incorporate into the existing system. The only alternative would involve replacing the entire existing Storage System.

Project Schedule

The project is scheduled to start in February 2012 and be completed by the end of June 2012.

**Future Plans:**

Future upgrades will be proposed in future capital budget applications. Enterprise storage upgrades are planned for the next four years as shown in the five year plan (2012 Capital Plan Tab, Appendix A).

**Project Title:** Overhaul Turbine/Generator Units

**Location:** Granite Canal and Upper Salmon

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to partially dismantle Granite Canal (GCL) and the Upper Salmon River (USL) turbine/generator units to inspect, test, clean, repair and replace equipment components. This overhaul involves removal of cleaning and inspection of rotor and stator assembly, electrical testing on rotor/stator assembly, calibration and testing of turbine and generator protection devices, verification of bearing and seal clearances and a thorough inspection of turbine, draft tube and penstock. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| Material Supply | 41.4 | 0.0 | 0.0 | 41.4 |
| Labour | 346.8 | 0.0 | 0.0 | 346.8 |
| Consultant | 0.0 | 0.0 | 0.0 | 0.0 |
| Contract Work | 0.0 | 0.0 | 0.0 | 0.0 |
| Other Direct Costs | 22.1 | 0.0 | 0.0 | 22.1 |
| Interest and Escalation | 5.8 | 0.0 | 0.0 | 5.8 |
| Contingency | 40.5 | 0.0 | 0.0 | 40.5 |
| **TOTAL** | **456.6** | **0.0** | **0.0** | **456.6** |

**Operating Experience:**

Upper Salmon and Granite Canal turbine/generator units are two of fifteen units that Hydro operates and maintains to meet system load requirements. These units went into service in 1983 and 2003 respectively.

All our turbine/generator units are given a major PM inspection (PM9) every six (6) years which is based on the operating and maintenance experience along with the Original Equipment Manufacturer (OEM) recommendations.

**Existing System:**

Hydro Generation has Hydro Electric Generating units at Bay d'Espoir, Upper Salmon, Hinds Lake, Cat Arm, Paradise River, Granite Canal, Snooks Arm and Venams Bight, for a total installed capacity of 939 MW. All hydro electric generators, intakes, spillways, control structures and plant auxiliary equipment are inspected annually but major inspections/overhauls are conducted on a six (6) year frequency.

Age of Equipment or System

Attached are the Unit In-Service dates for Hydro's current island interconnected hydraulic generation fleet:

- Bay d'Espoir Units No. 1 – No. 6 1967/1968
- Bay d'Espoir Unit No. 7 – 1977
- Hinds Lake Unit – 1980
- Cat Arm Units No. 1 & No. 2 – 1985
- Paradise River – 1989
- Snooks Arm/Venams Bight – 1957
- Granite Canal – 2003
- Upper Salmon Unit – 1983

Major Work/or Upgrades

The only major upgrade on the USL hydroelectric generator was the replacement of the unit governor with a new electronic type. The governor was replaced as it became obsolete and manufacturers no longer provided spare parts or technical support.

No major repairs or upgrades have been completed on the GCL unit.

Anticipated Useful life

These hydro electric generators are expected to last up to 75 years if proper maintenance and upgrades are completed.

Maintenance History

**Table 2: Five Year Maintenance History – Granite Canal**

| FIVE YEAR MAINTENANCE HISTORY<br>GRANITE CANAL<br>($000) | | | |
|---|---|---|---|
| YEAR | ANNUAL PREVENTIVE MAINT COST | ANNUAL CORRECTIVE MAINTENANCE COST | TOTAL MAINTENANCE |
| 2010 | 12.8 | 13.0 | 25.8 |
| 2009 | 11.9 | 46.9 | 58.8 |
| 2008 | 9.3 | 96.2 | 105.5 |
| 2007 | 9.5 | 13.0 | 22.5 |
| 2006 | - | 3.6 | 3.6 |

NOTE: In 2008,there were some major governor issues at GCL and a major problem with a broken servo motor shaft. These problems resulted in significant parts cost and consultant cost from the manufacturers.

**Table 3: Five Year Maintenance History – Upper Salmon**

| FIVE YEAR MAINTENANCE HISTORY<br>UPPER SALMON<br>($000) | | | |
|---|---|---|---|
| YEAR | ANNUAL PREVENTIVE MAINT COST | ANNUAL CORRECTIVE MAINTENANCE COST | TOTAL MAINTENANCE |
| 2010 | 26.5 | 23.2 | 49.7 |
| 2009 | 31.8 | 57.9 | 89.7 |
| 2008 | 28.1 | 110.5 | 138.6 |
| 2007 | 25.8 | 115.8 | 141.6 |
| 2006 | 43.4 | 92.3 | 135.7 |

Outage Statistics

**Table 4: Outage Statistics Granite Canal Unit**

| Year | Forced Outages | Maint. Outages | Planned Outages |
|---|---|---|---|
| 2010 | 6 | 2 | 1 |
| 2009 | 12 | 11 | 6 |
| 2008 | 8 | 5 | 2 |
| 2007 | 7 | 1 | 3 |
| 2006 | 5 | 1 | 6 |

**Table 5: Outage Statistics Unit Upper Salmon Unit**

| Year | Forced Outages | Maint. Outages | Planned Outages |
|---|---|---|---|
| 2010 | 4 | 1 | 1 |
| 2009 | 5 | 0 | 20 |
| 2008 | 6 | 3 | 1 |
| 2007 | 4 | 1 | 3 |
| 2006 | 1 | 3 | 7 |

Industry Experience

Works performed during major inspections/overhauls are based on experience and manufacturer recommendations.

Maintenance or Support Arrangements

All maintenance of Hydro Generation hydro electric generators is conducted internally by Hydro Generation employees. The only time contractors/consultants are used is to perform large exceptional pieces of work where the skill sets are lacking internally.

Vendor Recommendations

Vendor maintenance recommendations were considered and applied where applicable when the major PM inspection programs were developed.

Availability of Replacement Parts

Critical spares are maintained in inventory and exceptional replacement parts are readily available.

Safety Performance

The activities that take place during major inspections are well documented and defined. Any tasks that have been identified as critical with respect to safety have safety work methods available to follow to ensure all safety hazards are controlled or eliminated. If new critical safety tasks are identified during the inspection, work will stop until a work method is developed.

Work Methods are written for critical safety jobs. They include a task-based risk assessment, written job procedures or guidelines, safety precautions, PPE requirements, Emergency Plans, Rescue Plans, etc.

Environmental Performance

Environmental impacts are considered for all jobs and necessary precautions are followed, including following necessary Environmental Standard Operating Procedures (SOP's), to ensure the environment is not affected in an adverse manner.

Operating Regime

During the winter season, December – March, these units are required to be available 99.5% of the time. It's also critical that these units be available to take care of excess headpond water that runs off during the spring season. The maintenance on all hydro electric units has to be completed between mid-May and mid-November.

**Justification:**

These large turbine/generator units are required to be operating efficiently and effectively. To meet the winter availability targets and annual system load requirements, these units are required to have all major components inspected, tested and/or repaired on a six year frequency to avoid forced outages, forced de-ratings or unplanned maintenance outages.

Net Present Value

A net present value calculation was not performed since there is no viable alternative to performing these major inspections/overhauls on the established 6 year frequency.

Levelized Cost of Energy

As this project does not involve new generation services, the levelized cost of energy is not applicable.

Cost Benefit Analysis

A cost benefit analysis was not performed as there are no quantifiable benefits.

Legislative or Regulatory Requirements

There are no Legislative or Regulatory requirements around those major inspections/overhauls.

Historical Information

The Upper Salmon hydroelectric generator has been affected by concrete cracking, creating vertical problem with the unit. This condition is evaluated and corrected during major inspections every six years.

Forecast Customer Growth

Forecast customer growth does not impact this plant.

Energy Efficiency Benefits

There are no energy efficiency benefits that can be attributed to this project.

Losses during Construction

There will be no losses during construction; inspections/overhauls take place at the most appropriate time as approved by System Operations personnel.

Status Quo

Major inspections/overhauls are constantly evaluated with respect to work performed and the frequency at where it is performed. If changes are required, then changes will be made.

Alternatives

There are no viable alternatives.

**Conclusion:**

Hydro electric generators are required to be available 99.5% during the winter season. They are also required to meet system load requirements on a daily basis. Inspection/overhaul programs are evaluated regularly to ensure they are the most efficient/effective program. Major inspections/overhauls are an essential part of these programs and are critical to the reliability of the provincial electrical system.

Project Schedule

These major inspections/overhauls are performed by Hydro Generation employees. The schedule varies between three to four weeks. The Preventive Maintenance Program is well established and timeline well defined. There are times when planned outages have to be extended up to a week to deal with corrective maintenance items.

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years ($000) | Total | Page Ref |
|---|---|---|---|---|---|
| **GENERATION** | | | | | |
| Replace Rip Rap - Bay d'Espoir | | 199 | | 199 | D - 2 |
| Replace Beta Attenuation Monitoring Analyzers - Holyrood | | 161 | | 161 | D - 21 |
| **TOTAL GENERATION** | 0 | 360 | 0 | 360 | |
| **TRANSMISSION AND RURAL OPERATIONS** | | | | | |
| Install Fall Protection Equipment - Various Sites | | 199 | | 199 | D - 87 |
| Legal Survey of Primary Distribution Line Right of Way - Various Sites | | 198 | | 198 | D - 98 |
| Install Alternate Station Services - Stony Brook and Massey Drive | 86 | 109 | | 195 | |
| Purchase Meters, Equipment and Metering Tanks - Various Sites | | 190 | | 190 | D - 103 |
| Replace Excavator - L'Anse au Loup | | 120 | | 120 | D - 128 |
| Perform Front End Engineering Design for Diesel Plant Remediation -Various Sites | | 110 | | 110 | D - 131 |
| Upgrade Mechanical Workshop - St. Anthony | | 87 | | 87 | D - 134 |
| Install Waste Oil Storage Tank - L'Anse au Loup | | 82 | | 82 | D - 170 |
| Replace Surge Arrestors - Various Sites | | 76 | | 76 | D - 173 |
| **TOTAL TRANSMISSION AND RURAL OPERATIONS** | 86 | 1,171 | 0 | 1,257 | |
| **GENERAL PROPERTIES** | | | | | |
| Replace Telephone Systems - Port Saunders and Whitbourne | | 199 | | 199 | D - 176 |
| Replace Radomes - Various Sites | | 172 | | 172 | D - 178 |
| Upgrade Server Technology Program - Hydro Place | | 172 | | 172 | D - 195 |
| Upgrade Energy Management System - Hydro Place | | 118 | | 118 | D - 200 |
| Implement Work Protection Safety Code Application - Hydro Place | | 116 | | 116 | D - 202 |
| Upgrade Communication Services - Paradise River | | 98 | | 98 | D - 205 |
| Perform Minor Application Enhancements - Hydro Place | | 82 | | 82 | D - 208 |
| Upgrade Computer Room - Hydro Place | | 81 | | 81 | D - 210 |
| Upgrade Microsoft Project - Hydro Place | | 60 | | 60 | D - 216 |
| **TOTAL GENERAL PROPERTIES** | 0 | 1,096 | 0 | 1,096 | |
| **TOTAL PROJECTS OVER $50,000 AND UNDER $200,000** | 86 | 2,628 | 0 | 2,714 | |

**Project Title:** Replace Rip Rap

**Location:** Bay d'Espoir

**Category:** Generation - Hydraulic

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project involves the production and placement of rip rap both as wave protection and slope protection on Southeast Cut-off Dam (LD-3) and Southwest Cut-off Dam (LD-4). Rip rap is a composition of large rocks placed on the face of dykes and dams to absorb the shock of wave action to prevent erosion. At LD-3 and LD-4 wave protection is required in eight to ten areas. There is approximately 150 meters of slope protection required on LD-3 and there are two over steepened[1] sections identified on LD-4 that will require new rip-rap. In total, approximately 750 cubic meters of rip-rap are required. Both dams form part of the Long Pond Reservoir in the Bay d'Espoir (BDE) System. Both are identified as "very high[2]" consequence structures[3], as a result of the potential impact they might have in the event of a dam breach. Rip rap material will be placed at selected locations on the crest of the dams, in the wave protection zone, to re-establish the required freeboard[4] on both structures. For these structures a consistent height of 0.5 metres of rip rap above the crest elevation should[5] be maintained over the entire length of the dam. Figure 1 is a cross section sketch of Long Pond Dam, LD-3.

[1] An over steepened section is an area where the rip rap has become displaced resulting in voids along the face of the slope increasing its slope.
[2] A structure rated as a "very high" consequence structure has the potential for loss of life if a breach occurs.
[3] This rating system is defined in the 2007 Canadian Dam Association (CDA) Dam Safety Guidelines.
[4] Freeboard is the vertical distance between a stated water level and the top of the dam and is critical in preventing overtopping of a structure.
[5] As required by the 2007 CDA Guidelines.

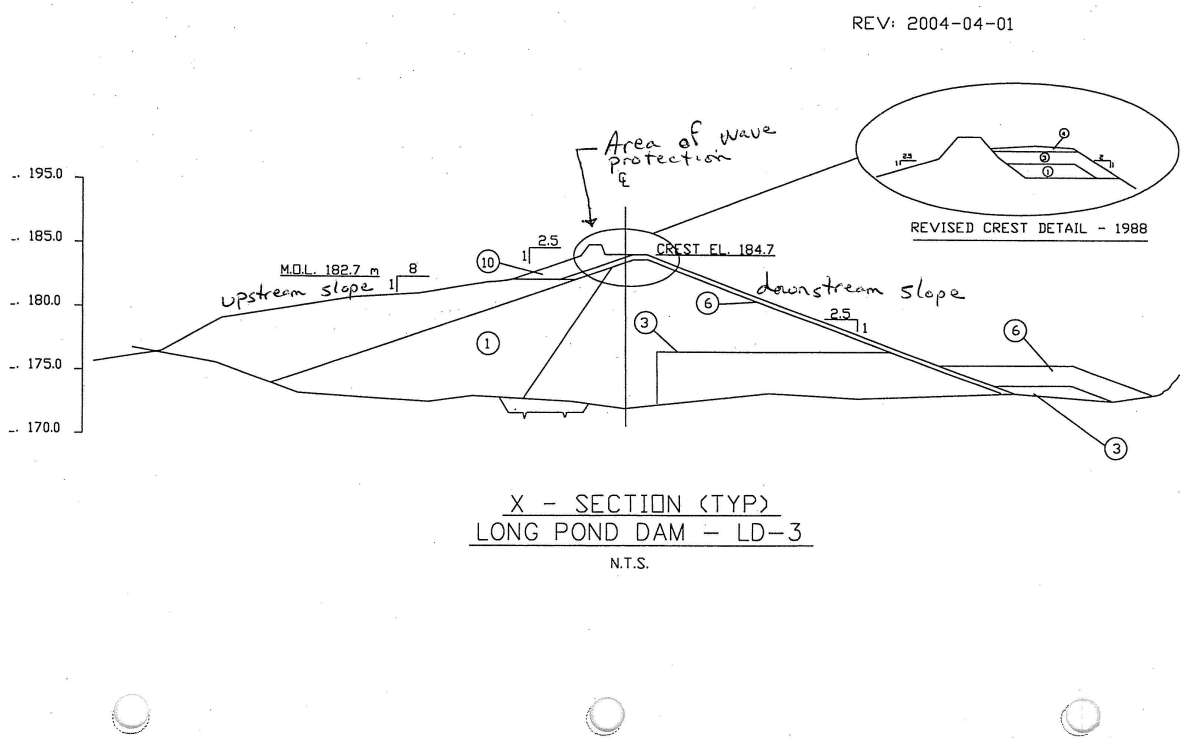


**Figure 1: Cross section of Long Pond Dam, LD-3**

The rip-rap protection along the slope has been damaged or removed over the years as a result of constant wind and wave action. This protection zone is designed to protect the dam from forces of erosion. To ensure this protection, the areas that are currently deficient need to be refurbished.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 37.7 | 0.0 | 0.0 | 37.7 |
| **Consultant** | 7.9 | 0.0 | 0.0 | 7.9 |
| **Contract Work** | 127.5 | 0.0 | 0.0 | 127.5 |
| **Other Direct Costs** | 2.6 | 0.0 | 0.0 | 2.6 |
| **Interest and Escalation** | 5.8 | 0.0 | 0.0 | 5.8 |
| **Contingency** | 17.6 | 0.0 | 0.0 | 17.6 |
| **TOTAL** | **199.1** | **0.0** | **0.0** | **199.1** |

**Operating Experience:**

Southeast and southwest dams were constructed in 1967 as part of the initial Bay d'Espoir hydroelectric development. The structures have performed well over that time but some minor work associated with rip rap repairs was done in 1992 and 1999. Both structures were raised 0.3 metres in 1988 as a result of a flood in 1983. Hydro initiated a flood study of the Bay d'Espoir System that was completed in 1986. This study led to a number of upgrades and additions to the Bay d'Espoir system.

The Long Pond Reservoir is the main head pond for the BDE Generating Station. If either of these two structures were to be lost it would significantly compromise the ability of Hydro to supply power to the Island. As noted these structures are classified as “Very High”, which under the Canadian Dam Association Guidelines indicate there is potential for loss of life in the event of a dam failure. Other dams form part of the Long Pond Reservoir, and some of these are even more critical due to the fact they are higher structures and would result in the loss of more reservoir storage in the event of a dam failure. The Long Pond Reservoir is formed by a total of five dams including the previously mentioned LD-3 and LD-4. If either of these five dams were to fail it would severely impact the generating capacity of the Bay d'Espoir facility. If either of the larger dams were to fail the facility would not be able to operate at all and if LD-3 or LD-4 were to fail it is believed the facility could possibly operate in a significantly reduced capacity but this has not been studied. It is therefore presumed that if either of these dams were to fail Hydro would lose 600 MW of generating capacity off the power grid.

**Project Justification:**

As part of Hydro's Dam Safety Program, in 2008 Hydro commissioned Hatch Ltd. to conduct a formal Dam Safety Review (DSR) as per the Canadian Dam Safety Guidelines. The relevant guidelines are included in the Hatch report which is attached as Appendix A. This review identified deficient areas in the wave protection zone of both structures. Rip rap in the wave protection zone was identified as being low and/or absent, and varying in size at several locations. The material here is of poor gradation and varies in size, and is not adequate for the exposure at these sites. Additionally, the material used for the minor repairs previously carried out was undersized.

Portions of the dam are more exposed to wind generated wave action because of the orientation of the dam and the length of the reservoir that the dam is exposed to. The length of reservoir (fetch) is one of the main factors in determining the size of the wind generated waves that the dam may be exposed to. It varies but greater than 50% of the length of the dam is exposed to the longest fetch.

Hatch recommended that dam upgrades be undertaken at the wave protection zone of both structures, using properly sized material to maintain a consistent height of 0.5 metres of wave protection zone material above the crest elevation of the dam. The report further recommends that the upstream slope of LD-3 needs rip rap material added to the section of dam that has the greatest exposure to wind generated waves. See Appendix A for relevant sections from the Hatch DSR Report. If this work is not carried out and a sufficiently powerful storm were to occur while the reservoir is at a high level then there is potential for overtopping and dam failure. This is a potential worst case scenario for this structure. The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Open capital job cost | January 2012 | January 2012 |
| Design | Complete detailed design | March 2012 | April 2012 |
| Procurement | Obtain appropriate environmental permits | March 2012 | April 2012 |
| | Prepare tender specifications | April 2012 | April 2012 |
| | Evaluate tenders | May 2012 | May 2012 |
| | Award tender | May 2012 | June 2012 |
| | Conduct initial survey | June 2012 | June 2012 |
| Construction | Mobilize contractor | July 2012 | July 2012 |
| | Secure material through quarrying | July 2012 | July 2012 |
| | Haul material and place material | July 2012 | August 2012 |
| Commissioning | Conduct final survey | August 2012 | August 2012 |
| | Complete site work | August 2012 | August 2012 |
| Closeout | Pay all invoices | September 2012 | September 2012 |
| | Close out job | September 2012 | October 2012 |

**Future Plans:**

None.

**APPENDIX A**
**HATCH – LONG POND DAM SAFETY REVIEW**

newfoundland labrador hydro
a nalcor energy company

# Long Pond

## Dam Safety Review

February 2009



# 1. Introduction

In August 2008, Newfoundland and Labrador Hydro (Hydro) engaged Hatch to perform a Dam Safety Review (DSR) for the following four dams on the Long Pond Reservoir.

- LD-1 (Power Canal Embankment)
- LD-2 (North West Cutoff)
- LD-3 (South East Cutoff)
- LD-4 (South West Cutoff)

The DSR was conducted in accordance with good engineering practice, accepted industry standards, and the 2007 Canadian Dam Association (CDA) Dam Safety Guidelines (2007 CDA Guidelines), and consideration of the Canadian Dam Safety Technical Bulletins (CDA Bulletins).

## 1.1 CDA Guidelines

Dams across Canada are owned by utilities, mining companies, pulp and paper companies, various levels of government and private owners. Regulation of dam safety in Canada is primarily a provincial responsibility; some provinces have enacted specific dam safety regulations, while others use existing Acts or regulations to authorize the design, construction, inspection, operation, rehabilitation, alteration, or decommissioning of dams. For the province of Newfoundland and Labrador, there is currently no provincial regulation related to dam safety; however, the *Water Resources Act* is used to authorize the design and construction of new dams, and ensure the safe operation and maintenance of existing dams to ensure public safety. Although not legislated, the Government of Newfoundland and Labrador support the use of the 2007 CDA Guidelines.

The evolution of the 2007 CDA Guidelines started in 1992 and with efforts by working groups across Canada to publish the Canadian Dam Safety Association (CDSA) Dam Safety Guidelines in 1995. In 1999, the CDA (new association amalgamating the CDSA and CANCOLD membership) issued a revised version of the 1995 Guidelines. In 2003, the CDA began soliciting input and suggestions for revisions and additions to the 1999 Guidelines. The product of this input and review led to the successful completion of the 2007 CDA Guidelines. The recently issued 2007 CDA Guidelines consist of the following.

- ***Section 1 - principles that are applicable to all dams.*** The principles should be understood by dam owners, regulators, managers, operators, and other interested parties. The brief explanatory text outlines, in general, how conformance with the principles could be demonstrated.
- ***Section 2-6, guidelines that outline processes and criteria for management of dam safety in accordance with the principles***. The guidelines are of interest to dam owners, regulators, managers, operators, and other decision-makers, as well as engineers and consultants.


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## 1.2 Dam Safety Reviews

A DSR is a systematic review and evaluation of all aspects of design, construction, operation, maintenance, processes, and other systems affecting a dam's safety, including the dam safety management system. The review defines and encompasses all components of the dam system under evaluation such as dams, spillways, foundations, abutments, reservoir, and tailraces. The review should be based on current knowledge and methods, which may be different from the acceptable practices at the time of original construction or a prior DSR. The 2007 CDA Guidelines provide the following two principles related to DSR's.

*PRINCIPLE 4a*
*A safety review of the dam ("Dam Safety Review") shall be carried out periodically.*

*PRINCIPLE 4b*
*A qualified registered professional engineer shall be responsible for the technical content, findings, and recommendations of the Dam Safety Review and report.*

The level of detail in the DSR should be sufficient either to demonstrate that the dam meets dam safety requirements or to identify areas where conformance cannot be demonstrated and future investigation or action is needed. The level of detail may be modified on the basis of previous assessments, complexity of the dam, continuity of surveillance and records, external and internal hazards, operating history, dam performance and age, and the need for public protection during operation. A DSR should include visual inspection of the dam and a review of the following.

- Consequences of dam failure.
- Operation, maintenance, and surveillance documentation and practices.
- Emergency preparedness plans and procedures.
- Previous DSR's.
- Analysis of failure modes, inflow design flood, seismic loads, other load combinations, stability and performance, reliability and functionality of discharge facilities, and overall effectiveness of safety management at the dam.

The frequency required for the DSR should be based on the consequences of failure, external hazards, failure modes, the ongoing surveillance program, and demonstrated dam performance. The DSR should be documented in a formal report, with conclusions and recommendations, to enable the dam owner to conform to accepted practices in dam safety and to comply with regulations.

The DSR should be carried out by a registered professional engineer (or team of engineers) with a background in design, construction, operation, and performance analysis of dams. The terms of reference for the review should define who is accountable for the final report with the findings and recommendations of the study being independent of conflict of interest.


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# 4. Site Inspection and Staff Interviews

Site inspections and staff interviews are critical to a DSR such that the actual condition of the dam system can be observed and that further information can be collected from staff knowledgeable with the system. The following sections discuss the site inspection and staff interviews conducted for this DSR.

## 4.1 Site Inspection

Site inspections were held October 9, 2008 and included Robert Woolgar, P.Eng. (Hatch), Roly Peggs, P.Eng. (Hatch), and Garry Poole, P.Eng. (Hydro). Weather conditions during the site inspections were sunny and cool, and the Long Pond Reservoir was operating at elevation 181.1 m (normal operating level = 182.7 m). The site inspections included a "walk-over" of each structure photographing the structures and noting observations on Hatch standard inspection forms. The detailed site inspections were conducted by Mr. Peggs and the results of these inspections are in Appendix B with site inspection photos provided in Appendix C. During the detailed site inspections, Mr. Woolgar and Mr. Poole discussed other items such as freeboard, riprap, required surveying, and operation. The following sections provide a list of notes related to other observations during the course of the detailed site inspections.

### *4.1.1 LD-1 General Observations*

- Access to structure is restricted – locked gate on either side of structure.
- Signage on gate indicating that spraying has taken place.
- There is boat access near LD-1 with no apparent signage visible regarding boat safety.
- During the course of the site investigation, there was boating activity and boat launching.
- Riprap is in good condition.

### *4.1.2 LD-2 General Observations*

- There were no gates or signs, and access to the dam is not restricted.
- G. Poole noted that the estimated $D_{50}$ sizing for the riprap is 95 cm.
- Riprap sizing for LD-2 appeared to be much larger than that of LD-3 and LD-4, although the fetches are similar.

### *4.1.3 LD-3 General Observations*

- There were no gates or signs, and access to the dam is not restricted.
- From chainage 0 m to chainage 150 m, dam is sheltered and not exposed to large fetches.
- After chainage 150 m, dam is exposed and fetches are relatively long.


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- The riprap section (wave protection zone) does not appear to be equally 0.5 m above the dam crest.
- The debris line along the upstream slope appears to be at the Maximum Operating Level.
- At the debris line, there appears to be some undercutting.
- It was suggested during the site inspections that the riprap slope should be flattened.

### *4.1.4 LD-4 General Observations*

- There were no gates or signs, and access to the dam is not restricted.
- There is signage at beginning of road and speed limit signs are posted.
- There is a cabin at end of dam and access to cabin is along dam.
- It appears that riprap sizing on dam increases relative to dam exposure to longer fetches.
- There are some locations along the riprap crest that should be filled in.

## 4.2 Staff Interviews

Two separate staff interviews were conducted, as follows.

1. Management Interview – the purpose of this interview is to discuss overall dam safety management with the client to understand the owner's attitude towards dam safety and to start collecting information necessary to conducting the DSR. The particulars regarding this meeting follow.
   - Date: August 7, 2008
   - Location: Hydro Place, St. John's
   - Attendees:
     - Garry Poole (Hydro)
     - Robert Woolgar (Hatch)
     - Michael Rosales (Hatch)
2. Operators Interview – the purpose of this interview is to discuss details of the system operation and to discuss dam safety with site operators. The particulars regarding this meeting follow.
   - Date: October 8, 2008
   - Location: Bay d'Espoir Powerhouse, Bay d'Espoir
   - Attendees:
     - Garry Poole (Hydro)
     - Louis Barnes (Hydro)


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- Lev Kearley (Hydro)
- Robert Woolgar (Hatch)
- Roly Peggs (Hatch)

The results of the Management Interview and Operators Interview are presented in Appendix D and Appendix E, respectively.

## 4.3 Conclusions and Recommendations

The interviews and site inspections went well and the overall condition of the dams, based on visual observations, is good. All Hydro staff participating in the interviews were very knowledgeable with the sites, the operations, and dam safety. Conclusions and recommendations drawn from the interviews as they relate to operation, maintenance, surveillance, emergency preparedness, public safety, and dam safety management are discussed in a subsequent section of this report. The key recommendations arising from the site inspection and staff interviews follow.

- Surveys are required for LD-3 and LD-4. Information collected should include the following.
  - Crest profile – survey along crest to confirm the reported crest elevation of 184.7 m. Survey should be along centerline of crest and include both low and high points along crest.
  - Wave protection zone profile – survey along top of rock to confirm the reported elevation of 185.2 m. Survey should include both low and high points along crest.
  - Profile along water surface edge on upstream slope – Survey the water surface edge to confirm water level during survey.
  - Upstream slope at various locations – surveys along the upstream slope should be taken in areas were slope appears to be different along the dam.
- Wave protection zones for LD-3 and LD-4 needs repair.
- Upstream slope on LD-3 needs repair.
- Surveillance monitoring protocol should be upgraded to include annual, repeatable (and "superimposable") photos from several locations on each structure.


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**LD3**



At Chainage 150 – Low Rip-Rap Berm US Crest Edge



At Chainage 120 – Low Rip-Rap Berm US Crest Edge




Chainage 120 US Slope looking East, Benching, Rip-Rap Lacking




Chainage 120 US Slope looking West, Vegetation, Rip-Rap Poor




At Chainage 220 – US Slope looking East, Benching, Rip-Rap Poor



At Chainage 220 – US Slope looking West, Benching, Rip-Rap Poor

**LD4**



Chainage 370 – Looking West Rip-Rap Berm, US Slope, Vegetation



At Chainage 300 – Low & Absent US Rip-Rap Berm



At Chainage 290 – Low US Rip-Rap Berm



At Chainage 280 – Low & Absent US Rip-Rap Berm

**Project Title:** Replace Beta Attenuation Monitoring Analyzers

**Location:** Holyrood

**Category:** Generation - Thermal

**Definition:** Other

**Classification:** Mandatory

**Project Description:**

The Holyrood Thermal Generating Station (Holyrood) operates six ambient air monitoring stations that monitor the local air quality within a 6.5 km radius of the plant. One of the six stations, located at Seal Cove, is mobile and referred to as the Mobile Ambient Air Monitoring Station (MAAMS). All other stations are permanent installations. Information on each station is presented in Table 1.

**Table 1: Ambient Air Monitoring Stations**

| *Station Name* | *Station Address* | *City/Municipality* | *Contaminants Measured* |
|---|---|---|---|
| Butterpot Road | Butterpot Road | Holyrood | $SO_2$, $NO_x$, $PM_{2.5}$ |
| Indian Pond Road | Seal Cove Road | Seal Cove | $SO_2$, TPM, $NO_x$, $PM_{2.5}$ |
| Lawrence Pond Road | Lawrence Pond Road | Conception Bay South | $SO_2$, TPM, $NO_x$, $PM_{2.5}$ |
| Hydro Main Gate | Holyrood Thermal Generating Station | Holyrood | TPM, $PM_{2.5}$ |
| Green Acres Road | Green Acres Road | Holyrood | $SO_2$, TPM, $NO_x$, $PM_{2.5}$ |
| MAAMS | Indian Pond Drive | Seal Cove | $SO_2$, TPM, $NO_x$, $PM_{2.5}$ |

The ambient air monitoring equipment at each station is designed to sample outdoor air and analyze the concentrations of pollutants as required by the provincial Department of Environment and Conservation (see Appendix C). These pollutants include sulphur dioxide ($SO_2$), oxides of nitrogen ($NO_x$), total particulate matter (TPM), and particulate matter less than or equal to 2.5 microns (0.0025 mm) in diameter ($PM_{2.5}$). The Beta Attenuation Mass Monitors currently installed at each station to monitor concentrations of particulate matter in the $PM_{2.5}$ range have not been acceptable to the Department of Environment and Conservation since 2010. These monitors, along with Holyrood's

spare monitor, will be replaced under this project with equipment approved for use by the Department of Environment and Conservation. The budget for this project is presented in Table 2.

**Table 2: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 110.0 | 0.0 | 0.0 | 110.0 |
| **Labour** | 24.0 | 0.0 | 0.0 | 24.0 |
| **Consultant** | 5.8 | 0.0 | 0.0 | 5.8 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 7.1 | 0.0 | 0.0 | 7.1 |
| **Contingency** | 14.0 | 0.0 | 0.0 | 14.0 |
| **TOTAL** | **160.9** | **0.0** | **0.0** | **160.9** |

**Operating Experience:**

In 2010, an internal environmental audit revealed that the $PM_{2.5}$ particulate monitoring equipment installed at Holyrood's six ambient air monitoring stations does not meet the requirements of Condition 68 of the plant's Certificate of Approval (No. AA06-025458C) (see Appendix A). Condition 68 indicates that methods used for $PM_{2.5}$ monitoring must be listed in the United States Environmental Protection Agency (US EPA) document "*List of Designated Reference and Equivalence Methods*". Holyrood's $PM_{2.5}$ monitoring equipment uses procedures and settings recommended by the National Air Pollution Surveillance (NAPS) Network. The NAPS procedures are not listed in the US EPA document and are therefore not approved for use in the province.

In 2010, the Department of Environment and Conservation sent Hydro a letter (see Appendix B) that indicated that upon expiry of Holyrood's Certificate of Approval that Hydro shall upgrade or replace the $PM_{2.5}$ monitoring equipment at Holyrood and operate this equipment in accordance with the approved methods. Holyrood's Certificate of Approval expired on February 2, 2011, but has been extended to provide enough time to complete the required upgrades to the ambient air monitoring systems.

**Project Justification:**

Large industrial facilities in Newfoundland and Labrador that utilize combustion processes are required to establish an ambient air monitoring program for the purpose of ensuring that emissions of air contaminants are less than the maximum permissible under the province's *Air Pollution Control Regulations 39/04*. Holyrood operates six ambient air monitoring stations as part of its ambient air

monitoring program. The $PM_{2.5}$ continuous particulate monitoring equipment installed at these stations no longer meets provincial regulations and must be upgraded.

According to the Province's *Air Pollution Control Regulations 39/04* Section 21 (see Appendix C), all ambient air measurements, recordings and analysis are to be performed by devices and methods acceptable to the Department of Environment and Conservation. The *Guidelines for Ambient Air Monitoring*, Section 3 (see Appendix D), issued December 16, 2010 by the Department of Environment and Conservation, indicate that the approved list of monitoring devices and methods are listed in the United States Environmental Protection Agency (US EPA) Air Monitoring Methods - Criteria Pollutants "*List of Designated Reference and Equivalence Methods*" document. Each of Holyrood's ambient air monitoring stations uses a Met One Instruments Model BAM 1020 beta attenuation monitor to continuously monitor particulate matter in the $PM_{2.5}$ range. These units were installed in 2004 before the enactment of the current provincial regulations and operate using National Air Pollution Surveillance (NAPS) Network monitoring methods. The NAPS methods differ from those currently approved by the US EPA. As a result, the NAPS monitoring methods are no longer approved for use by the provincial Department of Environment and Conservation.

On March 23, 2010, Newfoundland and Labrador Hydro (Hydro) contacted the Department of Environment and Conservation and requested that the Department approve the use of Met One Instruments Model BAM 1020 beta attenuation monitors using NAPS monitoring methods for monitoring particulate matter in the $PM_{2.5}$ range at its six ambient air monitoring stations near Holyrood. The Department denied this request (see Appendix B) and indicated that upon expiry of Hydro's Certificate of Approval (No. AA06-025458C) for its Holyrood plant that Hydro shall upgrade or replace the existing Met One Instruments Model BAM 1020 units with BAM 1020-FEM (Federal Equivalent Methods) units, and operate the units in accordance with the US EPA "*List of Designated Reference and Equivalence Methods*". The manufacturer of the Met One Instruments Model BAM 1020 has indicated that Holyrood's existing $PM_{2.5}$ monitoring equipment cannot be upgraded to meet the current US EPA requirements. Therefore, new monitoring equipment is required. Parts of the existing monitoring systems, such as the air inlets, power supplies, heaters and support structures will be reused.

To comply with the March 26, 2010 directive from the Department of Environment and Conservation, Holyrood must upgrade its $PM_{2.5}$ monitoring equipment at its six ambient air monitoring stations to meet current standards.

The anticipated project schedule is shown in Table 3.

**Table 3: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Project initiation | January 2012 | January 2012 |
| Design | Prepare specifications for new equipment | January 2012 | February 2012 |
| Procurement | Purchase new equipment | February 2012 | April 2012 |
| Construction | Install new equipment | July 2012 | July 2012 |
| Commissioning | Commissioning new equipment | July 2012 | July 2012 |
| Closeout | Prepare project closeout documents and close project | September 2012 | September 2012 |

**Future Plans:**

None.

**APPENDIX A**
**CERTIFICATE OF APPROVAL**

Newfoundland Labrador

GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR
Department of Environment and Conservation

# CERTIFICATE OF APPROVAL

Pursuant to the Environmental Protection Act, SNL 2002 c E-14.2 Section 83

Issue Date: ***February 2, 2006*** Approval No. AA06-025458C

Expiration: ***February 2, 2011*** File No. 716.008

**Amendment Date: *March 17, 2009***

Proponent: **Newfoundland and Labrador Hydro**
P.O. Box 29
Holyrood, NL
A0A 2R0

Attention: Mr. Mike Manuel, Environment and Performance Manager

Re: **Holyrood Thermal Generating Station**

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Approval is hereby given for: the operation of a thermal generating station, including power house, waste water treatment plant, hazardous waste landfill and associated works located at Holyrood, NL.

This certificate of approval does not release the proponent from the obligation to obtain appropriate approvals from other concerned provincial, federal and municipal agencies. Nothing in this certificate of approval negates any regulatory requirement placed on the proponent. Where there is a conflict between conditions in this certificate of approval and a regulation, the condition in the regulation shall take precedence. Approval from the Department of Environment and Conservation shall be obtained prior to any significant change in the design, construction, installation, or operation of the facility, including any future expansion of the works. This certificate of approval shall not be sold, assigned, transferred, leased, mortgaged, sublet or otherwise alienated by the proponent without obtaining prior approval from the Minister.

This certificate of approval is subject to the terms and conditions as contained in Appendix 'A' attached hereto, as may be revised from time to time by the Department. Failure to comply with any of the terms and conditions may render this certificate of approval null and void, may require the proponent to cease all activities associated with this certificate of approval, may place the proponent and its agent(s) in violation of the *Environmental Protection Act*, and will make the proponent responsible for taking such remedial measures as may be prescribed by the Department. The Department reserves the right to add, delete or modify conditions to correct errors in the certificate of approval or to address significant environmental or health concerns.

**MINISTER**

# APPENDIX "A"

**TERMS AND CONDITIONS FOR APPROVAL No. AA06-025458C**
**March 17, 2009**

## General

1. This Certificate of Approval is for: the operation of a thermal generating station, including power house, waste water treatment plant, hazardous waste landfill and associated works located at Holyrood, NL. Future modification or expansion may require an amendment to this Approval or a separate Approval.

2. Any inquires concerning this approval shall be directed to the St. John's office of the Pollution Prevention Division (telephone: (709) 729-2555; or facsimile: (709) 729-6969).

3. In this Certificate of Approval:

   - **accredited** means the formal recognition of the competence of a laboratory to carry out specific functions;
   - **acutely lethal** means that the effluent at 100% concentration kills more than 50% of the rainbow trout subjected to it during a 96-hour period, when tested in accordance with the ALT;
   - **Administrative Boundary** means the boundary surrounding the thermal generating station outside of which the ambient air quality standards, outlined in Schedule A of the ***Air Pollution Control Regulations, 2004***, apply;
   - **air contaminant** means dust, fumes, mist, smoke, other particulate matter, vapour, gas, odorous substances or a combination of them in air which may impair the quality of the natural environment for any use that can be made of it, cause harm or discomfort to a person, adversely affect the health or impair the safety of a person or cause injury or damage to property or to plant or animal life;
   - **ALT (acute lethality test)** means a test conducted as per Environment Canada's Environmental Protection Series reference method EPS/1/RM-13 Section 5 or 6;
   - **blanketed** means to cover a vessel with a lid that is specifically designed to contain vapours;
   - **$BOD_5$** means biochemical oxygen demand (5 day test);
   - **CEMS** means the continuous emissions monitoring system used to measure gaseous releases of $SO_2$, $NO_X$, $CO_2$, CO and $O_2$ from each boiler;

- **CO** means carbon monoxide;
- **$CO_2$** means carbon dioxide;
- **Department** means the Department of Environment and Conservation, and its successors;
- **Director** means the Director of the Pollution Prevention Division of the Department;
- **discharge criteria** means the maximum allowable levels for the parameters listed in Table 3;
- **effluent** means waste water resulting from the thermal generating station operations, including process water, boiler blowdown water, wash-down water, cooling water and leachate from the landfill;
- **grab sample** means a quantity of undiluted effluent collected at any given time;
- **hazardous waste** means a product, substance or organism that is intended for disposal or recycling, including storage prior to disposal or recycling, and that:
  (a) is listed in Schedule III of the *Export and Import of Hazardous Waste Regulations under the Canadian Environmental Protection Act, 1999*;
  (b) is included in any of Classes 2 to 6, and 8 and 9 of the *Transportation of Dangerous Goods Regulations* under the *Transportation of Dangerous Goods Act, 1992*; or
  (c) exhibits a hazard classification of a gas, a flammable liquid, an oxidizer, or a substance that is dangerously reactive, toxic, infectious, corrosive or environmentally hazardous;
- **HYDRO** means Newfoundland and Labrador Hydro;
- **Landfill Operations Manual** means the ***HTGS Procedures Manual for the Controlled Waste Landfill*** (most recent version);
- **licenced** means has a Certificate of Approval issued by the Minister to conduct an activity;
- **liquid waste** is defined by the *Slump Test* (Canadian Standards Association test method A23.2-5C for determining the slump of concrete). The liquid waste slump test involves placing the waste in a 30 cm open inverted cone. The cone is removed and the immediate decrease (slump) in height of the waste material is measured. If the material slumps such that the original height is reduced by 15 cm or more, the waste is considered liquid;
- **leachate holding pond** means the detention pond for leachate control prior to transfer to the on-site waste water treatment plant;

- **malfunction** means any sudden, infrequent and not reasonably preventable failure of air pollution control equipment, waste water treatment equipment, process equipment, or a process to operate in a normal or usual manner. Failures caused in part by poor maintenance or careless operation are not malfunctions;
- **Minister** means the Minister of the Department;
- **$NO_x$** means oxides of nitrogen;
- **$NO_2$** means nitrogen dioxide;
- **$O_2$** means oxygen;
- **on-scene commander** means the person designated to co-ordinate and direct pollution control efforts at the scene of an existing spill of a toxic or hazardous material;
- **PCBs** means polychlorinated biphenyls;
- **$PM_{10}$** means particulate matter with a diameter of 10 $\mu$m or less;
- **$PM_{2.5}$** means particulate matter with a diameter of 2.5$\mu$m or less;
- **proficiency testing** means the use of inter-laboratory comparisons to determine the performance of individual laboratories for specific tests or measurements;
- **QA/QC** means Quality Assurance/Quality Control;
- **register(ed)**, in the context of storage tanks, means that information regarding the storage tank system has been submitted to a Government Service Centre office and a registration number has been assigned to the storage tank system. In the context of source testing, registered means source testing results that have been submitted to and approved by the department in accordance with the *Stack Emission Testing Guidance Document* (GD-PPD-016.1);
- **regulated substance** means a substance subject to discharge limit(s) under the *Environmental Control Water and Sewage Regulations, 2003*;
- **$SO_2$** means sulfur dioxide;
- **SOP** means Standard Operating Procedure;
- **spill or spillage** means a loss of gasoline or associated product in excess of 70 litres from a storage tank system, pipeline, tank vessel or vehicle, or of any volume of a regulated substance, onto or into soil or a body of water;

- **storage tank system** means a tank and all vent, fill and withdrawal piping associated with it installed in a fixed location and includes a temporary arrangement;
- **TDS** means total dissolved solids;
- **TPH** means total petroleum hydrocarbons as measured by the Atlantic PIRI method;
- **TSP** means total suspended particulate with diameters less than 100$\mu$m. For the purposes of this approval, TSP shall be measured using a high volume TSP sampler;
- **TSS** means total suspended solids;
- **used lubricating oil** means lubricating oil that as a result of its use, storage or handling, is altered so that it is no longer suitable for its intended purpose but is suitable for refining or other permitted uses;
- **used oil** means a used lubricating oil or waste oil;
- **waste oil** means an oil that as a result of contamination by any means or by its use, is altered so that it is no longer suitable for its intended purpose; and
- **waste water treatment plant** means HYDRO's treatment plant for waste water streams resulting from periodic cleaning of boiler fireside equipment, and includes the periodic basin, the batch reactor, filter press and all associated works.

4. All necessary measures shall be taken to ensure compliance with all applicable acts, regulations, policies and guidelines, including the following, or their successors:

- *Environmental Protection Act;*
- *Water Resources Act;*
- *Air Pollution Control Regulations, 2004;*
- *Environmental Control Water and Sewage Regulations, 2003;*
- *Storage and Handling of Gasoline and Associated Products Regulations, 2003;*
- *Halocarbon Regulations;*
- *Used Oil Control Regulations;*
- *Storage of PCB Waste Regulations, 2003;*
- *Ambient Air Monitoring Policy Directive;*
- *Accredited and Certified Laboratory Policy;*
- *Compliance Determination Guidance Document;*
- *Stack Emission Testing Guidance Document; and*
- *Plume Dispersion Modelling Guidance Document.*

This Approval provides terms and conditions to satisfy various requirements of the above listed acts, regulations, Departmental policies and guidelines. If it appears that all of the pertinent requirements of these acts, regulations, policies and guidelines are not being met, then a further review of the thermal generating station shall be conducted, and suitable

pollution control measures may be required by the Minister.

5. All reasonable efforts shall be taken to minimize the impact of the thermal generating station on the environment. Such efforts include minimizing the area disturbed by the thermal generating station, minimizing air or water pollution, finding alternative uses, acceptable to the Director, for waste or rejected materials, and considering the requirement for the eventual rehabilitation of disturbed areas when planning the development of any area on the thermal generating station property.

6. HYDRO shall provide to the Department, within a reasonable time, any information, records, reports or access to data requested or specified by the Department.

7. HYDRO shall keep all records or other documents required by this Approval at the thermal generating station location for a period of not less than three (3) years, beginning the day they were made. These records shall be made available for review by Departmental representatives when requested.

8. Should HYDRO wish to deviate in any way from the terms and conditions of this Certificate of Approval, a written request detailing the proposed deviation shall be made to the Minister. HYDRO shall comply with the most current terms and conditions until the Minister has authorized otherwise. In the case of meeting a deadline requirement, the request shall be made 60 days ahead of the applicable date as specified in this Approval or elsewhere by the Department.

## Waste Management

9. All waste generated at the thermal generating station is subject to compliance with the ***Environmental Protection Act***. All non-industrial waste shall be placed in closed containers and, on at least a weekly basis, removed from the site. If required, industrial waste shall be disposed of by a licenced operator. These wastes shall be disposed of at an authorized waste disposal site with the permission of the owner/operator of the site.

10. HYDRO shall submit a Waste Management Plan for their thermal generating station operation. With the goal of minimizing adverse effects on the environment, the Waste Management Plan shall: be comprehensive, including all operations within the thermal generating station; identify the types of waste materials (i.e. boiler ash, sewage, empty chemical packaging, etc.); provide general direction in dealing with the handling, storage, transport, treatment and disposal of waste materials; and incorporate the basic waste management principles of reduce, reuse, recycle, recover and residual disposal. An outline of the Plan shall be submitted to the Director for review by ***October 2, 2006***. The outline shall include a schedule of dates for preparation and implementation for each section of the Plan. The completed Plan shall then be submitted to the Director for review by ***February 2, 2007***. Every year the Waste Management Plan shall be reviewed and revised as necessary, accounting for expanding or alteration of activities. All proposed revisions shall be submitted to the Director for review. The Department will acknowledge receipt of the Plan and/or

revisions, and shall provide any review comments within a reasonable time frame.

11. HYDRO shall ensure that all volatile chemical and solvent wastes, if they can not be reused, are placed in suitable covered containers for disposal in a manner acceptable to the Department. Disposal of liquid wastes at waste disposal sites in the province is not considered an acceptable alternative.

12. Disposal of hazardous waste in a municipal or regional waste disposal site in this Province is prohibited. Transporters of hazardous waste shall have an approval issued by the Minister. Those generating hazardous waste shall have a waste generators number issued by the Director and shall also complete the required information outlined in the Waste Manifest Form.

## Noise

13. HYDRO shall submit a Noise Management Plan with the goal of minimizing noise resulting from the thermal generating station operations. The Noise Management Plan shall be comprehensive, including all sources within the thermal generating station which generate noise in the surrounding environment, and shall provide direction in dealing with the noise levels. An outline of the plan shall be submitted to the Director by ***October 2, 2006***. The complete plan then shall be submitted to the Director for review by ***February 2, 2007***. Every year the Noise Management Plan shall be reviewed and revised as necessary. All proposed revisions shall be submitted to the Director for review. The Department will acknowledge receipt of the Plan and/or revisions, and shall provide any review comments within a reasonable time frame.

## Chemical Operations

14. All chemical loading and blending shall be done inside the thermal generating station, with no chemical containers being opened outside. All vessels storing volatile chemicals or solvents shall be blanketed to eliminate vapour or odour releases.

## Spill Prevention and Containment

15. Areas in which chemicals are stored shall have impermeable floors and dykes or curbs and shall not have a floor drain system, nor shall it discharge to the environment. Areas inside the dykes or curbs shall have an effective secondary containment capacity of at least **110%** of the chemical storage container capacity, in the case of a single container. If there is more than one storage container, the dyked area shall be able to retain no less than **110% of the capacity of the largest container or 100 % of the capacity of the largest container plus 10% of the aggregate capacity of all additional containers, whichever is greater.**
16. All on site storage of petroleum shall comply with the ***Storage and Handling of Gasoline***

***and Associated Products Regulations, 2003***, or its successor. Storage tank systems shall be registered with the Government Service Centre. All aboveground storage tanks shall be clearly and visibly labelled with their GAP registration numbers.

17. Where applicable, all tanks and fuel delivery systems shall be inspected to appropriate American Petroleum Institute or Underwriters' Laboratories of Canada standards, or any other standards acceptable to this Department. The required frequency of inspections may be changed at the discretion of the Director.

18. An inventory of all petroleum and chemical storage tanks shall be submitted to the Director for review by ***August 2, 2006***. This inventory shall include a plan showing location, registration and/or approval number (where applicable), identification number, material stored, capacity, tank material, tank type, year of manufacture, date of installation, date of last inspection, failure history, maintenance history, dyke capacity and date of next planned inspection. Every two (2) years, an update of any significant changes to the inventory shall be submitted to the Director.

## Contingency Plan

19. A contingency plan for the operation of HYDRO's thermal generating station shall be submitted to the Director for review by ***August 2, 2006***. The contingency plan shall clearly describe the actions to be taken in the event of a spill of a toxic or hazardous material. It shall include, as a minimum: notification and alerting procedures; duties and responsibilities of the "on-scene commander" and other involved staff; spill control and clean-up procedures; restoration of the spill site; information on disposal of contaminants; and resource inventory. Copies of the plan shall be placed in convenient areas throughout the thermal generating station so that employees can easily refer to it when needed. HYDRO shall ensure that all employees are aware of the plan and understand the procedures and the reporting protocol to be followed in the event of an emergency. An annual response exercise is recommended for response personnel. Every year, as a minimum, the plan shall be reviewed and revised as necessary. Any proposed significant revisions shall be submitted to the Director for review. Changes which are not considered significant include minor variations in equipment or personnel characteristics which do not effect implementation of the plan.

20. Every time HYDRO implements the contingency plan, information shall be recorded for future reference. This will assist in reviewing and updating the plan. The record shall consist of all incidents with environmental implications, and include such details as: date; time of day; type of incident (i.e. liquid spill, gas leak, granular chemical spill, equipment malfunction, etc.); actions taken; problems encountered; and other relevant information that would aid in later review of the plan performance. A summary of all incident reports shall be submitted as per the ***Reporting*** section.

## Site Decommissioning and Restoration Plan

21. A plan to restore areas disturbed by the thermal generating station shall be submitted to the Director for review at the time that closure of the thermal generating station is determined. For guidance on the preparation of the plan, refer to Appendix B. Wherever possible, the plan shall promote progressive reclamation of disturbed areas. HYDRO shall proceed through a phased environmental site assessment process to closure.

## Bunker C

22. Each delivery of Bunker C shall be analysed for the parameters listed in Table 1. Analysis shall be on a representative sample of the Bunker C received.

**Table 1: Fuel Analysis Program**

| Parameters | | | Frequency |
|---|---|---|---|
| A.P.I. Gravity @ 60 °F | Density (kg/m3 @ 15 °C) | Flash Point | **every batch delivered** |
| Pour Point | Viscosity cSt @ 51 °C | Viscosity SFS @ 122 °F | |
| Sulfur % by weight | BTU's per US Gallon | Ash % by weight | |
| Sediment % by weight | Water % by volume | Asphaltenes % by weight | |
| Aluminum | Nickel | Silicon | |
| Sodium | Vanadium | | |

23. HYDRO shall maintain, and submit to the Director as per the ***Reporting*** section, a record of all Bunker C received. The record shall include:
    - name of the supplier;
    - date and volume of Bunker C unloaded;
    - the certificate of analysis for each batch of Bunker C delivery received; and
    - the name of the laboratory where the analysis was performed.

24. HYDRO is permitted to accept and burn alternative fuel only with the written approval of the Department.

## Used Oil

25. Used oil shall be retained in an approved tank or closed container, and disposed of by a company licenced for handling and disposal of used oil products.

26. An SOP for the handling and storage of used oil shall be submitted to the Director by ***August 2, 2006***. The SOP shall, as a minimum, detail procedures for the following:
    - storage and handling of used oil generated on-site; and
    - recording of volumes of used oil generated from each source.

## Waste Water Flows and Treatment

27. The thermal generating station's once-through cooling water shall be obtained from Indian Pond, and shall be discharged directly to Conception Bay.

28. The thermal generating station's south-east floor drains shall be routed through an oil/water separator and then to Indian Pond through the storm water collection system;

29. The thermal generating station's south-west floor drains shall be routed through a grease trap and an oil/water separator and then to the cooling water discharge piping associated with Units # 1 & 2;

30. The thermal generating station's north-east and north-west floor drains shall be routed through a grease trap and an oil/water separator and then to a 900 $m^3$ equalization basin (continuous basin).

31. All oil/water separators shall be checked routinely to ensure they are working properly. A log of these checks shall be maintained.

32. Waste water streams resulting from daily operations, including raw water clarification, filter backwashes, boiler blowdown and other similar activities shall be directed to the continuous basin. Any flow or drainage from the continuous basin shall be discharged to Indian Pond.

33. Demineralizer regeneration waste water flows may be directed to the seal pit associated with Units # 1 & 2, during such times that at least one cooling water pump is active.

34. Waste water streams resulting from periodic events where water is used to clean boiler fireside equipment, including air preheater wash flows, fireside boiler wash flows and boiler acid wash flows, shall be directed to a 900 $m^3$ equalization basin (periodic basin). Any flow or drainage from the periodic basin shall be directed to the waste water treatment plant.

35. Any flow or drainage from the waste water treatment plant shall be discharged to the cooling water intakes for Units # 1 & 2.

36. Effluent from the dewatering of filter cake shall be re-cycled through the waste water treatment plant.

37. All solid waste generated from the waste water treatment plant operations shall be directed to the hazardous waste landfill.

## Effluent Monitoring and Discharge

38. HYDRO shall perform an Effluent Monitoring Program as per Table 2.

| Table 2: Effluent Monitoring Program | | | | | |
|---|---|---|---|---|---|
| **Location** | **Parameters** | | | | **Frequency** |
| Batch Reactor | Aluminum<br>Vanadium | Iron<br>pH | Magnesium<br>TSS | Nickel<br>TPH | grab sample prior to each batch release † |
| | ALT | | | | grab sample from each batch following new addition of waste water to the periodic basin |
| Continuous Basin outfall | Iron<br>TSS | Nickel<br>TPH | Vanadium | pH | weekly grab |
| | ALT | | | | monthly grab |
| † grab samples for all parameters shall be taken from the batch reactor at the same time | | | | | |

All results from the Effluent Monitoring Program shall be submitted to the Director as per the ***Reporting*** section.

39. Refer to Table 3 for the discharge criteria.

| Table 3 - Effluent Discharge Criteria† | |
|---|---|
| **Parameter** | **Allowable Limits *** |
| Iron | 10 |
| Nickel | 0.5 |
| Vanadium | 0.5 |
| pH | 5.5 - 9.0 pH units |
| TSS | 30 |
| TPH | 15 |
| † over background for metals and suspended solids<br>* units are in mg/L unless otherwise indicated | |

40. If effluent is determined to be acutely lethal for three consecutive ALTs, HYDRO shall implement a toxicity identification evaluation (TIE) to identify the toxin, and from this develop measures to prevent or reduce the toxin. The report, written as a result of these identification activities, shall be submitted to the Director for review, ***within 60 days*** of the third consecutive failed acutely lethal test result. After review of the report, the Director may

place additional requirements upon the proponent for treatment of effluent prior to discharge.

## Water Chemistry Analysis

41. HYDRO shall perform a Water Chemistry Analysis Program every three (3) months, starting ***June, 2006***, as per Table 4.

**Table 4 - Water Chemistry Analysis Program**

| Location | Parameters |
|---|---|
| 1. Cooling water intake at Indian Pond (grab sample) | **General Parameters** - must include the following:<br>pH TSS |
| 2. Cooling water outfall stream, prior to release into Conception Bay (grab sample)<br>3. Continuous Basin outfall stream, prior to release into Indian Pond (grab sample) | **Metals Scan** - must include the following:<br>aluminum boron iron nickel tin<br>antimony cadmium lead selenium titanium<br>arsenic chromium manganese silver uranium<br>barium cobalt molybdenum strontium vanadium<br>beryllium copper mercury thallium zinc<br>bismuth |

All results shall be submitted to the Director as per the ***Reporting*** section. The Water Chemistry Analysis Program may be discontinued after two (2) years of quarterly analysis are submitted to the Department, and the results are satisfactory.

## Environmental Effects Monitoring

42. HYDRO shall conduct an Environmental Effects Monitoring study to monitor the impacts of the discharge of the cooling water, the continuous basin's water and the waste water treatment plant's treated water on Conception Bay. An outline of the study shall be submitted to the Director for review and approval by ***June 31, 2008.*** The results of the completed study shall be submitted to the Director for review by ***June 31, 2009***.

## Hazardous Waste Landfill Operations

43. The hazardous waste landfill shall be operated in the manner described in the ***Landfill Operations Manual***. Any proposed revisions to the ***Landfill Operations Manual*** shall be submitted to the Director for review and approval prior to such revisions being made.

44. Only waste identified in Section 5.1 (Waste Characterization) of the ***Landfill Operations Manual*** shall be placed in the hazardous waste landfill. These include:

- bottom and fly ash;
- periodic basin sludge;
- continuous basin sludge;
- waste water treatment plant filtercake;
- raw-water treatment ion exchange resins; and
- clean-up from chemical spills.

In addition, Bunker C ash from institutions, such as hospitals, may be disposed of in space efficient containers in the hazardous waste landfill. HYDRO shall notify the Department prior to deposition of ash from sources other than from the thermal generating station.

45. Liquid waste shall not be disposed of in the landfill.

46. The Department reserves the right to require some form of pretreatment of waste before placement in the site.

47. HYDRO shall periodically review opportunities for reuse and/or recycling of the waste types disposed of in the site.

48. HYDRO shall maintain a landfill security fence with a sign affixed to the fence identifying the site as a hazardous waste containment system. This sign shall identify the owner of the landfill and a contact phone number. The sign and its placement shall be acceptable to the Department.

49. No activities shall occur within the fenced area of the landfill, except for the deposition of waste; extraction of leachate; or other maintenance requirements of the landfill cap or the landfill.

50. An annual inspection program shall be performed as per the ***Landfill Operations Manual***.

51. Leachate accumulated in each of the hazardous waste landfill collection systems, including the leachate holding pond, shall be removed as required so that leachate does not overflow the collection system.

52. Any flow or drainage from the leachate holding pond shall be directed to the periodic basin. Leachate shall not be discharged directly to the environment without prior authorization by the Department.

## Hazardous Waste Landfill Monitoring

53. HYDRO shall perform an Environmental Monitoring Program as per section 7.12 (Environmental Monitoring) of the ***Landfill Operations Manual***. This shall include monitoring of:
- groundwater quality and levels;
- surface water quality;

- leachate leakage;
- liner integrity; and
- physical movement of the landfill.

54. HYDRO shall perform a Groundwater Monitoring Program as per Table 5. This monitoring program shall be performed throughout the operational life of the landfill, and during the 25 years following closure.

**Table 5: Groundwater Monitoring Program**

| Location | Parameters | | | | Frequency |
|---|---|---|---|---|---|
| **Monitoring Wells:**<br><br>BH-1 BH-2 BH-3<br>BH-4 BH-5 BH-6<br>BH-7 | Aluminum<br>Vanadium | Iron | Magnesium | Nickel | **every four months** |
| **Monitoring Wells:**<br><br>BH-1 BH-2 BH-3<br>BH-4 BH-5 BH-6<br>BH-7 | Antimony<br>Bismuth<br>Chromium<br>Mercury<br>Selenium<br>PCB's<br>pH | Arsenic<br>Cadmium<br>Copper<br>Molybdenum<br>Silver<br>VOC's | Barium<br>Calcium<br>Lead<br>Phosphorus<br>Sodium<br>TSS | Beryllium<br>Cobalt<br>Manganese<br>Potassium<br>Zinc<br>TDS | **annual** |

55. HYDRO shall perform a Surface Water Monitoring Program as per Table 6. This monitoring program shall be performed throughout the operational life of the landfill, and during the 25 years following closure.

**Table 6: Surface Water Monitoring Program**

| Location | Parameters | | | Frequency |
|---|---|---|---|---|
| 3 locations from the upstream drainage ditch (i.e background)<br><br>3 locations from the downstream drainage ditch | Cadmium<br>Lead<br>Vanadium<br>TSS | Chromium (total)<br>Mercury<br>pH<br>VOCs | Iron<br>Nickel<br>TDS | **monthly (provided water is flowing in the ditches during the month)** |

56. The total monthly flow:

- from the primary and secondary leachate collection systems;
- from the leachate holding pond to the periodic basin; and
- through the primary cell and holding pond leak detection manholes;

shall be accurately measured and recorded. This record and all results from the Groundwater and Surface Water Monitoring Programs shall be submitted to the Director as per the ***Reporting*** section.

57. HYDRO shall submit an annual Landfill Operating Report to the Director by ***February 28*** of the subsequent year. This report shall include:

- results of the Environmental Monitoring Program; and
- summaries of all materials placed in the landfill site including: waste characterization reports, volumes of waste deposited in the landfill, source(s) of the waste, identification of contaminants of concern, and copies of the hazardous waste manifest forms.

## Ambient Air

58. HYDRO shall operate an ambient air monitoring program as per the conditions in this Approval and its amendments. Approval shall be obtained from the Director prior to purchase or installation of any monitoring equipment.

59. Locations and parameters to be monitored are outlined in Table 7.

**Table 7 - Ambient Air Monitoring Program**

| Site | Parameter |
|---|---|
| Butter Pot | $PM_{2.5}$, $SO_2$, $NO_x$, $NO_2$ |
| Green Acres | TSP, $PM_{2.5}$, $SO_2$, $NO_x$, $NO_2$, Nickel*, Vanadium* |
| Indian Pond | TSP, $PM_{2.5}$, $SO_2$, $NO_x$, $NO_2$ |
| Lawrence Pond | TSP, $PM_{2.5}$, $SO_2$, $NO_x$, $NO_2$ |
| Lower Indian Pond Drive | TSP, $PM_{2.5}$, $SO_2$, $NO_x$, $NO_2$, Nickel*, Vanadium* |
| Main Gate | TSP, $PM_{2.5}$, Nickel*, Vanadium* |
| * Nickel and Vanadium analyses shall be performed on all TSP samples for these sites | |

60. Ambient air monitoring shall be done in accordance with the ***Ambient Air Monitoring Policy Directive (PPD 98-01)***, its successors, or alternate methods approved by the Director.

61. Frequency of sampling of TSP shall coincide with the National Air Pollution Survey (NAPS) schedule. Sampling of all other parameters shall be continuous. All results from the Ambient Air Monitoring Program shall be submitted to the Director as per the ***Reporting*** section.

62. TSP shall be determined by the United States EPA Test Method: "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)" Section 2.2, 1983, and by a method indicated in United States EPA 40 CFR 50, Appendix J, "Reference Method for the Determination of Particulate Matter as $PM_{10}$ in the Atmosphere (High Volume $PM_{10}$ Sampler Method)," or alternate method approved by the Director.

63. $SO_2$ shall be determined by the United States EPA Test Method: "Reference Method for the Determination of Sulfur Dioxide in the Atmosphere (Fluorescence)" Section 2.9, 1982, or alternate method approved by the Director.

64. NOx (as $NO_2$) shall be determined by the United States EPA Test Method: "Reference Method for the Determination of Nitrogen Dioxide in the Atmosphere (Chemiluminescence)" Section 2.3, February 2002, or alternate method approved by the Director.

65. Automated $PM_{2.5}$ monitors shall determine $PM_{2.5}$ by a method indicated in United States EPA 40 CFR 50, Appendix L, "Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere," or alternate method approved by the Director. Installation and operation of these monitors shall comply with United States EPA Quality Assurance Guidance Document 2.12 "Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class 1 Equivalent Methods." Automated monitors for $PM_{2.5}$ and $PM_{10}$ shall be approved as United States EPA designated equivalent methods for $PM_{10}$ in ambient air, and must be acceptable to the Director.

66. HYDRO shall operate and maintain a meteorological station at Green Acres site in accordance with the guidelines specified in the United States EPA document "Meteorological Monitoring Guidance for Regulatory Modeling Applications," EPA- 454/R-99-005, February 2000, or its successors. Parameters to be measured and recorded shall include: wind speed, wind direction, ambient air temperature, dew point, solar radiation, barometric pressure, cloud height and precipitation. All results from this station shall be submitted in an acceptable digital format annually or as otherwise specified by the Department, as per the ***Reporting*** section.

67. The data loggers for $SO_2$, NOx and $PM_{2.5}$ shall be Campbell Scientific array-based data loggers, or alternates approved by the Director, with battery backup of data. The Green Acres data logger shall have enough differential input channels to allow input of meteorological station data. All dataloggers shall be remotely programmable and compatible with current Departmental standards for access to data for monthly Quality Assurance, and for scheduled access for data download.

68. All analysers shall be operated and maintained in accordance with United States EPA "List of Designated Reference and Equivalent Methods" issued October 9, 2003, or its successors.

## Sulfur in Fuel

69. HYDRO shall not burn any fuel with sulfur content greater than 0.7% by weight.

## Continuous Opacity Monitoring System

70. Opacity of emissions from each boiler shall be continuously measured and recorded using a Continuous Opacity Monitoring System (COMS) that meets all the requirements of *Performance Specification 1 (PS-1) - Specifications and Test Procedures for Opacity Continuous Emission Monitoring Systems in Stationary Sources,* of the United States *Code of Federal Regulations - 40 CFR Part 60, Appendix B*. Minimum QA/QC requirements are specified to assess the quality of COMS performance. Daily zero and span checks, quarterly performance audits, and annual zero alignment checks are required to assure the proper functioning of the COMS and the accuracy of the COMS data. These shall be recorded in a written log and a copy made available on request.

71. The United States EPA Federal Register *Test Method 203 - Determination of the Opacity of Emissions from Stationary Sources by Continuous Opacity Monitoring Systems* shall be used to determine compliance with the ***Air Pollution Control Regulations, 2004***, or its successor.

72. Monthly opacity data reports, in digital format, shall be submitted in the form of six minute arithmetic averages of instantaneous readings, as per the ***Reporting*** section. Each six minute average data point shall be identified by date, time and average percent opacity.

## Continuous Emissions Monitoring System

73. By ***August 2, 2006***, HYDRO shall submit to the Director a plan for the automated CEMS to meet the requirements of Environment Canada's 1993 Report *Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation (EPS 1/PG/7)*, or its successor. The plan shall identify the proposed actions to be taken by HYDRO and shall include the time-lines for completion. Upon review of the plan and in consultation with HYDRO, the Director will establish a reasonable deadline for completion of activities necessary for the CEMS to meet the requirements of *EPS 1/PG/7*, or its successor. Notwithstanding this, application of specific requirements of *EPS 1/PG/7* to the CEMS may be modified subject to approval by the Director.

74. Monthly CEM data reports containing one-hour arithmetic averages of emission rates of $SO_2$, $NO_X$, $CO_2$, CO and $O_2$ (all expressed in ppmv) shall be submitted in digital format, as per the ***Reporting*** section.

## Administrative Boundary

75. Under this approval the Administrative Boundary shall be established as the land boundary of the thermal generating station property, as indicated on the land boundary map forwarded to the Department on ***December 7, 2005***.

## Stack Emissions Testing and Dispersion Modelling

76. Stack emissions testing shall be done in accordance with the ***Source Emission Testing Guidance Document (GD-PPD-016)***. Dispersion Modeling shall be done in accordance with the ***Plume Dispersion Modeling Guidance Document (GD-PPD-019)***. Determination of frequency of stack emissions testing and dispersion modeling shall be done in accordance with the ***Compliance Determination Guidance Document (GD-PPD-009.02)***.

77. HYDRO shall be required to complete stack emissions testing once every four years if it has been shown, via a registered dispersion model, that the thermal generating station is in compliance with this Approval. If it has been shown, via a registered dispersion model, that the thermal generating station is not in compliance with section 3(2) and Schedule A of the ***Air Pollution Control Regulations, 2004***, then the thermal generating station shall complete stack emissions testing every two years. Plume dispersion modeling results shall be submitted to the Department within ***120 days*** of completion of the stack emissions testing.

## Annual Air Emissions Reporting

78. HYDRO shall submit an annual Air Emission Report to the Director by ***February 28*** of the subsequent year. This report shall include:

- total fuel consumption;
- the weighted average sulphur content of the fuel;
- the fuel specific gravity;
- the estimated, or, if available, the monitored annual emissions of the following flue gas constituents: $SO_2$, $NO_X$, $CO_2$, CO and particulate; and
- the actual calculations including factors, formulae and/or assumptions used.

## Analysis and QA/QC

79. Unless otherwise stated herein, all solids and liquids analysis performed pursuant to this Approval shall be done by either a contracted commercial laboratory or an in-house laboratory. Contracted commercial laboratories shall have a recognized form of accreditation. In-house laboratories have the option of either obtaining accreditation or submitting to an annual inspection by a representative of the Department, for which HYDRO

shall be billed for each laboratory inspection in accordance with Schedule 1 of the ***Accredited and Certified Laboratory Policy (GD: PP2001-01)***. Recommendations of the Director stemming from the annual inspections shall be addressed within 6 months, otherwise further analytical results shall not be accepted by the Director.

80. If HYDRO wish to perform in-house laboratory testing and submit to an annual inspection by the Department then a recognized form of proficiency testing recognition shall be obtained for compliance parameters for which this recognition exists. The compliance parameters are listed in the ***Effluent and Monitoring*** section. If using a commercial laboratory, HYDRO shall contact that commercial laboratory to determine and to implement the sampling and transportation QA/QC requirements for those activities.

81. The exact location of each sampling point shall remain consistent over the life of the monitoring programs, unless otherwise approved by the Director.

82. HYDRO shall bear all expenses incurred in carrying out the environmental monitoring and analysis required under the conditions of this Approval.

## Monitoring Alteration

83. The Director has the authority to alter monitoring programs or require additional testing at any time when:

- pollutants might be released to the surrounding environment without being detected;
- an adverse environmental effect may occur; or
- it is no longer necessary to maintain the current frequency of sampling and/or the monitoring of parameters at a particular sampling station.

84. HYDRO may, at any time, request that monitoring program or requirements of this Approval be altered by:

- requesting the change in writing to the Director; and;
- providing sufficient justification, as determined by the Director.

The requirements of this Approval shall remain in effect until altered, in writing, by the Director.

## Reporting

85. Monthly reports containing the environmental compliance monitoring and sampling information required in this Approval, as summarized in Table 8, shall be received by the Director, in hardcopy and digital formats (e-mail, diskette or CD), within 30 calendar days of the reporting month. A hardcopy of all related laboratory reports shall be submitted to the Director with the monthly report. The digital copy, if e-mailed, shall be sent to the following address: <<statenv@gov.nl.ca>>

**Table 8 - Monthly Reporting Requirements**

| Section | Condition(s) |
|---|---|
| Bunker C | 22 |
| Effluent Monitoring and Discharge | 38 |
| Water Chemistry Analysis * | 41 |
| Hazardous Waste Landfill Monitoring | 54, 55 |
| Ambient Air | 59, 66 |
| Continuous Opacity Monitoring System | 72 |
| Continuous Emissions Monitoring System | 74 |
| * to be included for the following reporting months; January, April, July and October | |

86. All incidents of:

- *Contingency Plan* implementation; or
- non-conformance of any condition within this approval; or
- spillage or leakage of a regulated substance; or
- whenever discharge criteria is, or is suspected to be, exceeded; or
- verbal/written complaints of an environmental nature from the public received by HYDRO related to the thermal generating station, whether or not they are received anonymously;

shall be immediately reported, within one working day, to a person, message manager or facsimile machine as follows:

- contact this Department (St. John's office) by phoning (709) 729-2556, or faxing (709) 729-6969.

A written report including a detailed description of the incident, summary of contributing factors, and an action plan to prevent future incidents of a similar nature, shall be submitted to the Director. The action plan shall include a description of actions already taken and future actions to be implemented, and shall be submitted within two weeks from the date of the initial incident. The address for written report submission is:

Director, Pollution Prevention Division
Department of Environment and Conservation
P.O. Box 8700
St, John's, NL
A1B 4J6
Telephone: (709) 729-2556
Facsimile: (709) 729-6969

87. Any spillage or leakage of gasoline or associated product shall be reported immediately through the Canadian Coast Guard at 1-(709)-772-2083.

## Liaison Committee

88. The Department recognizes the benefits, and at times the necessity, of accurate, unbiased communication between the public and industrial operations which have an impact on the properties and residents in the area. Regular meetings of the Liaison Committee, comprised of representatives of HYDRO, the Department and independent members of the general population of Holyrood and Conception Bay South, shall be maintained so as to provide a clear conduit of communication between concerned citizens and HYDRO.

## Expiration

89. This Certificate of Approval expires ***February 2, 2011.***

90. Should HYDRO wish to continue to operate the thermal generating station beyond this expiry date, a written request shall be submitted, by ***August 2, 2010***, to the Director for the renewal of this Approval.

# APPENDIX B

## Industrial Site Decommissioning and Restoration Plan Guidelines

As part of the Department of Environment and Conservation's ongoing commitment to minimize the residual impact of industrial activities on the environment of the province, the Department requires that HYDRO develop a decommissioning and restoration plan for the thermal generating station at Holyrood and its associated property. The guidelines listed below are intended to provide some general guidance as to the expectations of the Department with regard to the development of a decommissioning and restoration plan, and to identify areas that are of particular concern or interest. The points presented are for consideration, and are open to interpretation and discussion.

Decommissioning and restoration plans are intended to present the scope of activities that a company shall undertake at the time of final closure and/or decommissioning of the industrial properties. Where it is useful and practical to do so the company is encouraged to begin undertaking some of the activities outlined in the plan prior to final closure and decommissioning. The objectives of the restoration work to be undertaken can be summarized as follows:

- to ensure that abandoned industrial facilities do not endanger public health or safety;
- to prevent progressive degradation and to enhance the natural recovery of areas affected by industrial activities;
- to ensure that industrial facilities and associated wastes are abandoned in a manner that will minimize the requirement for long term maintenance and monitoring;
- to mitigate, and if possible prevent, the continued loadings of contaminants and wastes to the environment. The primary objective shall be to prevent the release of contaminants into the environment. Where prevention is not practical due to technical or economic limitations then activities intended to mitigate the consequence of such a release of contaminants shall become the objective of restoration work;
- to return affected areas to a state compatible with the original undisturbed condition, giving due consideration to practical factors including economics, aesthetics, future productivity and future use; and
- to plan new facilities so as to facilitate eventual rehabilitation.

The decommissioning and restoration plan should:

- identify areas of known historical or current contamination;
- identify past or existing operational procedures and waste management practices that have, or may have, resulted in site contamination;
- highlight the issues or components to be addressed;
- identify operational procedures and waste management practices that can prevent or reduce site contamination;
- consider future land use, regulatory concerns and public concerns;
- enable estimation of the resources and time frame required to decommission the facility and restore the site to a condition acceptable to the Department;
- enable financial planning to ensure the necessary funds for decommissioning and restoration are set aside during the operational life of the facility, and;
- include arrangements for appropriate project management to ensure successful completion of the decommissioning and restoration program.

cc: Mr. Kevin Power, P.Eng. - Head
Environmental Protection Section
Environment Canada
6 Bruce Street
Donovans Industrial Park
Mount Pearl, NL
A1N 4T3

Mr. Kevin King - Operations Manager
Government Service Centre (GSC)
5 Mews Place
P. 0. Box 8700
St. John's, NL
AlB 4J6

Mr. Terry French, MHA
5th Floor - East Block
Government Members Office
Confederation Building
St. John's, NL

Ms. Cynthia Layden-Barron - Chief Administrative Officer / Town Clerk
Town of Holyrood
P.O. Box 100
Holyrood, NL

Mr. Keith Arns - Town Manager / Clerk
Town of Conception Bay South
P.O. Box 280
Conception Bay South, NL
A1W 1M8

**APPENDIX B**
**LETTER FROM GOVERNMENT OF NEWFOUNDLAND AND LABRADOR**

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment & Conservation

Pollution Prevention Division
(Environment)

26 March 2010

File #716.008

Mr. Mike Manuel
Asset Manager - Thermal, Common Systems
P.O. Box 29
Holyrood, NL
A0A 2R0

Dear Mr. Manuel,

**RE: Request for Deviation from Certificate of Approval No. AA06-025458C**

This is in regards to your letter to Derrick Maddocks dated March 23, 2010, whereby it was requested that Hydro be permitted to operate the Met One BAM 1020 instruments using National Air Pollution Surveillance (NAPS) procedures and settings, rather than the United States EPA "List of Designated Reference and Equivalent Methods." Such a request constitutes a deviation From Condition #68 of Hydro's Certificate of Approval No. AA06-025458C, as issued by this Department.

Please be advised that upon expiry of this Approval, the Department shall require Hydro to upgrade or replace their BAM 1020s to BAM 1020-FEM and operate these in accordance with the current United States E.P.A. "List of Designated Reference and Equivalent Methods". In the interim, the Department hereby grants the requested deviation as noted above.

If you have any questions or comments regarding this matter, you may contact me by phone at (709) 729-6771, or by e-mail at dpittman@gov.nl.ca.

Sincerely,

Dexter Pittman

**Dexter Pittman**
Manager of Industrial Compliance (Acting)

P.O. Box 8700, St. John's, NL, Canada A1B 4J6 Tel: 709-729-6697 Fax: 709-729-6969

**APPENDIX C**

**AIR POLLUTION CONTROL REGULATIONS**

**This is an official version.**

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**Important Information**
(Includes details about the availability of printed and electronic versions of the Statutes.)

**Table of Regulations** **Main Site** **How current is this regulation?**

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**NEWFOUNDLAND AND LABRADOR**
**REGULATION 39/04**

*Air Pollution Control Regulations, 2004* pdf
under the
*Environmental Protection Act*
(O.C . 2004-232)

Amended by:

94/10

*Air Pollution Control Regulations, 2004*
under the
*Environmental Protection Act*
(O.C. 2004-232)

*(Filed May 20, 2004 )*

Under the authority of sections 22 and 111 of the *Environmental Protection Act* , the Lieutenant-Governor in Council makes the following regulations.

Dated at St. John's , May 19, 2004 .

Robert C. Thompson
Clerk of the Executive Council

**REGULATIONS**

*Analysis*

1. Short title
2. Definitions
3. Ambient air quality standards
4. Incineration prohibition
5. Good engineering stack height
6. Best available control technology
7. Sulphur dioxide emission cap
8. Administrative penalty
9. Opacity of visual emissions
10. Performance testing facilities
11. Potential for air pollution in accident, emergency or urgent circumstances
12. Burning prohibited
13. Burning of waste products
14. Burning of grades 4, 5, or 6 fuel prohibited
15. Residential wood combustion prohibition
16. Motorized vehicles
17. Non-portable aboveground storage tanks
18. Gasoline distribution networks
19. NOx standards for fossil fuel fired boilers and heaters
20. Monitoring and recording devices
21. Manner of measurements, recording and analyses

22. Repeal

Schedule A

Schedule B

Schedule C

Schedule D

Schedule E

Schedule F

Schedule G

**Short title**

**1.** These regulations may be cited as the *Air Pollution Control Regulations , 2004* .

39/04 s1

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**Definitions**

2. In these regulations

(a) "Act" means the *Environmental Protection Act* ;

(b) "air contaminant" means any discharge, release, or other propagation into the air and includes, but is not limited to, dust, fumes, mist, smoke, particulate matter, vapours, gases, odours, odorous substances, acids, soot, grime or any combination of them;

(c) "air pollution" means the presence in air of an air contaminant or combination of air contaminants in excess of the maximum permissible standard, concentration or level as prescribed by these regulations or an approval issued under the Act;

(d) "air quality management plan" means a plan developed by the minister to manage the level of air contaminants in an area, and may include a company specific air quality management plan approved by the minister;

(e) "ambient air" means the portion of the atmosphere which is external to buildings, structures or underground spaces;

(f) "Canadian standard" means the Canadian Standards Association Code CAN/CSA - B415.1, *Performance Testing of Solid Fuel Burning Heating Appliances* ;

(g) "combustion process equipment" means a furnace, boiler, dryer, apparatus, stack and all appurtenances used in the combustion process but does not include mobile internal combustion engines when used to provide propulsion;

(h) "department " means the department presided over by the minister;

(i) "emission " means an air contaminant emitted into the environment;

(j) "emission source" means any combustion process equipment, installation, machinery,

appliance, equipment or tanks from which air contaminants may be released or discharged;

(k) "facility " means any stationary property, real or personal, taken as a whole, which has an emission source;

(l) "fuel " means any fuel used directly or indirectly for heating, steam generation or electricity production, or for combustion in industrial processes;

(m) "good engineering stack height (Hg)" means the greater of:

(i) 45 metres,

(ii) the height as calculated using the formula Hg = H + 1.5L where H is the height of any nearby structure and L is the lesser of the height H or projected width of any nearby structure, as measured from the ground level elevation at the base of the stack, or

(iii) the height demonstrated by a fluid model or approved field study which ensures that stack emissions do not result in air pollution resulting from atmospheric downwash or wakes created by the facility, nearby emission sources or terrain features;

(n) "heavy duty motorized vehicle" means a vehicle with a gross vehicle weight rating greater than 2721.6 kilograms for the 1987 model year and older, and greater than 3855.5 kilograms for the 1988 model year and newer;

(o) "light duty motorized vehicle" means a vehicle with a gross vehicle weight rating less than or equal to 2721.6 kilograms for the 1987 model year and older, and less than or equal to 3855.5 kilograms for the 1988 model year and newer;

(p) "minister " means the minister appointed under the *Executive Council Act* to administer the Act;

(q) "modified " means any addition or alteration to emission sources which may cause:

(i) an increase in the release of an air contaminant, or

(ii) an emission of an air contaminant that was not previously emitted;

(r) "nearby " means within the lesser of 800 metres or 5 times the lesser of the height or the projected width of a structure;

(s) "opacity " means the degree to which an emission reduces the passage of light or obscures the view of an object in the background, expressed numerically from 0%, transparent, to 100%, opaque;

(t) "particulate matter" means a material, except water in an uncombined form, that is or has been airborne and exists as a liquid or a solid at reference conditions;

(u) "point of impingement" includes a part or combination of those things referred to in subparagraphs (i) to (iii) upon which an air contaminant may impinge

(i) land and water,

(ii) plant and animal life, including human life, and

(iii) a building, structure, machine or other device or thing made by humans;

(v) "projected width" means the greatest distance between two points on a structure;

(w) "reference conditions" means a dry gas temperature of 25 ° Celsius and a gas pressure of 101.325 kilopascals;

(x) "stack " means a chimney, flue, conduit or duct arranged to conduct an air contaminant into the environment;

(y) "sulphur content" means the amount of sulphur by weight as determined by standard methods;

(z) "used oil" means a used lubricating oil or waste oil;

(aa ) "US EPA standard" means the *Standards of Performance for New Residential Wood Heaters* , Title 40, Part 60, Subpart AAA of the Code of Federal Regulations, published by the United States Environmental Protection Agency; and

(bb ) "visible emission" means an emission which can be detected by the naked eye.

39/04 s2

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**Ambient air quality standards**

**3.** (1) The ambient air quality standards prescribed in Schedule A shall be used to maintain air quality in the province.

(2) The concentration of air contaminants due to all sources shall not exceed the standards prescribed in Schedule A.

(3) For the purpose of ensuring that the standards prescribed in Schedule A are met, the minister may:

(a) specify a condition in an approval issued under Part XI of the Act; or

(b) develop an air quality management plan specifying the provisions to reduce the level of air contaminants emitted by each facility identified in the plan, and the owner or operator of each facility shall

(i) provide the minister with any information he or she may require regarding the development of an air quality management plan, including a company specific air quality management plan, and

(ii) comply with the provisions of the plan within the time specified by the minister.

39/04 s3

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**Incineration prohibition**

**4.** An owner or operator shall not operate or permit the operation of new incineration or pyrometric equipment having an in-stack concentration in excess of the standards prescribed in Schedule B.

39/04 s4

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**Good engineering stack height**

**5.** (1) Commencing July 1, 2004, all new stack installations with annual releases in excess of 20 tonnes of particulate matter or sulphur dioxide shall meet good engineering stack height.

(2) Subject to subsection (1), for the purposes of enforcing these regulations, the calculated concentration of an air contaminant at a point of impingement shall be from good engineering stack height.

39/04 s5

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**Best available control technology**

**6.** (1) An owner or operator who installs a new or modified emission source shall employ the best available control technology.

(2) Notwithstanding subsection (1), an owner or operator may install a new or modified emission source which does not comply with that subsection with the written approval of the minister.

(3) Notwithstanding subsection (1), best available control technology shall not apply to:

(a) routine maintenance, repair and parts replacement;

(b) normal increases in production rates unless otherwise prohibited;

(c) increases in hours of operation unless otherwise prohibited; or

(d) use of an alternative cleaner fuel or raw material.

(4) Best available control technology shall be acceptable to the department and shall, in that particular circumstance, be:

(a) the most effective emission control device or technique;

(b) the most stringent emission control device or technique;

(c) proven reliable in comparable processes; and

(d) economically feasible as determined by the minister in light of industry standards after consultation with the particular owner or operator.

39/04 s6

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**Sulphur** dioxide emission cap

**7.** (1) There is established a provincial sulphur dioxide emission cap which shall be 60,000 tonnes per calendar year.

(2) Subsection (1) shall come into effect on January 1, 2005 .

(3) The owner or operator of a facility which releases in excess of 20 tonnes of sulphur dioxide per year in the aggregate, shall submit to the department an annual report on fuel usage, fuel

sulphur content, fuel specific gravity and sulphur dioxide emissions, no later than February 28 of each subsequent year.

(4) The first report under subsection (3) shall be submitted to the department no later than February 28, 2006 .

39/04 s7

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**Administrative penalty**

**8.** (1) For the purpose of environmental protection, the minister may, under the authority of section 106 of the Act, impose an administrative penalty prescribed in Schedule C against an owner or operator who emits an air contaminant.

(2) Administrative penalties imposed under this section shall be payable within 60 days of notification of the penalty by the department.

39/04 s8

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**Opacity of visual emissions**

**9.** (1) The owner or operator of an emission source with a nameplate capacity greater than 100 GJ / hr, or with an annual particulate matter release greater than 100 tonnes shall determine the opacity of a visible emission on a continuous basis.

(2) Notwithstanding subsection (1), the minister may require the owner or operator of other emission sources to determine the opacity of a visible emission on a continuous basis.

(3) The opacity of a visible emission shall be determined by means of a continuous opacity monitoring system and shall be calculated as a 6 minute arithmetic average of instantaneous observations.

(4) An owner or operator shall not cause or permit to be caused a visible emission having an opacity greater than 20%.

(5) Notwithstanding subsection (4), a visible emission may have an opacity exceeding 20% but not exceeding 25% for one 6 minute period in any one hour period.

(6) Notwithstanding subsections (4) and (5), every time a fire is started in combustion process equipment, a visible emission may have an opacity exceeding 20%, but not exceeding 40% for one 6 minute period in the first 30 minute period after that new fire is started.

(7) Commencing July 31, 2005 , opacity readings under subsections (1) and (2) shall be reported monthly to the department by the last day of each subsequent month.

(8) Where an emission source employs best available control technology, an owner or operator shall be exempt from the provisions of subsections (1) to (7).

(9) Where an emission source employs best available control technology, the owner or operator of that emission source shall

(a) provide the minister with a contingency plan detailing the remedial action for compliance with the provisions of this section when best available control technology is non-operational;

(b) the contingency plan may be approved by the minister, including any additions or deletions that the minister may require; and

(c) the owner or operator shall comply with the approved contingency plan.

(10) Where a continuous opacity monitoring system does not achieve a monthly valid data capture rate of 95 %, an administrative penalty of $5 shall be payable with respect to each non-measured opacity reading below the valid data capture rate.

(11) Commencing January 1, 2006 an administrative penalty, as prescribed in Schedule D, shall be payable with respect to opacity which exceeds the standards in this section.

(12) Administrative penalties imposed under this section shall be payable within 60 days of notification of the penalty by the department.

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**Performance testing facilities**

**10.** (1) The owner or operator of good engineering stack height installations shall provide the following performance testing facilities:

(a) sampling ports adequate for testing devices and applicable methods;

(b) safe sampling platforms;

(c) safe access to sampling platforms; and

(d) utilities for sampling and testing devices.

(2) The minister may require the owner or operator of an emission source other than the emission source referred to in subsection (1) to provide performance testing facilities.

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**Potential for air pollution in accident, emergency or urgent circumstances**

**11.** (1) Where a facility has the potential for air pollution due to an unanticipated failure to operate in the normal manner due to an accident, emergency or urgent situation, a change in operating conditions, or a shut-down of a pollution control device, the owner or operator of the facility shall:

(a) take immediate remedial action to reduce any emissions and provide the department with the particulars of that failure, change or shutdown; and

(b) provide the department in writing with the particulars of the remedial action taken under paragraph (a) and the reasons for that action as soon as it is practicable.

(2) Where the minister considers an emission by a facility to be a nuisance, the owner or operator of that facility shall:

(a) investigate to determine the nature of the emission; and

(b) provide the minister with a remediation plan.

(3) The minister may approve the plan required by paragraph 2(b) subject to any changes he or she may require and an owner or operator shall comply with an approved plan.

(4) Notwithstanding sections 3 and 9, the minister may, under the authority of section 105 of the Act, enter into a compliance agreement with the owner or operator in writing regarding a situation contemplated by subsection (1), authorizing the continuance of the operation for the period of time as the minister considers reasonable.

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**Burning prohibited**

**12.** (1) A person shall not burn or permit the burning of any material listed in Schedule E in a fire.

(2) Notwithstanding subsection (1), a person may burn or permit the burning of materials listed in Schedule E in a fire with the written approval of the minister.

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**Burning of waste products**

**13.** Notwithstanding section 12, a person shall not burn or permit the burning of used oil, waste products or other materials in combustion process equipment except

(a) where the design and the intended use of the equipment according to the manufacturer's manual permits the burning of the specific material;

(b) where the equipment has the combustion and emission control devices that may be required by the minister;

(c) where the rate does not exceed the equipment design; and

(d) where the written approval of the minister has been obtained.

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**Burning of grades 4, 5, or 6** fuel prohibited

**14.** Commencing January 1, 2005 , a person shall not burn, or permit the burning of any fuel, grade numbers 4, 5 or 6

(a) where emission sources employ best available control technology ,

(i) containing a sulphur content in excess of 3.0%; and

(ii) containing a sulphur content in excess of 2.0% on an annual basis, as calculated by the formula:

where :

$SO_2$ = sulphur dioxide emissions in tonnes

$V_t$ = volume of fuel in litres; and

(b) where emission sources do not employ best available control technology,

(i) containing a sulphur content in excess of 2.2%, and

(ii) containing a sulphur content in excess of 2.0% on an annual basis, as calculated by the formula:

where :

n = number of shipments during a calendar year

$S_i$ = sulphur content of each shipment, expressed as %

$V_i$ = volume of each shipment.

39/04 s14

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**Residential wood combustion prohibition**

**15.** (1) Commencing July 1, 2008 a person shall not manufacture, sell or permit the selling of a residential woodstove, fireplace insert or factory built fireplace which may emit particulate matter into the environment in excess of:

(a) the emission requirements of the Canadian standard; or

(b) the emission requirements of the US EPA standard.

(2) The emission requirements under subsection (1) shall be determined by the test methods and procedures contained in that standard.

(3) Each unit manufactured, permitted or sold under subsection (1) shall have a readily visible, permanently affixed manufacturer's label which:

(a) conforms to the labelling requirements in that standard; and

(b) indicates that the unit conforms to the particulate matter emission requirements of that standard.

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**Motorized vehicles**

**16.** (1) A person shall not operate or permit the operation of a light duty motorized vehicle having an emission in excess of the standards prescribed in Schedule F.

(2) The opacity of a visible emission from a diesel fuelled heavy duty motorized vehicle, as determined by procedure SAE J1667 entitled *Snap Acceleration Smoke Test Procedure for Heavy-Duty Diesel Vehicles* , shall not exceed:

(a) 40% for 1991 model vehicles and newer; and

(b) 55% for 1990 model vehicles and older.

(3) For the purpose of ensuring that the standards prescribed in Schedule F and subsection (2) are met, according to paragraph 111(1)(p) of the Act, the minister may, by regulation, establish an emission inspection and maintenance program as a means of reducing exhaust and evaporative air contaminants.

39/04 s16

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**Non-portable aboveground storage tanks**

**17.** (1) Commencing January 1, 2012, all new and existing non-portable aboveground storage tanks with a volume greater than 4 $m^3$ and storing a volatile organic liquid with a vapour pressure greater than 10 kPa at 21.1 ° Celsius shall comply with the provisions of the CCME guidelines *"Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks, PN 1180"* including any amendments to those guidelines.

(2) The owner or operator of emission sources shall provide the department in writing with a plan outlining its schedule for compliance with subsection (1) no later than January 1, 2006 .

(3) All records under Part 7 of the guidelines shall be reported annually to the department by February 28 of each subsequent year.

(4) The first report under subsection (3) is due no later than February 28, 2012 .

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**Gasoline distribution networks**

**18.** (1) Commencing January 1, 2012, all new and existing persons engaged in the gasoline distribution network shall comply with the vapour balancing, recovery and control requirements of the CCME guidelines *"Environmental Code of Practice for Vapour Recovery in Gasoline Distribution Networks, PN 1057"* including any amendments to those guidelines.

(2) Subsection (1) shall not apply to:

(a) terminals with an annual gasoline throughput less than 25 million litres;

(b) bulk plants with an annual gasoline throughput less than 4.5 million litres;

(c) service stations with an annual gasoline throughput less than one million litres;

(d) cargo tank trucks with a capacity less than 21,000 litres; or

(e) ships and barges.

(3) The owner or operator of emission sources shall provide the department in writing with

a compliance schedule no later than January 1, 2006 .

(4) All records under Parts 3, 4, 5, & 6 of the guidelines, shall be reported annually to the department by February 28 of each subsequent year.

(5) The first report under subsection (4) is due no later than February 28, 2012.

39/04 s18; 94/10 s1

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**NOx standards for fossil fuel fired boilers and heaters**

**19.** All new and modified fossil fuel fired boilers and heaters, with a nameplate capacity equal to or greater than 10.5 GJ/hr, shall not exceed the emission standards prescribed in Schedule G.

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**Monitoring and recording devices**

**20.** The minister may require the installation of

(a) devices which are necessary to record the throughput and operation of process, combustion or control equipment; and

(b) monitoring and recording devices which are necessary to measure and record concentrations of air contaminants, opacity and flow at their origin and at point of impingement.

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**Manner of measurements, recording and analyses**

**21.** All measurements, recordings and analyses conducted under these regulations shall be

(a) performed at locations and by devices and methods acceptable to the department; and

(b ) made readily accessible to the department in a time and manner acceptable to the department.

39/04 s21

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**Repeal**

**22. The *Air Pollution Control Regulations, 2003* , Newfoundland and Labrador Regulation 56/03, are repealed.**

39/04 s22

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**Schedule A**

Table I: Ambient Air Quality Standards at Reference Conditions

| ITEM | COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 |
|---|---|---|---|---|---|---|
| | Name of Contaminant | Contaminant Code or CAS No. | Unit of Concentration | Concentration | Period of Time | Additional Notes |
| 1 | Ammonia | 7664-41-7 | Micrograms per cubic metre of air | 100 | 24 hour | |
| 2 | Arsenic | 7440-38-2 | Total micrograms of arsenic in free and combined form per cubic metre of air | 0.3 | 24 hour | |
| 3 | Asbestos | 1332-21-4 | Micrograms per cubic metre of air | 1.5 | 24 hour | |
| 4 | Cadmium | 7440-43-9 | Total micrograms of cadmium in free and combined form per cubic metre of air | 2 | 24 hour | |
| 5 | Carbon monoxide | 630-08-0 | Micrograms per cubic metre of air | 35000<br>15000 | 1 hour<br>8 hour | |
| 6 | Copper | 7440-50-8 | Total micrograms of copper in free and combined form per cubic metre of air | 50 | 24 hour | |
| 7 | Dustfall | | Grams of dustfall per square metre | 7.0<br>4.6 | 30 day<br>1 year | (1)<br>(1) |
| 8 | Hydrogen sulphide | 7783-06-4 | Micrograms per cubic metre of air | 15<br>5 | 1 hour<br>24 hour | |
| 9 | Lead | 7439-92-1 | Total micrograms of lead in free and combined form per cubic metre of air | 2.0<br>0.7 | 24 hour<br>30 day | <br>(1) |
| 10 | Mercaptans | | Total micrograms of mercaptans per cubic metre expressed as methyl mercaptan | 20 | 1 hour | |
| 11 | Mercury | 7439-97-6 | Total micrograms of mercury in free and combined form per cubic metre of air | 2 | 24 hour | |
| 12 | Nickel | 7440-02-0 | Total micrograms of nickel in free and combined form per cubic metre of air | 2 | 24 hour | |
| 13 | Nitrogen dioxide | 10102-44-0 | Total micrograms of nitrogen oxides per cubic metre of air, expressed as $NO_2$ | 400<br>200<br>100 | 1 hour<br>24 hour<br>1 year | <br><br>(1) |
| 14 | Ozone | 10028-15-6 | Micrograms per cubic metre of | 160 | 1 hour | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | air | 87 | 8 hour | |
| 15 | Particulate matter (less than 2.5 microns) | | Micrograms per cubic metre of air | 25 | 24 hour | |
| 16 | Particulate matter (less than 10 microns) | | Micrograms per cubic metre of air | 50 | 24 hour | |
| 17 | Particulate matter (total) | | Micrograms per cubic metre of air | 120<br>60 | 24 hour<br>1 year | (2) |
| 18 | Polychlorinated biphenyls (PCBs) | 1336-36-3 | Micrograms per cubic metre of air | 0.15<br>0.035 | 24 hour<br>1 year | (1) |
| 19 | Reduced sulphur compounds | | Micrograms of reduced sulphur compounds per cubic metre of air expressed as hydrogen sulphide | 30 | 1 hour | |
| 20 | Sulphur dioxide | 7446-09-5 | Micrograms per cubic metre of air | 900<br>600<br>300<br>60 | 1 hour<br>3 hour<br>24 hour<br>1 year | (1) |
| 21 | Vanadium | 7440-62-2 | Total micrograms of vanadium in free and combined form per cubic metre of air | 2 | 24 hour | |
| 22 | Zinc | 7440-66-6 | Micrograms per cubic metre of air | 120 | 24 hour | |

(1) Arithmetic mean

(2) Geometric mean

Table II: Ambient Air Quality Standards for Dioxins and Furans at Reference Conditions

| ITEM | COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 |
|---|---|---|---|---|---|---|
| | Name of Contaminant | Contaminant Code or CAS No. | Unit of Concentration | Concentration | Period of Time | Additional Notes |
| 1 | Polychlorinated dibenzo -p-dioxins (PCDDs ) & poly-chlorinated dibenzofurans (PCDFs ) (TEQ) | | Picograms (TEQ) per cubic metre of air | 5 | 24 hour | (3) |

(3) The Total Equivalent Quotient (TEQ) concentration of PCDDs and PCDFs is determined by multiplying the concentration of each congener listed in Column 1 of Table III by the corresponding toxicity factor set out in Column 2 of that item and by adding the products of them.

TABLE III : Dioxins and Furans Toxicity Factors

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| ITEM | COLUMN 1 | COLUMN 2 |
|---|---|---|
| | Congener | Toxicity Factor |
| 1 | 2,3,7,8-T4CDD | 1 |
| 2 | 1,2,3,7,8-P5CDD | 0.5 |
| | | |

| | | |
|---|---|---|
| 3 | 1,2,3,4,7,8-H6CDD | 0.1 |
| 4 | 1,2,3,6,7,8-H6CDD | 0.1 |
| 5 | 1,2,3,7,8,9-H6CDD | 0.1 |
| 6 | 1,2,3,4,6,7,8-H7CDD | 0.01 |
| 7 | OCDD | 0.001 |
| 8 | 2,3,7,8-T4CDF | 0.1 |
| 9 | 1,2,3,7,8-P5CDF | 0.05 |
| 10 | 2,3,4,7,8-P5CDF | 0.5 |
| 11 | 1,2,3,4,7,8-H6CDF | 0.1 |
| 12 | 1,2,3,6,7,8-H6CDF | 0.1 |
| 13 | 1,2,3,7,8,9-H6CDF | 0.1 |
| 14 | 2,3,4,6,7,8-H6CDF | 0.1 |
| 15 | 1,2,3,4,6,7,8-H7CDF | 0.01 |
| 16 | 1,2,3,4,7,8,9-H7CDF | 0.01 |
| 17 | OCDF | 0.001 |

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**Schedule B**

In-Stack Standards for Incineration and Pyrolysis

| Facility Type | Mercury (1) | Polychlorinated dibenzo-p-dioxins (PCDDs) & poly-chlorinated dibenzofurans (PCDFs) (1) |
|---|---|---|
| Municipal Waste Incineration | 20 ?g/$m^3$ | 80 pg I-TEQ/$m^3$ |
| Medical Waste Incineration | 20 ?g/$m^3$ | 80 pg I-TEQ/$m^3$ |
| Hazardous Waste Incineration | 50 ?g/$m^3$ | 80 pg I-TEQ/$m^3$ |
| Sewage Sludge Incineration | 70 ?g/$m^3$ | 80 pg I-TEQ/$m^3$ |

(1) at reference conditions, dry gas basis, corrected to 11% oxygen by volume

Where:

(a) (ug/m3) = micrograms per cubic metre; and

(b) (pg I-TEQ/m3) = International Total Equivalent Quotient picograms per cubic metre

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**Schedule C**

Administrative Penalties for
Emissions Exceedences

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| Pollutant | Maximum Allowable Annual Emission Without Administrative Penalty | Administrative Penalty |
|---|---|---|
| Ammonia | 10 tonnes | $2 / tonne |
| Nickel | 10 tonnes | $2 / tonne |
| Vanadium | 10 tonnes | $2 / tonne |
| Carbon Monoxide | 20 tonnes | $2 / tonne |
| Nitrogen Oxides | 20 tonnes | $2 / tonne |
| Particulate Matter (total) | 20 tonnes | $2 / tonne |
| Sulphur Dioxide | 20 tonnes | $2 / tonne |
| Arsenic | 50 kilograms | $2 / kilogram |
| Lead | 50 kilograms | $2 / kilogram |
| Cadmium | 5 kilograms | $2 / kilogram |
| Mercury | 5 kilograms | $2 / kilogram |
| Polychlorinated dibenzo -p-dioxins (PCDDs ) & poly-chlorinated dibenzofurans (PCDFs )(TEQ) | 1000 milligrams TEQ | $2 / milligram TEQ |

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**Schedule D**

Administrative Penalties for Opacity Exceedences

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| New Fire | Best Available Control Technology | Time Frame | Opacity | 1st Exceedence | Subsequent Exceedences |
|---|---|---|---|---|---|
| NO | NO | 1 Hour | > 20% , # 25% | $ 0 | $ 5 |
| NO | NO | 1 Hour | > 25% , # 30% | $ 5 | $ 10 |
| NO | NO | 1 Hour | > 30% | $ 10 | $ 15 |
| YES | NO | 30 Minutes | > 20% , # 40% | $ 0 | $ 5 |
| YES | NO | 30 Minutes | > 40% , # 50% | $ 5 | $ 10 |
| YES | NO | 30 Minutes | > 50% | $ 10 | $ 15 |

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**Schedule E**

Materials Prohibited from Burning in a Fire

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| | |
|---|---|
| (a) tires | (k) manure |
| (b) plastics | (l) rubber |
| (c) treated lumber | (m) tar paper |
| (d) asphalt and asphalt products | (n) railway ties |
| (e) drywall | (o) paint and paint products |
| (f) demolition waste | (p) fuel and lubricant containers |
| (g) hazardous waste | (q) used oil |
| (h) biomedical waste | (r) animal cadavers |
| (i) domestic waste | (s) hazardous substances |
| (j) trash, garbage, or other waste from commercial, industrial or municipal operations | (t) materials disposed of as part of the removal or decontamination of equipment, buildings or other structures |

39/04 Sch E

**Schedule F**

Standards for Vehicle Emissions for Light Duty Motorized Vehicles at Idle Speed

| Category Definitions | | | Passenger Vehicles | | Light Duty Trucks (1) | |
|---|---|---|---|---|---|---|
| Item | Model Year | Engine Size (litres) | Hydro-carbons (ppm) | Carbon Monoxide (%) | Hydro-carbons (ppm) | Carbon Monoxide (%) |
| 1 | pre 1973 | <= 2.5 | 1500 | 7.5 | 1500 | 7.5 |
| 2 | pre 1973 | > 2.5 | 1500 | 5.5 | 1500 | 5.5 |
| 3 | 1973 - 1974 | <= 2.5 | 750 | 6.0 | 750 | 6.0 |
| 4 | 1973 - 1974 | > 2.5 | 650 | 5.0 | 650 | 5.0 |
| 5 | 1975 - 1981 | <= 2.5 | 450 | 5.0 | 450 | 5.0 |
| 6 | 1975 - 1981 | > 2.5 | 400 | 4.5 | 400 | 4.5 |
| 7 | 1982 - 1987 | <= 1.8 | 350 | 4.0 | 350 | 4.0 |
| 8 | 1982 - 1987 | > 1.8, <= 2.6 | 350 | 4.0 | 350 | 4.0 |
| 9 | 1982 - 1987 | > 2.6, <= 4.0 | 300 | 3.5 | 300 | 3.5 |
| 10 | 1982 - 1987 | > 4.0 | 300 | 3.5 | 300 | 3.5 |
| 11 | 1988 - 1995 | <= 1.8 | 130 | 1.1 | 260 | 2.2 |
| 12 | 1988 - 1995 | > 1.8, <= 2.6 | 120 | 1.0 | 240 | 2.0 |
| 13 | 1988 - 1995 | > 2.6, <= 4.0 | 105 | 0.8 | 210 | 1.6 |
| 14 | 1988 - 1995 | > 4.0 | 90 | 0.6 | 180 | 1.2 |
| 15 | 1996 + | <= 1.8 | 90 | 0.6 | 180 | 1.2 |
| 16 | 1996 + | > 1.8, <= 2.6 | 80 | 0.5 | 160 | 1.0 |
| 17 | 1996 + | > 2.6, <= 4.0 | 80 | 0.4 | 160 | 0.8 |
| 18 | 1996 + | > 4.0 | 80 | 0.4 | 160 | 0.8 |

(1) LDT = Light Duty Truck (pre 1988, <= 2721.6 kg gross vehicle weight rating (GVWR))

LDT = Light Duty Truck (1988 +, <= 3855.5 kg gross vehicle weight rating (GVWR))

Where:

(a) (ppm ) = parts per million by volume

(b) (%) = percentage by volume

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**Schedule G**

Emission Standards for $NO_x$

| Capacity | $NO_x$ Emission Limit (g / GJ) | | |
|---|---|---|---|
| (GJ / hr) | Gaseous Fuel | Distillate Oil | Residual Oil |
| 10.5 - 105 | 26 | 40 | 90 |
| > 105 | 40 | 50 | 90 |

Where:

(a) (GJ/hr)= gigajoules/hour

(b) (g/GJ)- grams per gigajoule .

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**APPENDIX D**

**GUIDELINES FOR AMBIENT AIR MONITORING**

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment & Conservation

Pollution Prevention Division
(Environment)

# Guidance Document

**Title:** Guidelines for Ambient Air Monitoring

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Robert Redmond, Environmental Scientist

**Issue Date:** December 16, 2010

**Approved By:**
Derrick Maddocks, Director

**Ambient Air Monitoring**
**GD-PPD-065**

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## SUBJECT

The ambient air monitoring methods and protocols approved by the department to monitor the air quality in the Province.

## OBJECTIVE

To define the terms and conditions that a person is to follow when conducting ambient air quality monitoring in Newfoundland and Labrador. In so doing, the department ensures that the quality of all results obtained and submitted to the department are complete and consistent across all ambient air monitoring stations and employ the latest technological advances.

## BACKGROUND

Large industrial facilities in the province, particularly industries utilizing combustion process equipment, are required to establish an ambient air monitoring program for the purpose of ensuring that emissions of air contaminants are less than the maximum permissible standards as set forth in the *Air Pollution Control Regulations* 39/04. The data collected from the ambient air monitoring program is used for human health risk assessments; public awareness; ensuring environmental compliance in accordance with guidance document GD-PPD-009.3 is achieved and maintained; and validation of compliance modelling. With the advent of new and improved monitoring technologies, and the ever increasing monitoring requirements being placed on a person, it has become imperative for the Department to establish a standard protocol to ensure that all air quality is monitored in a way that is consistent, complete and comparable across all industrial sectors.

Section 21 of the *Air Pollution Control Regulations* dictates that all measurements, recordings and analysis conducted under the regulations are performed by devices and methods acceptable to the Department. This guidance document defines the acceptable ambient air quality monitoring devices and methods to be used in Newfoundland and Labrador. It replaces the rescinded policy document PPD: 98-01.

## DEFINITIONS

In this guidance document:

(a) "air contaminant" means any discharge, release, or other propagation into the air and includes, but is not limited to, dust, fumes, mist, smoke, particulate matter, vapours, gases, odours, odorous substances, acids, soot, grime or any combination of them;

(b) "ambient air" means the portion of the atmosphere which is external to buildings, structures or underground spaces;

(c) "combustion process equipment" means a furnace, boiler, dryer, apparatus, stack and all appurtenances used in the combustion process but not including mobile internal combustion engines used to provide propulsion;

(d) "department" means the Department of Environment and Conservation and it's successors;

(e) "DR DAS" means the data acquisition software provided by the DR DAS software company and includes, but is not limited to Envista, Envista ARM, Communication Center and Envidas FW;

(f) "$NO_x$" means oxides of nitrogen and includes the summation of nitric oxide (NO) and nitrogen dioxide ($NO_2$);

(g) "person" includes an association of persons, a municipality and the government of the province;

(h) "$PM_{2.5}$" means particulate matter less than or equal to 2.5 microns;

(i) "$SO_2$" means sulphur dioxide;

(j) "TPM" means total particulate matter;

(k) "US EPA" means the United States Environmental Protection Agency.

# 1. CRITERIA POLLUTANTS

## 1.1 Oxides of Nitrogen ($NO_x$)

In a combustion process, $NO_x$ is produced through 3 mechanisms, namely thermal $NO_x$, fuel $NO_x$ and prompt $NO_x$. Thermal $NO_x$ is the primary source of $NO_x$ and is formed as a high temperature dissociation and subsequent reaction of nitrogen ($N_2$) and oxygen ($O_2$). It is produced in the hottest part of the flame and its formation increases exponentially with the flame temperature. The control of thermal $NO_x$ is generally achieved through reducing the flame temperature, reducing the residence time, or by operating under fuel rich conditions. Fuel $NO_x$ is formed by the reaction of nitrogen compounds chemically bound in liquid or solid fuels with oxygen in the combustion air. In the combustion of such fuels, fuel $NO_x$ can account for up to 50% of the total $NO_x$ emissions. Prompt $NO_x$ is formed from the rapid reaction of atmospheric nitrogen with hydrocarbon radicals, and typically under partially fuel-rich conditions. It can be reduced through combustion staging or by operating under highly oxidizing combustion conditions.

$NO_2$ is the primary component of concern in $NO_x$ emissions. For example, only about 5% of the $NO_x$ emitted from diesel fuel combustion is emitted as $NO_2$. The remainder is emitted as NO, which is subsequently converted to $NO_2$ in reactions with various oxidants and oxygen as the plume is transported downwind from the source. The rate of $NO_2$ formation varies with time of day, season, temperature, wind speed, solar radiation and the availability of oxidants to help drive the chemical reactions.

$NO_2$ is a reddish brown gas with a pungent odour, which upon reaction with other atmospheric compounds, becomes a major contributor to smog, acid rain, inhalable particulates and reduced visibility. At significant levels and exposure, inhalation may result in irritation and burning to the skin and eyes, nose and throat. Prolonged exposure may result in permanent lung damage.

## 1.2 Particulate Matter (PM)

Particulate matter is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets, and can be large and dark enough to be seen with the naked eye or so small that they can only be detected with an electron microscope. Many manmade and natural sources emit particulate matter directly while others emit gaseous pollutants that react in the atmosphere to form particulate matter.

The size of the particulate has important health considerations. Particulate matter less than 10 microns in diameter ($PM_{10}$) poses a health concern because it can be inhaled into and accumulate in the respiratory system. Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is believed to pose the greatest health risks as it can lodge deeply into the lungs; a $PM_{2.5}$ particle is approximately 1/30$^{th}$ the average width of a human hair. Typically these smaller particles are suspended in the air for long periods of time. Total Particulate Matter (TPM) is the term applied to any particle suspended in the atmosphere, but depending on the monitoring method, is typically limited to particulate matter less than 44 microns. Particulate larger than 10 microns is typically associated with a nuisance issue rather than a health issue.

### 1.3 Sulphur Dioxide ($SO_2$)

Levels of sulphur dioxide ($SO_2$) in ambient air are directly related to the concentration of sulphur in fuel and the quantity of fuel being combusted. Upon combustion, approximately 98% of the sulphur in the fuel will oxidize to form $SO_2$, with the remaining 2% producing sulphur trioxide ($SO_3$). The emitted $SO_2$ can also further oxidize to $SO_3$ and react with water to produce acid rain in the form of sulphuric acid ($H_2SO_4$).

Short-term exposures to $SO_2$ have shown adverse respiratory effects including bronchoconstriction and increased asthma symptoms.

## 2. AMBIENT AIR QUALITY STANDARDS

The maximum concentrations of criteria air pollutants considered to be protective of the environment are defined in the *Air Pollution Control Regulations, 2004*. For the pollutants routinely monitored in the province the ambient air quality standards are detailed in Table 2.1.

**TABLE 2.1 - AMBIENT AIR QUALITY STANDARDS IN NEWFOUNDLAND AND LABRADOR**

| Pollutant | Averaging Period | Concentration ($\mu g/m^3$) |
|---|---|---|
| Nitrogen Dioxide ($NO_2$) | 1-hour | 400 |
| | 24-hour | 200 |
| | 1-year | 100 |
| Particulate Matter ≤ 2.5 microns ($PM_{2.5}$) | 24-hour | 25 |
| Particulate Matter Total (TPM) | 24-hour | 120 |
| | 1-year | 60 |
| Sulphur Dioxide ($SO_2$) | 1-hour | 900 |
| | 3-hour | 600 |
| | 24-hour | 300 |
| | 1-year | 60 |

## 3. APPROVED MONITORS AND METHODS

The monitoring methods for criteria pollutants acceptable to the Department are those which are continuous and are designated as US EPA "reference methods" or "equivalent methods" in accordance with Title 40, Part 53 of the United States Environmental Protection Agency Code of Federal Regulations (40 CFR Part 53). These methods are listed in the US EPA Air Monitoring Methods-Criteria Pollutants "*List of Designated Reference and Equivalence Methods*", as per the link www.epa.gov/ttn/amtic/criteria.html and as updated from time to time, the current version dated August 24, 2010. Methods not on the list are not acceptable unless a preferred method is specified by the Department.

Though the Department will consider all Reference and Equivalence Methods, a list of the preferred methods is available upon request. The monitors are required to be operated and maintained in accordance with, and meet the same absolute performance specifications for the appropriate analytical working range, as delineated in their respective reference or equivalence methods.

EPA method specifications, performance criteria and standard operating procedures established for an EPA approved reference or equivalent method are

subject to modification by the Department in order to enhance monitor performance and improve data quality. The Department reserves the right to modify methods to meet more stringent guidelines and/or performance specifications.

If a variance from an EPA Reference or Equivalent Method is adopted by the Department, written notification will be provided to those affected to adopt accordingly.

All industrial facilities that are required to establish an ambient air monitoring program shall follow the provisions of the *US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program (EPA-454/B-08-003 December 2008)* as updated from time to time.

The monitoring of non-criteria pollutants shall only be conducted after consultation with the Department.

**All persons not currently using an approved method are required to upgrade the monitor accordingly by December 31, 2012, unless otherwise approved by the Department.**

## 4. DATA ACQUISITION

The Department requires real-time, on-demand access to raw and diagnostics data. This data may not be modified, manipulated or massaged in any way. The access has to be direct to the data logging device, not to a system which transmits these data files elsewhere and can be altered by built-in algorithms or data functions.

Communication between the central data polling computer and the ambient air monitoring stations for data retrieval shall be accomplished via an IP address or a standard telephone line and fax modem. For data stability purposes, a connection via an IP address is preferred.

The DR DAS software package has been chosen by the Department as our data acquisition-data recovery system. The requirement for a person is to utilize the DR DAS or another software package that is approved by the director and is compatible with the features and functions of DR DAS as specified below. Data acquisition and data recovery must be in the format that is compatible with the DR DAS system. If a person requests utilizing an alternate software package then the person must demonstrate to the Department that the alternate software is compatible with DR DAS before approval is granted by the Director. It is not the Department's responsibility to make other data acquisition software packages

compatible with DR DAS as that is the responsibility of the alternate software package supplier.

Should a person acquire a software package other than DR DAS, then the software package must:

- have a Windows based operating system;
- provide communication between the data recovery Envista software and the data logger at each industrial ambient air monitoring station. Remote connectivity to each station must be available at any time to the Department for data collection and verification purposes;
- provide digital communication between the station datalogger and the monitoring instruments via RS232 or USB connection. Dataloggers that collect data via an analog connection such as Campbell Scientific are not acceptable;
- provide diagnostics data of all monitors utilized in an industrial ambient air monitoring network. As ambient air monitoring raw data is polled from these stations, the diagnostics data, which is the numerical values of the instrument parameter settings during the generation of the raw data, must be simultaneously supplied. This "instrument parameter settings" monitoring indicates when instrument parameter values are degenerating and is therefore a vital data validation/invalidation tool;
- utilize instrument alarms (a.k.a. digital monitors) which can be polled by the Envista software. This allows user-configurable alarm levels to automatically invalidate data that is above or below user-specified values and provide immediate notification when alarm levels are exceeded. This provides automatic data invalidation, minimizes instrument down-time and improves technician response time;
- utilize automated daily zero and span checks for instrument performance verification. The software package must allow these calibration sequences to be configured in order to automatically open and close zero and span valves within the monitors and perform these daily checks. These user-configured sequences should be performed without loss of hourly ambient data. The software package must allow the calibration reports generated from these daily performance verifications to be polled by the Envista software;
- allow communication and data collection from all continuous monitors and be approved as per Section 3 of this guidance document. In particular, the Met One BAM 1020 FEM Configuration monitor, specifically designed for $PM_{2.5}$ monitoring, has unique software functions that have been designed by DR DAS. An alternate software package must have the ability to communicate with this monitor and gather telemetry;
- utilize an electronic logbook.

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Information on this software can be found at www.dr-das.com or contact:

DR DAS
194 Clouse Lane
Granville, Ohio 43023
Phone# 740-587-2995

The Department reserves the right to require new DR DAS or equivalent software features as standard operating procedures.

**All persons not currently using DR DAS are required to upgrade to this software (or equivalent) by December 31, 2012, unless otherwise approved by the Department.**

## 5. PERFORMANCE AUDITS

Performance audits of industrial ambient air monitoring stations will be conducted on a schedule determined by the Department. The Department may provide notification prior to conducting an audit. A report of the audit findings and required and/or recommended corrective actions will be provided to the respective person subsequent to the audit.

## 6. ZERO AND SPAN VERIFICATION CHECKS

Zero and span verification checks allow for quantitative assessment of analyzer performance between calibrations. If performed manually, zero and span checks must be performed at least weekly. If the checks are achieved through the DR DAS automatic calibration sequences then the automated zero and span check sequences are to be performed daily, as this would allow for the most clear and precise assessment of trends in analyzer performance. These sequences must occur at a time which prevents loss of hourly data. This is normally achieved by programming the duration of calibration sequences not to exceed twenty minutes and starting them at 10 minutes to the hour and ending 10 minutes after the hour.

As a rule, analyzers should not be re-zeroed following routine zero checks performed during station visits. A correction for a drifting zero may be applied later, at the data validation stage, based on assessment of zero check data for an extended time period. If automated daily zero checks are performed, correction of near-real-time data based on the zero check value for that date is permitted, though cumulative zero data should still be reviewed manually to assess trends and ensure that zeros remain within typical ranges.

Method specifications for EPA approved $SO_2$ and $NO_x$ methods typically indicate an acceptable zero drift to be ≤0.5 ppb over 24 hours and ≤1 ppb over 7 days. Re-zeroing of monitors is recommended when a zero check indicates a shift of ≥2 ppb in the analyzer zero response. Any such action must be recorded in a permanent logbook, or on log sheets designed for recording analyzer diagnostics and zero/span data. The analyzer should not be re-zeroed a second time if there is a continuation of zero drift in the same direction. Rather, the cause of the zero shift should be investigated. A zero check value obtained using a dilution calibrator and zero air system should confirm whether or not the zero values obtained during routine checks are true analyzer zero responses, or perhaps the result of a depleted scrubber. Also, the operator should disconnect the analyzer's zero air scrubber from the zero port and reconnect it to the sample port to assess if there is any difference in zero response. A lower zero reading on the sample port may indicate an internal leak in zero port plumbing.

Results obtained for routine span checks are assessed against the control values established on the date of the most recent calibration. Clear trends or sudden shifts in analyzer response to the verification standard should be addressed before deviation of span check values from control values exceeds 10%.

## 7. CONTROL CHARTS

Results obtained from routine span checks are assessed against the span control values established on the date of the most recent calibration. This is accomplished by control charting the daily span checks and comparing with the span control value of the most recent calibration. Clear trends or sudden shifts in analyzer response to the verification standard should be addressed before deviation of span check values from control values exceeds 10%. If the true deviation exceeds 15%, recalibration is mandatory, and collected ambient data from the monitor may be invalidated back to a date where it can be established, with reasonable confidence, that the deviation had not exceeded 15%.

In addition to all the aforementioned calibration criteria, all monitors must be calibrated on a quarterly basis and recorded in the station logbook.

The Department will provide the control chart templates.

## 8. CERTIFICATION

On a yearly basis, all gas dilution calibrators' mass flow controllers and all primary flow devices deployed in the calibration of particulate and criteria air pollutant monitors, respectively, must be certified.

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All certifications must be traceable to the Canadian National Research Council-Institute of National Measurements Standards (NRC-INMS) or the United States National Institute of Standards and Technology (NIST).

A copy of all calibration certifications must be submitted to the Department.

## 9. UNINTERRUPTIBLE POWER SUPPLIES (UPS)

All ambient monitors, their external pumps and station data loggers / computers (excluding the computer monitor) shall be connected to an uninterruptible power supply (UPS) in order to provide short term battery backup for brief power outages. This will ensure continuous monitoring and prevent the need for resetting these instruments during these brief power outages.

## 10. SHELTER TEMPERATURE

All ambient air monitoring stations are to be continually maintained and monitored such that the hourly shelter temperature is between 20 C and 30 C. Hourly shelter temperatures outside this range may result in data invalidation.

**Project Title:** Install Fall Protection Equipment

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Properties

**Definition:** Pooled

**Classification:** Mandatory

**Project Description:**

This project is required to design, supply and install fall protection systems at several Hydro facilities. It includes installing new fall protection systems on a surge tank in Bay d'Espoir and on Oxen Pond and Massey Drive control building roofs, anchor plates for transformers where needed and ladder cable systems for ladders where needed. Table 1 provides the budget estimate for this project.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Labour** | 60.0 | 0.0 | 0.0 | 60.0 |
| **Consultant** | 27.6 | 0.0 | 0.0 | 27.6 |
| **Contract Work** | 55.0 | 0.0 | 0.0 | 55.0 |
| **Other Direct Costs** | 7.0 | 0.0 | 0.0 | 7.0 |
| **Interest and Escalation** | 12.5 | 0.0 | 0.0 | 12.5 |
| **Contingency** | 17.0 | 0.0 | 0.0 | 17.0 |
| **TOTAL** | **199.2** | **0.0** | **0.0** | **199.2** |

**Operating Experience:**

Hydro initiated a program in 2005 to install fall protection systems on transformers, fuel tanks and roofs at its facilities. There are a large number of sites (see Appendix A), some of which are in remote locations. This is the eighth year of the program which started in 2005.

Below is a discussion of the three basic types of fall protection systems installed by Hydro. The photographs illustrate how each system is used.

Roof Fall Protection System

Generally, a fall protection system is not a complex system. Figure 1 shows a worker tethered to a permanently installed system comprised of a cable secured to the roof by a series of fall arrest anchors. The tether is called a lifeline and the anchors are travel restraints. As the worker moves around on the roof, he is able to attach the lifeline between the anchors as needed. If a fall occurs, the anchors will arrest the fall, thereby, saving the worker's life.

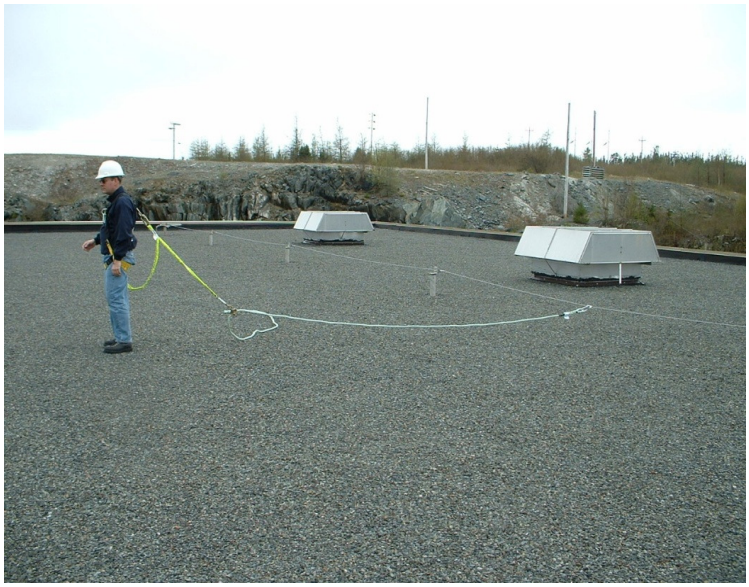

**Figure 1 Roof Fall Protection System**

Ladder Fall Protection System

In this system, a safety cable is installed vertically on the side of the ladder as shown in Figures 2 and 3 to the right. The workers secure themselves to the ladder fall protection system by attaching their harness to a D ring, as shown in the picture that is attached to a cable grab which in turn rides on the cable.



**Figures 2 and 3. Ladder Fall Protection System**

The cable grab allows the worker to move with ease up the ladder but in the event of a sudden downward movement, as in a fall, the cable grab is designed to abruptly grab the cable, securing the worker and preventing a fall. This action is similar to the behavior of a seat belt in a car.



Transformer Fall Protection System

Figure 4 illustrates a transformer fall protection system used by the three workers standing on top of a transformer. This system is a portable system. The fall protection system is mounted on a fixed anchor plate welded to the top of the transformer. When work is completed, the fall protection system can be taken to another site.

The three basic types of fall protection systems shown above are for illustrative purposes. Systems may vary when they are installed because of, for example, extra cable arrangements or the need for railings. The systems will be inspected annually. The anticipated useful life of a fall protection system is 20 years.

Fall protection systems are required to perform work safely at elevations above 3.05 meters. Hydro must conform to Section 60 of the Occupational Health and Safety Regulations. The section, "Safety Belts and Lifelines" states in part "the employer shall ensure that fall protection systems are used by all workers employed over pits, shafts or moving machinery and by all workers working at elevations greater than 3.05 meters above ground or floor level". The complete Section 60 regulations are presented in Table 3. Without proper fall protection systems in place, a worker can refuse to perform his/her assigned duties.



**Figure 4: Transformer Fall Protection System**

**Project Justification:**

This project is justified on the requirement to provide a safe work environment and to comply with Section 60 of the Occupational Health and Safety Regulations. The fall protection system program started in 2005 did not provide for installations at all of Hydro's sites where fall protection systems were needed. New sites were identified throughout the program. Table 2 presents annual capital budget and actual expenditures for years 2006 to 2011.

**Table 2: Capital Expenditure History**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Comments |
|---|---|---|---|
| 2011F | 198.4 | | Ladders, transformers, tanks and roofs |
| 2010 | 198.4 | 215.5 | Ladders, transformers and roofs |
| 2009 | 321.7 | 302.7 | Tanks, transformers and roofs |
| 2008 | 404.5 | 193.9[1] | Tanks, transformers and roofs |
| 2007 | 250.9 | 245.2 | Tanks, transformers and roofs |
| 2006 | 268.1 | 241.9 | Tanks, transformers and roofs |

[1]Operations personnel were scheduled to install roof lines on three powerhouse buildings but could not meet the obligation due to other commitments. It was too late to tender when this was discovered. Also some design changes to the fall protection system for the penthouse roof at the Holyrood Thermal Generating Station provided significant savings.

This work must continue until all facilities are properly equipped with fall protection systems in compliance with Section 60 "Safety Belts and Lifelines" of the Occupational Health and Safety Regulations.

**Future Plans:**

A list of future fall protection installations are included in Appendix A and will be proposed in future capital budget applications. See five-year capital plan (Capital Plan 2012 Tab, Appendix A).

60. (1) Where it is impracticable to provide adequate work platforms or staging, the employer shall ensure that fall protection systems are used by all workers employed over pits, shafts or moving machinery and by all workers working at elevations greater than 3.05 metres above grade or floor level in accordance with current standards of the C.S.A. Code with respect to fall protection and fall protection systems.
(2) Rep. by 23/99 s2 (2)
(3) When a worker is employed under circumstances where he or she might become entrapped by material, or be overcome by another cause, he or she shall wear a safety-belt or safety-harness attached to a lifeline or other device attended by another worker who shall be stationed, equipped and capable of immediately effecting a rescue.
(4) Safety-belts, safety straps, lifelines and all interconnecting parts shall be of sufficient strength to support before breaking a weight of 1134 kilograms.
(5) All metal fittings used on or with safety-belts shall conform to the metallurgical strength requirement standards as specified by the Canadian Standards Association.
(6) Permanent anchors to which safety straps or rope terminals may be attached shall conform to the requirements of subsections (4) and (5).
(7) Rope used for lifelines or safety straps shall comply with the requirements of current C.S.A. Code standards with respect to fall protection.
(8) When axes or other tools are used which are likely to sever, abrade or burn the lifeline or safety strap, a wire rope or wire cored fibre rope shall be used.
(9) Where workers are engaged in work in proximity to energized electrical circuits where conductive safety straps cannot be used, 2 non-conductive safety straps shall be worn to provide the additional protection required.
(10) The safety strap shall be so attached to the safety-belt that it cannot pass through the belt fittings should either end become loose from its anchorage.
(11) Thimbles shall be installed to protect ropes from chafing at points of connection to eyes, rings and snaps.
(12) Safety-belts, safety straps and lifelines shall be arranged to limit the free fall of a worker to 1.22 metres.
(13) No more than one worker shall be attached to a lifeline.
(14) Belts, straps, harnesses, lifelines and other similar devices shall be kept free from substances and conditions which could contribute to deterioration and this equipment shall be carefully inspected before use.
(15) If an impairment of function is detected the defective part shall be removed from service.

**Figure 5. Safety belts and lifelines from Occupational Health and Safety**

**APPENDIX A**

**FALL PROTECTION PROJECT LIST**

**Fall Protection Project List**

| Location | Description | Comment |
|---|---|---|
| **Bay d'Espoir** | | |
| General | Intake #1 Access ladder modifications/safety slide | Planned for 2011 |
| Powerhouse 1 | Requirements for proper height and standard for cab | Planned for 2011 |
| | Sump pit #1 ladder | Planned for 2011 |
| | Sump Pit #2 ladder | Planned for 2011 |
| | Sump Pit #3 ladder | Planned for 2011 |
| Up Country | Ladder system at Burnt Dam spillway | Planned for 2011 |
| | Suitable access to aircraft warning lights at Salmon Spillway | Planned for 2011 |
| | Burnt Catwalk for gate control building | Planned for 2011 |
| | Burnt gate control Building access ladder | Planned for 2011 |
| **Central** | | |
| Bottom Brook TS | Fall protection system on control building roof | Planned for 2011 |
| St Brendan's | Fall protection system on diesel plant roof | Planned for 2011 |
| Various transformers | Anchor plates for transformers | Planned for 2011 |
| **Labrador** | | |
| Black Tickle | Travel restraint system on top of two tanks | Planned for 2011 |
| | 5/16" cable replacing 3/8" cable from ladder station to roof post | Planned for 2011 |
| Hopedale | Upgrade Fall protection system on diesel plant roof | Planned for 2011 |
| Makkovik | Upgrade Fall protection system on diesel plant roof | Planned for 2011 |
| | Travel restraint system on top of three tanks | Planned for 2011 |
| Rigolet | Travel restraint system on top of tank | Planned for 2011 |
| **Northern** | | |
| L'Anse au Loup | Fixed ladder on diesel plant | Planned for 2011 |
| Various Transformers | Anchor plates for transformers | Planned for 2011 |
| **Holyrood** | Four ladder cable systems for pumphouse | Planned for 2011 |

| Location | Description | Comment |
|---|---|---|
| **Bay d'Espoir** | | |
| General | Platform Access to hoist control panel at Salmon Spillway | Planned for 2012 |
| | Intake #2 Access ladder modifications/safety slide | Planned for 2012 |
| | Intake #3 Access ladder modifications/safety slide | Planned for 2012 |
| | Intake #4 Access ladder modifications/safety slide | Planned for 2012 |
| | Surge Tanks 1,2 and 3 balcony gates | Planned for 2012 |
| | Surge Tank #3 Fall Arrest System | Planned for 2012 |
| **Central** | | |
| Bishop's Falls | Fall protection system on diesel building roof | Planned for 2012 |
| Francois | Fall protection system on diesel plant roof | Planned for 2012 |
| Holyrood TS | Fall protection system on control building roof | Planned for 2012 |
| Massey Drive TS | Fall protection system on control building roof | Planned for 2012 |
| Oxen Pond TS | Fall protection system on control building roof | Planned for 2012 |
| Stony Brook TS | Fall protection system on control building roof | Planned for 2012 |
| Sunnyside TS | Fall protection system on control building roof | Planned for 2012 |
| Various Transformers | Anchor plates for transformers | Planned for 2012 |
| Western Avalon TS | Fall protection system on control building roof | Planned for 2012 |
| **Labrador** | | |
| Happy Valley | Sure-Track ladder system on North side plant ladder | Planned for 2012 |
| **Northern** | | |
| Charlottetown | Travel restraint system on top of tank | Planned for 2012 |
| Mary's Harbour | Travel restraint system on top of two tanks | Planned for 2012 |
| William's Harbour | Ladder station and fall protection system on diesel building roof | Planned for 2012 |

| Location | Description | Comment |
|---|---|---|
| **Bay d'Espoir** | | |
| Cat Arm | Intake ladder Slider | Future projects |
| | New ladder for spherical valve pit | Future projects |
| | Rail for stairs to fire pump room | Future projects |
| | Remove penstock access ladder safety slide | Future projects |
| General | Support For Oil Tank Rescue | Future projects |
| | Intake #4 Gate control access rail | Future projects |
| | Access Catwalk for installing Stoplogs | Future projects |
| | Surge Tank #1 Fall Arrest System | Future projects |
| | Surge Tank #2 Fall Arrest System | Future projects |
| Granite Canal | Intake railing modifications | Future projects |
| | By-pass stoplog railing | Future projects |
| | Gap in Rail on overhead crane landing | Future projects |
| | Modify rail to firepump room | Future projects |
| | Extend ladder siderails for overhead crane | Future projects |
| | Drafttube crane access mezzanine extension | Future projects |
| Hinds Lake | Sump pit ladder at powerhouse | Future projects |
| | Ladder cable system at warehouse roof | Future projects |
| | Ladder with barrier at draft tube area-powerhouse | Future projects |
| | Spillway ladder modification/safety slide | Future projects |
| | Install handrail for stairs leading to penstock-powerhouse | Future projects |
| | Extend handrail near control room to close gap-powerhouse | Future projects |
| | Remove intake safety slide rail | Future projects |
| | Remove control structure safety slide rail | Future projects |
| | Intake ladder modification/safety slide | Future projects |
| | Ladder with barrier at east end of powerhouse | Future projects |
| | Ladder with barrier at west end of powerhouse | Future projects |
| Paradise River | Platform for powerhouse overhead crane | Future projects |
| | Install intermediate rail | Future projects |
| | Overhead crane ladder modification/safety slide | Future projects |
| | Install flip rail or gate | Future projects |
| | Remove penstock access ladder safety slide | Future projects |
| | Install penstock access fall arrest | Future projects |
| | Railing around top of unit | Future projects |
| Powerhouse 1 | Unit # 1-6 Rotor/Stator access ladder | Future projects |
| | Unit #2 railing install toeboards | Future projects |
| | Unit #5 Spherical Valve rail/ladder mod | Future projects |
| | Unit #6 Spherical Valve rail/ladder mod | Future projects |
| | Grating unit #4 improvement | Future projects |
| | Grating unit #5 improvement | Future projects |

| Location | Description | Comment |
|---|---|---|
| Powerhouse 1 | Grating unit #6 improvement | Future projects |
| | Overhead crane access ladder | Future projects |
| | Downstream Unit 5 ladder | Future projects |
| | Downstream Unit 6 ladder | Future projects |
| | Cable tunnel shelter ladder | Future projects |
| Powerhouse 2 | Railing to Fire Pump Area | Future projects |
| | Sump pit ladder | Future projects |
| Up Country | Ladder to upper deck at Victoria Control Structure | Future projects |
| | Ladder with barrier to Staff gauge at Victoria Control Structure | Future projects |
| | Burnt Diesel Tank Modifications | Future projects |
| | Burnt Spill access Catwalk for installing Stoplogs | Future projects |
| Upper Salmon | Ladder cable system at North Salmon spillway roof | Future projects |
| | Ladder cable system at West Salmon spillway roof | Future projects |
| | Ladder cable system at warehouse roof | Future projects |
| | Intake Ladder Modification/safety Slide-powerhouse | Future projects |
| | Diver access ladder at West Salmon Spillway | Future projects |
| | Reinforce ladder at North Salmon Spillway | Future projects |
| | Install railing around unit-powerhouse | Future projects |
| **Central** | | |
| Bishop's Falls | Lifelines on service building | Future projects |
| | Fall protection system on office building | Future projects |
| | Fall protection system on salvage stores | Future projects |
| Various Transformers | Anchor plates for transformers | Future projects |

**Project Title:** Legal Survey of Primary Distribution Line Right Of Way

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Properties

**Definition:** Other

**Classification:** Normal

**Project Description:**

Newfoundland and Labrador Hydro (Hydro) owns and operates approximately 2,370[6] km of distribution lines located on Crown land, which is owned by the provincial government.
In 2004, Hydro initiated a program to obtain easements on the land on which these lines are located. From 2004 to 2010, a total of 792 km of distribution line has been surveyed and is being processed through the Department of Environment and Conservation, Lands Division (Crown Lands). In 2011, 50 km of distribution line are planned to be surveyed and processed. Table 2 provides the details of the length of lines surveyed to date. This project is required to continue the program to acquire legal surveys and prepare documentation to acquire Crown Land easements for approximately 150 km of primary distribution line in operation throughout the Province. Easements are granted for a term of 50 years. Hydro can renew the easements granted for a further period of 50 years if the renewal is requested in writing before the expiration of the existing easement.

The budget estimate for this project is shown in Table 1.

[6] In early 2011, Hydro re-examined its distribution systems single line drawings and discovered that an additional 120 km of distribution lines were located on Crown lands. The adjusted total length of lines is 2,370 km from previously reported 2,250 km.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 4.8 | 0.0 | 0.0 | 4.8 |
| **Labour** | 134.0 | 0.0 | 0.0 | 134.0 |
| **Consultant** | 8.0 | 0.0 | 0.0 | 8.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 20.3 | 0.0 | 0.0 | 20.3 |
| **Interest and Escalation** | 14.4 | 0.0 | 0.0 | 14.4 |
| **Contingency** | 16.4 | 0.0 | 0.0 | 16.4 |
| **TOTAL** | **197.9** | **0.0** | **0.0** | **197.9** |

**Operating Experience:**

Older distribution lines were constructed without obtaining easements. The effort to obtain easement title to the primary distribution lines on Crown Land began in 2004. Assuming continued funding, title for the distribution systems located on Crown Land will be in place by the end of 2021. Due to the retirement of Hydro's only Licensed Surveyor, in 2010, surveys for the 2011 project had to be contracted out to a licensed surveyor in order to obtain title. This capital budget has been adjusted based on the cost quotes received from the bids on the 2011 surveys. The cost per km received from those bids range from $1,248 to $1,575 per km so this capital budget was adjusted based on the lowest quote of $1,248 per km. This will add a number of years to the project with project completion now being 2021.

**Table 2: Length of Lines Surveyed**

| Year | Length (km) | Comments |
|---|---|---|
| 2010 | 89 | Barachois Distribution Lines and Partial Surveying of English Harbor West Distribution Lines |
| 2009 | 150 | Northern Distribution Lines |
| 2008 | 43 | Northern Distribution Lines |
| 2007 | 160 | Northern Distribution Lines |
| 2004-2006 | 350 | Baie Verte Area, South Brook, Little Bay, Rencontre East, Come By Chance, Monkstown, South East Bight, Coombs Cove to English Harbor West, Westport to Baie Verte |

Table 3 shows the history of expenditures for this project for the five-year period 2006 to 2010.

**Table 3: Budget History**

| Year | Budget ($000) | Actual ($000) |
|---|---|---|
| 2011F | 78.7 | |
| 2010 | 65.4 | 65.4 |
| 2009 | 56.0 | 54.5 |
| 2008 | 52.0 | 54.0 |
| 2007 | 50.8 | 47.9 |
| 2006 | 49.9 | 51.2 |

In 2007, Crown Lands performed a review of the Hydro surveys, which were completed by an outside consultant during the period 2004 through 2006. Hydro's surveys required editing to comply with current Crown Lands Standards, and in 2008, Hydro spent much of the approved capital budget to have Hydro's outside consultant edit and correct these drawings for re-submission to Crown Lands. Issues included surveying roads and including them in the drawings, adding a legend on the drawings, and editing features to make them more distinctive. Due to Sections 33 and 34 of the Land Surveyors Act, 1991, Hydro could not use its own surveyors to make corrections to these drawings. The Land Surveyors Act, 1991, Section 33, Use of Seal states that "A Land Surveyor shall not affix his or her seal to a plan or document prepared in the practice of land surveying unless the plan or document was prepared by or under the personal supervision, direction or control of that Land Surveyor." Furthermore, Section 34, Survey Plan Documents, states that "(1) A master plan and duplicates of all survey plans, records and documents prepared by or under the direction of a Land Surveyor shall be retained by that Land Surveyor; (2) A person shall not, without the prior written consent of the Land Surveyor who prepared a land survey plan, alter, add to or delete from that plan or a copy or reproduction of that plan; and (3) A person who contravenes subsection (2) commits an offence."

In 2010, it was anticipated that 160 kilometers of distribution lines would be surveyed but due to higher than expected costs for surveying , a total of 89 kilometers were surveyed in order to remain within budget.

There are approximately 2,370 kilometers of distribution lines for which Hydro has no title. Applications for title to surveyed lines have been submitted to Crown Lands and are currently being processed. Since 2004, 842 (792 up to 2010 and 50 anticipated for 2011) kilometers of distribution line

has been surveyed. The legal surveys are being completed and obtaining title is currently in progress for these surveyed lines.

**Project Justification:**

The distribution lines occupy Crown land without title, contrary to the Crown Lands Act. Lack of adequate title is a risk to the operation of the lines should competing requirements for the lands arise. In addition, maintenance and upgrading of the lines could be cumbersome and costly without appropriate legal easements when these lands become privately owned. Property owners are reticent to have Hydro accessing their land. The sole purpose of these surveys is to obtain easements over Crown land to prevent other parties from getting title to the land, thereby potentially complicating maintenance of the lines.

Upon purchase of Crown land, a resident receives title and it becomes private land. Although Hydro's access to Crown land has not been directly challenged, private land owners have requested Hydro to move poles and lines off private land in instances where Hydro has not acquired easements. Hydro has obliged since it has no right to cross the land to access the poles and lines.

Maintaining the status quo is unacceptable. In the absence of title, other parties may be able to construct, develop or otherwise use the property on which Hydro's lines are located without Hydro being consulted. Obtaining title ensures that developments do not interfere with Hydro operations.

**Future Plans:**

Approximately 1,578 kilometers of distribution lines remain to be surveyed. Table 4 presents Hydro's future plan for surveying lines.

**Table 4: Length of Lines to be Surveyed**

| Year | Budget ($,000) | Proposed Survey Length to be Completed (Km) | Length Remaining to be Surveyed at Year End (Km) |
|---|---|---|---|
| 2011 | 78.7 | 50 | 1,528 |
| 2012 | 195.5 | 150 | 1,378 |
| 2013 | 196.2 | 151 | 1,227 |
| 2014 | 197.0 | 152 | 1,075 |
| 2015 | 199.4 | 153 | 922 |
| 2016 | 197.4 | 154 | 768 |
| 2017 | 197.4 | 155 | 613 |
| 2018 | 197.4 | 155 | 458 |
| 2019 | 197.4 | 155 | 303 |
| 2020 | 197.4 | 155 | 148 |
| 2021 | 190.0 | 148 | 0 |

Future projects for legal surveys will be proposed in future capital budget applications. See five-year plan (2012 Capital Plan Tab, Appendix A).

The anticipated project schedule is shown in Table 5.

**Table 5: Project Schedule**

| Activity | Start Date | End Date |
|---|---|---|
| Project initiation and design transmittal completion | February 2012 | February 2012 |
| Prepare survey scope of work and plan Field Work | February 2012 | March 2012 |
| Complete surveying | April 2012 | October 2012 |
| Preparation and review of legal survey documents<br>Submission of legal plans to Crown Lands | May 2012<br>November 2012 | November 2012<br>November 2012 |
| Close out and documentation | December 2012 | December 2012 |

**Project Title:** Purchase Meters, Equipment and Metering Tanks

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Metering

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of purchasing 350 demand meters, 1,000 residential meters and associated equipment for use in revenue metering applications which require replacement each year due to government retest, technology changes or obsolescence. As well, Hydro will purchase six Dry-Type Metering Units (Meter Tanks) to replace existing aging and obsolete 2.5 element units. Table 1 provides the budget estimate for this project.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 131.0 | 0.0 | 0.0 | 131.0 |
| **Labour** | 27.9 | 0.0 | 0.0 | 27.9 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and escalation** | 15.6 | 0.0 | 0.0 | 15.6 |
| **Contingency** | 15.9 | 0.0 | 0.0 | 15.9 |
| **TOTAL** | **190.4** | **0.0** | **0.0** | **190.4** |

**Operating Experience:**

Meters of the electromechanical design have reached or surpassed their life expectancy of 25 years. Furthermore, new electromechanical meters can no longer be purchased from meter manufacturers.

There are 80 oil-filled metering tanks of which 41 are in service and 39 in storage as critical spares. Aside from all being 2.5 element units, which are no longer permitted to be used for new services by Measurement Canada, they range in age from 21 to 40 years. In recent years, there have been five tanks removed from service due to deterioration from the outside environment or due to failure of components. The most recent tank to be replaced will be in 2011 due to hot spots on the tank which creates a high potential for failure of components.

**Project Justification:**

Meters/metering equipment obsolescence and failure requires spares to be purchased so that equipment is available to replace defective or worn out equipment. As the meters that are of the electromechanical design are becoming obsolete and can no longer be purchased, failure to replace this equipment would affect metering accuracy and reliability. Furthermore, Measurement Canada introduced a new compliance sampling specification (S-S-06) on January 1, 2011 that can be used on a voluntarily basis until fully implemented on January 1, 2014. This specification is attached as Appendix A. Once implemented, fewer meters will be passing compliance testing due to more stringent guidelines related to compliance testing of electromechanical meters. Measurement Canada highly recommends that utilities manage their compliance sampling groups effectively to avoid a tsunami effect of failing meters that will occur if groups aren't properly managed. Measurement Canada acknowledges that many meters currently passing the old standard, LMG-EG-04, will not pass the new standard (S-S-06) (See Appendix A). Compliance testing is a process where a sample of meters is taken from a group of in-service meters which are homogeneous with respect to design, production and quality characteristics. This process is based on ISO 2859-2:1985, "Sampling procedures for inspection by attributes – Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection." See attachments for more details.

Hydro's metering tanks are reaching the end of their useful lives and require replacement to prevent failures. Refurbishment of existing units is not permitted by Measurement Canada as existing units are a 2.5 element design and Measurement Canada requires all new and reconstructed applications to use 3 element design.

In addition, a minimum inventory of 3 element metering tanks is required for new customer applications and emergency replacement of existing applications due to the failure of in-service tanks. When a new customer requirement arises, the five to six week delivery time of a new 3 element metering tank often does not meet the customer requirements. Therefore, an inventory of 3 element metering tanks is required for such new requests and also to ensure that a sufficient supply is available for failures of in-service tanks.

As per Measurement Canada Bulletin E-24-E (rev.1), 2.5 element meters along with the 2.5 element metering tanks were designed to reduce costs associated with metering, by using one less instrument

transformer and associated components internal to the meter. Although 2.5 element metering is an approved form of metering used in Canada for existing services, there is a potential for metering inaccuracies due to original design limitations of this model.

Due to the above concern with 2.5 element metering, a national survey was completed by industry representatives of the Canadian Electricity Association and supported by Measurement Canada to determine the actual impact of 2.5 element metering on the Canadian market. The results of that survey were discussed by Measurement Canada and industry during the Canadian Forum on Trade Measurement in 2001 and a number of recommendations were agreed on to reduce the impact of the potential metering error. Therefore, effective April 2, 2003;

(a) all new and

(b) all reconstruction of existing, 3-phase 4-wire wye configured metering installations shall use 3-element metering. An example of a reconstructed metering installation may include service upgrades and, or instrument transformer replacement.

Furthermore, there are environmental benefits of having dry-type metering units (3 element metering unit) versus oil-filled units (2.5 element metering unit) because there is the potential for environmental hazards from oil leaks.

The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Prepare order | January 2012 | January 2012 |
| Design | Prepare drawings | January 2012 | January 2012 |
| Procurement | Order meters and tanks | January 2012 | March 2012 |
| Construction | Install meters and tanks | May 2012 | October 2012 |
| Commissioning | Verify installations | May 2012 | October 2012 |
| Closeout | Close out projects | December 2012 | December 2012 |

**Future Plans:**

Over the next five years, Hydro plans to remove all electromechanical meters and replace them with electronic meters.

This is the second year of a five year plan to replace metering tanks and ensure compliance to the Electricity and Gas Inspection Act and Regulations. During 2011 we will be replacing five of the 39 metering tanks that are currently in service.

**APPENDIX A**

**MEASUREMENT CANADA INTERPRETATION BULLETIN**

Measurement Canada / Mesures Canada
An Agency of Industry Canada / Un organisme d'Industrie Canada

# Specifications

| | | |
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| | Supersedes: **PS-S-04, LMB-EG-04** | |

**Sampling Plans for the Inspection of Isolated Lots of Meters in Service**

## 1.0 Scope

This specification establishes the requirements that are applicable to in-service isolated lots of homogeneous electricity or gas meters, where a meter owner has chosen to utilize sampling inspection for the purposes of extending the reverification period of an in-service lot of meters. Where applicable, this specification may be utilized as an alternative to performing 100% meter reverification, upon expiry of a meter lot's initial or subsequent reverification period.

**NOTE:** Sampling plans, by design, contain inherent risks and limitations with regard to their usage and the conclusions they may or may not provide. Meter owners are therefore advised that, although conformity with the requirements of this specification may allow for the extension of a meter's reverification period, relying solely on the use of the sampling plans contained in this specification will not provide users with an assurance of compliance with the metering accuracy obligations prescribed under the *Electricity and Gas Inspection Act*.

## 2.0 Authority

This specification is issued under the authority of section 19 of the *Electricity and Gas Inspection Regulations*.

## 3.0 Normative References

3.1 ISO 2859-2:1985, *Sampling procedures for inspection by attributes – Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*. Table A - Single sampling plans indexed by limiting quality (LQ) (Procedure A).

3.2 S-S-01, *Specifications for Random Sampling and Randomization*

3.3 Relevant Measurement Canada specification for the verification and reverification of the meter under test.

## 4.0 Administrative Requirements

Sampling inspection shall be carried out well in advance of the expiry of the reverification period of the meters so that in the case of non-conformity with the requirements, all meters forming part of the lot can be removed from service prior to the expiry of the reverification period.

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| | Supersedes: **PS-S-04, LMB-EG-04** | |

**5.0 Sampling Inspection Requirements**

**5.1 Lot Formation**

**5.1.1** The lot shall be formed from meters that are homogeneous with respect to the requirements in Annex A.

**5.1.2** At the discretion of a meter owner, larger lots may be reformed into multiple lots of smaller size.

**5.2 Sample Selection**

**5.2.1** The sample shall be drawn at random, without replacement, from the lot listing, using authorized random sampling software that meets the requirements referenced in section 3.2. (Systematic sampling shall not be used).

**5.2.2** The size of the sample shall be one obtained from the table in Annex C as per the sampling instructions provided by this specification. The sample representing the lot shall correspond to a value between $n_{min}$ and $n_{max}$ as identified in the table of Annex B.

**5.2.3** Meter owners shall be responsible for assuring that the meters which are included in the sample meet the following criteria:

(a) the identified meter is one which is currently installed in service;

(b) the identified meter's metrological parameters have not been adjusted post installation;

(c) the identified meter is homogeneous with regard to the criteria of A.1 of Annex A: and

(d) the identified meter meets the total time on test criteria of A.2 of Annex A.

**5.2.4** Where a sample meter does not qualify for inclusion as per the requirements of 5.2.3, meter owners shall not consider this meter as part of the sample group for performance testing purposes, and shall replace it with the sequentially subsequent meter on the preselected unsorted sample meter listing meeting the applicable criteria. The exclusion rationale for the subject meter(s) shall be reported as per the requirements of 5.3.4.

**5.2.5** Where a meter, which has been removed from service, is not capable of having its performance assessed in accordance with the requirements of this document, the meter owner shall replace it with the sequentially subsequent meter on the preselected unsorted sample listing of meters available for testing. All meters and their associated test results shall be included unless compelling evidence for exclusion is identified and reported as per the requirements of 5.3.4.

**5.2.6** Meters which have been excluded as sample meters as a result of not satisfying either 5.2.3 (a), 5.2.3 (b), 5.2.3 (c), 5.2.3 (d) or 5.2.5 shall not be returned to the parent lot.

**5.2.7** Lots failing to meet the minimum sample size ($n_{min}$) criterion as a result of the total number of exclusions under 5.2.3, are not considered to be homogeneous and are not acceptable for seal extension. Where a lot is deemed to be nonhomogeneous, meter owners shall implement one of the following actions:

(a) Re-form the lot on the basis of both the lot and sample homogeneity criteria contained in Annex A;

(b) Assign a lower initial reverification period to the lot as per the requirements of section 5.7; or

(c) Remove the lot from service.

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| | Supersedes: **PS-S-04, LMB-EG-04** | |

**5.3 Meter Sampling Records**

**5.3.1** For each lot assessed, a meter owner shall maintain records documenting:

(a) a unique, owner-assigned lot number or record reference which includes an ordinal number indicating the lot's occurrence for assessment under this specification (including the current - i.e. 1st, 2nd, 3rd, etc.);

(b) the homogeneity criteria details specified in A.1;

(c) the utility number and manufacturer's serial number for each meter.

**5.3.2** All meters identified by the owner as forming part of the lot, shall be listed in ascending order based on meter identification numbers or an inventory number generated by the associated informatics system.

**5.3.3** The identification of each unsorted sample meter ($n$ to $n_{max}$) selected from the lot, the sample meters tested, the quality characteristics examined, and the test results obtained, shall be documented.

**5.3.4** All sample meters selected but not involved in the final calculations shall be accounted for by the meter owner and the reasons for exclusion shall be documented and, on request, made available for Measurement Canada review. Evidence of deliberate exclusion or improper accounting may disqualify the results of the sample's analysis.

**5.4 Meter Inspection, Quality Characteristics, and Corrective Actions**

**5.4.1** Each sample meter shall be examined for conformance to all pertinent requirements as prescribed by reference 3.3.

**5.4.2** Sample meters shall be inspected under identical conditions and within as short a time period as is practicable to achieve valid inspection results.

**5.4.3** Each defective meter excluded from the final calculations shall be preserved for Measurement Canada review and shall be the subject of an investigation by the meter owner to determine the cause of the defect or defects. In the case of defective meters, a report shall be prepared and shall include the following information associated with this investigation:

(a) details of the meter's make, model, Notice of Approval number, seal year, and identification numbers;

(b) a description of the defect and its effect on the meter's operation, including performance test results where feasible;

(c) a description of the steps taken to investigate the cause of the defect, including identification of the personnel both performing the investigation and providing information for its purpose;

(d) an explanation of how the defect occurred, including where it occurred in the process;

(e) an evaluation of the extent of the defect in the immediate situation as well as in situations likely to be similarly affected; and

(f) details of the corrective and preventive action proposed or performed to address the cause and symptoms of the defect.

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**5.4.4** In cases where a defective meter is encountered, the report required by clause 5.4.3 shall be provided to the local Measurement Canada representative for review prior to deciding upon the acceptability of the affected lot. Decisions regarding acceptability of the affected lot and the possible need for further investigation or corrective action shall not be made until Measurement Canada has evaluated the report and the statistical analysis of the data from the sample meters involved in the final calculations.

**5.5 Acceptance Criteria**

**5.5.1 Individual Meters**

**5.5.1.1**
Each meter in the sample can be considered acceptable if the following conditions are met:

(a) the meter complies with all specified reverification performance requirements (reference 3.3);

(b) the meter does not possess any defect which could affect its ability to meet specified requirements during its usage;

(c) the meter has been obtained from a population whose seal year is still valid;

(d) the meter has been received with a broken seal and an exclusion as per 5.3.4 cannot be justified.

**5.5.1.2**
To maintain overall homogeneity of the lot, sample meters, obtained from lots qualifying for an extension, which meet reverification requirements and which have been granted the same extension as the parent lot, shall, wherever possible, be returned to the parent lot and reinstalled following acceptance of the lot. Alternatively, these meters can be reverified.

**5.5.1.3**
Where sample meters require their seals to be broken in order to conduct meter performance testing, precautions should be taken to ensure the integrity of the results. If the lot is acceptable, the individual sample meters that are also acceptable shall be resealed with an additional identifier indicating the original seal year in the sealing assembly. Alternatively, these meters shall be reverified.

**5.5.1.4**
Sample meters that meet reverification requirements, yet have been obtained from lots not qualifying for an extension or sample meters not returned to the parent lot, shall be governed by Measurement Canada bulletins E-26 *Reverification Periods for Electricity Meters and Metering Installations* or G-18 *Reverification Periods for Gas Meters, Ancillary Devices and Metering Installations,* with respect to the assigned reverification period.

**5.5.2 Meter Lots**

**5.5.2.1**
The sampling plan parameters of ISO 2859-2 (reference 3.1) as modified in Annex C of this document, shall be utilized for the inspection of isolated lots of meters in service.

**5.5.2.2**
The acceptability of the lot for the purposes of extending its reverification period, shall be established on the basis of the performance results of the sample with regard to the number of marginally conforming meters ($C_1$) and the number of nonconforming meters ($C_2$) evidenced, as defined in section 5.5.3.

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**5.5.2.3**
Contractors are responsible for ensuring the performance quality of the in-service meter lots which they own. Where a seal extension period is available under this specification, contractors shall give consideration to their statutory obligation for keeping meters in good repair, when selecting the seal extension period to be applied from those which are available. Specifically, the conformance quality of an in-service lot of meters shall, in all cases, meet or exceed the declared limiting quality that is associated with level 5.

### 5.5.3 Meter Performance Test Limits

**5.5.3.1**
For all performance tests, required to be conducted as per the reverification specification applicable to the subject meter type or class, a Type 1 ($C_1$) marginally conforming meter is one whose performance error exceeds ± 2.0% at any test point.

**5.5.3.2**
For all performance tests, required to be conducted as per the reverification specification applicable to the subject meter type or class, a Type 2 ($C_2$) nonconforming meter is one whose performance error exceeds ± 2.9% at any test point.

**5.5.3.3**
For the purposes of section 5.5.2.2, a Type 2 ($C_2$) nonconforming meter is also counted as a Type 1 ($C_1$) marginally conforming meter.

### 5.5.4 Seal Extension Levels

**5.5.4.1**
Where a lot of meters is assessed against the requirements of this specification, the maximum seal extension level available for application to the lot, shall be established on the basis of satisfying the following criteria when applied to the $n_{min}$ sample size as specified in a column of the applicable Annex C table:

**Maximum Extension Level Criteria:**

(i) $c1 \leq Ac_{type\ 1}$
(ii) $c2 \leq Ac_{type\ 2}$

**5.5.4.2**
Subject to the requirements of section 5.6, the maximum seal extension level that may be available for application to a lot, is the seal extension level associated with the limiting quality column of the applicable table in Annex C, C-1 or C-2 which satisfies the requirements of 5.5.4.1 for the established sample size $n_{min}$.

**5.5.4.3**
Where the maximum level of extension available to a lot of meters is determined to be level 4, the applicable seal extension period, as determined under Annex E, may be repeated without limitation on an ongoing basis where the applicable level 4 limiting quality criteria of Annex C, C-1 or C-2 and the Time on Test criteria of Annex E are met.

**5.5.4.4**
Subject to section 5.5.4.5, lots failing to meet at least level 4 criteria are not acceptable for extension. All meters in non-acceptable lots shall be removed from service.

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**5.5.4.5**
Where a lot failing to meet level 4 criteria is capable of meeting the limiting quality criteria of level 5 (where available), the applicable level 4 extension period available as per Annex E, may be applied to the lot. However, upon expiry of this period, the lot cannot be re-sampled and must be removed from service.

**5.5.4.6**
Where a lot fails to meet at least level 4 criteria and this failure is as a result of not meeting the requirements of sec 5.5.4.1(ii), all sample meters identified as $C_2$ meters under section 5.5.3.2 shall be held in storage until Measurement Canada authorizes their further processing. Sample meters shall not be required to be held in storage (without just cause) after December 31st of the calendar year in which the sampling was conducted.

**5.6 Use of Sampling Tables (Annex C, C-1, and C-2)**

**5.6.1** The value of $n_{min}$ shall be established on the basis of the lot size and the maximum seal extension level being targeted. Once the $n_{min}$ sample size has been determined, it is this value that shall be utilized for establishing the maximum seal extension level, where further movement within the table is limited to either the horizontal or a diagonal downward direction for the same $n_{min}$.

**5.6.2** Notwithstanding the seal extension level available under the requirements of section 5.5.4.1, and subject to section 5.6.3, the maximum seal extension level that may be applied to the lot shall be established on the basis of the lot's ordinal sampling occurrence under this specification as specified in Annex D.

**5.6.3** Where the maximum seal extension level available to the lot under Annex D is longer in duration than the previous seal extension period granted to the lot, the period applied shall not be greater than one level better than the previous extension level and this eligibility for the application of a longer period, is limited to a single occurrence within a meter lot's in-service life.

**5.6.4** Where a lot population has never been assessed against the requirements of this specification, the seal extension period of reference for the purposes of 5.6.3, shall be the last extension period granted to the lot under the previously authorized compliance sampling program.

**5.6.5** Where a lot population is re-formed under the requirements of 5.1.2 or 5.2.7, the maximum seal extension levels available to the re-formed lot shall be established in accordance with the requirements of 5.6.2, 5.6.3, and 5.6.4, as applicable to the parent lot before re-formation.

**5.6.6** Where a lot's population size is 500 meters or less, a meter owner may, at their discretion, utilize the sampling plan as specified in Annex C-1. Where the sampling plan of Annex C-1 is utilized, the seal extension periods available under Annex E are reduced by 50% (rounded down to the nearest whole year).

**5.6.7** Where a lot's population size is 60 meters or less, a meter owner may, at their discretion, utilize the sampling plan as specified in Annex C-2. Where the sampling plan of Annex C-2 is utilized, the only seal extension periods available under Annex E are those associated with a level 4 extension.

**5.7 Seal Extension Periods (Annex E)**

**5.7.1** For meter lots still within their initial reverification period, the time on test (TT) requirements which need to be met or surpassed by each meter in the sample (as per the homogeneity requirements of A.2), shall be established on the basis of the meter's initial reverification period and the minimum period (in months) prescribed under Annex E.

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**5.7.2** For meter lots still within their initial reverification period, a sample meter's time on test (in months) is established from the date the sample meter is placed into service, to the date that it is removed from service (rounded down to the nearest whole month). For the purposes of this section and section 5.7.4, where months are established on the basis of day counts, one month is to be considered 31 days. Alternatively, months may be established on the basis of actual month days where this information is tracked on an ongoing basis relative to true months completed within a calendar period.

**5.7.3** Subject to section 5.7.5, where a meter lot is no longer within its initial reverification period, the time on test (TT) requirements that need to be met or surpassed by each meter in the sample (as per the homogeneity requirements of A.2), shall be established on the basis of the previous seal extension period granted to the lot and the applicable subsequent extension percentage prescribed for the subject row as per Annex E.

**5.7.4** For meter lots no longer within their initial reverification period, a sample meter's time on test (in months) is established from the date that the certificate was issued relative to the meter lot's last seal extension, to the date that the sample meter is removed from service (rounded down to the nearest whole month). Alternatively, a meter's time on test requirement is satisfied where it can be demonstrated that the sample meter has continuous uninterrupted service.

**5.7.5** Meter lots that are sampled on an annual basis under this plan, are not subject to the time on test requirements of Annex E.

**5.7.6** Where the time on test requirements for the 1st extension or subsequent extensions of a lot have not been met or where a sample is deemed non-homogeneous relative to the applicable time on test requirement, a lower initial reverification period (where the time on test requirements are satisfied) may be assigned to the lot.

**5.7.7** Once a lower initial reverification period row has been assigned to a lot, further movement within the table is limited to either the horizontal, downward or diagonal downward directions (i.e. the initial reverification period reference cannot be increased on subsequent samplings of the lot).

**5.8 Reverification Date Calculations**

**5.8.1** Subject to 5.8.2 , where a seal period extension is granted under Annex E, the meters in the lot, less any nonconforming meters, shall be considered due for reverification on or before December 31 of the calendar year calculated as the sum of the year in which the first sample meter was removed from service and the extension period granted under Annex E (in years).

**5.8.2** Where the first sample meter is removed from service in the calendar year which immediately precedes the meter lot's seal expiration year, the meters in the lot, less any nonconforming meters, shall be considered due for reverification on or before December 31 of the calendar year calculated as the sum of the lot's seal expiration year and the extension period granted under Annex E (in years).

**5.8.3** Subject to 5.8.4, where a lot of meters fails to meet the requirements for an extension of its reverification period, the meters in the lot shall be considered due for reverification on the date established by the previous verification or reverification, as the case may be.

**5.8.4** In the case of a lot of meters which fails to meet the requirements for an extension of its reverification period and the first sample meter was removed from service in a calendar year which preceded the meter lot's seal expiration year by more than one (1) calendar year, the meters in the lot shall be considered due for 100% reverification, on or before December 31st of the calendar year which postdates the year in which the first sample meter was removed from service.

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**Annex A**
(normative)

## A.1 Lot Homogeneity Requirements

Where applicable, the meters in the lot shall be homogeneous with respect to the following characteristics:

**Electricity Meters**

(a) type (transformer or self contained);

(b) manufacturer and model, unless otherwise authorized in accordance with clause A.1.1;

(c) voltage or voltage range;

(d) maximum current range, unless otherwise authorized in accordance with clause A.1.1;

(e) measurement functions (e.g. measured quantities, energy, demand), unless otherwise authorized in accordance with clause A.1.1;

(f) firmware version, unless otherwise authorized in accordance with clause A.1.1;

(g) frequency rating;

(h) same model or type of telemetering device (if so equipped), unless otherwise authorized in accordance with clause A.1.1;

(i) configuration / form (i.e. number of elements*, wye, delta or auto configuration);

(j) status at time of last inspection (i.e. new, renewed, or reserviced);and

(k) seal year (same seal year or two consecutive seal years, provided both are valid);

***With the exception that 1-element and 1.5-element meters may be mixed to form a lot.**

**Natural Gas Meters**

(a) manufacturer and model, unless otherwise authorized in accordance with clause A.1.1.

(b) same or similar capacity rating, unless otherwise authorized in accordance with clause A.1.1.

(c) measurement functions (e.g. measured quantities, temperature/pressure conversion).

(d) firmware version, unless otherwise authorized in accordance with clause A.1.1.

(e) same model or type of telemetering device or auxiliary attachment (if so equipped), unless otherwise authorized in accordance with clause A.1.1.

(f) status at time of last inspection (i.e. new, renewed, or reserviced).

(g) seal year (same seal year or two consecutive seal years, provided both are valid).

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|---|---|---|
| Document(s): **S-S-06 Implementation, Information Bulletin (2010-02-08)** | Issue Date: **2010-06-21** | Effective Date: **2011-01-01** |
| | Supersedes: **PS-S-04, LMB-EG-04** | |

### A.1.1 Forming Lots with Mixed Meters

Where a lot includes meters which, for the purposes of lot homogeneity, are ones which possess a similar characteristic rather than a characteristic which can be readily identified as being the same, meter owners are responsible for maintaining documented records identifying the similarities which support the homogeneity conclusion (as concerns including these meters within the subject lot). For the purposes of compliance sampling, if an accredited organization wishes to combine, in one lot, various models or vintages of meters, and/or meters equipped with and without a telemetering device, the accredited organization shall submit a request to MC with accompanying documentation in support of their claim that these differing meters can be considered homogeneous.

### A.2 Sample Homogeneity Requirements

The meters in a sample shall be homogeneous with respect to similar time in usage. For a sample meter to be considered homogeneous with regard to similar time in use, a meter shall have been in service for a time period that meets or exceeds the applicable time on test (TT) requirements of Annex E. Where $n_{min}$ is not achieved with regard to this criteria, a meter owner may re-form the lot or reduce the seal period extensions available as per the requirements of section 5.7.

## Annex B
(normative)

## Table of $n_{min}$ to $n_{max}$ Sample Sizes

| Single Sampling | |
|---|---|
| $n_{min}$ | $n_{max}$ |
| 30 | 37 |
| 42 | 52 |
| 44 | 55 |
| 65 | 81 |
| 80 | 100 |
| 125 | 156 |
| 200 | 250 |
| 315 | 394 |

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| | Supersedes: **PS-S-04, LMB-EG-04** | |

**Annex D - Available Extension Levels**
(normative)

| Ordinal Sampling Occurrence | Maximum Seal Period Extension Levels Available | | | |
|---|---|---|---|---|
| 1st | Level 1 | Level 2 | Level 3 | Level 4 |
| 2nd | | Level 2 | Level 3 | Level 4 |
| 3rd | | | Level 3 | Level 4 |
| 4th (and higher) | | | | Level 4 |

**Annex E - Time on Test (TT) Requirements and Maximum Seal Period Extensions**
(normative)

| Initial Reverification Period (years) | 1st Extension (Months) | Subsequent Extensions* | Maximum Seal Period Extension (years) | | | |
|---|---|---|---|---|---|---|
| | | | Level 1 | Level 2 | Level 3 | Level 4 |
| 12 | 115 | 75% | 10 | 8 | 5 | 2 |
| 11 | 105 | 75% | 9 | 7 | 5 | 2 |
| 10 | 84 | 70% | 8 | 6 | 4 | 2 |
| 9 | 75 | 70% | 7 | 5 | 3 | 2 |
| 8 | 67 | 70% | 6 | 4 | 3 | 2 |
| 7 | 58 | 70% | 5 | 4 | 2 | 1 |
| 6 | 50 | 70% | 4 | 3 | 2 | 1 |
| 5 | 42 | 70% | | 3 | 2 | 1 |

***Subsequent extension TT based on indicated percentage multiplied by the previous extension (rounded up to the next whole month).**

Alan E. Johnston
President

**APPENDIX B**

**MEASUREMENT CANADA INTERPRETATION BULLETIN**

Measurement Canada / Mesures Canada
An Agency of Industry Canada / Un organisme d'Industrie Canada

# Bulletin

| | | |
|---|---|---|
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| Document(s): **S-01; S-S-01; S-S-02; S-S-03; S-S-04; LMB-EG-04; PS-S-01; S-G-02; S-E-02** | Issue Date: **2011- 02-11** | Effective Date: **2011-02-11** |
| | Supersedes: **S-02 (rev. 3)** | |

**Implementation Schedule for the Application of Statistical Sampling Requirements in S-S-01, S-S-02, S-S-03, S-S-04 and S-S-06**

## 1.0 Purpose

This bulletin identifies Measurement Canada's (MC) statistical sampling plans and related specifications applicable to the verification and reverification of electricity and gas meters, and communicates a comprehensive schedule for the implementation of these requirements.

## 2.0 References

**2.1** Bulletin S-01 – Implementation Guide for the Application of Statistical Sampling Requirements

**2.2** S-S-01 – Specifications for Random Sampling and Randomization

**2.3** S-S-02 – Measurement Uncertainty and Meter Conformity Evaluation Specifications

**2.4** S-S-03 – Prerequisites to the Use of Sampling Inspection

**2.5** S-S-04 – Sampling Plans for the Inspection of Isolated Lots and Short Series of Lots

**2.6** S-S-06 – Sampling Plans for the Inspection of Isolated Lots of Meters in Service

**2.7** LMB-EG-04, Part 1 – Statistical Sampling Plans for the Verification and Reverification of Electricity and Gas Meters (with Amendments No. 1– 4)

**2.8** PS-S-01 – Provisional Specifications for the Processing and Analysis of Defective Meters Discovered during Compliance Sampling (an amendment to LMB-EG-04)

**2.9** S-G-02 – Specifications for the Verification and Reverification of Diaphragm Meters

**2.10** S-E-02 – Specifications for the Verification and Reverification of Electricity Meters

**2.11** P-EG-01 – Electricity & Gas Measurement Dispute Investigation Procedure

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### 3.0 Terminology

**Acceptance sampling** - The process of accepting or rejecting a lot of meters by inspecting a sample in accordance with a predetermined sampling plan. The object is to ensure that lots of acceptable quality have a high probability of acceptance.

**Compliance sampling** - A specialized form of acceptance sampling of isolated lots of meters in service, having the object of ensuring that lots of unacceptable quality have a high probability of rejection.

### 4.0 Implementation Schedule for Electricity Meters

### 4.1 Electro mechanical (Energy-Only) Electricity Meters

#### 4.1.1 Measurement Uncertainty Specifications - S-S-02

Prior to the implementation of 100% inspection or acceptance sampling of the meters identified in 4.1, all of the associated measurement uncertainties (i.e. those associated with the measuring apparatus and meter) must first be determined, as per the requirements of S-S-02 and the guidelines in Bulletin S-01.

#### 4.1.2 Acceptance Sampling

**4.1.2.1**
Application of the meter verification specifications in S-E-02 , Annex A (required for the use of the new specifications in S-S-01, S-S-03 and S-S-04) for the meters identified in 4.1 shall become mandatory effective January 1st, 2012.

**4.1.2.2**
The determination of the measurement uncertainties established pursuant to the specifications in S-S-02 required to support the verification or reverification of the aforementioned meters shall be completed and authorized by MC by June 1, 2011.

**Note:** Throughout this document S-E-02 refers to the latest published version of that document.

#### 4.1.2.3 Isolated Lots and Short Series of Lots

The use of specifications S-S-01, S-S-03, and S-S-04 for the verification or reverification of the meters identified in 4.1 shall become mandatory effective January 1, 2012. Until this date, acceptance sampling specification LMB-EG-04 may continue to be applied on a temporary basis.

#### 4.1.3 Compliance Sampling

**4.1.3.1**
As of January 1, 2011, S-S-06 may be applied for the reverification of electromechanical meters by compliance sampling. Alternatively LMB-EG-04 may continue to be used for the reverification of the aformentioned meters until December 31, 2013. As of January 1, 2014, LMB-EG-04 will be rescinded and S-S-06 will be the only specification authorized for use in the inspection of isolated lots of meters in service.

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**4.1.3.2**
A mandatory implementation date for the application of the uncertainty requirements in specification S-S-02 for the reverification of the aforementioned in service meters by compliance sampling under specification S-S-06, has been set.

**4.1.4 100% Inspection**

**4.1.4.1**
Use of existing inspection methods under S-E-02 (with the exception of Annex A) for the verification or reverification of the aforementioned meters by 100% inspection may continue to be used until December 31st, 2011. As of January 1st, 2012 , S-E-02 (including Annex A) and S-S-02 shall be applied in support of the use of measurement uncertainty in conformity assessment.

**4.2 Electronic Meters with or without Advanced Functions**

**4.2.1 Measurement Uncertainty Specifications - S-S-02**

**4.2.1.1**
Prior to implementation of 100% inspection or acceptance sampling of the meters identified in 4.2, all of the associated measurement uncertainties (i.e. those associated with the measuring apparatus and meter) must first be determined, as per the requirements of S-S-02 and the guidelines in Bulletin S-01.

**4.2.2 Acceptance Sampling**

**4.2.2.1**
The application of the meter verification specifications in S-E-02, Annex A (required for the use of the new specifications in S-S-01, S-S-03, and S-S-04) for the meters identified in 4.2 is mandatory effective July 1st, 2009.

**4.2.2.2 Isolated Lots and Short Series of Lots**

Use of specifications S-S-01, S-S-03 and S-S-04 for the verification or reverification of the meters identified in 4.2 is mandatory effective July 1st, 2009.

**4.2.3 Compliance Sampling**

**4.2.3.1**
Compliance sampling specification PS-S-04 was rescinded on December 31, 2010. As of January 1, 2011, S-S-06 is the only specification authorized for use in the inspection of isolated lots of electronic electricity meters in service.

**4.2.3.2**
A mandatory implementation date for the application of the uncertainty requirements in specification S-S-02 for the reverification of the aforementioned in service meters by compliance sampling has not been set at this time.

**4.2.4 100% Inspection**

**4.2.4.1**
The application of the specifications in S-E-02, Annex A and the uncertainty requirements of specification S-S-02 for the verification or reverification of the aforementioned meters, is mandatory effective July 1st, 2009.

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| | Supersedes: S-02 (rev. 3) | |

### 4.3 Other Electricity Meters

#### 4.3.1 Measurement Uncertainty Specifications - S-S-02

A mandatory implementation date for the application of the uncertainty requirements in specification S-S-02 for the verification or reverification of the meters identified in 4.3 has not been set at this time.

#### 4.3.2 Acceptance Sampling

Acceptance sampling is not currently authorized for hybrid-type electricity meter types or other electricity meters not identified in sections 4.1 to 4.2. Once MC has authorized revised meter specification requirements in S-E-02 to support the use of acceptance sampling under S-S-04, Accredited Meter Verifiers (AMVs) may then submit a request to MC for expansion of scope of their accreditation program to implement acceptance sampling using the new specifications in S-S-01, S-S-03 and S-S-04.

#### 4.3.3 Compliance Sampling

Compliance sampling inspection is not currently authorized for hybrid-type electricity meter types or other electricity meters not identified in sections 4.1 to 4.2. Once MC has authorized revised meter specification requirements in S-E-02 (required to support the use of compliance sampling specifications currently under development), AMVs may then submit a request to MC for expansion of scope of their accreditation program to implement compliance sampling for the reverification of these meters.

#### 4.3.4 100% Inspection

**4.3.4.1**
Use of the existing inspection method under S-E-02 (with the exception of Annex A) for the verification or reverification of the aforementioned meters by 100% inspection shall continue until MC has authorized revised meter specification requirements in S-E-02 required to support the use of measurement uncertainty in conformity assessment of the aforementioned meters.

## 5.0 Implementation Schedule for Gas Meters

### 5.1 Diaphragm Meters

#### 5.1.1 Measurement Uncertainty Specifications - S-S-02

**5.1.1.1**
Prior to the implementation of 100% inspection or acceptance sampling of the meters identified in 5.1, all of the associated measurement uncertainties (i.e. those associated with the measuring apparatus, proving process, and meter) must first be determined, as per the requirements of S-S-02 and the guidelines in Bulletin S-01. Where such measurement uncertainty values have not been determined, gas organizations will need to implement the following default uncertainty value:

- Default combined uncertainty value (i.e. based on 1 standard deviation) is 0.267% and the extended values are 0.44% (k = 1.6449) and 0.80% (k = 3.0000). The application of this value results in a test limit (TL) value of +/- 0.80% and under sampling inspection the uncertainty value of 0.44% applies.

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| | Supersedes: **S-02 (rev. 3)** | |

**5.1.1.2**
Organizations may use the default uncertainty value prescribed in 5.1.1.1 until the actual measurement uncertainty values are determined and authorized by MC. Once the actual measurement uncertainty value is authorized, this value shall be used for meter verification or reverification.

### 5.1.2 Meter Verification and Reverification Specifications - S-G-02

**5.1.2.1**
The applicable requirements in specification S-G-02 (related to the use of the new specifications in S-S-01, S-S-03 and S-S-04) for the meters identified in 5.1 is mandatory effective July 1st, 2008.

**Note:** Throughout this document, S-G-02 refers to the latest published version of that document.

**5.1.2.2 Median Absolute Deviation from Target (MADT) Limit**

The applicable MADT limit value specified in S-G-02 section 6.3.9.2 for 100% inspection of large diaphragm gas meters is 0.80 until December 31st, 2015. On January 1st, 2016, the MADT limit value of 0.60 shall apply.

### 5.1.3 Acceptance Sampling

**5.1.3.1**
Use of specifications S-S-01, S-S-03, and S-S-04 is mandatory effective July 1st, 2008.

**5.1.3.2**
Prior to implementation of acceptance sampling for the aforementioned meters, all of the associated measurement uncertainties (i.e. those associated with the measuring apparatus, proving process, and meter) must first be determined, as per the requirements of S-S-02 and the guidelines in Bulletin S-01. The measurement uncertainty requirements of S-S-02 shall be implemented as prescribed in section 5.1.1.

### 5.1.4 Compliance Sampling

**5.1.4.1**
As of January 1st, 2011, S-S-06 may be applied for the reverification of diaphragm gas meters by compliance sampling. Alternatively, LMB-EG-04 may continue to be used for the reverification of the aforementioned meters until December 31st, 2013. As of January 1st, 2014, LMB-EG-04 will be rescinded and S-S-06 will be the only specification authorized for use in the inspection of isolated lots of meters in service.

**5.1.4.2**
A mandatory implementation date for the application of the uncertainty requirements in specification S-S-02 for the reverification of the aforementioned in-service meters by compliance sampling has not been set at this time.

### 5.1.5 100% Inspection

**5.1.5.1**
Application of the specifications S-G-02 and S-S-02 for 100% inspection of the meters identified in 5.1 is mandatory effective July 1st, 2008.

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| | Supersedes: **S-02 (rev. 3)** | |

### 5.2 Other Gas Meters

#### 5.2.1 Measurement Uncertainty Specifications - S-S-02

**5.2.1.1**
Prior to the implementation of 100% inspection or acceptance sampling of the meters identified in 5.2, all of the associated measurement uncertainties (i.e. those associated with the measuring apparatus and meter) must first be determined, as per the requirements of S-S-02 and the guidelines in Bulletin S-01.

**5.2.1.2**
The determination of the measurement uncertainties for the gas measuring apparatus established pursuant to the specifications in S-S-02 required to support the verification or reverification of the aforementioned meters shall be completed and the actual measurement uncertainty values authorized by MC.

#### 5.2.2 Acceptance Sampling

Acceptance sampling is not currently authorized for gas meters not identified in section 5.1. Once MC has authorized revised meter specification requirements in S-G-02 to support the use of acceptance sampling under S-S-04, AMVs may then submit a request to MC for expansion of scope of their accreditation program to implement acceptance sampling using the new specifications in S-S-01, S-S-03, and S-S-04.

#### 5.2.3 Compliance Sampling

Compliance sampling inspection is not authorized for meter types other than diaphragm meters. Once MC has authorized revised meter specification requirements in S-G-02 to support the use of compliance sampling specifications, AMVs may then submit a request to MC for expansion of scope of their accreditation program to implement compliance sampling for the reverification of these meters.

#### 5.2.4 100% Inspection

**5.2.4.1**
AMVs may continue to use 100% inspection methods, for which they are accredited, for the purposes of verification or reverification of the aforementioned meters until MC has authorized revised meter specification requirements in S-G-02 (required to support the use of the 100% inspection and/or sampling specifications in S-S-04) for the aforementioned meters.

**5.2.4.2**
A mandatory implementation date for the application of measurement uncertainty in conformity assessment of the aforementioned meters by 100% inspection has not been set at this time. The applicable implementation date will be established to coincide with the effective date of the revised meter specification requirements in S-G-02 (required to support the use of the 100% inspection and/or sampling specifications in S-S-04) for the aforementioned meters.

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| | Supersedes: **S-02 (rev. 3)** | |

**6.0 Measurement Canada Inspections**

**6.1 Electricity and Gas Measurement Dispute Investigation Procedure**

**6.1.1 Measurement Uncertainty Specifications - S-S-02**

**6.1.1.1**
A mandatory implementation date for the application of the measurement uncertainty requirements, at the operational location, in specification S-S-02 for the dispute investigation procedure identified in 6.1, has not been set at this time. The applicable implementation date for S-S-02, regarding the operational location, will be established to coincide with the effective date of the revised meter verification specifications in S-E-02 or S-G-02 (required to support the use of sampling and/or 100% inspection) for the aforementioned meters.

**6.1.1.2**
Prior to the implementation of the dispute investigation procedure, all of the associated system measurement uncertainties (i.e. those associated with the measuring apparatus and an ideal meter) must first be determined, as per the requirements stipulated in sections 4.1.1, 4.2.1, 4.3.1, 5.1.1, and/or 5.2.1.

**6.1.1.3**
The determination of the measurement uncertainty for each apparatus established pursuant to the specifications in S-S-02 (i.e. those associated with the measuring apparatus and an ideal meter) required to support the dispute investigation of the aforementioned meters, shall be completed and authorized by MC by date stipulated in section 4.1.1, 4.2.1, 4.3.1, 5.1.1, and/or 5.2.1.

**6.1.1.4**
The method of determination of the combined measurement uncertainty of the meter calibration result established pursuant to the specifications in S-S-02 (i.e. those associated with the measuring apparatus and meter) required to support the dispute investigation of the aforementioned meters shall be completed and authorized by MC by the date stipulated in section 4.1.1, 4.2.1, 4.3.1, 5.1.1, and/or 5.2.1.

**6.1.1.5**
The scope of application of measurement uncertainty in dispute investigations will only apply to the meter verification compliance assessment portion and not to the dispute specification compliance assessment.

**6.1.2 Dispute Investigation - Electricity**

**6.1.2.1**
Use of S-E-02 (with the exception of Annex A) and P-EG-01 may continue to be used for the dispute investigation procedure until the applicable date stipulated in section 4.1.4, 4.2.4, and/or 4.3.4. Application of the specification S-E-02 (including Annex A) and P-EG-01 for the dispute investigation procedure, is effective July 1st, 2009. The applicable date stipulated in section 4.1.4, 4.2.4, and/or 4.3.4 falling after July 1st, 2009 shall apply.

**6.1.2.2**
Subject to section 6.1.1.1, application of the uncertainty requirements in specification S-S-02 for the dispute investigation procedure is effective July 1st, 2009. The date stipulated in section 4.1.4, 4.2.4, and/or 4.3.4, falling after July 1st, 2009 shall apply.

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| | Supersedes: **S-02 (rev. 3)** | |

### 6.1.3 Dispute Investigation - Gas

**6.1.3.1**
Existing 100% inspection methods and P-EG-01 may continue to be used for the purposes of the dispute investigation procedure until the applicable date stipulated in section 5.1.5 and/or 5.2.4. Application of the specification S-G-02 and P-EG-01 for the dispute investigation procedure, is effective October 1st, 2008. The applicable date stipulated in section 5.1.5 and/or 5.2.4, falling after October 1st, 2008 shall apply.

**6.1.3.2**
Subject to section 6.1.1.1, application of the uncertainty requirements in specification S-S-02 for the dispute investigation procedure is effective October 1st, 2008. The date stipulated in section 5.1.5 and/or 5.2.4, falling after October 1st, 2008 shall apply.

## 7.0 Revisions

The purpose of this revision is to:

- Include the Compliance Sampling Specification S-S-06 for the Inspection of Isolated Lots of Meters in Service.

- Include the implementation plan for S-S-06 as previously published in an Information Bulletin.

- Include the application of measurement uncertainty to electromechanical electricity meters.

The following changes were made in revision 3:

- Title and sections 1.0, 4.0 and 5.0 : amended bulletin title. Added MC web-site to section 1.0. Various format changes and grammatical amendments to sections 4.0 and 5.0.

- Sections 4.1.1, 4.2.1, 4.3.1, 5.1.1.1 (first paragraph) and 5.2.1: separated the date when the value of uncertainty is to be expressed vs. the application of that value for conformity assessment.

- Sections 4.1.4, 4.2.4, 4.3.4, 5.1.5 and 5.2.4: added new sections to clarify the verification and reverification of meters by 100% inspection.

- Sections 4.1.2, 4.1.3 and 4.1.4: for the identified electromechanical electricity meters, clarified the use of existing specifications and the application of measurement uncertainty.

- Sections 4.2.2, 4.2.3, 4.2.4: for the identified electronic electricity meters, revised the implementation dates to April 1st and July 1st, 2009; and clarified the use of existing specifications and the application of measurement uncertainty.

- Sections 4.3.2, 4.3.3 and 4.3.4: for the identified electronic electricity meters, clarified the use of existing specifications and the application of measurement uncertainty.

- Section 5.1.1.2: for gas diaphragm meters, revision to the default end date - may be used until the time when the actual measurement uncertainty values are determined and authorized by MC.

- Sections 5.1.2, 5.1.3, 5.1.4 and 5.1.5: for the identified gas meters, clarified the use of existing specifications and the application of measurement uncertainty. Section 5.1.3 the January 1, 2007 acceptance sampling implementation date was removed as it has no purpose. Section 5.1.4 compliance sample implementation date removed as the actual date is to be determined.

| | | |
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- Section 5.2.2, 5.2.3 and 5.2.4: for the identified gas meters, clarified the use of existing specifications and the application of measurement uncertainty.

- Section 6.0, added new section to address Investigations of Electricity and Gas Measurement Disputes by Inspectors of MC. Section 6.1.1 clarified the application of the uncertainty requirements, at the operational location. Renumbered "Revision" section to 7.0.

### 8.0 Additional Information

For additional information regarding this bulletin, please contact the Senior Program Officer responsible for statistical methods. For more information regarding Measurement Canada and its programs, visit our website located at http://mc.ic.gc.ca.

Gilles P. Vinet
Vice-President
Program Development Directorate

**Project Title:** Replace Excavator

**Location:** L'anse Au Loup

**Category:** Transmission and Rural Operations – Tools and Equipment

**Definition:** Other

**Classification:** Normal

**Project Description:**

The scope of this work is to replace V7780, a 1992 model, mid-size excavator, stationed in L'anse Au Loup. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 110.0 | 0.0 | 0.0 | 110.0 |
| **Labour** | 0.2 | 0.0 | 0.0 | 0.2 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **O/H, AFUDC & Escln.** | 4.3 | 0.0 | 0.0 | 4.3 |
| **Contingency** | 5.5 | 0.0 | 0.0 | 5.5 |
| **TOTAL** | **120.0** | **0.0** | **0.0** | **120.0** |

**Operating Experience:**

Heavy duty equipment is a standard component of any electric utility maintenance fleet used to maintain transmission or distribution lines and access trails in remote areas. The replacement criterion across the Canadian Utility Industry varies depending on location, exposure to harsh environmental conditions, and the number of service hours for the equipment. Generally this type of equipment is replaced within 15 to 20 years depending on its functionality and condition. The criteria utilized by Hydro is to consider replacement for units which are 15 years old based upon an evaluation of maintenance costs and technological advances.

Mid-size excavators such as V7780, have an average life expectancy which ranges from 15 to 20 years, dependent on location and usage. This unit will be 20 years old at time of replacement. This unit it utilized extensively for pole hole excavation and pole erection by the distribution line crews in their daily work assignments. The present unit does not comply with the new Occupational Health and

Safety (OH&S) regulations for the requirement of holding valves on equipment used to place Hydro poles. Holding valves cannot be installed on Unit No. 7780. The regulations state:

> *Section 479(c). Poles shall be installed or removed using equipment manufactured for this purpose or by a method acceptable to the Minister.*

Since 1992, technological improvements in cab design have reduced the noise and heat levels in the cab. Safety improvements include interlocks on the doors, to prevent operation of the unit with the doors open, an automatic braking system and integral holding valves to prevent boom drop while erecting transmission and distribution poles.

Hydro maintains 3,742 kilometers of transmission lines and 3,334 kilometers of distribution lines throughout Newfoundland and Labrador, much of which is located in remote areas that are inaccessible to wheeled vehicles. Heavy off-road track equipment is essential to the line crews in accessing these lines for inspections and to perform planned or emergency maintenance.

Hydro operates in many diverse locations across the province. This equipment is an essential maintenance tool to provide timely economical and reliable electricity support to ongoing operations. Replacement units are now certified Tier 3 for emission compliance. Tier 3 is a standard to regulate sulfur emissions from diesel engines. The regulations promulgated in February 2005 by Environment Canada, introduced emission standards for model year 2006 and later diesel engines used in off-road applications. The Canadian Off-Road Compression-Ignition Engine Emission Regulations align the engine certification values with those of the US EPS Tier 2 and Tier 3 values.

**Project Justification:**

The project provides for the normal replacement of a mid-size excavator due to its age and condition because of its hours of service operations in rough terrain. Excavators are an integral part of the line crew equipment and are utilized extensively for pole hole excavation and pole erection by the distribution line crews in their daily work assignments. The present unit does not comply with the new regulations for the requirement of holding valves on equipment used to place Hydro poles. Technological improvements in cab design have reduced the noise and heat levels in the cab. Safety improvements include interlocks on the doors, to prevent operation of the unit with the doors open,

an automatic braking system and integral holding valves to prevent boom drop while erecting Hydro poles.

A cost benefit analysis (CBA) was performed to determine whether the unit should be replaced or overhauled. Table 2 shows the results of the CBA and indicates that it is more cost effective to replace excavator V7780 than to overhaul it.

**Table 2: Cost Benefit Analysis**

| **Replace Excavator V7780** | | |
|---|---|---|
| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2015** | | |
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Replace Unit<br>Overhaul | 55,371<br>97,705 | 0<br>42,334 |

This project is scheduled to be completed by December 2012.

**Future Plans:**

Newfoundland and Labrador Hydro's Transportation Department will continue to replace light duty mobile equipment as per Hydro's replacement criteria.

**Project Title:** Perform Front End Engineering Design for Diesel Plant Remediation

**Location:** Various Sites

**Category:** Transmission and Rural Operations - Generation

**Definition:** Other

**Classification:** Normal

**Project Description:**

A review of arc flash hazard analysis assessment reports in conjunction with available condition assessment reports will be completed to determine what type of remedial actions are required to address the reported arc flash hazards and building condition issues. The operations group will develop a Front End Engineering Design (FEED) and plan for remedial works with a recommended remediation scheduled to start in 2013. FEED is an approach used to evaluate and analyze existing conditions, in this case arc flash hazards and building conditions, to develop a strategy for corrective measures. Based on the hazards indicated in arc flash hazard analysis reports and the deficiencies indicated in the building condition reports and from FEED, a long term prioritized remediation program will be developed to correct the identified arc flash and building condition issues.

An electrical arc is the result of air being stressed beyond its insulating ability, ionizing and allowing current to flow. When an arc occurs in an industrial electrical system, the release of energy is called an arc flash. The heat energy from an arc flash incident can cause severe burns and the ignition of clothing. An arc flash hazard analysis report summarizes the calculated arc flash incident energy levels and arc flash boundaries for each simulated plant operating condition. Highlighted in arc flash hazard analysis reports are the maximum arc flash incident energy, the hazard risk categories and the maximum arc flash boundary within each diesel plant.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 39.0 | 0.0 | 0.0 | 39.0 |
| **Consultant** | 45.4 | 0.0 | 0.0 | 45.4 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 10.0 | 0.0 | 0.0 | 10.0 |
| **Interest and Escalation** | 7.8 | 0.0 | 0.0 | 7.8 |
| **Contingency** | 8.2 | 0.0 | 0.0 | 8.2 |
| **TOTAL** | **110.4** | **0.0** | **0.0** | **110.4** |

**Operating Experience:**

There are 15 diesel plants in Labrador that had arc flash hazard analysis assessments completed by Stantec and eight of these plants have also had a condition assessment completed by Hatch Limited. Some of the building condition issues reviewed by the consultant included clearance around equipment as per the Canadian Electrical Code, plant ventilation, adequate lifting devices, building egress as per the Life Safety Code and fire protection. Building condition deficiencies were noted at all plants reviewed by Hatch.

**Project Justification:**

This project is justified on the need to identify hazardous conditions and develop remedial actions to mitigate these hazards. Identified arc flash hazards and sub code conditions of many of the diesel plants in Labrador have been observed by operating staff and were assessed by Stantec and Hatch in 2009. Table 2 lists the diesel plants where arc flash hazard analyses and building condition assessments were completed by the consultants.

**Table 2: Consultant Reports**

| Location | Arc Flash Hazard Analysis | Condition Assessment |
|---|---|---|
| Black Tickle | Stantec – 2009 | Hatch - 2009 |
| Cartwright | Stantec – 2009 | |
| Charlottetown | Stantec – 2009 | Hatch - 2009 |
| Hopedale | Stantec – 2009 | |
| Makkovik | Stantec – 2009 | Hatch - 2009 |
| Marys Harbour | Stantec – 2009 | |
| Nain | Stantec – 2009 | |
| Normans Bay | Stantec – 2009 | Hatch - 2009 |
| Paradise | Stantec – 2009 | Hatch - 2009 |
| Postville | Stantec – 2009 | Hatch - 2009 |
| Rigolet | Stantec – 2009 | Hatch - 2009 |
| Williams Harbour | Stantec – 2009 | Hatch - 2009 |
| St. Lewis | Stantec – 2009 | |
| L'Anse au Loup | Stantec – 2009 | |
| Happy Valley | Stantec – 2009 | |

A review of the consultant reports by operations staff is required to determine which plants require remediation to address these documented condition issues and arc flash hazards, and to develop the appropriate remediation design for each plant.

**Future Plans:**

Implement recommendations from this operations development plan over a recurring capital program starting in 2013. It is anticipated that remediation works will cost approximately $300,000 to $400,000 per site with two sites completed per year.

**Project Title:** Upgrade Mechanical Workshop

**Location:** St. Anthony

**Category:** Transmission and Rural Operations - Properties

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to complete structural upgrades to the Mechanical Workshop, located at Hydro's St. Anthony Depot. Upgrades include reinforcement of the building's roof beams, roof deck, deck supports, and end wall supports. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 17.5 | 0.0 | 0.0 | 17.5 |
| **Consultant** | 3.0 | 0.0 | 0.0 | 3.0 |
| **Contract Work** | 50.0 | 0.0 | 0.0 | 50.0 |
| **Other Direct Costs** | 5.3 | 0.0 | 0.0 | 5.3 |
| **Interest and Escalation** | 3.6 | 0.0 | 0.0 | 3.6 |
| **Contingency** | 7.6 | 0.0 | 0.0 | 7.6 |
| **TOTAL** | **87.0** | **0.0** | **0.0** | **87.0** |

**Operating Experience:**

In 2009, a new 9 meter x 15 meter maintenance shop was constructed adjacent to an existing 9 meter x 10 meter mechanical workshop, at Hydro's St. Anthony Depot. The new building was constructed to serve as an extension to the original workshop. The two buildings are located two meters apart and are connected by an access enclosure. See Figure 1 for a layout view of this area. The new maintenance shop is 8.4 meters high and is approximately twice the height of the existing mechanical workshop.

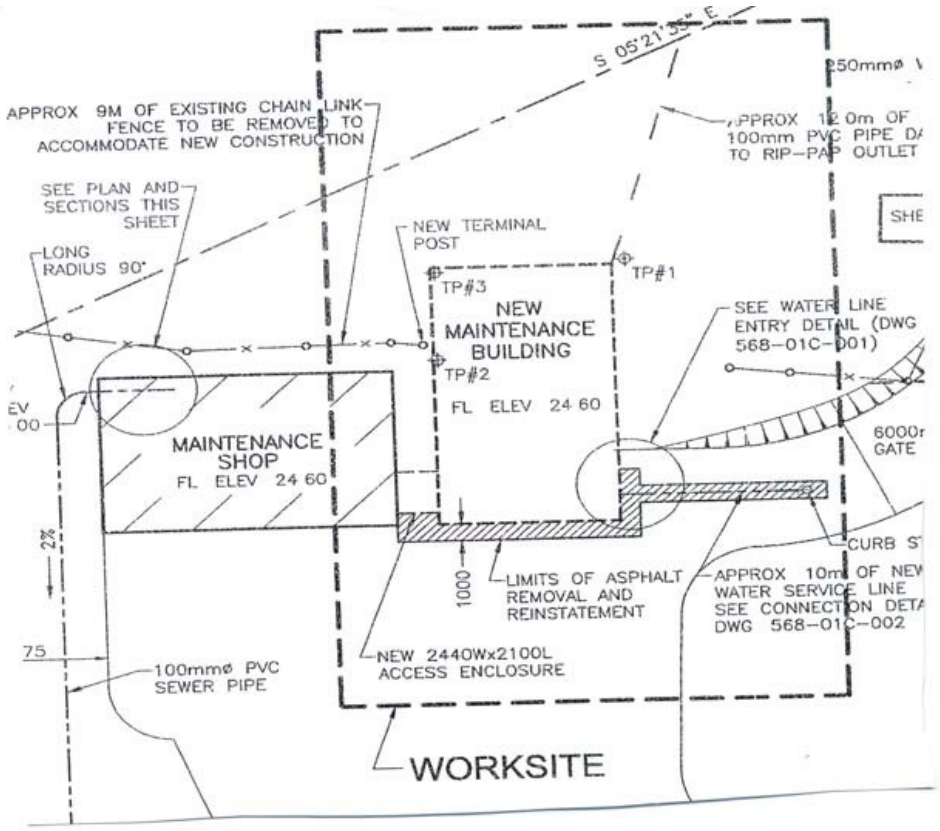


**Fig. 1: Building Arrangement**

It was anticipated at the time of construction of the new maintenance shop that snow loading would increase on the existing mechanical workshop. The increased snow load is a result of changes to the snow distribution created by the new building arrangement (See Figure 2). The contract, in 2009, to construct the new maintenance shop stipulated that the successful vendor (Brook Construction (2007) Inc.) obtain the services of a Professional Engineer(CBCL Limited) to complete a structural assessment of the old mechanical workshop. A copy of this report is included in Appendix A. The assessment would highlight any deficiencies in the workshop's structure and make recommendations for upgrades to ensure compliance with National Building Code of Canada, 2005 Structural Commentaries (Part 4 of Division B) and CAN/CSA S16-01, Limit States Design of Steel Structures.

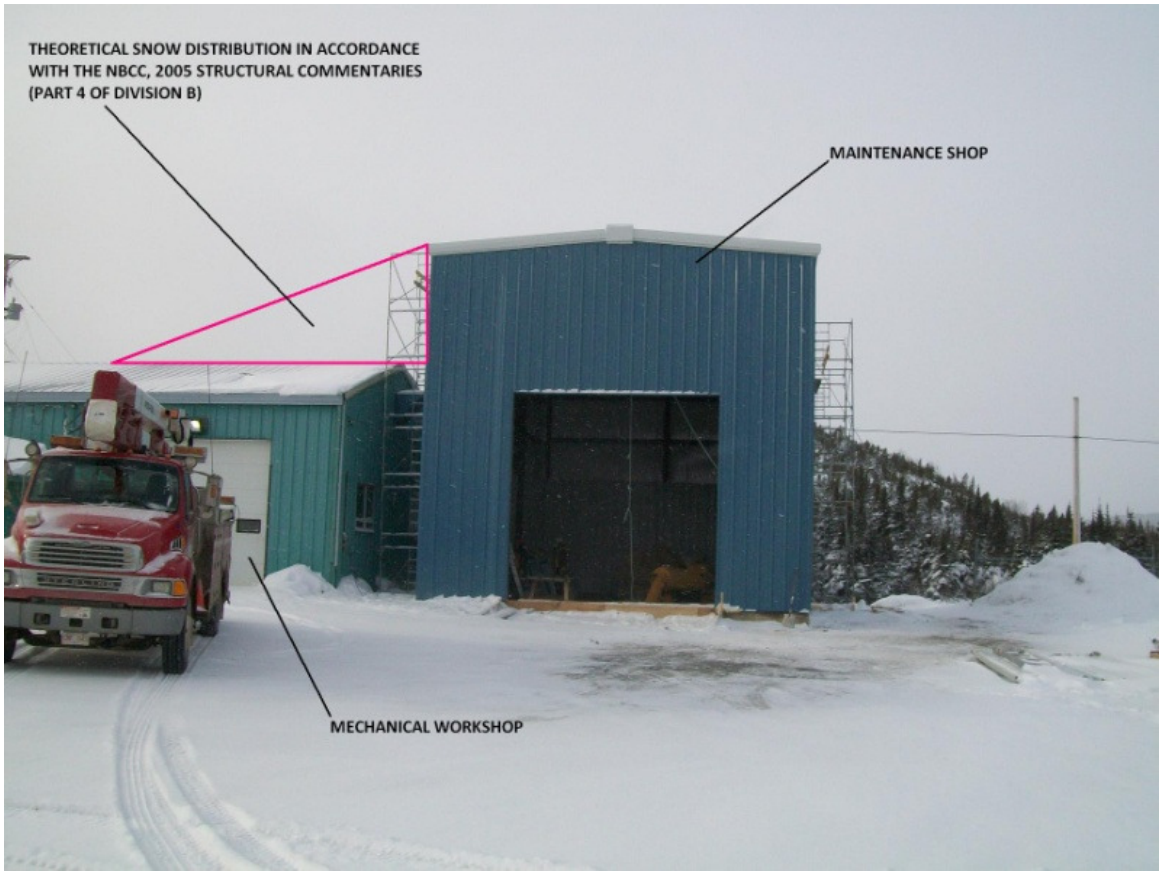


**Fig. 2: Snow Load Distribution**

The original mechanical workshop was constructed in 1970. The steel support members, that comprise the building's structure, are thin, by today's industry standards, making the welding of reinforcement plates both difficult and expensive. Consequently, the scope of work to complete the required structural upgrades has changed. The 2009 contract stipulated a $10,000 allowance to complete the recommended upgrades, however, the cost to complete the work turned out to be much greater than was originally estimated. Therefore the $10,000 was not spent as the scope and magnitude of the required work far exceeded the specified allowance.

After reviewing the preliminary structural assessment, Hydro engaged Parsons Engineering Consultants Limited to verify the findings of the assessment and generate a design concept for the required structural upgrades. A copy of the structural assessment review findings and design concept sketches are contained in Appendix B.

**Project Justification:**

An independent review completed by Parsons Engineering Consultants Limited confirmed that the construction of the new maintenance shop has increased snow loading on the mechanical workshop. As a result, the workshop does not meet the current design requirements, as specified in the National Building Code of Canada, 2005 Structural Commentaries (Part 4 of Division B) and CAN/CSA S16-01, Limit States Design of Steel Structures, see Appendix C. The consultant recommends that upgrades be completed to strengthen the building's roof beams, roof deck, deck supports and end wall framing members to bring the structure in compliance with National Building Code standards. The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Design Transmittal Development and Scheduling | May 2012 | May 2012 |
| Design | Tender Package Preparation | May 2012 | June 2012 |
| Procurement | Tendering and Steel Procurement | June 2012 | August 2012 |
| Construction | Completion of Structural Upgrades | September 2012 | September 2012 |
| Commissioning | Inspection of Work by Design Engineer | September 2012 | September 2012 |
| Closeout | Contract Closeout | October 2012 | October 2012 |

**Future Plans:**

None.

**APPENDIX A**

**CBCL LIMITED STRUCTURAL ASSESSMENT REPORT**




Front

Project No. 093096.00

# STRUCTURAL ANALYSIS
# EXISTING MAINTENANCE SHOP
## ST. ANTHONY, NL

December , 2009

Prepared for:

**ELITE BUILDERS LTD.**
**c/o BROOKS CONSTRUCTION**
90-92 North Street
P.O. Box 813
St. Anthony, NL
A0K 4S0

On behalf of:

**NL HYDRO**




Side




Presented by:

CBCL LIMITED
Consulting Engineers

38 Main Street, 2nd Floor
P.O. Box 428
Corner Brook, NL A2H 6E3
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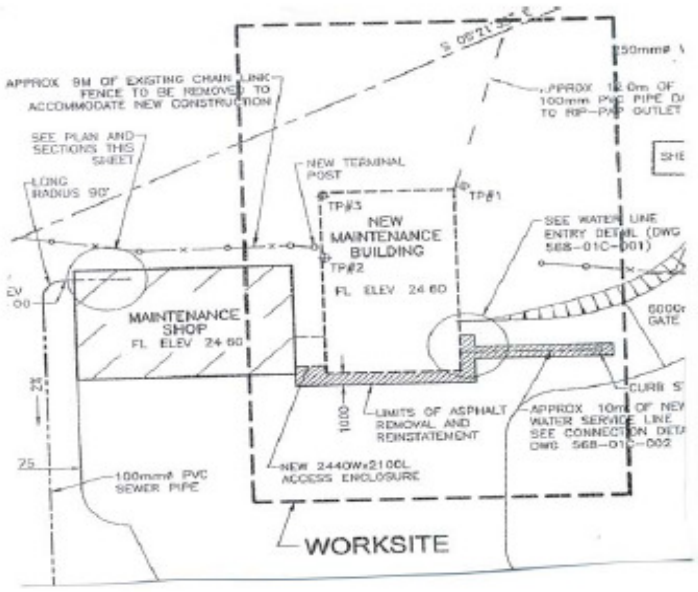
## 1.0 Introduction

In 2009, Newfoundland and Labrador Hydro (NLH) decided to construct a new maintenance shop in St. Anthony, NL. It is located at the entrance to the Town of St. Anthony at its power house site. The new building will be located adjacent to its existing maintenance garage, connected via access enclosure as shown on the partial site plan.




The Tender was issued on June 26, 2009. The scope of the Tender and Contract, comprises of the supply of the labour, construction plant and material necessary to construct the work identified and described in the specifications, including but not limited to:

- Completion of required site works
- Supply and placement of required structural fill material
- Design, supply and installation of concrete foundations
- Design, supply and installation of concrete floor slab
- Design, supply and erection of metal building
- Supply and installation of building access enclosure
- Supply and installation of rolling insulated service doors
- Supply and installation of hollow metal insulated personnel doors
- Supply and installation of building electrical components
- Supply and installation of building mechanical components
- Supply and installation of building asphalt concrete pavement

- Supply and installation of water service line
- Completion of a structural analysis on the existing maintenance building and the preparation of a detailed report, outlining the findings
- Completion of structural modifications to existing maintenance building as deemed necessary by the Owner, based on the report findings

The tender for the Construction Contract was awarded to Brook's Construction Limited (BCL) of Corner Brook, NL. BCL, then subcontracted the construction work to Elite Builders Ltd. (EBL) of St. Anthony, NL.

One of the work items associated with the contract was the completion of a Structural Analysis on the existing maintenance building and the preparation of a detailed report. To complete this work, EBL contracted a Consulting Engineering Company in Corner Brook, NL., CBCL Limited.

CBCL Limited is based in Halifax, Nova Scotia, since 1955 and with over 220 professional engineers, technologists, environmental scientists and support staff. CBCL has developed into one of the largest multidiscipline consulting firms in Atlantic Canada. Owned and managed by senior employees, CBCL Limited provides professional consulting services in the following engineering disciplines:

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- Mechanical
- Electrical/Instrumentation
- Civil
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CONSULTING ENGINEERS

- Industrial Services
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- Infrastructure Services

ENVIRONMENTAL SERVICES

- Planners
- Landscape Architects

PROJECT MANAGERS

- Construction Inspectors

With offices in:

Halifax (Head Office)
Sydney, NS
Charlottetown, PEI
Saint John, NB
Fredericton, NB
St. John's, NL
Corner Brook, NL
Happy Valley-Goose Bay, NL

Basically, the scope of the structural analysis is to determine the effects of any new snow loads, the existing structure may be subject to as a result of the construction of the new building and provide recommendations, as to modifications required, if any, on the existing structure to withstand the loads.

## 2.0 Existing Maintenance Building

The existing structure is a pre-engineered metal building system with concrete foundations and slab-on-grade concrete floor. It measures 14.680meters (48 feet) long by 9.150 meters (30 feet) wide. It has a height of approximately 4.200 meters (14 feet) high with a slope of 18 degrees (4:12).

The metal building system basically consists of:

- 38mm (1.5 inch) thick metal roof deck
- Approximately 76mm wide, 229mm deep, 3.2mm thick steel cold formed C-channels roof purlins
- Two (2) end-wall frames consisting of cold formed steel C-channel beams and columns. The column measures 76mm wide, 200mm deep and 3.2mm and beams measure 76mm wide, 229mm deep, 3.2mm.
- Approximately 76mm wide, 165mm high, by 3.2mm thick steel cold formed C-channel wall girts
- One center located steel W-shaped tapered rigid frame, sized from 305mm deep by 152mm wide at the bottom to 508mm deep by 152mm wide at the wall/roof intersection. The flange and web have an approximate thickness of 6.25mm (1/4") and 3.2mm (1/8") respectively.

The maintenance shed has a 2nd floor mezzanine level, consisting of electrician's office and lunch room. It also has a wood framed porch, measuring approximately 880mm (3 feet) wide by 3740mm (12 feet) long.

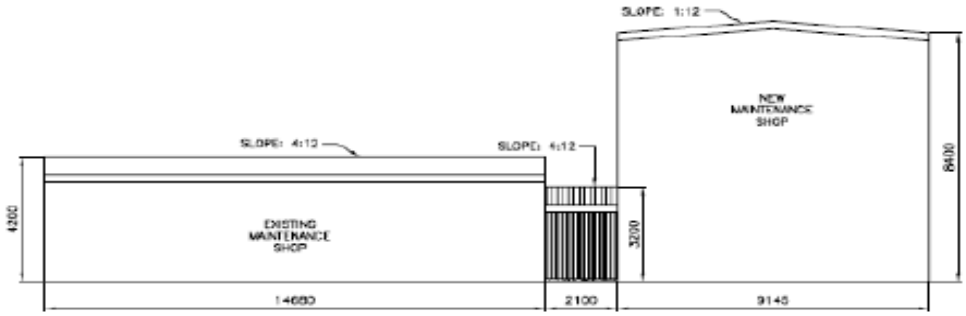


## 3.0 Structural Analysis

The National Building Code of Canada (NBCC 2005 Edition) and Handbook of Steel Construction will be utilized as the Standards and Guidelines for this analysis. In particular, Section 4 of the NBCC User's Guide – NBC 2005 Structural Commentaries (Part 4 of Division B) and CAN/CSA S16-01-Limit Status Design of Steel Structures.

As a result of constructing a new maintenance shed adjacent and linked to the existing, there are three (3) roofs at different elevations located as shown in Figure 1 below. Also, the highest roof (new construction) is sloped towards the two (2) lower roofs.

Figure 1.




This situation will cause higher snow loadings on the two (2) lower roofs. The revised snow load and its distribution is covered under paragraph 38, lower roof (figures G-5 and G-6) of the User's Guide. I have attached applicable pages to Appendix "C".

In summary, I have calculated the normal snow load in an exposed area with no other structures in close vicinity to be 3.66 KPa. Because of the snow drifting and location of the new building(s) it causes an increase triangular snow load distribution on the existing structure plus the entrance enclosure. The snow drift

would start at the base of the high building and extend 14.2 meters towards the existing structure. As a result the snow load uniformly increases from 3.66 KPa to a maximum of 10.9 KPa.

Therefore, at the end wall of the existing structure, 2.1 meters from the new building, the revised snow load would be 9.17 KPa and at the center rigid frame 5.18 KPa. In comparison to the normal snow load this is increases of 2.5 times and 1.6 times.

The next step was to utilize the increased loadings to analyze the existing structure for resistance and/or structural integrity. To do this, I utilized existing on-site measurements to identify structural steel members of similar size and capacity. The members and layout is shown in Appendix B.

The first analysis consisted of applying an average snow load of 7.49 KPa to the roof purlins that are spaced at 1.524 meters (5 feet) and span a length of 7.000 meters (23 feet). The analysis showed that the members are inadequate to resist the revised increased loads.

The second analysis consisted of applying an average snow load of 7.49 KPa to the existing end wall structure. Over a span of 3.500 meters (11.5 feet), the analysis showed that the existing members are inadequate to resist the revised increased loads.

The third analysis consisted of applying an average snow load of 7.49 KPa to the existing rigid frame, over a span of 7.000 meters (23 feet). The analysis showed that the existing members are inadequate to resist the revised increase load.

The last analysis was a repeat of the previous third ($3^{rd}$) but with the assumption that the spans of 3.500 meters and 7.000 meters would be half (0.5) on their values. This would be accomplished by designing and erecting new structural steel rigid frames. The analysis showed that the existing members were adequate to resist the revised increased loads.

## 4.0 Conclusions

CBCL Limited has completed the structural analysis of the existing maintenance shed in conformance with your contract requirements and the NBCC, 2005 Edition and CAN/CSA – S16, 1-94 latest editions. In association with this structural analysis, we have completed a visual on site investigation plus as-built measurements.

It has been determined that the existing structural steel is in good condition with only minor surface corrosion noted. However, because of the location of the new building construction, the snow loads are greatly increased on the existing building and entrance enclosure. For the enclosure, a snow load value of 10 KPa should be utilized. For the existing building, an average snow load of 7.49 KPa was used in the calculations.

As a result of the analysis, the existing structural frames and roofing members are inadequate to support the new revised, increased loadings.

## 5.0 Recommendations

CBCL Limited has completed some preliminary analysis to the existing structural system. Because the existing structural steel members are so thin (less than 5mm) welding reinforcement plates become very difficult and expensive. Plus, the amount of reinforcement required to increase the resistance, makes it impractical.

It is for this reason, that we recommend adding two (2) new structural steel rigid frames. The preliminary analysis shows that the revised structural system would adequately support the new increased revised roof loadings.

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# APPENDIX A




Photograph #1 – Front Of Existing Maintenance Shed




Photograph #2 – Right Side Of Existing Maintenance Shed




Photograph #2 – Left Side And Rear Of Existing Maintenance Shed




Photograph # 4 – Power House Site




Photograph #5 – Existing Site Location




Photograph #6 –Existing Site Location




Photograph #7 – End Wall




Photograph #8 – End Wall



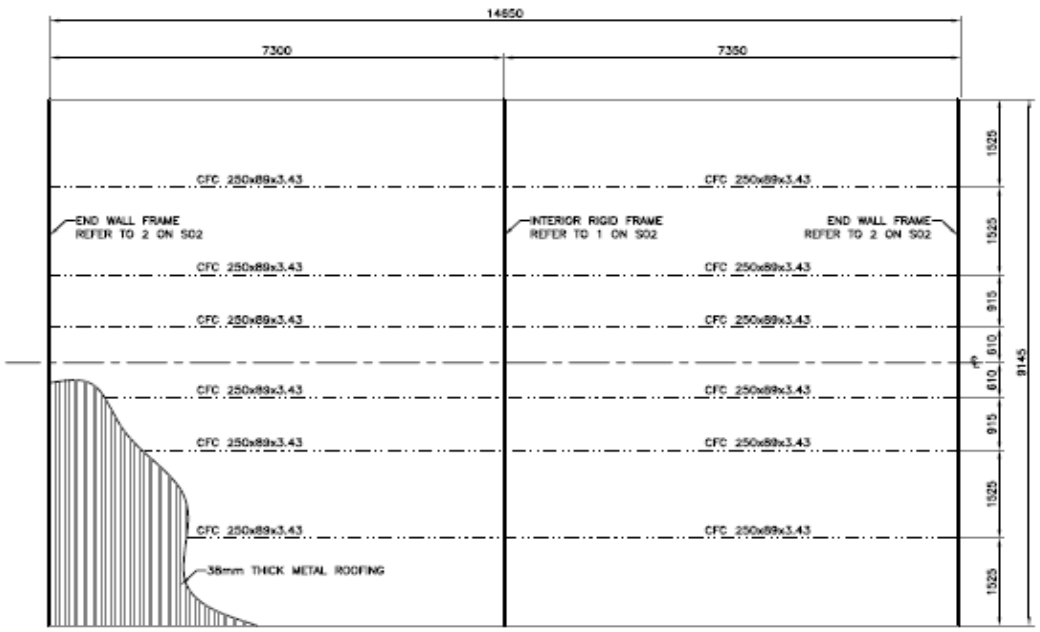

Photograph #9 – End Wall/Corner




Photograph #10 – Rigid Frame

15

# APPENDIX B




ROOF PLAN

SCALE: 1 : 50

1
S01

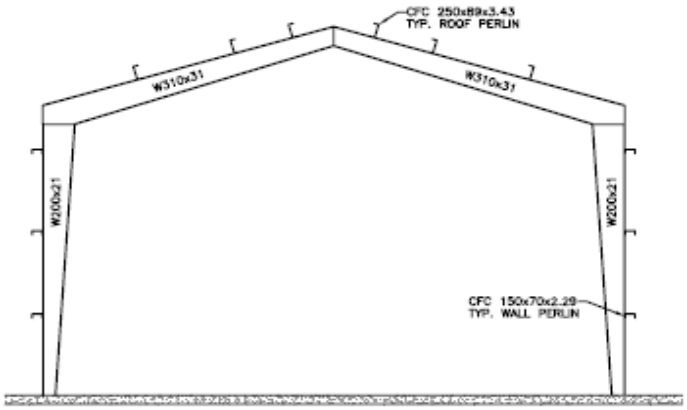
| Scale | Date | Designed | Checked | Approved | Project |
|---|---|---|---|---|---|
| AS SHOWN | DECEMBER 2009 | WP | CD | DR | 093096 |

CBCL LIMITED
Consulting Engineers

NEW MAINTENANCE BUILDING
NEWFOUNDLAND AND
LABRADOR HYDRO
ST. ANTHONY, NL

EXISTING ROOF PLAN

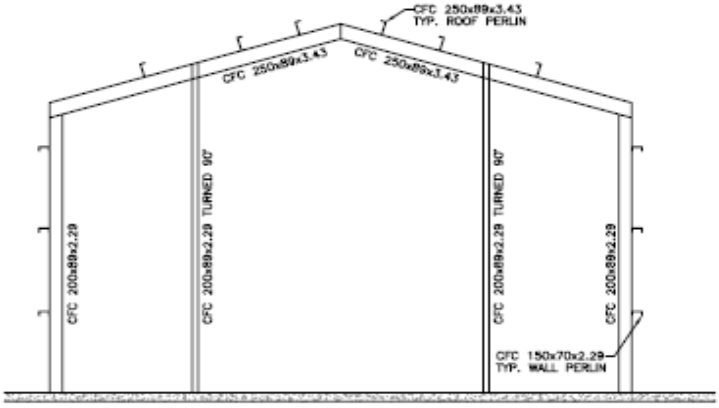
SKETCH No.S01




## INTERIOR RIGID FRAME SECTION

1 / S02

SCALE: 1 : 50




## END WALL SECTION

2 / S02

SCALE: 1 : 50

| Scale | Date | Designed | Checked | Approved | Contract |
|---|---|---|---|---|---|
| AS SHOWN | DECEMBER 2009 | WP | CD | DR | 093096 |

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NEWFOUNDLAND AND
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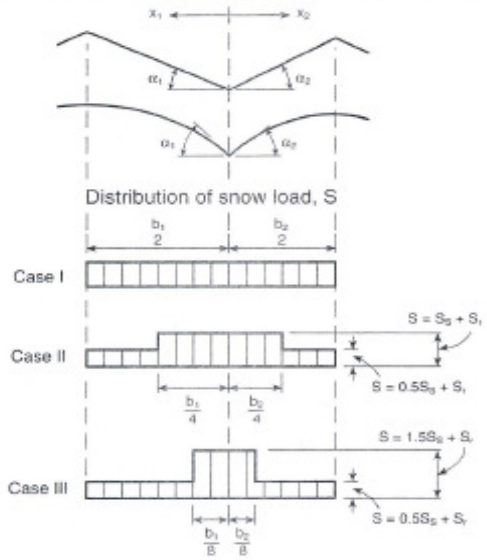
SECTIONS

SKETCH No. S02

16

# APPENDIX C

36. **Valleys in curved or sloped roofs (Figure G-4).** In the design of roofs with valleys, uniform loads and loads accounting for drifting, sliding or creep, and the movement of meltwater are important to consider. A reduction factor due to slope is allowed for Case I loading, because as the snow creeps down the slope and wrinkles and layers at the bottom of the valley, the loads on the upper slopes are reduced. Since Cases II and III describe the worst loads due to drifting and slope effects, the $C_s$ factor is taken as equal to 1.0.




| Load case | Roof slope α | Factors | | |
|---|---|---|---|---|
| | | $C_w$ | $C_s$ | $C_b$ |
| I | α ≤ 90° | 1.0[2] | f (α)[1] | 1.0 |
| II | 10° < α ≤ 90° | 1.0 | 1.0 | For 0 < x ≤ b/4: $C_a = 1/C_b$<br>For b/4 < x ≤ b/2: $C_a = 0.5/C_b$ |
| III | 10° < α ≤ 90° | 1.0 | 1.0 | For 0 < x ≤ b/8: $C_a = 1.5/C_b$<br>For b/8 < x ≤ b/2: $C_a = 0.5/C_b$ |

EG00552A

**Figure G-4**
**Snow distributions and snow loading factors for valley areas of roofs**

**Notes to Figure G-4:**
(1) Varies as a function of slope α as defined in NBC Sentence 4.1.6.2.(5).
(2) For Low and Normal Importance Category buildings, as described in NBC Sentence 4.1.6.2.(4), $C_s$ may be reduced to 0.75 or, in exposed areas north of the treeline, to 0.5.

37. **Multi-level roofs, obstructions and parapets.** Multi-level roofs, obstructions and parapets are all "bluff objects" creating turbulent wakes downwind where snow accumulates in drifts. Such objects can be considered as geometrical variations of a rectangular object situated on or adjacent to a lower flat roof. If the object is narrow and lower than the design depth of uniformly distributed snow on the roof, it is, for the purposes of this Commentary, a "non-obstructing" object; if higher, it is considered as an obstruction; if higher than a "non-obstructing" bluff object and wide enough to accumulate a significant amount of snow on its upper surface, it is considered as an "upper level" roof.

38. **Lower roofs (Figures G-5 and G-6).** The load distribution on roofs adjacent to higher ones is taken to be a triangular shape as illustrated in Figure G-5. Thus $C_a$ varies with distance x from the step in roof elevation, being $C_a(0)$ at x = 0 and decreasing linearly to a value $C_a(x_d)$ at the tail of the drift defined by $x = x_d$. The magnitude of the drift on the lower roof depends primarily on the amount of snow that can drift off the upper roof and be trapped in the step. Therefore the loading in the step tends to increase significantly as the size of the upper level roof increases.[17] For roofs with relatively small step heights and, in particular, for large roofs, the step can fill to the top. In this case $C_a(0)$ should be taken as:

$$C_a(0) = \gamma h / C_b S_s \qquad (2)$$

## Commentary G

where h is the difference in elevation between the lower roof surface and the top of the parapet on the upper roof, and $\gamma$ is the specific weight of snow. (Note that in the region of the drift, $C_w$ is 1.0, since the lower roof is sheltered by the roof step.) However, in many cases there may be insufficient snow to fill in the step. Therefore an upper limit on $C_a(0)$ equivalent to

$$C_a(0) = F/C_b$$

may be used, where the factor F is to be taken as the greater of

$$F = 2, \text{ or}$$
$$F = 0.35\left(\gamma l_c/S_s - 6\left(\gamma h_p/S_s\right)^2\right)^{0.5} + C_b$$

where $l_c$ is a characteristic length of a roof defined by

$$l_c = 2w - w^2/l$$

where w and $l$ are the shorter and longer dimensions of the roof plan form.

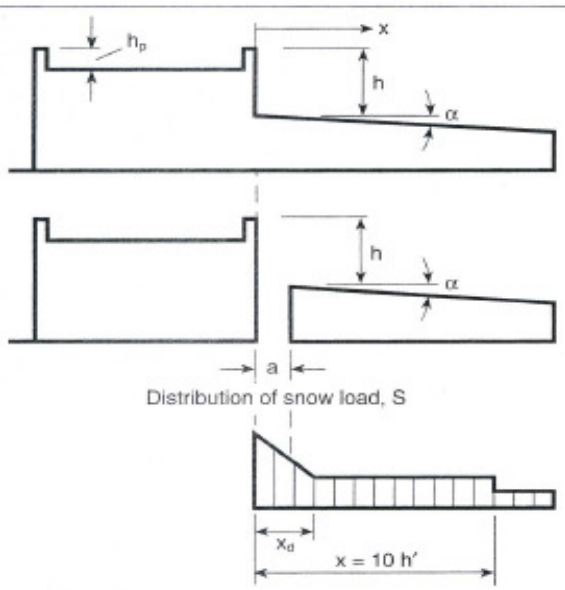
In Equation (4), $l_c$ for the upper roof is used, and $h_p$ is the height of the upper roof's parapet as illustrated in Figure G-5. In Equations (2), (3) and (4), and in the equation in NBC Sentence 4.1.6.2.(1), $C_b$ is the basic roof snow load factor applicable to the lower roof. Figure G-6 shows the variation of the factor F as a function of $\gamma l_c/S_s$. Background information on the derivation of Equation (4) is provided in Reference [17]. For buildings in sheltered locations (i.e. Exposure B or C as defined in Paragraphs 41 and 42 of Commentary I, Wind Load and Effects), an upper limit of 5.0 can be placed on the value of F, as shown in Figure G-6. The horizontal length $x_d$ of the drift extending out from the step should be based on the top surface of the drift having a 1:5 slope. This implies that

$$x_d = 5\left(h - C_b S_s/\gamma\right)$$

in cases where the step fills to the top, or

$$x_d = 5\left(S_s/\gamma\right)\left(F - C_b\right)$$

in cases where the drift is limited by other factors accounted for by Equation (4). The value of $C_b$ in Equations (6) and (7) is that applicable to the lower roof ($C_b$ is normally taken as 0.8 except where the plan dimensions of the lower roof are so large as to produce a value of $l_c$ for the lower roof exceeding 70 m, in which case a higher value of $C_b$ would apply as provided for in NBC Clauses 4.1.6.2.(2)(a) and (b)). Drifts deposited as a result of a change in elevation occur not only when the upper roof is part of the same building but also when it is on an adjacent building not more than 5 m away, as shown in Figure G-5. Where the upper roof is very large, the limiting gap, a, of 5 m should be confirmed by model tests. Where the drift obtained from Figure G-5 is longer than the lower roof, the drift should be truncated at the edge of the lower roof.




Value of $x_d$:
lesser of
$x_d = 5(h - C_b S_s/\gamma)$
and
$x_d = 5(S_s/\gamma)(F - C_b)$

Value of h′:

$$h' = h - \frac{C_b C_w S_s}{\gamma}$$

Value of $C_a(0)$:
lesser of
$C_a(0) = (\gamma h)/(C_b S_s)$
and
$C_a(0) = F/C_b$

| x | Factors[2] | | |
|---|---|---|---|
| | $C_w$ | $C_s$ | $C_a$ |
| 0 | 1.0 | f (α)[1] | $C_a(0)$ |
| $0 < x \le x_d$ | 1.0 | f (α)[1] | $C_a(0) - \frac{(C_a(0) - C_a(x_d))\,x}{x_d}$ |
| $x_d < x \le 10\ h'$ | 1.0 | f (α)[1] | 1.0 |
| $> 10\ h'$ | 1.0[3] | f (α)[1] | 1.0 |

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**Figure G-5**
**Snow distributions and snow loading factors for lower levels of adjacent roofs**

**Notes to Figure G-5:**

(1) Varies as a function of slope α as defined in NBC Sentences 4.1.6.2.(5) and (6).

(2) If $a > 5$ m or $h \le 0.8 S_s/\gamma$, drifting need not be considered. Where the upper roof is very large, the limiting gap, a, of 5 m should be confirmed by model tests.

(3) For Low and Normal Importance Category buildings, as described in NBC Sentence 4.1.6.2.(4), $C_w$ may be reduced to 0.75 or, in exposed areas north of the treeline, to 0.5.

**APPENDIX B**

**PARSON'S ENGINEERING CONSULTANTS LIMITED STRUCTURAL ASSESSMENT REVIEW AND DESIGN CONCEPT**

Parsons Engineering
CONSULTANTS LTD.

52 St. Anne's Crescent, Paradise, NL A1L 1K1
Tel: (709) 782-2882 Fax: (709) 782-8527
www.parsonsgroup.ca

15th March 2011

Mr. Matthew Leonard, P. Eng.
Civil Engineer
Project Execution & Technical Services
Newfoundland and Labrador Hydro
St. John's, NL

RE: (STA) St. Anthony Maintenance Shop Structural Analysis, St. Anthony, NL

Dear Mr. Leonard;

We write in repsect of the above captioned project. This is the preliminary report in arising from our assessment of the structural condition at the St. Anthony Maintenance Shop.

If you have any questions about any of the information contained the report, please contact the undersigned for clarification.

We would like to take this opportunity to thank you for inviting us to complete this work and remain,

Yours truly,

W.R. (Bill) Parsons, CD, P.Eng.
President

wparsons@parsonsgroup.ca
Direct: (709) 685-9343

REGISTERED PROFESSIONAL ENGINEER
William R. Parsons
11 Mar 2011
PROVINCE OF NEWFOUNDLAND

goanywhere. staysafe.

Parsons Engineering
CONSULTANTS LTD.

# Nalcor, NL Hydro

## Maintenance Shop, St. Anthony, NL

### INTRODUCTION

Parsons Engineering has been engaged to determine the structural condition of the maintenance shop at the Nalcor diesel generation facility, St. Anthony, NL.

The assessment includes a review of relevant expected loadings compared with the capacity of the modified structure to resist them together with commentary and recommendations.

Recommendations have been made based upon examination of all relevant information and are provided to give information pertaining to the ongoing use of the facility.

### SITE CONDITIONS

The maintenance shop was constructed prior to 2009, when a new maintenance building was built. The construction of the new maintenance building caused a change in the snow loading conditions for the shop as a result of its proximity and relative height. In December 2009, CBCL prepared a report for the contractor, which examined the snow load changes. It concluded that the normal snow load is 3.66kPa, with drifting effects added. CBCL's report states: "The snow drift would start at the base of the high [new] building and extend 14.2 metres toward the existing structure. As a result the snow load uniformly increases from 3.66kPa to a maximum of 10.9kPa." Therefore, the revised snow load would be 9.17kPa at the end wall frame adjacent to the new building, and 5.18kPa at the centre rigid frame of the old building.

CBCL recommended the addition of two new main frames to the building.

### COMMENTARY

We conducted a site visit in the fall of 2010. Based on the review, the addition of new frames as recommended by CBCL has the following disadvantages:

- It would interfere with the function of the building as the new frames would be located within the width of the overhead door, impeding its use,
- It would require substantial construction, particularly in respect of the foundation. Much of the interior structure and cladding would require removal and subsequent replacement in order to achieve the upgrading

- It would be more costly than other options of reinforcement.

In order to achieve compliance with the NBCC loading, we considered the following structural items to be assessed in supporting the loads:

- Roof deck panels, based on span between purlins
- Roof perlins, based on spacing and span between main frames/end wall frame,
- Main frame and end wall frame,
- Structure of porchway between the two buildings.

Each of these was considered with the idea of minimizing the demolition and reconstruction required.

**CONCLUSIONS & RECOMMENDATIONS**

It is concluded that the structure is not capable of supporting NBCC loadings on it satisfactorily; as such it requires structural improvements.

The following are the recommendations arising from the analysis and the conclusions:

1. Construct a load bearing wall, or, a centerline column at the center frame.
2. Create a truss structure within the end wall framing to increase its capacity.
3. Reinforce the existing perlins in the bay adjacent to the new building using the bolt-on method. (see attached sketch).
4. Add deck spacers (approximately 100mm deep) and a new layer of roof deck on the bay adjacent to the new building to create a 'sandwich' construction.
5. Some additional analysis is required to achieve 'for construction' details on the above recommendations.



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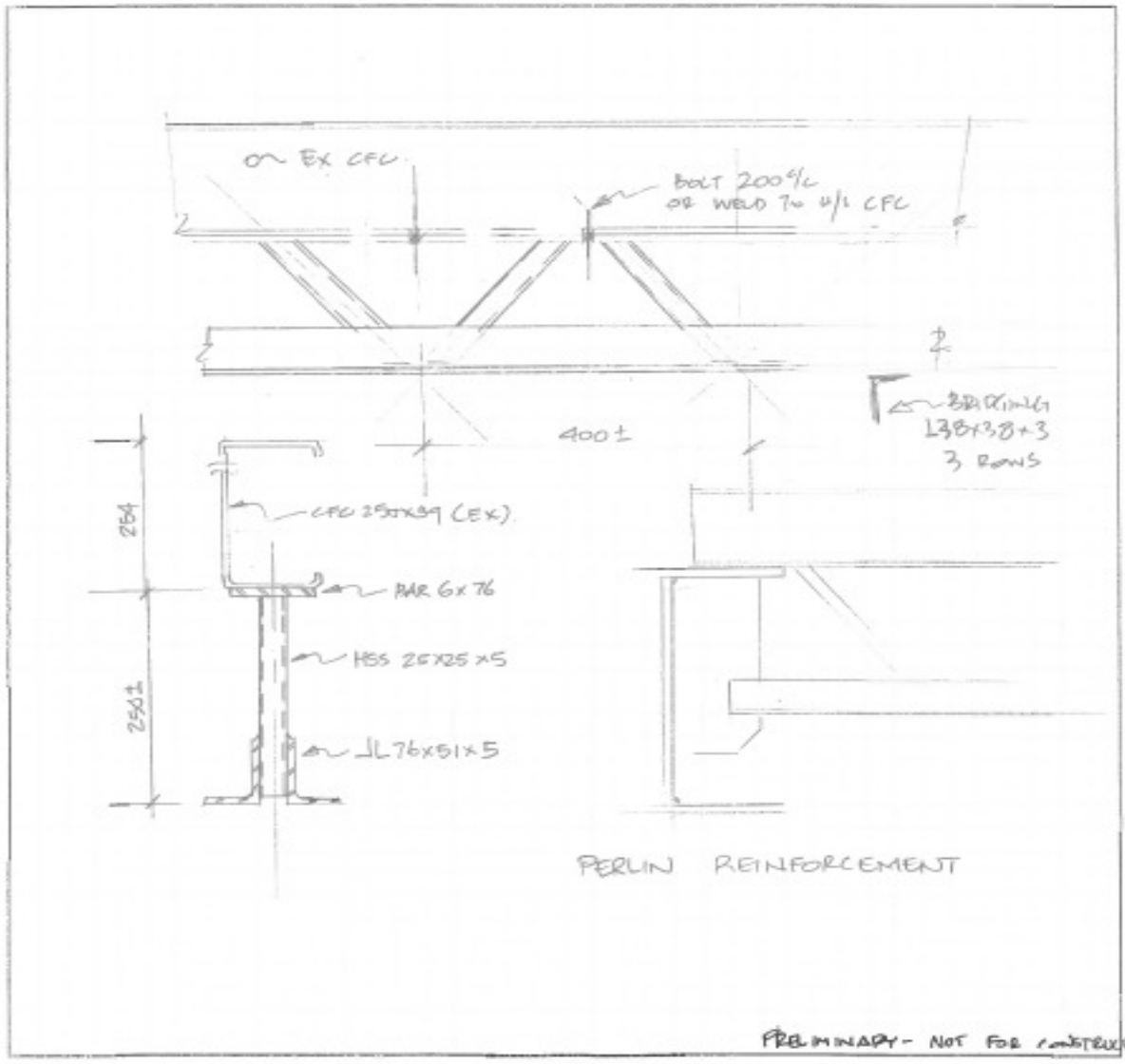
PROJECT: NALCOR ST ANTHONY
OUR FILE No.:
Page 3 of
DATE:
PREPARED BY:

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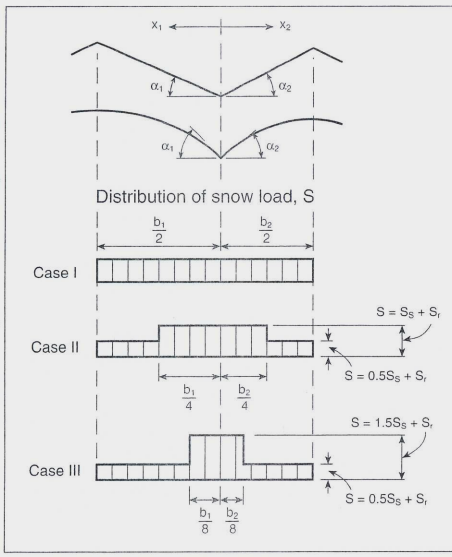
A Member of the Parsons Engineering Group

**APPENDIX C**

**NBCC, 2005 STRUCTURAL COMMENTARY**

36. **Valleys in curved or sloped roofs (Figure G-4).** In the design of roofs with valleys, uniform loads and loads accounting for drifting, sliding or creep, and the movement of meltwater are important to consider. A reduction factor due to slope is allowed for Case I loading, because as the snow creeps down the slope and wrinkles and layers at the bottom of the valley, the loads on the upper slopes are reduced. Since Cases II and III describe the worst loads due to drifting and slope effects, the $C_s$ factor is taken as equal to 1.0.




| Load case | Roof slope α | Factors | | |
|---|---|---|---|---|
| | | $C_w$ | $C_s$ | $C_a$ |
| I | $\alpha \le 90°$ | 1.0(2) | f (α)(1) | 1.0 |
| II | $10° < \alpha \le 90°$ | 1.0 | 1.0 | For $0 < x \le b/4$: $C_a = 1/C_b$<br>For $b/4 < x \le b/2$: $C_a = 0.5/C_b$ |
| III | $10° < \alpha \le 90°$ | 1.0 | 1.0 | For $0 < x \le b/8$: $C_a = 1.5/C_b$<br>For $b/8 < x \le b/2$: $C_a = 0.5/C_b$ |

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**Figure G-4**
**Snow distributions and snow loading factors for valley areas of roofs**

**Notes to Figure G-4:**
(1) Varies as a function of slope α as defined in NBC Sentence 4.1.6.2.(5).
(2) For Low and Normal Importance Category buildings, as described in NBC Sentence 4.1.6.2.(4), $C_w$ may be reduced to 0.75 or, in exposed areas north of the treeline, to 0.5.

37. **Multi-level roofs, obstructions and parapets.** Multi-level roofs, obstructions and parapets are all "bluff objects" creating turbulent wakes downwind where snow accumulates in drifts. Such objects can be considered as geometrical variations of a rectangular object situated on or adjacent to a lower flat roof. If the object is narrow and lower than the design depth of uniformly distributed snow on the roof, it is, for the purposes of this Commentary, a "non-obstructing" object; if higher, it is considered as an obstruction; if higher than a "non-obstructing" bluff object and wide enough to accumulate a significant amount of snow on its upper surface, it is considered as an "upper level" roof.

38. **Lower roofs (Figures G-5 and G-6).** The load distribution on roofs adjacent to higher ones is taken to be a triangular shape as illustrated in Figure G-5. Thus $C_a$ varies with distance x from the step in roof elevation, being $C_a(0)$ at $x = 0$ and decreasing linearly to a value $C_a(x_d)$ at the tail of the drift defined by $x = x_d$. The magnitude of the drift on the lower roof depends primarily on the amount of snow that can drift off the upper roof and be trapped in the step. Therefore the loading in the step tends to increase significantly as the size of the upper level roof increases.[17] For roofs with relatively small step heights and, in particular, for large roofs, the step can fill to the top. In this case $C_a(0)$ should be taken as:

$$C_a(0) = \gamma h / C_b S_s \qquad (2)$$

## Commentary G

where h is the difference in elevation between the lower roof surface and the top of the parapet on the upper roof, and $\gamma$ is the specific weight of snow. (Note that in the region of the drift, $C_w$ is 1.0, since the lower roof is sheltered by the roof step.) However, in many cases there may be insufficient snow to fill in the step. Therefore an upper limit on $C_a(0)$ equivalent to

$$C_a(0) = F/C_b \tag{3}$$

may be used, where the factor F is to be taken as the greater of

$$F = 2, \text{ or}$$
$$F = 0.35\left(\gamma l_c/S_s - 6\left(\gamma h_p/S_s\right)^2\right)^{0.5} + C_b \tag{4}$$

where $l_c$ is a characteristic length of a roof defined by

$$l_c = 2w - w^2/l \tag{5}$$

where w and $l$ are the shorter and longer dimensions of the roof plan form.

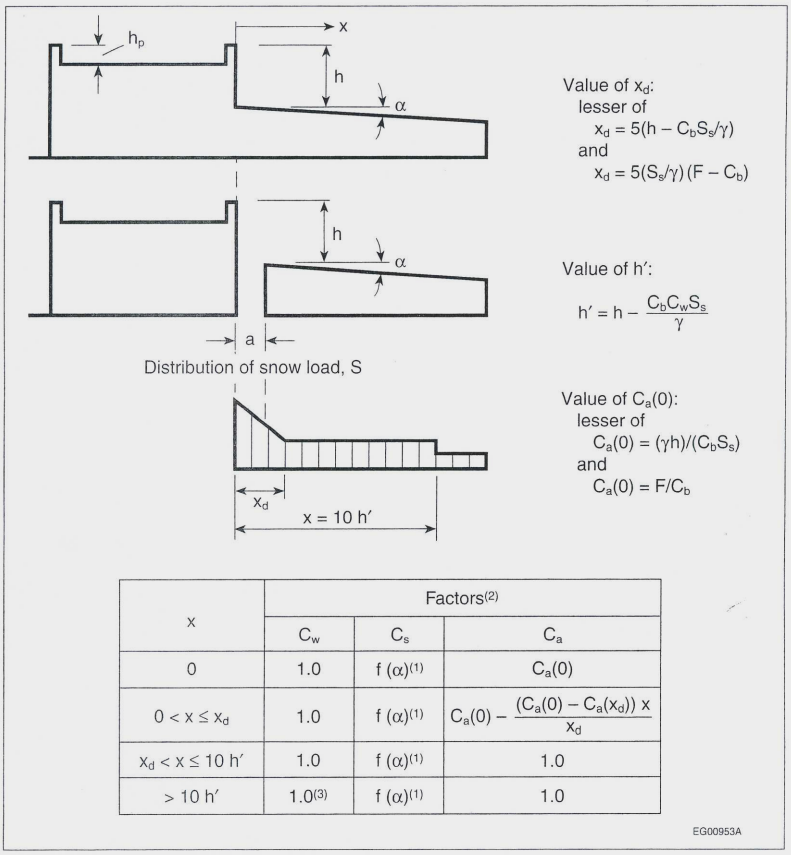
In Equation (4), $l_c$ for the upper roof is used, and $h_p$ is the height of the upper roof's parapet as illustrated in Figure G-5. In Equations (2), (3) and (4), and in the equation in NBC Sentence 4.1.6.2.(1), $C_b$ is the basic roof snow load factor applicable to the lower roof. Figure G-6 shows the variation of the factor F as a function of $\gamma l_c/S_s$. Background information on the derivation of Equation (4) is provided in Reference [17]. For buildings in sheltered locations (i.e. Exposure B or C as defined in Paragraphs 41 and 42 of Commentary I, Wind Load and Effects), an upper limit of 5.0 can be placed on the value of F, as shown in Figure G-6. The horizontal length $x_d$ of the drift extending out from the step should be based on the top surface of the drift having a 1:5 slope. This implies that

$$x_d = 5\left(h - C_b S_s/\gamma\right) \tag{6}$$

in cases where the step fills to the top, or

$$x_d = 5\left(S_s/\gamma\right)\left(F - C_b\right) \tag{7}$$

in cases where the drift is limited by other factors accounted for by Equation (4). The value of $C_b$ in Equations (6) and (7) is that applicable to the lower roof ($C_b$ is normally taken as 0.8 except where the plan dimensions of the lower roof are so large as to produce a value of $l_c$ for the lower roof exceeding 70 m, in which case a higher value of $C_b$ would apply as provided for in NBC Clauses 4.1.6.2.(2)(a) and (b)). Drifts deposited as a result of a change in elevation occur not only when the upper roof is part of the same building but also when it is on an adjacent building not more than 5 m away, as shown in Figure G-5. Where the upper roof is very large, the limiting gap, a, of 5 m should be confirmed by model tests. Where the drift obtained from Figure G-5 is longer than the lower roof, the drift should be truncated at the edge of the lower roof.




| x | Factors[2] | | |
|---|---|---|---|
| | $C_w$ | $C_s$ | $C_a$ |
| 0 | 1.0 | f (α)[1] | $C_a(0)$ |
| $0 < x \leq x_d$ | 1.0 | f (α)[1] | $C_a(0) - \frac{(C_a(0) - C_a(x_d))\, x}{x_d}$ |
| $x_d < x \leq 10\ h'$ | 1.0 | f (α)[1] | 1.0 |
| $> 10\ h'$ | 1.0[3] | f (α)[1] | 1.0 |

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**Figure G-5**
**Snow distributions and snow loading factors for lower levels of adjacent roofs**

**Notes to Figure G-5:**

(1) Varies as a function of slope α as defined in NBC Sentences 4.1.6.2.(5) and (6).

(2) If $a > 5$ m or $h \leq 0.8 S_s/\gamma$, drifting need not be considered. Where the upper roof is very large, the limiting gap, a, of 5 m should be confirmed by model tests.

(3) For Low and Normal Importance Category buildings, as described in NBC Sentence 4.1.6.2.(4), $C_w$ may be reduced to 0.75 or, in exposed areas north of the treeline, to 0.5.

**Project Title:** Install Waste Oil Storage Tank

**Location:** L'Anse au Loup

**Category:** Transmission and Rural Operations -Properties

**Definition:** Other

**Classification:** Mandatory

**Project Description:**

This project is required to purchase and install a 5,000 litre, double wall, vacuum sealed waste oil storage tank for Hydro's diesel plant located in the Southern Labrador community of L'Anse au Loup. Work will also include the installation of a steel pipe header system to connect the waste oil storage tank to the diesel units inside the plant. The header will be constructed as a double wall system, providing secondary containment of the primary line, complete with a leak detection device on the secondary containment. Lube oil transfer pumps will be purchased, and installed in the header system, to pump used oil from the diesel units to the storage tank. Low oil level indication and cut-out switches will also be installed to provide pump protection.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 12.5 | 0.0 | 0.0 | 12.5 |
| **Labour** | 27.1 | 0.0 | 0.0 | 27.1 |
| **Consultant** | 2.8 | 0.0 | 0.0 | 2.8 |
| **Contract Work** | 13.0 | 0.0 | 0.0 | 13.0 |
| **Other Direct Costs** | 14.1 | 0.0 | 0.0 | 14.1 |
| **Interest and Escalation** | 5.1 | 0.0 | 0.0 | 5.1 |
| **Contingency** | 6.9 | 0.0 | 0.0 | 6.9 |
| **TOTAL** | **81.5** | **0.0** | **0.0** | **81.5** |

**Operating Experience:**

Hydro's preventive maintenance procedures specify that lubricating oil, used in diesel generators, must be changed after every 500 hours of operation. Adhering to these procedures, the L'Anse Au Loup diesel plant produces 4,100 litres of waste lube oil per year. This waste oil is presently pumped into steel drums and stored on site, until it is collected annually by a certified waste oil collector. As a

result of being stored on exterior ramps over the winter months and shipping, the drums become rusty and dented and do not qualify for credit when returned.

The possibility of the deteriorated drums developing a leak also poses an environmental concern. As a protective measure, the drums are presently being stored inside oversized plastic drums for secondary containment.

**Project Justification:**

This project is justified on the need to comply with the environmental regulations pertaining to the storage of used oil. There are both safety and environmental concerns associated with the pumping of used oil from the engines into 205 litre drums, moving drums outside the plant and placing them on the waste oil storage ramp. The drums require heavy lifting and present a risk of spillage.

The Used Oil Control Regulations, under the Environmental Protection Act (O.C. 2002-430) states in Section 21 "Used oil in a quantity that does not exceed 205 litres a site, may be stored in one 18-guage, 205 litre steel drum". The quantity of used oil generated at the L'Anse au Loup diesel plant is well in excess of this limit. Therefore, to achieve compliance with the regulations, a certified storage tank should be utilized to contain the used oil. As part of its Environmental Management System (EMS), Hydro has initiated a program to install waste oil storage tanks at all isolated diesel generating sites in Labrador.

The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Design transmittal and discussions with Operations | March 2012 | March 2012 |
| Design | Preparation of tender package | April 2012 | April 2012 |
| Procurement | Tender and tank purchase | May 2012 | June 2012 |
| Construction | Tank installation | July 2012 | July 2012 |
| Commissioning | System commissioning | July 2012 | August 2012 |
| Closeout | Contract closeout | September 2012 | September 2012 |

**Future Plans:**

This is the final waste oil storage tank replacement to be carried out under the waste oil storage tank five year plan.

**Project Title:** Replace Surge Arresters

**Location:** Various Stations

**Category:** Transmission and Rural Operations - Terminal Stations

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of the purchase and installation of replacement surge arresters at various Hydro terminal stations on the Island Interconnected System. These units are in the 66, 138 and 230 kV classifications.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 52.7 | 0.0 | 0.0 | 52.7 |
| **Labour** | 10.1 | 0.0 | 0.0 | 10.1 |
| **Consultant** | 2.8 | 0.0 | 0.0 | 2.8 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 3.5 | 0.0 | 0.0 | 3.5 |
| **Contingency** | 6.6 | 0.0 | 0.0 | 6.6 |
| **TOTAL** | **75.7** | **0.0** | **0.0** | **75.7** |

**Operating Experience:**

Surge arresters are used on major terminal station equipment to protect that equipment from voltage surges due to lightning and switching. The expected service life of surge arresters is approximately 20 years depending on the lightning activity in the area and the switching duty. Surge arresters fail because of the cumulative effects of lightning strikes and switching surges. The wide variety of operating environments across the system make it is difficult to estimate the useful life and predict surge arrester failures. The older arrester designs have a higher incidence of failure than the newer designs. Hydro has approximately 440 surge arresters in service in all three voltage classes ranging in age from one year to approximately 40 years.

Table 2 shows the history of expenditures for this project for the past five years.

**Table 2: Budget History**

| Year | Budget ($000) | Actual ($000) | Units | Average Unit Cost ($000) |
|---|---|---|---|---|
| 2011F | 74.5 | | | |
| 2010 | 73.4 | 72.3 | 18 | 4.0 |
| 2009 | 81.1 | 80.0 | 15 | 5.3 |
| 2008 | 67.1 | 73.5 | 21 | 3.5 |
| 2007 | 71.3 | 84.8 | 9 | 9.4 |
| 2006 | 70.0 | 66.9 | 24 | 2.8 |

**Project Justification:**

Surge arresters provide critical overvoltage protection of power system equipment from lightning and switching surges. When the arresters fail they are not repairable. Replacement is the only option available. Surge arresters are regularly inspected and tested, and replacements are made based on these maintenance assessments as well as in-service failures. When a surge arrester fails, it must be replaced immediately; otherwise the major equipment is exposed to serious damage from lightning surges. Failure of any major equipment will result in major system disturbances which could result in system outages and interruption of service to customers.

**Project Schedule:**

The anticipated project schedule is shown in Table 3.

**Table 3: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage schedules and target replacements | January 2012 | February 2012 |
| Design | Equipment ordering and tendering | February 2012 | March 2012 |
| Procurement | Equipment delivery | March 2012 | June 2012 |
| Construction | Equipment removal<br>Equipment installations | June 2012 | November 2012 |
| Commissioning | Installations in service | June 2012 | November 2012 |
| Closeout | Project completion | December 2012 | December 2012 |

**Future Plans:**

Future replacements will be proposed in future capital budget applications. Surge arrestor replacements are planned for the next four years. Please see five-year capital plan (Capital Plan 2012, Tab, Appendix A).

**Project Title:** Replace Telephone Systems

**Location:** Port Saunders and Whitbourne

**Category:** General Properties - Telecontrol

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project consists of replacing the existing Nortel Norstar telephone systems at Hydro's Port Saunders and Whitbourne offices with an Avaya BCM 50 Private Branch Exchange (PBX) system. The system is used by office staff and line personnel for daily telephone business communications. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 60.0 | 0.0 | 0.0 | 60.0 |
| **Labour** | 88.0 | 0.0 | 0.0 | 88.0 |
| **Consultant** | 7.5 | 0.0 | 0.0 | 7.5 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 12.0 | 0.0 | 0.0 | 12.0 |
| **Interest and Escalation** | 15.1 | 0.0 | 0.0 | 15.1 |
| **Contingency** | 16.7 | 0.0 | 0.0 | 16.7 |
| **TOTAL** | **199.3** | **0.0** | **0.0** | **199.3** |

**Operating Experience:**

The telephone systems at Whitbourne and Port Saunders were originally installed in the 1980s by Newtel Communications and rented by Hydro. In 1995, Hydro purchased the systems and all maintenance since this date has been performed by Hydro's internal personnel. These systems have performed well with minimal failures; however they have reached their full capacity and cannot meet Hydro's current needs. The new PBX systems have voice mail capabilities, call hold, voice paging, and automated attendant features such as call routing to the appropriate persons without assistance of a switchboard operator. These features improve the efficiency of the office clerical staff. Additionally, the existing systems are manufacturer discontinued with no further support or parts available. The telephone system has surpassed its anticipated useful life of 15 years.

**Project Justification:**

The existing systems are an 8/24 PBXs which can accommodate eight incoming lines from the service provider and support 24 internal phones. The system cannot be further expanded. The Port Saunders Office has 20 permanent employees and four temporary employees, each requiring a telephone. The office area also includes a board room, lunch room, data closet, two maintenance shops, guest phone and three fax machines.

The Whitbourne Office has 26 permanent employees each requiring a telephone. The office area also includes a board room, lunch room, data closet, two maintenance shops, guest phone and a fax machine. These new systems will allow voice communications within the office and to external maintenance shops, warehouses, garages and line depots allowing them to remain functional in the event of a loss of service from the telephone company. This is important for safe and efficient office operation. The rental of key systems is an option no longer offered by Bell Aliant. The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Complete site surveys. Gather such information as back up power requirements, number and locations of new phones requested, new paging speakers requirement, Voice Mail and Auto Attendant specifics, required number of trunk lines. | February 2012 | February 2012 |
| Design | Prepare design brief; make hardware selection; prepare dial plans, technical and functional design. | February 2012 | March 2012 |
| Procurement | Prepare and review technical specifications for tender; Award tender. | April 2012 | May 2012 |
| Construction | Model entire system in Hydro's lab to verify configuration and system functionality, performance and features. | May 2012 | June 2012 |
| Commissioning | Travel to site to install new telephone system paging speakers and test and verify customer acceptance. | August 2012 | September 2012 |
| Closeout | Complete as build diagrams and finalize technical documentation, lessons learned and project closeout and completion certificate. | October 2012 | October 2012 |

**Future Plans:**

None.

**Project Title:** Replace Radomes

**Location:** Various Sites

**Category:** General Properties - Telecontrol

**Definition:** Pooled

**Classification:** Normal

**Project Description:**

To reduce the probability of system outages resulting from radome failure, Hydro has initiated a radome replacement program for the microwave antennas of the corporate network. This is an ongoing program to replace microwave antenna radomes, the protective covers that enclose the delicate components of the microwave antennas in Hydro's microwave radio system. The radome replacement program proposed by Hydro is based on operational experience and manufacturer's recommendation. Due to financial and operational risks associated with the failure of corporate microwave equipment, this project is a proactive approach to ensuring that the likelihood of failure of microwave antenna radomes is minimal.

Radomes are replaced at different sites throughout the network each year, depending on age and condition. The radome replacement schedule for 2012-2016 is provided in Appendix A. Twelve radomes are scheduled to be replaced in 2012. Historically, this project has been performed through the joint effort of an external contractor who performs the actual work and internal forces that perform project management and provide technical support. This joint effort will be continued in 2012. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 12.0 | 0.0 | 0.0 | 12.0 |
| **Labour** | 19.1 | 0.0 | 0.0 | 19.1 |
| **Consultant** | 6.5 | 0.0 | 0.0 | 6.5 |
| **Contract Work** | 104.5 | 0.0 | 0.0 | 104.5 |
| **Other Direct Costs** | 3.4 | 0.0 | 0.0 | 3.4 |
| **Interest and escalation** | 11.9 | 0.0 | 0.0 | 11.9 |
| **Contingency** | 14.6 | 0.0 | 0.0 | 14.6 |
| **TOTAL** | **172.0** | **0.0** | **0.0** | **172.0** |

**Existing System:**

Hydro has a network of microwave radios, by which corporate communications and system data are transmitted. The microwave radio system provides the backbone for all corporate voice and data communications. Traffic carried over the microwave system includes:

- Teleprotection signals for the provincial transmission system;
- Data pertaining to the provincial Supervisory Control and Data Acquisition (SCADA) system;
- Data pertaining to the corporate administrative system; and
- Operational and administrative voice systems.

Microwave radio signals are transmitted from one location to the next using parabolic antennas attached to towers. These antennas are mounted up to heights of 120 meters and range in diameter from two meters to five meters. At such extreme heights, the antennas are subjected to high wind and ice loading when storms occur, and must be protected. To provide this protection, the delicate components of the antennas responsible for sending and receiving microwave radio signals are covered using a shell known as a radome. These covers are made of advanced plastics known as Hypalon and Teglar that prevent the accumulation of ice and snow which could bend or break these elements. The white cover illustrated in Figure 1 is an example of a radome on an uninstalled antenna.



**Figure 1: Microwave Antenna with Radome**

Damage to radomes can occur in several ways. Exposure to wind, sun, rain, and ice causes the radomes to deteriorate over time. When the radome weakens, tears form in the fabric, as shown in Figure 2. Left unchecked, the tears quickly grow in size (Figure 2) and the material can be torn free by wind. Such tears may result in severe damage to the delicate antenna components.

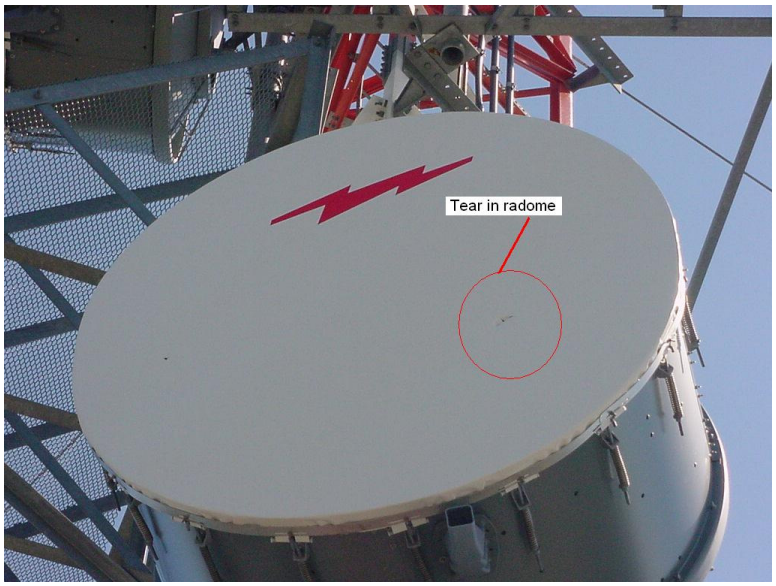



Figure 2: Tear in Radome




**Figure 3: Heavily Damaged Radome**

Other modes of failure are less common. Ice falling from the tower can damage radome components, such as the hardware that hold the radome in place, as shown in Figure 3. Vandalism by the use of shotguns, rocks, or other projectile has also occurred at sites that are accessible by road. Each of these occurrences has the potential to damage the radome and make it prone to complete failure.

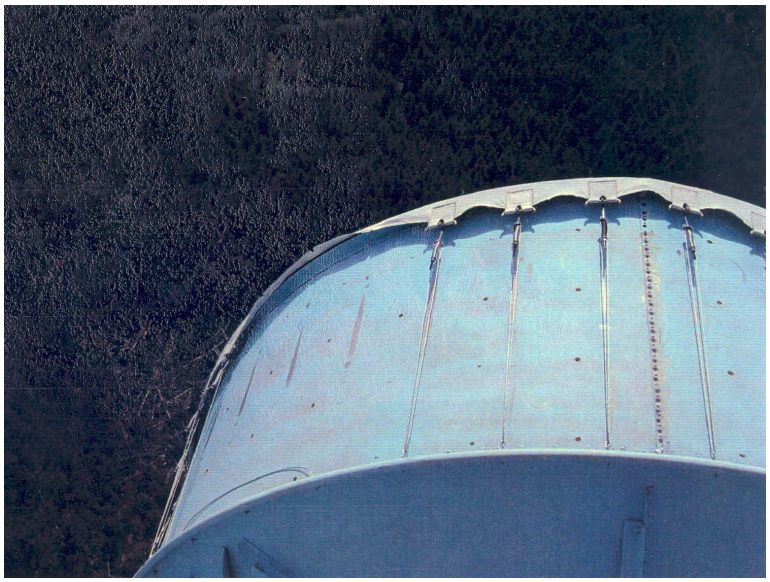


**Figure 4: Missing Radome Mounts**

There are 80 radomes throughout Hydro's system. They are installed on towers from St. John's to Deer Lake, and south to Bay d'Espoir. Figure 4 shows Hydro's Telecommunication Network.

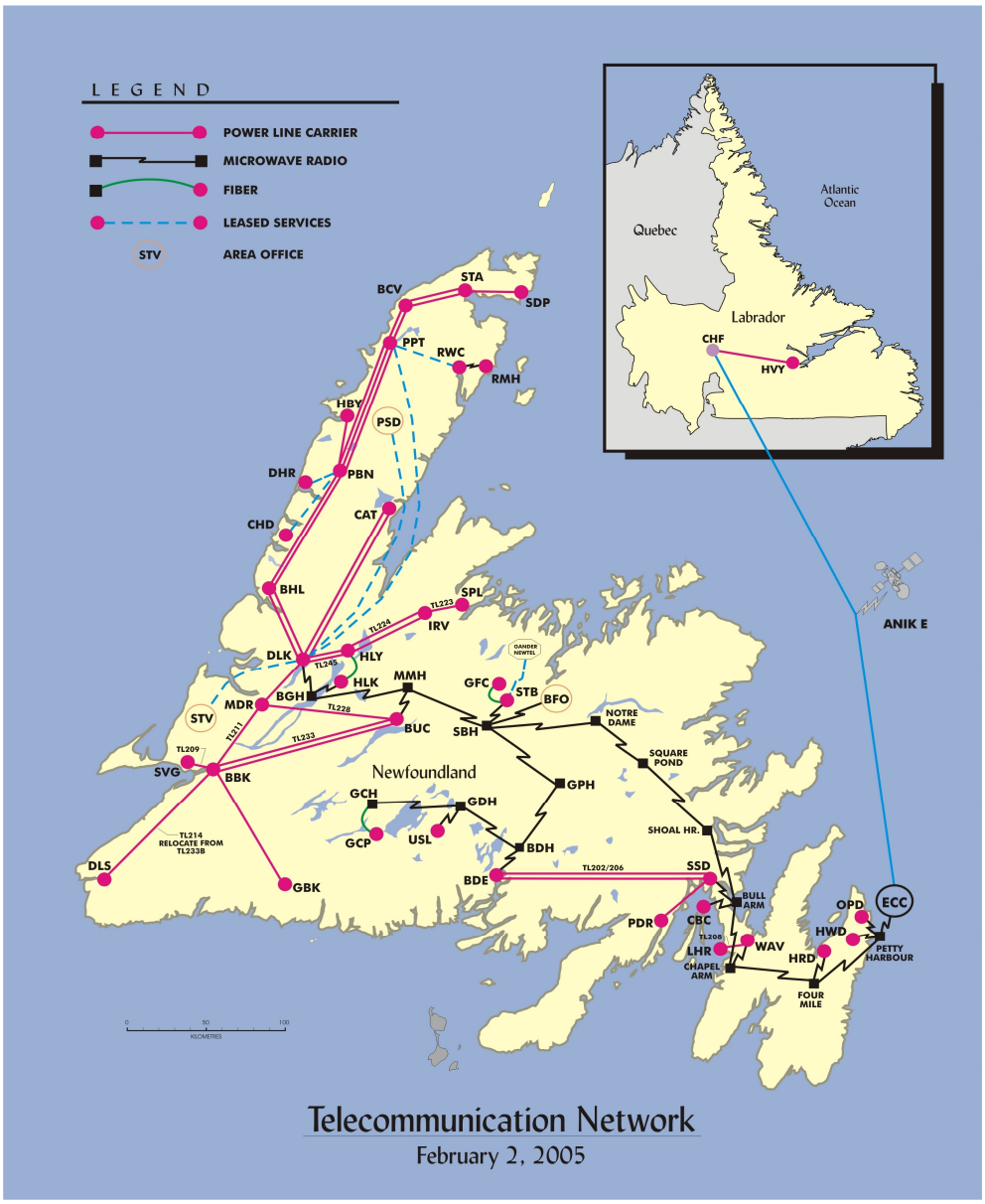



**Figure 5: Location of Towers**

Age of Equipment

Refer to the Installed/Last Replaced column of Appendix A for the ages of the radomes being replaced.

Major Work and/or Upgrades

There are no upgrades available for a radome. They must be replaced based upon the estimated useful lives of the individual radomes or upon observed damage during inspection.

Anticipated Useful Life

Hydro's microwave antennas are supplied primarily by two manufacturers, Andrew Solutions and CableWave. Each manufacturer uses a different radome. Radomes used on antennas manufactured by CableWave have a useful life of seven years, and the radomes used on Andrew antennas have a useful life of eight years.

Maintenance History

Radome maintenance consists of inspection when the tower is inspected. Because radomes cannot be repaired, damaged radomes are replaced when identified.

Outage Statistics

In the winter of 1996, a wind storm caused a significant and sustained outage to a part of Hydro's communications network as a result of the failure of two separate radomes at the Sandy Brook Hill and Mary March Hill Microwave Sites. Despite routine inspections, the radomes were torn and the material of the shells became entangled in the antenna feed horns. As a result, critical components at both sites were irreparably damaged and the antennas required replacement. Once the storm cleared and the cause of the outage was identified, antennas could not be replaced until three weeks later, due to lead times associated with material procurement and weather related delays.

In total, the microwave radio system was out of service for approximately six weeks. During that time, temporary leased services were procured and installed, resulting in unanticipated labour and materials costs.

Industry Experience

Industry experience information is not available.

Maintenance or Support Arrangements

There are no maintenance or support arrangements associated specifically with radomes. Radome inspection is included as part of an overall periodic tower inspection which occurs annually.

Vendor Recommendations

As a result of the costs and outage time associated with the 1996 storm, personnel from Hydro consulted with manufacturers to develop a proactive radome replacement plan. Based on discussions with representatives from radome manufacturers Andrew Solutions and CableWave, the following conclusions were met:

CableWave radomes (made of Hypalon material) should be replaced on a seven-year cycle;
Andrew Solutions radomes (made of Teglar material) should be replaced on an eight-year cycle.

Andrew Solutions radomes, with a slightly longer life, cannot be substituted for CableWave radomes on CableWave antennas on account of the structural differences associated with each type of antenna.

Availability of Replacement Parts

A radome consists of one piece of material with mounting hardware to connect it to an antenna. Mounting hardware is available should a piece be found missing or damaged. If a radome must be replaced, the mounting hardware is typically not re-used on account of wear and tear.

Safety Performance

There is no known safety performance issues associated with the radomes.

Environmental Performance

There are no environmental performance concerns or environmental code violations associated with the operation of microwave radomes.

Operating Regime

A microwave antenna, and by extension its radome, is in continuous use and has a 100 percent duty cycle.

**Justification:**

One of the challenges associated with the development of the radome replacement schedule is that many of Hydro's microwave sites were installed in the same year. For example, during the installation of the East Cost Microwave System in 2001, approximately 20 antennas were installed. To avoid the financial and logistical challenges that would be created by replacing each of these radomes in the same year, Hydro decided that the replacement program for these sites would be distributed over seven years, from 2007 – 2013 with the program continuing beyond 2013 as required.

The decision to distribute the replacement of radomes presents another obstacle: some radomes will be left in service for periods longer than recommended. In response to this issue, Hydro has initiated an inspection program that allows for the identification of radomes which are torn or otherwise damaged, as illustrated in Figure 2. These radomes must be replaced as soon as the damage is identified to ensure that the integrity of the microwave system is maintained.

The cost of a microwave failure today would be far more significant than the incident of 1996 due to the fact that teleprotection signals, which protect transmission lines in the event of a system disturbance, are now transmitted using the microwave network. Today, protection signals for 17 of Hydro's 24 critical 230 kV transmission lines are carried on the microwave network. Because of this, a microwave failure would cause the Energy Control Centre to lose control of the system stations and likely cause and/or extend customer outages.

Net Present Value

A net present value calculation has not been done as there is no viable alternative to replacing the radomes.

Levelized Cost of Energy

As the radomes are not related to generating units, the levelized cost of energy is not applicable.

Cost Benefit Analysis

A cost benefit analysis was not performed in this instance as there are no quantifiable financial benefits.

Legislative or Regulatory Requirements

There are no legislative or regulatory requirements associated with radome replacement.

Historical Information

Table 2 shows the historical information for the Radome Replacement Program which commenced in 2007.

**Table 2: Capital Budget and Expenditures for the Last Five Years**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Cost per unit ($000) | Comments |
|---|---|---|---|---|---|
| 2011F | 195.9 | | 10 | | |
| 2010 | 195.9 | 110.4 | 12 | 9.1 | No travel expenses; all sites close to St. John's. |
| 2009 | 129.7 | 110.5 | 9 | 12.3 | |
| 2008 | 123.8 | 111.0 | 9 | 12.3 | |
| 2007[7] | 26.9 | 9.2 | 1 | 9.2 | Labour only. No replacement. |

Forecast Customer Growth

Radomes are not impacted by forecast customer growth.

Energy Efficiency Benefits

There is no projected energy efficiency benefits related to the replacement of radomes.

Losses During Construction

There is no system outage required for this project.

Status Quo

The status quo is unacceptable. Allowing radomes to stay in service until failure will cause protracted

[7] First year of replacement program.

outages on Hydro's communications system and will increase the likelihood of power system outages.

Alternatives

No viable alternatives exist to radome replacement.

**Conclusion:**

Hydro's Radome Replacement Program is necessary in order to prevent outages caused by radome damage.

The radome replacement program proposed by Hydro is based on operational experience and manufacturer's recommendations. Historically, this project has been executed by external contractors and supported by internal resources and this joint effort will continue in 2012.

Due to financial and operational risks associated with the failure of corporate microwave equipment, this project is a proactive approach to ensuring that the likelihood of failure of microwave antenna radomes is minimal.

Project Schedule

The anticipated project schedule is shown in Table 3.

**Table 3: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Prepare Project Plan and site visits | January 2012 | February 2012 |
| Design | Complete Tender Package | February 2012 | March 2012 |
| Procurement | Purchase Radomes | April 2012 | April 2012 |
| Installation | Install Radomes | May 2012 | September 2012 |
| Commissioning | Site Inspections | October 2012 | October 2012 |
| Closeout | Project Closeout | November 2012 | Dec ember2012 |

**Future Plans:**

Future replacements will be proposed in future capital budget applications. Radome replacements are planned for the next five years as shown in the five-year capital plan (2012 Capital Plan Tab, Appendix A).

**APPENDIX A**

**2012-2016 RADOME REPLACEMENT SCHEDULE**

**2012 Radome Replacement**

| Antenna Site | Antenna Direction | Installed/ Last Replaced | Diameter | Manufacturer | Model Number |
|---|---|---|---|---|---|
| GDH-main | GCH-main | 2004 | 3.0m(10') | Andrew | HP10-71D |
| GDH-div | GCH-div | 2004 | 2.4m(8') | Andrew | HP8-71D |
| GDH | USL | 2004 | 3.0m(10') | CW | DA10-71hp |
| GDH | BDH | 2004 | 3.0m(10') | CW | DA10-71hp |
| GCH-main | GDH-main | 2004 | 3.0m(10') | Andrew | HP10-71D |
| GCH-div | GDH-div | 2004 | 2.4m(8') | Andrew | HP8-71D |
| DLK | DLP | 2001 | 4.5m(15') | Gabriel | SR15-71B |
| BFI | SBH | 2004 | 2.4m(8') | Andrew | HP8-71GE |
| NDH-main | SPH-main | 2004 | 3.6m(12') | Andrew | HP12-71E |
| NDH-div | SPH-div | 2004 | 3.6m(12') | Andrew | HP12-71E |
| NDH-main | SBH-main | 2003 | 3.6m(12') | Andrew | HP12-71E |
| NDH-div | SBH-div | 2003 | 3.6m(12') | Andrew | HP12-71E |
| HRP | FMH | 2001 | 2.4m(8') | Andrew | HP8-71D |
| OPD | PHH | 2001 | 1.8m(6') | Andrew | HP6-71E |

**2013 Radome Replacement**

| Antenna Site | Antenna Direction | Installed/ Last Replaced | Diameter | Manufacturer | Model Number |
|---|---|---|---|---|---|
| SHH-main | SPH-main | 2003 | 3.6m(12’) | Andrew | HP12-71E |
| SHH-div | SPH-div | 2003 | 3.6m(12’) | Andrew | HP12-71E |
| SHH-main | BAH-main | 2003 | 2.4m(8') | Andrew | HP8-71GE |
| SHH-div | BAH-div | 2003 | 2.4m(8') | Andrew | HP8-71GE |
| MMH | BGH | 2004 | 2.4m(8') | CW | DA8-71hp |
| MMH | SBH | 2004 | 3.6m(12') | CW | DA12-71hp |
| BGH | DLP | 2004 | 3.6m(12') | CW | DA12-71hp |
| BGH | MMH | 2004 | 2.4m(8') | CW | DA8-71hp |
| SPH-main | NDH-main | 2004 | 3.6m(12') | Andrew | HP12-71E |
| SPH-div | NDH-div | 2004 | 3.6m(12') | Andrew | HP12-71E |
| SPH-main | SHH-main | 2004 | 3.6m(12') | Andrew | HP12-71E |
| SPH-div | SHH-div | 2004 | 3.6m(12') | Andrew | HP12-71E |
| ECC | PHH | 2001 | 1.8m(6') | Andrew | HP6-71E |
| HWD | PHH | 2001 | 2.4m(8') | Andrew | HP8-71E |

**2014 Radome Replacement**

| Antenna Site | Antenna Direction | Installed/ Last Replaced | Diameter | Manufacturer | Model Number |
|---|---|---|---|---|---|
| BDH | GPH | 2006 | 1.8m(6') | CW | DA6-71hp |
| BDH | GPH | 2006 | 2.4m(8') | Andrew | HP8-71D |
| BDH | BDE | 2006 | 1.8m(6') | CW | DA6-71hp |
| BDH | GDH | 2006 | 3.0m(10') | CW | DA10-71hp |
| BDE | BDH | 2006 | 1.8m(6') | CW | DA6-71hp |
| SBH | MMH | 2004 | 3.6m(12') | CW | DA12-71hp |
| MMH | SBH | 2006 | 3.0m(10') | Andrew | HP10-71D |
| HLP | HLK | 2007 | 2.4m(8') | CW | DA8-71hp |
| HLP | BGH | 2007 | 2.4m(8') | CW | DA8-71hp |
| HLK | HLP | 2007 | 1.8m(6') | CW | DA6-71hp |

**2015 Radome Replacement**

| Antenna Site | Antenna Direction | Installed/ Last Replaced | Diameter | Manufacturer | Model Number |
|---|---|---|---|---|---|
| SBH | NDH-main | 2003 | 3.6m(12') | Andrew | HP12-71E |
| SBH | NDH-div | 2003 | 3.0m(10') | Andrew | HP10-71D |
| SBH | BFI | 2003 | 2.4m(8') | Andrew | HP8-71GE |
| BUC | MMH | 2008 | 1.8m(6') | CW | DA6-71hp |
| BGH | HLP | 2008 | 2.4m(8') | CW | DA8-71hp |

**2016 Radome Replacement**

| Antenna Site | Antenna Direction | Installed/ Last Replaced | Diameter | Manufacturer | Model Number |
|---|---|---|---|---|---|
| GPH | SBH-Main | 1999 | 3.6m(12') | Andrew | HP12-71E |
| GPH | SBH-Div | 2001 | 3.6m(12') | CW | DA12-71hp |
| GPH | BDH-Main | 1999 | 2.4m(8') | Andrew | HP8-71D |
| GPH | BDH-Div | 1999 | 1.8m(6') | CW | DA6-71hp |
| SBH | GPH | 2000 | 3.6m(12') | CW | DA12-71HP |
| SBH | STB | 2000 | 1.8m(6') | CW | DA6-71hp |
| SBH | GPH | 1999 | 3.6m(12') | CW | DA12-71hp |
| SBH | MMH | 1999 | 3.0m(10') | CW | DA12-71hp |

| **Station Code** | **Station Description** |
|---|---|
| Anniepsquotch | VHF Repeater Site |
| BBK | BOTTOM BROOK |
| BCNGS | Buchans Generating Plant |
| BCV | BEAR COVE |
| BCX | BARACHOIX |
| BDC | |
| BDE | |
| BDE1 | BAY D'ESPOIR STN #1 |
| BDE2 | BAY D'ESPOIR STN #2 AND PH #2 |
| BDP | |
| BHL | BERRY HILL |
| BIFGS | Exploits - Bishops Falls Generating Station |
| BIFTS | Bishops Falls Terminal Station |
| BLA | BAY L'ARGENT |
| BOY | NP- Boyd's Cove |
| BRT | BARTLETT SUBSTATION - LAB WEST |
| BUC | BUCHANS |
| BUD | |
| BVT | |
| BWT | BOTTOM WATERS |
| CAM | CONEY ARM |
| CAT | CAT ARM |
| CBC | COME BY CHANCE |
| CBF | CORNER BROOK FREQ. CONV'R |
| CBKFRC | |
| CFLCO | |
| CHD | COW HEAD |
| CRV | CONNE RIVER |
| DHR | DANIELS HARBOUR |
| DLK | DEER LAKE 'A' / DEER LAKE 'B' |
| DLP | |
| DLS | DOYLES |
| DPD | DUCK POND |
| EBBE | |
| ECC | |
| EHW | ENGLISH HARBOUR WEST |
| FHD | FAREWELL HEAD |
| GBK | GRANDY BROOK |

| | |
|---|---|
| GBY | GRAND BAY |
| GCL | GRANITE CANAL |
| GFC | GRAND FALLS FREQ. CONV'R |
| GFLFRC | |
| GFLGS | Exploits - Grand Falls Generating Station |
| GLB | GLENBURNIE |
| GNP | All stations on GNP |
| GWD | GLENWOOD |
| HBK | |
| HBY | HAWKES BAY |
| HDN | HAMPDEN |
| HDNTAP | HAMPDEN & JACKSON'S ARM TAPS |
| HLC | |
| HLI | |
| HLK | HINDS LAKE |
| HLS | |
| HLX | |
| HLY | HOWLEY |
| HRD | HOLYROOD 'A' / HOLYROOD 'B' / HOLYROOD 'C' / HOLYROOD 'D' |
| HRL | HARRIE LAKE SUBSTATION - LAB WEST |
| HRP | |
| HUD | HUDSON SUBSTATION - LAB WEST |
| HVY | HAPPY VALLEY 'A' / HAPPY VALLEY 'B' |
| HWD | HARDWOODS |
| HYP_ECC | Hydro Place ECC Network Services |
| IRV | INDIAN RIVER |
| JAM | JACKSON'S ARM |
| JAMTAP | |
| LHR | LONG HARBOUR |
| LLK | LINTON LAKE |
| LOC | |
| LPD | Long Pond |
| MBK | MAIN BROOK |
| MDR | MASSEY DRIVE |
| MFA | MUSKRAT FALLS |
| MKS | MONKSTOWN |
| MLG | Meelpaeg |
| NDH | Notre Dame Hill Microwave/Repeater Site |
| NLP | Newfoundland Power Station |
| NSD | |

| | |
|---|---|
| NZC | |
| OPD | OXEN POND |
| PBN | PETER'S BARREN |
| PPD | PARSON'S POND |
| PPT | PLUM POINT |
| PRV | PARADISE RIVER |
| QZT | QUARTZITE SUBSTATION - LAB WEST |
| RBK | RATTLE BROOK |
| RHR | ROCKY HARBOUR |
| Rocky Ridge | VHF Repeater Site |
| RWC | RODDICKTON WOODCHIP |
| SAL | |
| SAM | |
| SCV | SALLY'S COVE |
| SDP | ST. ANTHONY DIESEL PLANT |
| SHH | Shoal Harbour Microwave/Repeater Site |
| SLK | STAR LAKE |
| SOK | SOUTH BROOK |
| SPH | Square Pond Hill Microwave/Repeater Site |
| SPL | SPRINGDALE |
| SRS | |
| SSD | SUNNYSIDE |
| STA | ST. ANTHONY AIRPORT |
| STB | STONY BROOK |
| SVL | STEPHENVILLE |
| TRN | |

**Project Title:** Upgrade Server Technology Program

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Type:** Other

**Classification:** Normal

**Project Description:**

This project is a part of the Server and Operating System Refresh Program which involves the replacement, addition and upgrade of hardware components and software related to Hydro's server infrastructure and upgrades to the server-based office productivity tools.

The scope of the proposed Server and Operating System Refresh Program includes the replacement of 19 servers within the Hydro system, 11 of which belong to the Energy Management Center (EMS) and Backup Control System (BCS), while six are part of Hydro infrastructure. There are also two Blade Server shelves to be replaced for the Hydro Citrix System. A number of the Energy Systems servers will be moving from hardware platforms to a new Virtual Server platform to be installed. This will replace seven physical servers with two servers in this first year.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 134.0 | 0.0 | 0.0 | 134.0 |
| **Labour** | 25.0 | 0.0 | 0.0 | 25.0 |
| **Consultant** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 5.7 | 0.0 | 0.0 | 5.7 |
| **Contingency** | 17.9 | 0.0 | 0.0 | 17.9 |
| **SUB TOTAL** | **202.6** | **0.0** | **0.0** | **202.6** |
| **Cost Recovery** | **(30.9)** | **0.0** | **0.0** | **(30.9)** |
| **Total** | **171.7** | **0.0** | **0.0** | **171.7** |

**Existing System:**

There are 155 physical servers and 48 virtual[8] servers which support and are used to run various applications. The applications that run on these servers include the Energy Management System, Enterprise Resource Planning and email systems. These applications are used by staff in running the business on a day to day basis.

Based on the age of existing servers, each year an appropriate number of servers will be replaced. This ensures that the Corporation has a reliable and secure infrastructure environment required to support efficient operations.

As this budget proposal is for routine replacement of hardware and software related to the corporations shared server infrastructure, the following items are not relevant to this proposal:

- Major Work / Upgrades;
- Maintenance History;
- Outage Statistics;
- Safety Performance; and
- Environmental Performance.

Age of Equipment or System

The age of the equipment being replaced ranges from five to eight years. The average age is six years.

Anticipated Useful life

Industry standards indicate that server hardware has a useful life of five years. Beyond this timeframe reliability and support may become problematic.

Maintenance or Support Arrangements

IBM support for the 19 servers is discontinued. Hydro has determined that the standard three year manufacturer warranty is insufficient for its Intel Server Infrastructure and increases this warranty to

[8] A virtual machine (VM) is a software implementation of a machine (i.e. a computer) that executes programs like a physical machine.

five years at time of purchase. After the initial five year warranty, the server is placed on a Gold Card Maintenance program with IBM that is renewed yearly until the server is replaced.

Vendor Recommendations

IBM recommends that servers be replaced in a five year lifecycle.

Availability of Replacement Parts

Parts may not be available after five years for the 19 servers to be replaced depending on the component that fails.

Operating Regime

Hydro's servers are used on a continuous basis. The servers are active for the life of the unit once placed in service.

**Justification:**

The factors that are driving Hydro's proposal to replace/upgrade its server environment include:

- Addressing obsolescence/maintaining vendor support;
- Providing security/managing the infrastructure; and
- Supporting current versions of applications.

Obsolescence/Vendor Support – Without vendor support, the functions and services reliant on the server infrastructure are at risk as security and support patches for the operating system will no longer be available. As a result, Hydro's ability to support and ensure continuation of these functions and services is impeded. At this time, the vendor support and inventory of spare parts are discontinued. As the servers are used by Hydro employees to provide support in running the business on a daily basis, loss of availability of these servers would have a negative effect on employee productivity by not allowing access to software applications.

Providing security/managing the infrastructure – As technology advances, there are built-in architectures and devices that improve the security of the servers and allow for better management of them.

Supporting current versions of applications – As applications are upgraded and new applications implemented throughout the organization, many are built to take advantage of technologies only present in the newer servers. An example would be an application built to take advantage of the new Hyper-threading Technology, if it is present, would have an increased processing speed.

As this budget proposal is for routine replacement of hardware and software related to the corporations shared server infrastructure, the following items are not relevant to the justification of this proposal:

- Levelized Cost of Energy;
- Legislative and Regulatory Requirements;
- Forecast Customer Growth;
- Energy Efficiency Benefits; and
- Loss during Construction.

Net Present Value

A net present value calculation was not performed as there are no viable alternatives.

Cost Benefit Analysis

As this budget proposal is for the routine replacement of hardware and software related to the Corporations shared server infrastructure, Cost Benefit Analysis is not relevant to the justification of this proposal.

Historical Information

Table 2 shows the historical costs of the Server and Operating System Evergreen Program.

**Table 2: Five-Year Historical Information**

| Year | Capital Budget ($000) | Actual Expenditures ($000) | Units | Unit Cost ($000) [1] |
|---|---|---|---|---|
| 2011F | 209.4 | | 18 | |
| 2010 | 196.6 | 197.9 | 14 | 14.1 |
| 2009 | 272.6 | 269.0 | 14 | 19.2 |
| 2008 | 241.0 | 238.2 | 21 | 11.3 |
| 2007 | 81.8 | 79.1 | 5 | 15.8 |

(1) Server price varies on a year to year basis due to processor power and memory requirements.

Status Quo

Hydro must keep its servers current in order to adequately support and protect the Information Technology infrastructure required to operate its business. Failure to keep this infrastructure current will put Hydro at risk of unplanned outages, possible data loss, and data corruption. The replacement, addition and upgrading of hardware components to achieve this goal requires investment over the lifecycle of the infrastructure.

Alternatives

The alternative to a server refresh program is to replace servers as they fail. This would put the infrastructure at risk of unplanned outages, possible data loss, and data corruption. This alternative would also cause a significant increase in maintenance costs as repairs are undertaken and spare equipment is kept on hand. This is not a viable alternative.

**Conclusion:**

Project Schedule

The project is scheduled to start in March 2012 and be completed by the end of November 2012.

**Future Plans:**

This is an ongoing refresh program to maintain server performance. Future replacements and upgrades will be proposed in future budget applications. See five-year capital plan (2012 Capital Plan tab, Appendix A).

**Project Title:** Upgrade Energy Management System

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to upgrade the OSI Monarch Energy Management System (EMS). The vendor, Open Systems International (OSI), has made a fundamental change in the architecture of the software by using Microsoft's .Net platform in all new releases of the software. This upgrade is for the migration of the Monarch system to this .NET platform. This upgrade is needed as all future upgrades. The old system was based on Windows API (Application Programming Interface).

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2011** | **2012** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 17.1 | 0.0 | 0.0 | 17.1 |
| **Consultant** | 86.0 | 0.0 | 0.0 | 86.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 4.4 | 0.0 | 0.0 | 4.4 |
| **Contingency** | 10.3 | 0.0 | 0.0 | 10.3 |
| **TOTAL** | **117.8** | **0.0** | **0.0** | **117.8** |

**Operating Experience:**

The Monarch Energy Management System was purchased from Open Systems International and commissioned in June 2006. It has been in continuous operation since commissioning. Over the past five years annual upgrades have taken place to bring the software to the latest release. The original purchase cost provided for the annual upgrades for the period 2007-2011. The cost of the original project for the installation of a new EMS system was $9,356,640.

**Project Justification:**

The EMS is essential to the continued efficient and reliable operation of the provincial transmission grid and generation facilities operated by Hydro. The EMS provides a critical function for Hydro and the operation of the Island Interconnected Power System. Remote control of any station would be impossible and therefore all major stations would have to be staffed. This project will start in March 2012 and end in May 2012.

**Future Plans:**

The software will continue to be upgraded on a yearly basis to keep it current and up to date.

**Project Title:** Implementation Work Protection Code Software

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

The Work Protection Code (WPC) is a complex set of rules that must be applied to help ensure that Hydro employees are provided with the safest possible work environment by standardizing the conditions under which all sources of energy must be isolated and equipment de-energized. This project is to implement a specialized Work Protection Code (WPC) software application for the automation and work flow of the WPC requirements in Hydro plants to replace an existing manual system.

The software will provide the flexibility and capability for Hydro to improve safety, accuracy and efficiency as it applies to WPC data and requirements. An electronic Work Protection Code software application would reduce the focus on administration of the WPC and increase the focus on the creation and maintenance of a safe work area. It would also ensure compliance through automatic enforcement of code rules. As well there would be benefits to customer service through more efficient execution of work protections. This would be due to shorter customer outages and increased maintenance productivity as electronic code efficiencies are realized.

The software will provide an effective, efficient, consistent and standard means of creating work protection documentation. Creating electronic work protection forms will be helpful in preventing common operating errors such as inaccurate isolation points, or wrong device state. The software will result in increased safety for employee, contractor and the general public as well as increased plant and system availability.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 17.8 | 0.0 | 0.0 | 17.8 |
| **Labour** | 35.4 | 0.0 | 0.0 | 35.4 |
| **Consultant** | 50.0 | 0.0 | 0.0 | 50.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 2.1 | 0.0 | 0.0 | 2.1 |
| **Contingency** | 10.3 | 0.0 | 0.0 | 10.3 |
| **TOTAL** | **115.6** | **0.0** | **0.0** | **115.6** |

**Operating Experience:**

Work Protection Code requirements in Hydro plants, with the exception of the Holyrood Thermal Generating Station (Holyrood), and the Energy Control Center are currently paper based. Hydro received approval in the 2008 capital budget application, in Board Order No. P.U. 30 (2007), to purchase and install the Work Protection Code Management Software in Holyrood at a cost of $678,100. This project was required to enhance the level of compliance with work protection standards in the area of work protection documentation. The software was implemented successfully and has been utilized in Holyrood since 2008.

**Project Justification:**

Hydro's WPC was created to provide a safe work environment in which hazards can either be eliminated or controlled. It consists of important principles which, when combined with safe work practices, will provide workers with a safe work area to perform their work. WPC procedures are applicable to all individuals required to perform work on Hydro owned or operated property, circuits, or equipment. Historically, these procedures have been organized using manual paper-based processes. Since 2008, the proposed Work Protection Software has been utilized at Holyrood and has resulted in an overall 20 percent increase in WPC documentation compliance from the manual process in 2007 to the software based process in 2008.

The software will provide an effective, consistent and standard means of creating work protection documentation. This will enable adherence to work flow rules and tag management, and will permit archiving.

The benefits of this software are as follows:

- Safety - reduces risk for operating errors, which translates to less time spent analyzing errors and results in increased employee, contractor and public safety.
- Standardization – provides a standard interface for the WPC activities for the hydroelectric plants.
- Efficiency – increases the efficiency of generation and checking, relieving operator workloads; potentially translates to shorter outages as the tool enables users to more quickly adapt to changes in plant status and configuration.
- Accuracy – Greater accuracy of permits translates into shorter outage times and a more streamline work protection execution due to removal of tedious and error prone paper forms.
- Configuration Control – provides the generating unit operator, who has responsibility for all activities on the unit, with greater control of the unit configuration. This information is also available for efficient maintenance planning.

**Future Plans:**

None.

**Project Title:** Upgrade Communications Services

**Location:** Paradise River

**Category:** General Properties - Telecontrol

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to upgrade the voice and data communications at the Paradise River Hydroelectric Generating Plant (Paradise River). The Power Line Carrier which transmits SCADA data to and from Paradise River to the Energy Control Center over existing transmission lines will be re-configured to a mixed analog/digital mode providing data bandwidth. Currently there is no access to the Corporate Administrative data network, which is considered unacceptable by staff that utilizes the facilities.

When crews are at remote plants there is frequently a requirement to access important data such as: Engineering Directives; Work Methods and Task Based Risk Assessments; on-line Material Safety Data Sheets (MSDS); and Maintenance Standards. There is also an important need for scanning and e-mailing important documents such as: Work Protection Permits; correspondence and pictures to and from manufacturers and between headquarters at Bay d'Espoir, the Energy Control Center and the Plant. Corporate data access to all work locations has become a Hydro Standard and is considered critical for Operations, Maintenance and Safety aspects of the plant operation. The antenna for the VHF base station will be relocated from its current location at the Plant to a hill near to and above the Plant to allow for improved VHF network reception. The satellite antenna will be re-located from its current location on the side of the building to the roof of the power house to improve reception. The communication cable system to and inside the bunk house will be replaced as it is currently damaged. Cell service is not available in this remote location.

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 4.5 | 0.0 | 0.0 | 4.5 |
| **Labour** | 43.1 | 0.0 | 0.0 | 43.1 |
| **Consultant** | 3.9 | 0.0 | 0.0 | 3.9 |
| **Contract Work** | 25.7 | 0.0 | 0.0 | 25.7 |
| **Other Direct Costs** | 7.5 | 0.0 | 0.0 | 7.5 |
| **Interest and Escalation** | 4.3 | 0.0 | 0.0 | 4.3 |
| **Contingency** | 8.5 | 0.0 | 0.0 | 8.5 |
| **TOTAL** | **97.5** | **0.0** | **0.0** | **97.5** |

**Operating Experience:**

The existing VHF backup voice communications into the plant has been unreliable due to the location of the antennas blocked by the surrounding hills. Currently communications into the plant is limited to use of operational voice phone capabilities on Hydro's SCADA network. Consequently, there is no access to the Hydro Corporate Administrative Data Network, and hence staff cannot access corporate applications used to support regular operations. Key online applications include JD Edwards, for work order activity, the MDSD database for safety, and Hydro's intranet.

**Project Justification:**

The Paradise River Plant is located on the Burin Peninsula and is operated remotely. It is visited on a monthly basis by plant personnel for inspections, routine and corrective maintenance. Employee safety is critical and it's important that employees have a reliable phone system to report emergency events, to discuss material safety data sheets and worker protection, to deal with important family matters that may arise while away from home and to discuss critical job procedures with plant personnel with knowledgeable employees at headquarters and at Bay d'Espoir. The existing system was established for the communications and data requirements that were the norm at the time of plant construction. The evolution in safety procedures, work approach, and proactive equipment monitoring has rendered the existing communications arrangement inadequate.

This project will realize a number of safety and reliability benefits. From a safety perspective, communications is important for: acquiring emergency medical services; for reporting emergencies;

for acquiring critical safety data such as MSDS Sheets; for accessing Work Methods and Task Based Risk Assessments; for applying for and checking Worker Protection Permits; and for calling headquarters to inquire about any safety issues that may arise on the job.

Reliability of our large turbine/generator units is critical for providing safe electrical power to the people of this province. Most of our remote plants only have personnel at sites eight hours a day, Monday through Friday. In many cases an alarm results in a forced outage on a unit until an operator can be dispatched to investigate the problem. Hydro Generation is moving toward Asset Health Monitoring whereby Hydro receives information on critical operating parameters at a central location where it will alert operations staff in the way of soft alarms advising of a potential problem. This allows Hydro to be proactive and act on potential problems before they become a serious situation. This type of asset health monitoring requires advanced communications systems. Having adequate operating data and alarms fed back to a central location in advance of a failure allows Hydro to plan outages as opposed to being forced out of service. Forced outs are unplanned events and normally cost three to four times the amount of the same outage in a planned state.

The anticipated project schedule is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Planning | Jan 2012 | Mar 2012 |
| Design | Design | Feb 2012 | Apr 2012 |
| Procurement | Procurement | Apr 2012 | May 2012 |
| Construction | Construction | Jun 2012 | Jul 2012 |
| Commissioning | Commissioning | Jul 2012 | Jul 2012 |
| Closeout | Closeout | Nov 2012 | Nov 2012 |

**Future Plans:**

None.

**Project Title:** Perform Minor Application Enhancements

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

Hydro's many computer applications are used daily by employees to run the business. Examples of these applications include the JD Edwards Enterprise Resources Planning Suite, the Lotus Notes Email and Collaboration Suite, the Showcase Business Intelligence and Reporting Suite, and the Microsoft Office Productivity Suite. This project is necessary to enhance these applications to support changing business requirements. The application enhancement project provides for minor enhancements to applications in response to unforeseen requirements such as regulatory and changing business needs. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 48.5 | 0.0 | 0.0 | 48.5 |
| **Labour** | 37.7 | 0.0 | 0.0 | 37.7 |
| **Consultant** | 21.6 | 0.0 | 0.0 | 21.6 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 4.8 | 0.0 | 0.0 | 4.8 |
| **Contingency** | 10.8 | 0.0 | 0.0 | 10.8 |
| **Sub-Total** | **123.4** | **0.0** | **0.0** | **123.4** |
| **Cost Recovery** | **(41.9)** | **0.0** | **0.0** | **(41.9)** |
| **TOTAL** | **81.5** | **0.0** | **0.0** | **81.5** |

**Operating Experience:**

This project has been used in the past to fund enhancements to applications such as the safety and audit databases, full time equivalent reporting, and equalized billing. In 2010, the most recent year for which actual data is available, the following application enhancements were made:

- Acquired development software licenses to support the eBilling and ePaystubs initiatives.
- Acquired software and worked with a consultant to test purging and archiving of obsolete JD Edwards data.
- Acquired Spreadsheet Server software for Finance Group.
- Acquired Primavera Project Portfolio Management software in support of the Project Execution and Technical Services group and CF(L)Co.

- Obtained consulting service from Business Intelligence (BI) software vendor to assist with upgrades to BI applications.
- Installed and configured Course Park to house corporate online training information.
- Had Trim application provider perform an application health check.

**Project Justification:**

This project is justified on the basis of operational efficiency and response to regulatory and legislative requirements. As part of normal Information Systems department work, this project is necessary to enhance existing applications to support changing business and regulatory requirements.

Table 2 shows upgrades that have occurred from 2007-2011F.

**Table 2: Application Enhancements**

| Year | Budget ($000) | Actual ($000) | Comments[1] |
|---|---|---|---|
| 2011F | 120.7[2] | | Upgrade |
| 2010 | 120.7[2] | 122.9 | Upgrade |
| 2009 | 120.2[2] | 120.6 | Upgrade |
| 2008 | 372.5[2] | 369.8 | Upgrade |
| 2007 | 148.5[2] | 148.5 | Upgrade |
| 2006 | 780.0[3] | 390.0 | Upgrade |

(1) Upgrade refers to adding or extending functionality of applications.

(2) Previous Budgets included the Intranet and/or Internet Refresh Proposals. These have now been moved to distinct proposals.

(3) The "Enhancements to the Capital and Operating Process Applications" component of this budget was cancelled. The budgeted amount for this component was $390,000.

**Future Plans:**

Future enhancements will be proposed in future capital budget applications. Also see five-year capital plan (Capital Plan 2012 Tab, Appendix A).

**Project Title:** Upgrade Computer Room

**Location:** Hydro Place

**Category:** General Properties - Administrative

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project is required to replace the computer room air conditioners. The existing air conditioners have been in service since 1989 and are not reliable in cooling the computer room. The current air conditioners will be replaced with a Liebert 12-ton DS precision cooling system, with an outdoor air cooled condensing unit. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 40.0 | 0.0 | 0.0 | 40.0 |
| **Labour** | 21.4 | 0.0 | 0.0 | 21.4 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 45.0 | 0.0 | 0.0 | 45.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 5.0 | 0.0 | 0.0 | 5.0 |
| **Contingency** | 10.6 | 0.0 | 0.0 | 10.6 |
| **Sub-Total** | 122.0 | 0.0 | 0.0 | 122.0 |
| **Cost Recoveries** | 41.5 | 0.0 | 0.0 | 41.5 |
| **TOTAL** | **80.5** | **0.0** | **0.0** | **80.5** |

**Operating Experience:**

The air conditioners have been in service since their installation in 1989 when Hydro Place was originally built. The computer room houses all the computer servers that are used by staff in carrying out their day to day work. The servers provide the business functions for the company such as General Ledger, Accounts Payable, Accounts Receivable, Fixed Assets, Job Costing, Purchasing, Inventory, Human Resources, Payroll, Plant Equipment Management, Work Orders and Customer Services and Corporate Email.

The air conditioners have not been reliable over the last two years resulting in four calls placed for repairs. A report by IBM in 2009 recommended the air conditioners be replaced in two to three years before they became too unreliable. Refer to Appendix A: NL Hydro – Energy & Health Check Report.

**Project Justification:**

Failure of the air conditioners puts the computer equipment at risk of malfunctioning as the temperature will rise above the operating temperatures tolerated by the equipment. This will negatively affect Hydro's operation as the computer systems are used in day to day operations and business functions.

This project will start in May 2012 and end in September 2012.

**Future Plans:**

None.

**APPENDIX A**

**NL HYDRO – ENERGY AND HEALTH CHECK REPORT**

## Mechanical Systems

### Computer Room Air Conditioning

The temperature and humidity levels in the computer room are controlled by two Liebert precision air conditioning units. Each unit is rated at 10-tons (nominal). The following table lists the capacities and readings for each of these units:

**Table 17: Air Conditioner Inventory**

| Model Information | | | Sensible Rating | | Temperature (°F) | | | Humdification (RH) | | | Fan | | Vane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit # | Model Number | Manu. Date | BTU | Tons | Reading | Set | Sens | Reading | Set | Sens | HP | CFM | Y/N |
| AC-10 | Liebert FH114A-B00 | Jun 1989 | 115,600 | 9.63 | 74 | 70 | 3 | 41% | 45% | 3% | 1.5 | 4,650 | N |
| AC-11 | Liebert FH114A-B00 | Jun 1989 | 115,600 | 9.63 | 71 | 71 | 1 | 48% | 45% | 3% | 1.5 | 4,650 | N |
| | TOTALS | | 231,200 | 19.3 | | | | | | | | 9,300 | |

The air conditioning units in the computer room were manufactured in 1989. While these units are capable of operating beyond 20 years of age, it should be expected that reliability may become an issue as the years progress. There are previous service records left inside the AC units that indicate the units are maintained regularly. Other customers have reported to IBM that getting replacement parts for units of this age is becoming more difficult. NL Hydro has reported that it may not be possible to replace these units for another 2-3 years.

The AC units run autonomously. Each unit controls its own particular part of the room without regard to the operating status of the other unit. As such, it was not uncommon to observe one unit humidifying the room, while the other was de-humidifying. The heating circuit of one AC unit may be engaged while the other unit is simultaneously attempting to cool the room. The cooling load in the room (9.8 tons) is slightly above the total sensible capacity of either of these AC units. Redundancy may only be possible in limited circumstances. The unit that is closest to the IT equipment racks likely absorbs most of the workload. The other AC unit next to the operator's station probably does not see the same workload. Anecdotal evidence seems to confirm that only the AC unit next to the operator's station can realistically be removed from service for any length of time without adversely affecting the IT equipment. The same cannot be said of the other AC unit.

The set-points that have been selected for the AC units are 2-3°F higher than the AC units in the EMS room. The sensitivity range (or dead-band) of AC-10 is set higher as well. This, combined with its proximity to a majority of the IT equipment heat load, explains why the return air temperature (74°F) is higher. Despite these differences, temperature control at the face of the IT equipment rack was relatively stable and within the recommended ranges.

A temperature logger was installed at mid-point at the face of two equipment racks (PROD-3 and PROD-6) to determine how well temperatures are being controlled at the face of the racks. The results indicate that air temperature for both racks falls within the recommended temperature range of 64°F-80°F (see appendix). Albeit, these temperatures were at the lower end of the recommended range, indicating that some efficiency gains can still be made.

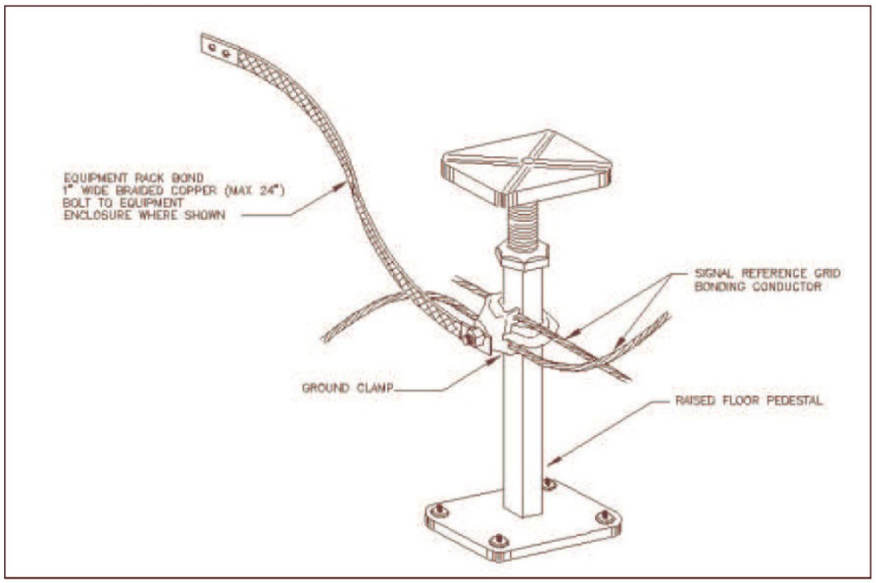
Humidity levels in the ADMIN computer room appeared to be influenced by external migration of outdoor moisture. There were no observed vapour barriers installed in the walls of the computer room. On the day of the initial site inspection, the weather was extremely rainy. As a result, humidification cycles (and de-humidification cycles) alternated between each AC unit, sometimes operating at cross-purposes simultaneously. Despite this, however, humidity levels at the rack faces were controlled to within the recommend range (see appendix).

- It is not currently possible to identify which IT servers or devices are connected to which circuit breaker. A method of cross-referencing this information should be created. In this way, it will be a simple matter to know which IT devices are implicated by any circuit overloads or planned service actions.
- Branch circuit labelling should be consistently administered at each receptacle and at the breaker panels. Receptacles should be labelled at their faceplates with a mechanically created label. Up to date panel schedules should be kept with each circuit breaker panel. The names of the circuits servicing each IT equipment rack should be posted on the rack itself.

### Grounding

- Grounding in the EMS computer room has not been installed as per the Canadian Electrical code or the IEEE-1100 grounding guidelines. The raised access floor must be bonded to ground. Individual IT equipment racks should also be bonded to the signal reference grid created by the floor ground. This also applies to air conditioning units, PDUs, circuit breaker panels, LAN racks, and any other device mounted on the raised floor.

**Figure 18: Typical Rack Grounding Method**




## Mechanical Systems

### AC Systems

- The age of the AC units will likely require NL Hydro to replace them within the next two to three years. Hopefully these units will not become totally unreliable before that time. The AC units that will ultimately replace the existing units should have some features included that are not currently installed on the existing units. These features include:

- Un-loader technology, variable speed fans, and/or digital scroll compressor technology to accommodate lightly loaded room conditions.
- Web/SNMP connection capability to allow the new AC units to communicate directly to a monitoring system and/or internal LAN.
- Inter-unit communications capability to allow AC units to operate collaboratively within each room. Various control scenarios should be explored to understand which will work best for each room (teamwork mode vs. standby mode vs. cascade mode)
- Ducting capability to allow the ceiling plenum space to be used as a hot air return.

- In the interim, the existing AC units can be configured to use less energy. There is no need to run both AC units in the EMS room simultaneously. An auto-changeover controller could be installed that would cycle each of these units on and off according to a set schedule. The position of the AC units in the room with respect to the orientation of the IT equipment racks will likely require the units to be ducted into the ceiling so that the ceiling plenum space can be used as a hot air return. Zinc whisker contamination issues in the ceiling space will first need to be addressed.
- In the ADMIN room, it will still be necessary to run both units simultaneously. However, some set-point adjustments could still be made if the air flow patterns in the room can first be improved. Again, ducting of the AC units will help to improve hot air return. When the time comes to replace these AC units, more advantageous positioning of the new units and some strategic baffling under the raised floor may permit a "standby" mode to be used in this room as well. This would allow the AC units to take turns controlling the room instead of both units running simultaneously. However, careful planning should be done before this is attempted. CFD modeling of the space would likely be necessary to ascertain where the units should best be positioned in the room, if under-floor baffling provides an advantage, and if a single AC unit can maintain the environment under present and future design loads.
- The temperature set-points and sensitivity ranges should be standardized on each AC unit. If air flow improvements can be made to each room, it will be possible to raise the set points of each AC unit. This will have a significant and direct impact on energy consumption and efficiency.
- Water leak dams or pans should be installed below the AC units to channel possible leaks towards leak detectors that will need to be installed under the raised floor inside the water dams.
- The water leak detection system should be extended to include the drains that are present under the raised floor, especially in the ADMIN room. Each drain should be provided with a back-flow prevention device.

### Air Flow

- Many cable cut-outs in the rear of equipment racks have not been properly sealed to prevent loss of air pressure under the floor. This also promotes air "bypass" problems for the air conditioning units. An example of a device that will greatly reduce this air leakage is shown at right. A "split" version of the device is available that will allow it to be installed over existing floor penetrations without disturbing the cables. There are also fire-rated memory-foam pillows that can be used to achieve the same effect. However, these devices are dependent on users replacing them back into the holes if they are removed, and do not absolve NL Hydro from also sealing the exposed wood-core cuts in the floor tiles with a fire-rated grommet.



**Project Title:** Upgrade Microsoft Project

**Location:** Hydro Place

**Category:** General Properties - Information Systems

**Definition:** Other

**Classification:** Normal

**Project Description:**

This project will upgrade users of Microsoft (MS) Project from version 2000 to version 2010. The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 71.4 | 0.0 | 0.0 | 71.4 |
| **Labour** | 9.3 | 0.0 | 0.0 | 9.3 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 2.5 | 0.0 | 0.0 | 2.5 |
| **Contingency** | 8.1 | 0.0 | 0.0 | 8.1 |
| **Sub-Total** | 91.3 | 0.0 | 0.0 | 91.3 |
| **Cost Recoveries** | (31.0) | 0.0 | 0.0 | (31.0) |
| **TOTAL** | **60.3** | **0.0** | **0.0** | **60.3** |

**Operating Experience:**

This software is used by engineering, managerial and information systems staff for various tasks within Hydro. There are 87 users of this product.

**Project Justification:**

The version of MS Project in use, MS Project 2000, has not had vendor support since July 2010, in accordance with Microsoft support policies. Without vendor support Hydro no longer receives security patches for this product. Upgrading to MS Project 2010 will provide Hydro with security patch support until 2020.

In addition since MS Project 2000 has been superseded by four later versions it is becoming more difficult to share project plans with external partners who are on later releases.

**Project Title:** Upgrade Microsoft Project **(cont'd.)**

**Future Plans:**

Other software upgrades will be proposed in future capital budget applications.

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | PUB Approval | Ref. No. |
|---|---|---|---|---|---|---|
| | | | ($000) | | | |
| Replace Static Excitation Systems - Upper Salmon, Holyrood and Hinds Lake | 487 | 2,403 | 1,219 | 4,109 | P.U. 38 (2010) 2011 Capital Budget | 1 |
| Upgrade Intake Gate Controls - Bay d'Espoir | 352 | 468 | | 820 | P.U. 38 (2010) 2011 Capital Budget | 2 |
| Upgrade Generating Station Service Water System - Cat Arm | 360 | 440 | | 800 | P.U. 38 (2010) 2011 Capital Budget | 3 |
| Replace Programmable Logic Controllers - Holyrood | 2,230 | 902 | | 3,132 | P.U. 1 (2010) 2010 Capital Budget | 4 |
| Upgrade Hydrogen System - Holyrood | 1,192 | 800 | | 1,992 | P.U. 38 (2010) 2011 Capital Budget | 5 |
| Upgrade Synchronous Condenser Unit 3 - Holyrood | 484 | 406 | | 889 | P.U. 38 (2010) 2011 Capital Budget | 6 |
| Replace Relay Panels Unit 3 - Holyrood | 277 | 554 | | 831 | P.U. 38 (2010) 2011 Capital Budget | 7 |
| Upgrade Electrical Equipment - Holyrood | 188 | 206 | 285 | 679 | P.U. 38 (2010) 2011 Capital Budget | 8 |
| Replace Steam Seal Regulator Unit 2 - Holyrood | 175 | 438 | | 613 | P.U. 38 (2010) 2011 Capital Budget | 9 |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 2,629 | 3,367 | | 5,995 | P.U. 1 (2010) 2010 Capital Budget | 10 |
| Upgrade Terminal Stations to 25 kV - Labrador City | 6,483 | 3,507 | | 9,990 | P.U. 36 (2008) 2009 Capital Budget | 11 |
| Perform Grounding Upgrades - Various Sites | 321 | 324 | 1,012 | 1,657 | P.U. 38 (2010) 2011 Capital Budget | 12 |
| Upgrade Substation - Wabush | 459 | 626 | | 1,086 | P.U. 38 (2010) 2011 Capital Budget | 13 |
| Upgrade Station Reliability and Safety - Rocky Harbour | 435 | 360 | | 795 | P.U. 38 (2010) 2011 Capital Budget | 14 |
| Replace 69 kV SF6 Breakers - St. Anthony Airport | 490 | 290 | | 780 | P.U. 38 (2010) 2011 Capital Budget | 15 |
| Replace Compressed Air System - Bay d'Espoir | 84 | 564 | | 648 | P.U. 38 (2010) 2011 Capital Budget | 16 |
| Replace 230 kV Circuit Breaker - Sunnyside | 41 | 590 | | 631 | P.U. 38 (2010) 2011 Capital Budget | 17 |
| Install Alternate Station Services - Stony Brook and Massey Drive | 86 | 109 | | 195 | P.U. 38 (2010) 2011 Capital Budget | 18 |
| Replace Guy Wires TL-215 - Doyles to Grand Bay | 289 | 318 | 880 | 1,487 | P.U. 38 (2010) 2011 Capital Budget | 19 |
| Voltage Conversion - Labrador City | 4,590 | 3,841 | 970 | 9,400 | P.U. 1 (2010) 2010 Capital Budget | 20 |
| Upgrade L2 Distribution Feeder - Glenburnie | 845 | 2,115 | 597 | 3,556 | P.U. 1 (2010) 2010 Capital Budget | 21 |
| Upgrade Distribution Systems - Francois, Rigolet and Happy Valley | 1,068 | 652 | | 1,720 | P.U. 38 (2010) 2011 Capital Budget | 22 |
| Replace Substation Infrastructure - Burgeo | 128 | 368 | | 496 | P.U. 38 (2010) 2011 Capital Budget | 23 |
| Perform Arc Flash Remediation - Various Sites | 430 | 380 | 1,206 | 2,016 | P.U. 38 (2010) 2011 Capital Budget | 24 |
| Replace Mini Hydro Turbine - Roddicton | 87 | 235 | | 322 | P.U. 38 (2010) 2011 Capital Budget | 25 |
| Install Automated Meter Reading - Labrador City and Port au Choix | 451 | 88 | | 539 | P.U. 38 (2010) 2011 Capital Budget | 26 |
| Replace Off-Road Track Vehicles - Bishop's Falls and Fogo | 494 | 609 | | 1,104 | P.U. 38 (2010) 2011 Capital Budget | 27 |
| Corporate Application Environment - Upgrade Microsoft Products | 1,426 | 678 | | 2,104 | P.U. 1 (2010) 2010 Capital Budget | 28 |
| Cost Recoveries | (428) | (203) | | (631) | P.U. 1 (2010) 2010 Capital Budget | |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | 72 | 683 | | 755 | P.U. 38 (2010) 2011 Capital Budget | 29 |
| Replace Vehicles and Aerial Devices (2011-2012) - Various Sites | 2,351 | 639 | | 2,989 | P.U. 38 (2010) 2011 Capital Budget | 30 |

**1. Replace Static Excitation Systems – Upper Salmon, Holyrood and Hinds Lake**

The initial project schedule and estimated cost are listed in the table below:

| Year | Activity | Cost ($000) |
|---|---|---|
| 2011 | Design and Installation of the Static Excitation System – Upper Salmon | 1,214.3 |
| 2012 | Design and Installation of the Static Excitation System – Holyrood Unit 3 | 1,528.0 |
| 2013 | Design and Installation of the Static Excitation System – Hinds Lake | 1,366.8 |
| | Total | $4,109.1 |

The intent was to tender for all three excitation systems and install one in Upper Salmon in 2011. There was insufficient time allotted for design, procurement, delivery and installation in 2011. In addition, the Hinds Lake exciter has experienced four failures in 2011 (one each in March, April, May and June); therefore it has become the first priority for replacement. The project schedule and cost have been adjusted to reflect the necessary changes. There has been no change to the overall project cost as shown in the table below. However, the annual budgets have been adjusted with the bulk of the expenditures now occurring in 2012. This is also reflected in the 2012 Capital Budget Application.

| Year | Activity | Cost ($000) |
|---|---|---|
| 2011 | Design and tender for all three excitation systems. | 487.3 |
| 2012 | Install Excitation Systems – Hinds Lake and Holyrood Unit 3 | 2,402.5 |
| 2013 | Install Excitation System – Upper Salmon | 1,219.3 |
| | Total | $4,109.1 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**2. Upgrade Intake Gate Controls – Bay d'Espoir**

This is a two year project to upgrade the electrical controls at the Bay d'Espoir Intake Gates 1, 2 and 3 which will also include the replacement of the powerhouse programmable logic controller (PLC) and the upgrading of the existing serial communication link between the powerhouse and intakes to

an Ethernet based technology. During 2011, the controls at Intake 2 and the communications link between all four intakes and the powerhouse will be upgraded. The intake gate controls at Intakes 1 and 3 will be upgraded during 2012. The project cost by year is shown in the table below.

| Year | Cost ($000) |
|---|---|
| 2011 | 352.3 |
| 2012 | 468.0 |
| Total | $820.3 |

The scope for this project remains unchanged and the project is expected to be complete within budget. It should be noted that, due to high inflow conditions, outage activity for summer 2011 has been impacted. Hydro is continuing to evaluate the impacts of these conditions on project schedule and cost.

**3. <u>Upgrade Generating Station Service Water System – Cat Arm</u>**

This is a two year project to replace components of the generating station service water system. The scope of the project involves:

- Replacing the current carbon steel piping of the generating station service water system, including:
  - The branch pipe lines from the take-off points on the cooling water supply header to the unit housing for both generating units,
  - All four-inch and smaller diameter piping,
  - The piping on the generator bearing water supply for Unit 1,
- Replacing the differential pressure flow meters with electromagnetic flow measuring devices,
- Replacing the surface air cooler temperature control valve on each generating unit,
- Replacing both penstock emergency supply pressure reducing valves
- Replacing both main cooling water pumps,
- Inspecting the common header and pressure piping within the plant,
- Removing any asbestos material from the above mentioned equipment,
- Re-insulating piping and components mentioned above.

In 2011 all the carbon steel pipes will be upgraded to stainless steel, the inspection program will be started on the plant cooling water header and emergency cooling water supply line, new flow meters will be installed and the asbestos abatement will be started. The balance of work will be completed in 2012.

The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 360.4 |
| 2012 | 440.0 |
| Total | $800.4 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**4. <u>Replace Programmable Logic Controllers – Holyrood</u>**

The original project schedule and estimated cost are listed in the table below.

| Year | Activity | Cost ($000) |
|---|---|---|
| 2010 | Units 1 and 2 burner management systems PLC replacement | 1, 207.9 |
| 2011 | Water Treatment Plant PLC | 747.1 |
| 2012 | Waste Water Treatment Plant and Warm Air Make-Up PLC Replacement | 901.7 |
| | Total | $2,856.7 |

The burner management system controls for Units 1 and 2 were replaced during 2010. There were safety related deficiencies in the burner management control systems that were not identified during the preparation of this proposal. The modifications required to correct these deficiencies resulted in an additional $50,000 for completion and commissioning. As well, the tender for the engineering and supply of the burner management systems and the electrical systems were $100,000 greater than expected. In addition, the scope of this project has been changed to exclude the replacement of the control systems for the warm air makeup system. There are mechanical

issues with this system that have to be addressed therefore it would not be prudent to replace the control systems at this time (See response to Request for Information PUB-NLH-13 and PUB-NLH-14, NLH 2010 Capital Expenditures and Carryover Report, for further detail). The total budget has increased to $3,131,700. The revised project schedule and estimated cost are listed in the table below.

| Year | Activity | Cost ($000) |
|---|---|---|
| 2010A | Units 1 and 2 burner management systems PLC replacement | 1, 357.5 |
| 2011 | Water Treatment Plant PLC | 872.5 |
| 2012 | Waste Water Treatment Plant | 901.7 |
| | Total | $3,131.7 |

**5. Upgrade Hydrogen System – Holyrood**

This is a two year project to upgrade the hydrogen gas system at Holyrood. In 2011, work includes the engineering design and supply of a hydrogen electrolyzer, low pressure hydrogen bulk storage tanks, and three hydrogen gas control panels. The installation of these components will also commence in 2011. Work in 2012 includes the installation of the hydrogen electrolyzer, low pressure hydrogen storage tanks, hydrogen gas control panels, automatic hydrogen venting systems on generating Units 2 and 3, and replacement of the manual gas control valves and piping. The project cost by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 1,191.9 |
| 2012 | 800.4 |
| Total | $1,992.3 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**6. Upgrade Synchronous Condenser Unit 3 – Holyrood**

This is a two year project to perform modifications to the Holyrood Generating Unit 3 to reduce vibration levels during synchronous condenser operation. The existing extension shaft will be replaced with a new extension shaft complete with a journal bearing, thrust bearing and coupling assemblies. The journal bearing will control the radial vibrations of the extension shaft and generator rotor. The thrust bearing will control the axial thrust vibrations from the generator rotor. The project will also reduce the time required to convert Unit 3 from generation to synchronous condenser mode from approximately 16 days to three to five days.

In 2011, the work will be tendered and awarded and the materials procured with installation and commissioning completed in 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 483.6 |
| 2012 | 405.5 |
| Total | $889.0 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**7. Replace Relay Panels Unit 3 – Holyrood**

This is a two year project to replace the existing hardwired relay logic infrastructure contained in the three relay panels on Unit 3 with a distributed control system (DCS) that will allow more dependability and better operator control functionality. The installation will be completed by removing the existing field wiring that terminates inside the existing relay panels. A new junction box will be installed to house the cabling required for the existing DCS control to remain functional. A new electrical enclosure containing all the required DCS hardware will be installed at the existing location and the field wiring will be re-terminated inside the new DCS control panels. The existing hardwired relay logic will be converted to a software based operating logic that will allow the system to function as it currently does. This new DCS hardware will be an expansion to the existing Foxboro DCS control system. In 2011, the engineering design and DCS programming will be

developed with installation and commissioning completed in 2012. The project cost by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 277.1 |
| 2012 | 553.6 |
| Total | $830.7 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**8. Upgrade Electrical Equipment – Holyrood**

This is a three year project to replace the circuit protection equipment in six motor control centers (MCCs) located in the Holyrood plant powerhouse and to replace one MCC and items of the electrical switchgear in the Gas Turbine building.

The project consists of a complete replacement of the protection equipment in each motor starter for the six MCCs that are located in the plant. The new protection will be in the form of thermal magnetic circuit breakers to replace the existing fuses. The new breakers will enable better coordination with the protective equipment to interrupt the electrical faults that could cause damage to the equipment or present safety hazards to workers. For the gas turbine plant, the original scope of work included the replacement of the MCC, the gas turbine start rectifier, the automatic voltage regulator, exciter, automatic transfer switch and the 13.8 kV fusible disconnect switch. However, Hydro is currently completing a condition assessment on the gas turbine and balance of plant and no work will be completed on these systems until the condition assessment study is completed. The project cost by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 188.0 |
| 2012 | 206.3 |
| 2013 | 284.5 |
| Total | $678.8 |

The MCC refurbishments will be completed in 2011. The scope for this project remains unchanged and the project is expected to be completed within budget.

**9. Replace Steam Seal Regulator Unit 2 – Holyrood**

This is a two year project to replace the existing hydraulic steam seal regulator on Unit 2 with two pneumatically operated steam pressure control valves. One of these pneumatically controlled pressure regulating valves will be used to supply steam to the steam seal header and one will be used to relieve pressure from the steam seal header. The new system will be controlled using a pressure transducer and the existing Foxboro Distributed Control System (DCS). In addition, the steam seal header piping will be modified to allow the new pressure control valves to be installed at a location which allows for easier operator access.

The detailed engineering design will be completed in 2011 with the procurement of materials and installation completed in 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 175.0 |
| 2012 | 438.4 |
| Total | $613.4 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**10. Upgrade Gas Turbine Plant Life Extension – Hardwoods**

Costs are listed in the table below:

| Year | Activity | Cost ($000) |
|---|---|---|
| 2010 | Refurbish end B gas turbine equipment. Site retrofits and upgrades. | 1,304.5 |
| 2011 | Refurbish end A gas turbine equipment. Site retrofits and upgrades. | 1,323.6 |
| 2012 | Refurbish generator and exciter. Site retrofits and upgrades. | 3,366.6 |
| | Total | $5,994.7 |

A major portion of the 2010 budget for this project was allocated to overhauling one gas turbine engine. The proposal assumed that a plant outage would occur early in the year so that the gas turbine engine could be removed, refurbished and returned to service before winter. The plant outage at Hardwoods did not occur until late in October. This did not allow sufficient time to have the engine overhauled and returned to service prior to the winter operation season (See response to Request for Information PUB-NLH-18, NLH 2010 Capital Expenditures and Carryover Report, for further detail). The total expenditure for 2010 was $705,000 with the remainder of the budget to be spent in 2011. Currently, the outage for Hardwoods to permit the installation of the refurbished engine has been set for late October to mid November, however, as always, such an outage is subject to overall interconnected system change and conditions. Also, depending on the degree of overhaul required once the engine is disassembled and inspected, some of the work planned for 2011 may be delayed to 2012. The scope for this project remains unchanged and the project is expected to be completed within budget. The revised budget for this project is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2010A | 704.5 |
| 2011 | 1,923.6 |
| 2012 | 3,366.6 |
| Total | $5,994.7 |

**11. <u>New 25 kV Terminal Station – Labrador City</u>**

The original budget was submitted as a three year project to construct two new 46/25 kV terminal stations. Each station will have two new 46/25 kV, 15/20/25 MVA power transformers, new 46 kV and 25 kV electrical equipment, and new control buildings The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2009 | 283.2 |
| 2010 | 3,894.8 |
| 2011 | 5,812.6 |
| Total | $9,990.6 |

There was no change in scope or budget, however, the project was extended to 2012 as part of the 2010 Capital Budget Application as shown in the 2010 Capital Plan Section, page viii, Appendix A, Five Year Capital Plan. The revised budget estimate showing actual costs for 2009 and 2010 is as follows:

| Year | Cost ($000) |
|---|---|
| 2009A | 100.8 |
| 2010A | 1,693.5 |
| 2011 | 4,688.7 |
| 2012 | 3,507.0 |
| Total | $9,990.0 |

There was no change to the project schedule or budget in the 2011 Capital Budget Application, however, the project name was changed to "Upgrade Terminal Station to 25 kV – Labrador City".

While there has been no confirmed change to the project schedule or budget, project tenders are currently coming in above budget, and there is some difficulty obtaining any tenders for certain pieces of work. Once the full extent of any changes are known, Hydro will include any required update in its future Quarterly Regulatory reporting.

**12. <u>Perform Grounding Upgrades – Various Sites</u>**

This is a five year project to upgrade terminal station and distribution substation grounding. The scope of this project consists of:

- Performing step and touch potential analysis of 22 terminal stations and 32 distribution substations;
- Upgrading grounding grids at 46 terminal stations and 17 distribution substations;
- Conducting a gradient control mat survey of 156 mats at 22 terminal stations to identify those that are substandard; and
- Upgrading 345 substandard gradient control mats.

The table below shows the original project schedule and budget estimates for each of the five years.

| Year | Activity | Cost ($000) |
|---|---|---|
| 2011 | Step and touch potential analysis of 18 terminal stations and 3 distribution substations<br>Grounding grid upgrades at 10 terminal stations<br>Gradient control mat survey of 156 mats in 22 terminal stations | 321.2 |
| 2012 | Step and touch potential analysis of 4 terminal stations and 15 distribution substations<br>Grounding grid upgrades at 12 terminal stations | 324.0 |
| 2013 | Step and touch potential analysis of 14 terminal stations and 15 distribution substations<br>Grounding grid upgrades at 13 terminal stations and 1 distribution station | 329.0 |
| 2014 | Grounding grid upgrades at 11 terminal stations and 10 distribution substations<br>Upgrade of 32 gradient control mats | 337.1 |
| 2015 | Grounding grid upgrades at 6 distribution substations<br>Upgrade of 313 gradient control mats | 345.4 |
| | Total | $1,656.7 |

Hydro is continuing to evaluate progress on this project and will provide the Board with an update on findings and progress as a part of the quarterly update for quarter four, 2011.

**13. <u>Upgrade Substation – Wabush</u>**

This is a two year project to perform the following:

- Converting the two 4.16 kV feeders to operate at 12.5 kV. This conversion includes installation of new 12.5 kV reclosers in the substation and retirement of the last two circuit breakers in the Westinghouse switchgear. As well, the 4.16 kV distribution feeders and auxiliary equipment will be upgraded to 12.5 kV standards.
- Upgrading the substation and fence grounding systems to comply with Hydro's current Terminals Engineering Standard TS07-004-R2 and Institute of Electrical and Electronic Engineers (IEEE) Standard 80-2000.
- Performing general civil works upgrades to the Westinghouse enclosure to correct deficiencies to ensure its suitability for continued use as the substation control building. To correct deficiencies related to:

- The weather: an upgrade of the roof and installation of sealing and weather proofing around the doors and window are required.
- The environment: proper ventilation for temperature and humidity control needs to be installed, and,
- Work place safety: eye wash facilities along with fire extinguishers and exit lighting has to be installed.

Detailed Engineering design, outside substation civil works and equipment delivery will be completed in 2011 with the substation electrical equipment installation and Westinghouse housing upgrades completed in 2012.

The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 459.3 |
| 2012 | 626.4 |
| Total | $1085.7 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**14. <u>Upgrade Station Reliability and Safety – Rocky Harbour</u>**

This is a two year project to perform a general upgrade to the Rocky Harbour Terminal Station. The wood pole structures will be replaced with steel structures; the reclosers and all disconnects, power fuses, bus work and hardware will be replaced; the power transformer and voltage regulators will be reused; the protection and control equipment will be replaced and housed in a new outdoor weatherproof enclosure; and the station and fence grounding systems will be upgraded. The detailed design engineering and equipment delivery will be completed in 2011 with the outside civil work and electrical equipment installation completed in 2012. The budget estimate for this project is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 434.8 |
| 2012 | 360.1 |
| Total | $794.9 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**15. <u>Replace 69 kV $SF_6$ Breakers – St. Anthony Airport</u>**

This project is a two year plan to replace two 69 kV sulfur hexachloride ($SF_6$) circuit breakers, B1T1 and B1L57, at the St. Anthony Airport Terminal Station. These two breakers will be replaced with new 69 kV $SF_6$ breakers.

The scope of work for this project includes the following:

- Purchase and delivery of the new breakers;
- Removal of the old breakers and installation of the new breakers;
- Reconnection of the protection and control equipment; and
- Commissioning of new breakers.

The replacement of breaker B1T1 scheduled for 2011 requires diesel generation at St. Anthony Diesel Plant to maintain service to approximately 1,200 customers.

The budget estimate for each year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 489.8 |
| 2012 | 290.1 |
| Total | $779.9 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**16. Replace Compressed Air System – Bay d'Espoir**

This is a two year project to replace the existing copper, brazed joint air distribution system with stainless steel piping and welded joints. The existing building enclosure in the terminal station is in disrepair and does not provide sufficient space to construct a new piping system while keeping the existing system in service. As a result, a new enclosure will be constructed in the terminal station yard to house the new header piping, valve panel, and instrumentation. The existing copper compressed air piping in the terminal station cable trenches will be replaced with a welded stainless steel system. The scope of work for 2011 includes the engineering and design of the piping system and the construction of the new enclosure. The new piping system will be installed in 2012.

The budget estimate for each year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 83.9 |
| 2012 | 563.6 |
| Total | $647.5 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**17. Replace 230 kV Circuit Breaker – Sunnyside**

This is a two year project to replace breaker L03L06 at the Sunnyside Terminal Station. The existing breaker is a 230 kV air blast breaker and it will be replaced by a new 230 kV sulfur hexachloride ($SF_6$) breaker. The scope of this work includes the removal of the existing breaker, construction of a new foundation for the breaker, purchase and installation of a new breaker and modifications to the protection and control circuits, if needed, and commissioning of the new breaker. Engineering, design and equipment tendering will be completed in 2011 with the equipment delivery and installation completed in 2012. The budget estimate for each year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 41.3 |
| 2012 | 590.1 |
| Total | $631.4 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**18. Install Alternate Station Services – Stony Brook and Massey Drive**

This is a two year project to install alternate station service power supply to Stony Brook and Massey Drive Terminal Stations. The engineering design and specification of equipment will take place in 2011 with the installation completed in 2012.

The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 86.0 |
| 2012 | 109.2 |
| Total | $195.2 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**19. Replace Guy Wires TL-215 – Doyles to Grand Bay**

This is a four year project to replace the existing guy wire arrangement on TL-215 with an assembly that helps reduce the fatigue problem on the existing pre-form grips. A single year project was completed in 2010 which replaced guy wires on approximately 20% of the line. This project will replace the guy wires on the remainder of the line with approximately 20% being replaced each year. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 288.8 |
| 2012 | 318.0 |
| 2013 | 350.1 |
| 2014 | 530.0* |
| Total | $1,486.9 |

*2014 cost includes entire project contingency

The scope for this project remains unchanged and the project is expected to be completed within budget.

**20. <u>Voltage Conversion - Labrador City</u>**

This is a four year project, to complete the voltage conversion on the existing Labrador City distribution system from 4.16 kV to 25 kV. The existing distribution line components, currently rated for a nominal voltage of 4.16 kV cannot operate at 25 kV. Work tasks will include the following activities:

- Pole Installation – The installation of poles will be required to replace deteriorated poles and extend existing lines.
- Insulator Replacement – The replacement of all insulators is required to provide adequate insulation levels for the 25 kV operations.
- Structure Framing – Existing structures will need to be reframed to provide adequate clearance between conductors and with ground.
- Conductor Replacement – Sections of existing conductor will be replaced to meet the requirements of the voltage conversion. New conductor will also be strung on any new extensions that may be required. Any existing conductor identified as weak and deteriorated will be replaced with new conductor.
- Porcelain Cutouts Replacement – The existing cutouts will be replaced with new polymer cutouts because porcelain cutouts no longer meet current Hydro standards with respect to safety performance.

The project schedule and budget estimate are listed in the table below:

| Year | Activity | Cost ($000) |
|---|---|---|
| 2010 | Field Assessment/Engineering Design | 1,088.9 |
| 2011 | Material Procurement/Installation | 3,501.2 |
| 2012 | Installation | 3,840.7 |
| 2013 | Installation | 969.5 |
| | Total | $9,400.3 |

The first year of this project, 2010, was designated for the ordering of materials and the upgrade of the Harrie Lake Trailer Court area to be 25 kV ready. The cost estimate for this project was created prior to an assessment of the line being performed. Once the assessment of the line was completed late in 2009, it was discovered that dual voltage distribution transformers were required to allow for the Harrie Lake 25 kV conversion. Some of the additional expenditures in 2010 included material costs which were originally expected to be incurred in 2011 (essentially transferring 2011 costs into 2010). Although there is an over expenditure for the budget year 2010, the four-year project is expected to be completed within budget overall. The revised budget showing actuals for 2010 are listed in the table below:

| Year | Cost ($000) |
|---|---|
| 2010A | 1,524.6 |
| 2011 | 3,065.5 |
| 2012 | 3,840.7 |
| 2013 | 969.5 |
| Total | $9,400.3 |

**21. <u>Upgrade L2 Distribution Feeder – Glenburnie</u>**

This is a four year project for the design, supply and construction of an 18.5 kilometer (km) three phase distribution line from the Tablelands area to Front River. It will also include the replacement of approximately 20 deteriorated poles located within the first 5.5 kms from the Glenburnie Terminal Station. The original project schedule and budget estimate are listed in the table below:

| Year | Activity | Cost ($000) |
|---|---|---|
| 2010 | Line/Environmental Assessment | 267.3 |
| 2011 | Field Assessment / Line Design | 578.2 |
| 2012 | Material Order/ Procurement/Installation | 2,114.6 |
| 2013 | Environmental | 596.6 |
| | Total | $3,556.7 |

In 2010, a line assessment and environmental assessment was planned. The environmental assessment cost was less than anticipated due to the limited number of environmental issues which were encountered. Due to other capital work commitments, the line assessment was delayed. In particular, in 2010 Hydro received two large customer work requests, both of which were unplanned from Hydro's perspective, which diverted work from this project (see response to Request for Information PUB-NLH-24, NLH 2010 Capital Expenditures and Carryover Report, for further detail). The overall project is expected to be completed with in budget. The revised budget showing actuals for 2010 are listed in the table below:

| Year | Cost ($000) |
|---|---|
| 2010A | 109.9 |
| 2011 | 735.6 |
| 2012 | 2,114.6 |
| 2013 | 596.6 |
| Total | $3,556.7 |

**22. <u>Upgrade Distribution Systems – Francois, Rigolet and Happy Valley</u>**

This is a two year project to replace distribution line components on the following distribution systems:

- Francois – Line 1 (L1)
  - 35 Poles
  - 20 Porcelain Cutouts
  - Six Distribution Transformers
  - One Diesel Plant Transformer Bank Structure (three -100 kVA Transformers, two – Poles, one – Transformer Platform, three Porcelain Cut-outs)

- Happy Valley – Line 8 (L8)
    - Two Poles
    - 50 Pin Type Insulators
    - Eight suspension Insulators
    - 86 Porcelain Cut-outs
    - 2.6 km 1/0 Primary Conductor
    - 23 Crossarms
- Rigolet – Line 1 (L1)
    - 50 Poles
    - 86 Pin Type Insulators
    - 45 Suspension Insulators
    - 44 Porcelain Cut-outs
    - 35 Crossarms
    - 1.0 km 1/0 Primary Conductor

The engineering design work for all three areas will be completed in 2011 as well as the installation for Francois and Happy Valley. The installation for Rigolet will be completed in 2012. The budget estimate for each year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 1,067.7 |
| 2012 | 652.4 |
| Total | $1,720.1 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**23. <u>Replace Substation Infrastructure – Burgeo</u>**

This is a two year project to replace the following infrastructure at the Burgeo Substation:

- Six Blackjack Wood Poles;
- 27 Crossarms;
- 21 Suspension Insulators;

- 21 Pin Type Insulators; and
- Nine Bypass Switches

The engineering design and ordering of equipment will take place in 2011 with the installation completed in 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 127.5 |
| 2012 | 368.3 |
| Total | $495.8 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**24. <u>Perform Arc Flash Remediation Various Sites</u>**

This project is a five year program to upgrade facilities to reduce the arc flash levels on electrical equipment throughout the Hydro system. The upgrades will, whenever possible, reduce the arc flash levels of equipment to more acceptable levels of Arc Flash Hazard Risk Category (HRC) 2 or lower to comply with the Canadian Standards Association Z462-08 Standard. The upgrades will include:

- Changes to existing relay settings to provide faster fault clearing times which will reduce the arc flash levels;
- Installation of special arc flash relays, which are devices designed to detect the presence of an arc flash and clear the fault instantaneously;
- Installation of multiple setting relays, which have dual protection settings (one for normal operation and one to be switched on when a worker is working on live or exposed equipment);
- Installation of current limiting fuses, which clear the fault instantaneously; and
- Installation of remote operators for circuit breakers, which allow the worker to operate the breaker from outside the arc flash boundary.

The work to be completed in 2011 includes the development of a detailed prioritized five year plan. Remediation work will be completed in the Francois diesel plant in conjunction with other work being completed. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 429.5 |
| 2012 | 380.3 |
| 2013 | 391.0 |
| 2014 | 401.8 |
| 2015 | 413.1 |
| Total | $2,015.7 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**25. <u>Replace Mini Hydro Turbine – Roddickton</u>**

This is a two year project to replace the hydraulic turbine at the Roddickton Mini Hydro Plant. The scope of this project is to replace the hydraulic turbine which includes the two guide vanes, the horizontal cross-flow runner, the casing and the associated bearings and seals. In addition, the design of the trash rack at the intake structure will be reviewed, and a modified or new trash rack will be installed if necessary. The engineering design work and equipment ordering will be completed in 2011 with installation completed in 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 86.8 |
| 2012 | 235.4 |
| Total | $322.2 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**26. Install Automated Meter Reading – Labrador City and Port au Choix**

This is a two year project to implement Automated Meter Reading (AMR) in Hydro's customer service areas of Labrador city and Port au Choix.

AMR is being implemented in approximately 20 percent of the Labrador City service area (1,000 customers). The work includes:

- The replacement of existing customer meters with AMR equipped meters;
- The installation of data collectors in the new Quartzite Substation being constructed in Labrador City as part of the distribution system upgrade project;
- Communications to the AMR server located in St. John's; and
- Configuring computer systems in St. John's to handle the AMR meter readings and billing for customers in Labrador City.

In 2011, the meters and the terminal station equipment will be bought and the terminal station equipment and some of the meters installed. The remainder of meters will be installed early in 2012. The budget estimate by service area and year are shown in the table below:

| Year | Labrador City Cost ($000) | Port au Choix Cost ($000) | Total |
|---|---|---|---|
| 2011 | 292.2 | 159.0 | 451.2 |
| 2012 | 58.3 | 29.4 | 87.7 |
| Total | $350.5 | $188.4 | $538.9 |

The scope for the Labrador City portion of the project remains unchanged and is expected to be completed within budget.

While implementation of AMR was also planned in Hydro's customer service area of Port au Choix (approximately 570 customers), this work has now been cancelled. The project was originally proposed based on a meter reader position becoming vacant, however, due to a change in circumstances, did not occur and the benefit anticipated from the implementation of this project would not be realized. The budget for this work will, therefore, not be spent.

**27. Replace Off-Road Track Vehicles – Bishop's Falls and Fogo**

This is a two year project to replace a two-passenger, cargo-carrying unit with material handling capability stationed at the Fogo line maintenance depot, and a crew and cargo-carrying unit stationed at the Bishop's Falls line maintenance depot. The existing units are utilized throughout the Hydro system by transmission and distribution line maintenance crews. They are used to transport the crew and their materials to work sites along the various rights-of-way.

The existing units will be replaced with similarly configured units, with the addition of a material handling boom on the Bishop's Falls unit. The boom will enhance the efficiency of the crew by allowing it to also serve as a heavy lifting unit.

This project is scheduled to be completed by the end of 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 494.3 |
| 2012 | 609.4 |
| Total | $1,103.7 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**28. Corporate Application Environment – Upgrade Microsoft Products**

This is a three year project for the purchase of Microsoft software under a Microsoft Enterprise Agreement. The budget estimate for each year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2010 | 526.0 |
| 2011 | 472.6 |
| 2012 | 474.7 |
| Total | $1,473.2 |

The actual expenditure for 2010 net of cost recoveries was $371,400. Due to a lack of resources, one component of the upgrade, Sharepoint that was scheduled to be implemented in 2010 will now

be done in 2011. More specifically, the Microsoft Enterprise Agreement, which provides Hydro with the licenses and contracts for the Microsoft software, was not signed until July of 2010. This allowed only 6 months to complete a full year's work on the Microsoft upgrades. Given other business and capital budget priorities for 2010 and the fact that this is a three year project, Hydro made the decision to move the Sharepoint portion of the project out to 2011. Hydro is confident this deferred portion of the project will be completed in 2011. This project is expected to be completed on time and within budget. The revised budget showing actuals for 2010 are listed in the table below:

| Year | Cost ($000) |
|---|---|
| 2010A | 371.4 |
| 2011 | 627.1 |
| 2012 | 474.7 |
| Total | $1,473.2 |

**29. <u>Replace MDR 6000 Microwave Radio (West) – Various Sites</u>**

This project will replace the low capacity microwave radio equipment installed in 1999 that has reached the end of its useful life. These radio links serve to connect remote terminal and generating stations to the main high capacity microwave radio system connecting the Energy control Centre in St. John's to the Bay d'Espoir Hydro Generating Station. The Corporate locations serviced by these links include the Hinds Lake, Granite Canal, and Upper Salmon hydroelectric generating stations, and the terminal stations at Deer Lake and Buchans.

The engineering design work will be done in 2011 with the installation completed in 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 72.0 |
| 2012 | 683.3 |
| Total | $755.3 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

**30. Replace Vehicles and Aerial Devices (2011-2012) – Various Sites**

This is a two year project to replace 25 light-duty vehicles and five heavy-duty work vehicles. This project is expected to be completed by the end of March 2012. The budget estimate by year is shown in the table below:

| Year | Cost ($000) |
|---|---|
| 2011 | 2,350.5 |
| 2012 | 638.9 |
| Total | $2,989.4 |

The scope for this project remains unchanged and the project is expected to be completed within budget.

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Definition |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **MANDATORY PROJECTS** | | | | | |
| Perform Grounding Upgrades - Various Sites | 321 | 324 | 1,012 | 1,657 | Pooled |
| **TOTAL MANDADORY PROJECTS** | 321 | 324 | 1,012 | 1,657 | |
| | | | | | |
| **NORMAL PROJECTS** | | | | | |
| Upgrade Transmission Line Corridor - Bay d'Espoir to Western Avalon | | 2,632 | 206,744 | 209,376 | Other |
| Rewind Stators Units 1, 3 and 4 - Bay d'Espoir | | 4,954 | 8,689 | 13,643 | Other |
| Rewind Generator Units 1 and 2 - Holyrood | | 112 | 11,789 | 11,901 | Other |
| Install Additional 230kV Transformer - Oxen Pond | | 3,535 | 7,004 | 10,540 | Other |
| Upgrade Terminal Stations to 25 kV - Labrador City | 6,483 | 3,507 | | 9,990 | Other |
| Voltage Conversion - Labrador City | 4,590 | 3,841 | 970 | 9,400 | Other |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 2,629 | 3,367 | | 5,995 | Other |
| Upgrade Marine Terminal - Holyrood | | 5,860 | | 5,860 | Other |
| Replace Static Excitation Systems - Upper Salmon, Holyrood and Hinds Lake | 487 | 2,403 | 1,219 | 4,109 | Pooled |
| Overhaul Unit 1 Turbine - Holyrood | | 4,193 | | 4,193 | Other |
| Provide Service Extensions - All Service Areas | | 4,172 | | 4,172 | Pooled |
| Upgrade L2 Distribution Feeder - Glenburnie | 845 | 2,115 | 597 | 3,556 | Other |
| Replace Programmable Logic Controllers - Holyrood | 2,230 | 902 | | 3,132 | Other |
| Replace Vehicles and Aerial Devices (2011-2012) - Various Sites | 2,351 | 639 | | 2,989 | Other |
| Replace Vehicles and Aerial Devices (2012-2013) - Various Sites | | 1,711 | 1,219 | 2,930 | Other |
| Replace Fuel Oil Heat Tracing - Holyrood | | 1,474 | 1,414 | 2,888 | Other |
| Perform Wood Pole Line Management Program - Various Sites | | 2,519 | | 2,519 | Pooled |
| Upgrade Distribution Systems - All Service Areas | | 2,508 | | 2,508 | Pooled |
| Upgrade Distribution Lines - Bay d'Espoir, Parsons Pond and Plum Point | | 1,385 | 1,111 | 2,496 | Pooled |
| Distribution System Additions - Various Sites | | 2,172 | | 2,172 | Pooled |
| Perform Arc Flash Remediation - Various Sites | 430 | 380 | 1,206 | 2,016 | Other |
| Upgrade Burnt Dam Spillway - Bay d'Espoir | | 1,703 | | 1,703 | Other |
| Upgrade Circuit Breakers - Various Sites | | 1,677 | | 1,677 | Pooled |
| Upgrade Stack Breaching Unit 2 - Holyrood | | 1,505 | | 1,505 | Other |
| Increase Generation Capacity - Mary's Harbour | | 1,489 | | 1,489 | Other |
| Replace Guy Wires TL-215 - Doyles to Grand Bay | 289 | 318 | 880 | 1,487 | Other |
| Corporate Application Environment - Upgrade Microsoft Products | 999 | 475 | | 1,473 | Other |
| Upgrade Power Transformers - Various Sites | | 1,246 | | 1,246 | Pooled |
| Condition Assessment and Life Extension Phase 2 - Holyrood | | 1,216 | | 1,216 | Other |
| Replace Off-Road Track Vehicles - Bishop's Falls and Fogo | 494 | 609 | | 1,104 | Pooled |
| Upgrade Substation - Wabush | 459 | 626 | | 1,086 | Pooled |
| Overhaul Diesel Units - Various Sites | | 974 | | 974 | Other |
| Replace Emergency Diesel Generator - Bay d'Espoir | | 611 | 283 | 894 | Other |
| Replace Battery Banks and Chargers - Various Sites | | 881 | | 881 | Other |
| Replace Off Road Track Vehicles - Flower's Cove and Cow Head | | 483 | 396 | 878 | Pooled |
| Replace Relay Panels Unit 3 - Holyrood | 277 | 554 | | 831 | Other |
| Upgrade Intake Gate Controls - Bay d'Espoir | 352 | 468 | | 820 | Other |
| Upgrade Generating Station Service Water System - Cat Arm | 360 | 440 | | 800 | Other |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Definition |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **NORMAL PROJECTS (cont'd.)** | | | | | |
| Upgrade Station Reliability and Safety - Rocky Harbour | 435 | 360 | | 795 | Pooled |
| Replace 69 kV SF6 Breakers - St. Anthony Airport | 490 | 290 | | 780 | Other |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | 72 | 683 | | 755 | Other |
| Upgrade Distribution Systems - Francois, Rigolet and Happy Valley | 73 | 652 | | 726 | Pooled |
| Upgrade Electrical Equipment - Holyrood | 188 | 206 | 285 | 679 | Pooled |
| Replace Compressed Air System - Bay d'Espoir | 84 | 564 | | 648 | Other |
| Replace 230 kV Circuit Breaker - Sunnyside | 41 | 590 | | 631 | Other |
| Replace Steam Seal Regulator Unit 2 - Holyrood | 175 | 438 | | 613 | Other |
| Upgrade JD Edwards - Hydro Place | | 187 | 388 | 575 | Other |
| Replace Network Communications Equipment - Various Sites | | 522 | | 522 | Other |
| **TOTAL NORMAL PROJECTS** | 24,833 | 74,149 | 244,192 | 343,174 | |
| | | | | | |
| **JUSTIFIABLE PROJECTS** | | | | | |
| Install Plant Operator Training Simulator - Holyrood | | 1,028 | 1,073 | 2,101 | Other |
| Upgrade Hydrogen System - Holyrood | 1,192 | 800 | | 1,992 | Other |
| Upgrade Forced Draft Fan Ductwork Unit 2 - Holyrood | | 929 | | 929 | Other |
| Upgrade Synchronous Condenser Unit 3 - Holyrood | 484 | 406 | | 889 | Other |
| Install Automated Meter Reading - Rocky Harbour and Glenburnie | | 380 | 288 | 667 | Other |
| **TOTAL JUSTIFIABLE PROJECTS** | 1,675 | 3,542 | 1,360 | 6,578 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Definition |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **MANDATORY PROJECTS** | | | | | |
| Replace Fuel Storage Tanks - St. Lewis | | 465 | | 465 | Other |
| Replace Instrument Transformers - Various Sites | | 452 | | 452 | Other |
| Replace Fuel Tank - Burnt Dam | | 208 | | 208 | Other |
| **TOTAL MANDATORY PROJECTS** | 0 | 1,125 | 0 | 1,125 | |
| **NORMAL PROJECTS** | | | | | |
| Replace Substation Infrastructure - Burgeo | 128 | 368 | | 496 | Other |
| Replace Personal Computers - Various Sites | | 491 | | 491 | Other |
| Overhaul Turbine/Generator Units - Granite Canal and Upper Salmon | | 457 | | 457 | Other |
| Replace Insulators - Various Sites | | 412 | | 412 | Pooled |
| Replace Light Duty Mobile Equipment - Various Sites | | 401 | | 401 | Other |
| Replace Disconnects - Various Sites | | 352 | | 352 | Other |
| Replace Peripheral Infrastructure - Various Sites | | 328 | | 328 | Pooled |
| Replace Mini Hydro Turbine - Roddicton | 87 | 235 | | 322 | Other |
| Upgrade Transmission Line Access Trails - Stony Brook to Springdale | | 313 | | 313 | Other |
| Replace Compressed Air Piping and Install Dew Point Monitor - Buchans | | 28 | 278 | 307 | Other |
| Remove Safety Hazards - Various Sites | | 249 | | 249 | Other |
| Upgrade Enterprise Storage Capacity - Hydro Place | | 202 | | 202 | Other |
| Replace Recloser Control Panels - Various Sites | | 202 | | 202 | Pooled |
| **TOTAL NORMAL PROJECTS** | 214 | 4,037 | 278 | 4,530 | |
| **JUSTIFIABLE PROJECTS** | | | | | |
| Install Automated Meter Reading - Labrador City | 292 | 58 | | 351 | Other |
| **TOTAL JUSTIFIABLE PROJECTS** | 292 | 58 | 0 | 351 | |

| PROJECT DESCRIPTION | Expended to 2011 | 2012 | Future Years | Total | Definition |
|---|---|---|---|---|---|
| | | | ($000) | | |
| **MANDATORY PROJECTS** | | | | | |
| Install Fall Protection Equipment - Various Sites | | 199 | | 199 | Pooled |
| Replace Beta Attenuation Monitoring Analyzers - Holyrood | | 161 | | 161 | Other |
| **TOTAL MANDATORY PROJECTS** | 0 | 360 | 0 | 360 | |
| **NORMAL PROJECTS** | | | | | |
| Replace Telephone Systems - Port Saunders and Whitbourne | | 199 | | 199 | Other |
| Replace Rip Rap - Bay d'Espoir | | 199 | | 199 | Other |
| Legal Survey of Primary Distribution Line Right of Way - Various Sites | | 198 | | 198 | Other |
| Install Alternate Station Services - Stony Brook and Massey Drive | 86 | 109 | | 195 | Other |
| Purchase Meters, Equipment and Metering Tanks - Various Sites | | 190 | | 190 | Other |
| Replace Radomes - Various Sites | | 172 | | 172 | Pooled |
| Upgrade Server Technology Program - Hydro Place | | 172 | | 172 | Other |
| Replace Excavator - L'Anse au Loup | | 120 | | 120 | Other |
| Upgrade Energy Management System - Hydro Place | | 118 | | 118 | Other |
| Implement Work Protection Safety Code Application - Hydro Place | | 116 | | 116 | Other |
| Perform Front End Engineering Design for Diesel Plant Remediation -Various Sites | | 110 | | 110 | Other |
| Upgrade Communication Services - Paradise River | | 98 | | 98 | Other |
| Upgrade Mechanical Workshop - St. Anthony | | 87 | | 87 | Other |
| Install Waste Oil Storage Tank - L'Anse au Loup | | 82 | | 82 | Other |
| Perform Minor Application Enhancements - Hydro Place | | 82 | | 82 | Other |
| Upgrade Computer Room - Hydro Place | | 81 | | 81 | Other |
| Replace Surge Arrestors - Various Sites | | 76 | | 76 | Other |
| Upgrade Microsoft Project - Hydro Place | | 60 | | 60 | Other |
| **TOTAL NORMAL PROJECTS** | 86 | 2,267 | 0 | 2,353 | |

| Type | Number | ($000) |
|---|---|---|
| Clustered | 0 | 0 |
| Pooled | 20 | 29,136 |
| Other | 71 | 330,992 |
| **Total** | **91** | **360,128** |

* *Includes multi-year projects but excludes contingency fund*

## 2012 LEASING COSTS

# *THERE ARE NO ITEMS FOR THIS SECTION*

| | ACTUALS | | | | BUDGET | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| **GENERATION** | 9,636 | 13,703 | 9,592 | 16,337 | 17,253 | 35,094 | 34,634 | 36,900 | 31,228 | 31,561 |
| **TRANSMISSION AND RURAL OPERATIONS** | 19,150 | 24,711 | 32,988 | 28,681 | 40,111 | 44,811 | 74,937 | 97,559 | 110,699 | 99,486 |
| **GENERAL PROPERTIES** | 6,883 | 7,832 | 11,572 | 10,535 | 9,911 | 7,957 | 11,798 | 17,227 | 13,310 | 15,926 |
| **TOTAL CAPITAL EXPENDITURES** | 35,669 | 46,246 | 54,152 | 55,553 | 67,275 | 87,862 | 121,369 | 151,686 | 155,237 | 146,973 |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures |
|---|---|---|---|---|---|
| **GENERATION** | **5,617** | **15,560** | **3,328** | **14,862** | **(698)** |
| **TRANSMISSION** | **2,303** | **14,889** | **3,596** | **14,889** | **0** |
| **RURAL SYSTEMS** | **5,618** | **23,729** | **7,276** | **23,570** | **(159)** |
| **GENERAL PROPERTIES** | **3,325** | **9,911** | **3,416** | **9,911** | **0** |
| **ALLOWANCE FOR UNFORESEEN EVENTS** | **0** | **1,000** | **1,266** | **1,000** | **0** |
| **PROJECTS APPROVED BY PU BOARD** | **139** | **2,133** | **140** | **2,133** | **0** |
| **NEW PROJECTS LESS THAN $50,000 APPROVED BY HYDRO** | **0** | **54** | **0** | **54** | **0** |
| **TOTAL CAPITAL BUDGET** | **17,002** | **67,275** | **19,022** | **66,418** | **(857)** |

| | |
|---|---|
| **2011 Capital Budget Approved by Board Order No. P.U. 38** | **55,043** |
| **Carryover Projects 2010 to 2011** | **10,126** |
| **New Project Approved by Board Order No. 29 (2010)** | **450** |
| **New Project Approved by Board Order No. 34 (2010)** | **1,602** |
| **2011 New Projects under $50,000 Approved by Hydro** | **54** |
| **TOTAL APPROVED CAPITAL BUDGET** | **67,275** |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures |
|---|---|---|---|---|---|
| **GENERATION** | | | | | |
| **HYDRO PLANTS** | **3,220** | **5,371** | **2,119** | **4,643** | **(727)** |
| **THERMAL PLANT** | **1,689** | **7,637** | **1,076** | **7,577** | **(60)** |
| **GAS TURBINES** | **708** | **2,552** | **133** | **2,641** | **89** |
| **TOTAL GENERATION** | **5,617** | **15,560** | **3,328** | **14,862** | **(698)** |
| **TRANSMISSION** | | | | | |
| **TERMINAL STATIONS** | **2,303** | **11,384** | **2,174** | **11,384** | **0** |
| **TRANSMISSION** | **0** | **3,504** | **1,422** | **3,504** | **0** |
| **TOTAL TRANSMISSION** | **2,303** | **14,889** | **3,596** | **14,889** | **0** |
| **RURAL SYSTEMS** | | | | | |
| **DISTRIBUTION** | **2,129** | **14,633** | **5,106** | **14,633** | **0** |
| **GENERATION** | **3,438** | **5,218** | **1,151** | **5,218** | **0** |
| **PROPERTIES** | **21** | **623** | **225** | **623** | **0** |
| **METERING** | **0** | **637** | **192** | **478** | **(159)** |
| **TOOLS AND EQUIPMENT** | **30** | **2,618** | **602** | **2,618** | **0** |
| **TOTAL RURAL SYSTEMS** | **5,618** | **23,729** | **7,276** | **23,570** | **(159)** |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures |
|---|---|---|---|---|---|
| **GENERAL PROPERTIES** | | | | | |
| **INFORMATION SYSTEMS** | **0** | **2,189** | **1,130** | **2,189** | **0** |
| **TELECONTROL** | **1,528** | **3,930** | **974** | **3,930** | **0** |
| **TRANSPORTATION** | **0** | **3,184** | **953** | **3,184** | **0** |
| **ADMINISTRATIVE** | **1,797** | **609** | **359** | **609** | **0** |
| **TOTAL GENERAL PROPERTIES** | **3,325** | **9,911** | **3,416** | **9,911** | **0** |
| **ALLOWANCE FOR UNFORESEEN EVENTS** | **0** | **1,000** | **1,266** | **1,000** | **0** |
| **PROJECTS APPROVED BY PU BOARD** | **139** | **2,133** | **140** | **2,133** | **0** |
| **PROJECTS APPROVED FOR LESS THAN $50,000** | **0** | **54** | **0** | **54** | **0** |
| **TOTAL CAPITAL BUDGET** | **17,002** | **67,275** | **19,022** | **66,418** | **(857)** |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **HYDRAULIC PLANT** | | | | | | |
| Replace Static Excitation System - Upper Salmon, Holyrood and Hinds Lake | | 1,214 | 0 | 487 | (727) | 1 |
| Upgrade Burnt Dam Access Road Phase 2 - Bay d'Espoir | | 998 | 53 | 998 | 0 | |
| Upgrade Generating Station Service Water System -Cat Arm | | 360 | 51 | 360 | 0 | |
| Upgrade Intake Gate Controls - Bay d'Espoir | | 352 | 285 | 352 | 0 | |
| Upgrade Burnt Dam Spillway Structure - Bay d'Espoir | | 258 | 67 | 258 | 0 | |
| Purchase Spare Disconnect - Bay d'Espoir | | 176 | 3 | 176 | 0 | |
| Replace Automatic Transfer Switches - Bay d'Espoir and Hinds Lake | | 156 | 13 | 156 | 0 | |
| Purchase Hydrometeorological Stations - Various Sites | | 113 | 0 | 113 | 0 | |
| Replace Fire Alarm System - Hinds Lake | | 109 | 0 | 109 | 0 | |
| Install Compressor for Frazil Ice Removal - Upper Salmon Changed to Granite Canal | | 69 | 8 | 69 | 0 | 2 |
| Upgrade Public Safety Around Dams and Waterways - Bay d'Espoir | | 49 | 0 | 49 | 0 | |
| Purchase Spare Stator Windings Units 2 - Bay d'Espoir | 3,143 | 1,049 | 1,334 | 1,049 | 0 | |
| Replacement of Fuel Tank - Bay D'Espoir Campsite | 10 | 110 | 92 | 110 | 0 | |
| Replace A/C Units in Control and Communications Room - Upper Salmon | 67 | 89 | 74 | 89 | 0 | |
| Replace 21 Inch Metal Cutting Lathe | | 80 | 77 | 80 | 0 | |
| Purchase Tools and Equipment Less than $ 50,000 | | 186 | 62 | 186 | 0 | |
| **TOTAL HYDRAULIC PLANT** | **3,220** | **5,371** | **2,119** | **4,643** | **(727)** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **THERMAL PLANT** | | | | | | |
| Replace Programmable Logic Controllers - Holyrood | | 932 | 233 | 872 | (60) | |
| Upgrade Hydrogen System - Holyrood | | 1,192 | 29 | 1,192 | 0 | |
| Replace Pumphouse Motor Control Centres - Holyrood | 99 | 950 | 275 | 950 | 0 | |
| Upgrade Synchronous Condenser Unit 3- Holyrood | | 484 | 0 | 484 | 0 | |
| Upgrade Forced Draft Fan Ductwork Unit 1 - Holyrood | | 843 | 113 | 843 | 0 | |
| Replace Relay Panels Unit 3- Holyrood | | 277 | 37 | 277 | 0 | |
| Replace Boiler Blowdown Tanks - Holyrood | | 750 | 43 | 750 | 0 | |
| Upgrade Electrical Equipment - Holyrood | | 188 | 3 | 188 | 0 | |
| Replace Steam Seal Regulator Unit 2 - Holyrood | | 175 | 1 | 175 | 0 | |
| Replace Steam Seal Regulator Unit 1 - Holyrood | 16 | 533 | 105 | 533 | 0 | |
| Replace Diesel Fire Pump - Holyrood | 28 | 279 | 22 | 279 | 0 | |
| Install Weatherhoods for Vent Fans - Holyrood | | 208 | 1 | 208 | 0 | |
| Purchase Laser Alignment Equipment - Holyrood | | 79 | 0 | 79 | 0 | |
| Condition Assessment and Life Extension Study - Holyrood | 1,327 | 568 | 198 | 568 | 0 | |
| Install Warm Air Make-up Access - Holyrood | 219 | 87 | 16 | 87 | 0 | |
| Purchase Tools and Equipment Less than $ 50,000 | | 94 | 0 | 94 | 0 | |
| **TOTAL THERMAL PLANT** | **1,689** | **7,637** | **1,076** | **7,577** | **(60)** | |
| **GAS TURBINES** | | | | | | |
| Upgrade Gas Turbine Plant Life Extension - Hardwoods | 705 | 1,924 | 65 | 1,924 | 0 | |
| Upgrade Glycol Systems - Stephenville | 3 | 557 | 68 | 646 | 89 | |
| Upgrade Gas Turbine Operator Console - Stephenville | | 72 | 0 | 72 | 0 | |
| **TOTAL GAS TURBINE PLANTS** | **708** | **2,552** | **133** | **2,641** | **89** | |
| **TOTAL GENERATION** | **5,617** | **15,560** | **3,328** | **14,862** | **(698)** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **TERMINAL STATIONS** | | | | | | |
| Upgrade Terminal Stations to 25 kV - Labrador City | 1,985 | 4,689 | 727 | 4,689 | 0 | |
| Perform Grounding Upgrades - Various Sites | | 321 | 61 | 321 | 0 | |
| Upgrade Substation - Wabush | | 459 | 8 | 459 | 0 | |
| Upgrade Power Transformers - Various Sites | | 866 | 31 | 866 | 0 | |
| Upgrade Station Reliability and Safety - Rocky Harbour | | 435 | 3 | 435 | 0 | |
| Replace 69 kV SF6 Breakers - St. Anthony Airport | | 490 | 34 | 490 | 0 | |
| Replace Breaker, Structures and Disconnects - Hawke's Bay | | 687 | 19 | 687 | 0 | |
| Replace Compressed Air System - Bay d'Espoir | | 84 | 3 | 84 | 0 | |
| Replace 230 kV Circuit Breaker - Sunnyside | | 41 | 0 | 41 | 0 | |
| Upgrade Trailer and Mobile Substation - Bishop's Falls | 151 | 834 | 498 | 834 | 0 | |
| Replace Compressed Air Piping and Install Dew Point Monitoring - Holyrood | 19 | 477 | 64 | 477 | 0 | |
| Replace Insulators - Various Sites | | 401 | 241 | 401 | 0 | |
| Upgrade Air Blast Circuit Breakers - Various Sites | | 334 | 236 | 334 | 0 | |
| Replace Disconnects - Various Sites | | 295 | 20 | 295 | 0 | |
| Replace Compressor, Dryer and Air Piping Header System - Corner Brook Frequency Converter Station | | 280 | 47 | 280 | 0 | |
| Replace Instrument Transformers - Various Sites | | 199 | 89 | 199 | 0 | |
| Install Alternate Station Services - Stony Brook and Massey Drive | | 86 | 0 | 86 | 0 | |
| Replace Digital Fault Recorder - Bay d'Espoir | | 169 | 2 | 169 | 0 | |
| Replace Surge Arresters - Various Sites | | 75 | 42 | 75 | 0 | |
| Voisey's Bay Nickel - Long Harbour Power Supply | 1,332 | 10,600 | 2,019 | 10,600 | 0 | |
| Cost Recovery - Vale Inco | (1,332) | (10,600) | (2,019) | (10,600) | 0 | |
| Replace Disconnects - Various Sites | 97 | 102 | 13 | 102 | 0 | |
| Replacement of Switch B5B2-2 - Oxen Pond | | 38 | 25 | 38 | 0 | |
| Replace 230 kV Breaker Controls - Massey Drive and Buchans | 51 | 22 | 11 | 22 | 0 | |
| **TOTAL TERMINAL STATIONS** | **2,303** | **11,384** | **2,174** | **11,384** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **TRANSMISSION** | | | | | | |
| Perform Wood Pole Line Management Program - Various Sites | | 2,019 | 1,302 | 2,019 | 0 | |
| Replace Guy Wires TL-215 - Doyles to Grand Bay | | 289 | 10 | 289 | 0 | |
| Upgrade Line TL-244 - Plum Point to Bear Cove | | 1,196 | 110 | 1,196 | 0 | |
| **TOTAL TRANSMISSION** | **0** | **3,504** | **1,422** | **3,504** | **0** | |
| **DISTRIBUTION** | | | | | | |
| Voltage Conversion - Labrador City | 1,525 | 3,065 | 674 | 3,065 | 0 | |
| Upgrade L2 Distribution Feeder - Glenburnie | 110 | 735 | 111 | 735 | 0 | |
| Provide Service Extensions - All Service Areas | | 3,385 | 2,282 | 3,385 | 0 | |
| Upgrade Distribution Systems - All Service Areas | | 2,499 | 1,211 | 2,499 | 0 | |
| Upgrade Distribution Lines - Roddickton and Makkovik | 84 | 1,779 | 233 | 1,779 | 0 | |
| Upgrade - Rigolet, Happy Valley and Francois | | 1,068 | 122 | 1,068 | 0 | |
| Replace Poles - Various Sites | | 882 | 198 | 882 | 0 | |
| Upgrade Line 2 Voltage Conversion to 25 kV - Gaultois | 40 | 553 | 182 | 553 | 0 | |
| Replace Substation Infrastructure- Burgeo | | 128 | 4 | 128 | 0 | |
| Install Voltage Regulators - Conne River and L'Anse au loup | | 293 | 23 | 293 | 0 | |
| Replace Recloser Control Panels (2011) - Various Sites | | 232 | 0 | 232 | 0 | |
| Replace Recloser Control Panels (2010) - Various Sites | 370 | 15 | 66 | 15 | 0 | |
| **TOTAL DISTRIBUTION** | **2,129** | **14,633** | **5,106** | **14,633** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **GENERATION** | | | | | | |
| Perform Arc Flash Remediation - Various Sites | | 430 | 22 | 430 | 0 | |
| Replace Fuel Storage Facility - Postville | | 2,007 | 175 | 2,007 | 0 | |
| Replace Diesel Unit 2001 and Engine 566 - Francois | 11 | 607 | 34 | 607 | 0 | |
| Replace Diesel Unit 2018 - McCallum | 10 | 430 | 48 | 430 | 0 | |
| Replace Mini Hydro Turbine - Roddicton | | 87 | 0 | 87 | 0 | |
| Install Sequence of Events Monitor in Diesel Plant - Port Hope Simpson | | 155 | 0 | 155 | 0 | |
| Replace Fuel Storage Tank - Francois | | 131 | 31 | 131 | 0 | |
| Upgrade Fuel Storage - Norman Bay | | 114 | 44 | 114 | 0 | |
| Upgrade Plant Overhead Crane Lifting System - Mary's Harbour | | 47 | 0 | 47 | 0 | |
| Nain Diesel Plant Rehabilitation | 3,452 | 923 | 730 | 923 | 0 | |
| Cost Recovery - Insurance Claim | (1,266) | 0 | (303) | 0 | 0 | |
| Increase Generation Capacity - L'Ance Au Loup | 1,231 | 288 | 370 | 288 | 0 | |
| **TOTAL GENERATION** | 3,438 | 5,218 | 1,151 | 5,218 | 0 | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **PROPERTIES** | | | | | | |
| Install Fall Protection Equipment - Various Sites | | 198 | 50 | 198 | 0 | |
| Legal Survey of Primary Distribution Line Right of Way - Various Sites | | 79 | 4 | 79 | 0 | |
| Install Waste Oil Storage Tank - St. Lewis | | 79 | 53 | 79 | 0 | |
| Construct New Office/Warehouse/Line Depot Facilities - Happy Valley | | 194 | 31 | 194 | 0 | |
| Replace Aviation Fuel Tank and Dispensing Unit - Bishop's Falls | 21 | 73 | 87 | 73 | 0 | |
| **TOTAL PROPERTIES** | **21** | **623** | **225** | **623** | **0** | |
| **METERING** | | | | | | |
| Install Automatic Meter Reading - Labrador City and Port au Choix | | 451 | 81 | 292 | (159) | 3 |
| Purchase Meters, Equipment and Tanks - Various Sites | | 186 | 111 | 186 | 0 | |
| **TOTAL METERING** | **0** | **637** | **192** | **478** | **(159)** | |
| **TOOLS AND EQUIPMENT** | | | | | | |
| Replace Off Road Track Vehicles - Bishop's Falls and Fogo | | 494 | 0 | 494 | 0 | |
| Replace Light Duty Mobile Equipment - Various Sites | | 757 | 37 | 757 | 0 | |
| Purchase Excavators - Bishop's Falls | | 361 | 0 | 361 | 0 | |
| Purchase Tools and Equipment Less than $ 50,000 (2011) | | 183 | 98 | 183 | 0 | |
| Purchase Tools and Equipment Less than $50,000 (2010) | 29 | 87 | 24 | 87 | 0 | |
| Purchase Portable Dissolved Gas Analysis Unit - Bishop's Falls | | 52 | 0 | 52 | 0 | |
| Replace Off Road Track Vehicles - Bishop's Falls and Whitbourne | 1 | 684 | 443 | 684 | 0 | |
| **TOTAL TOOLS AND EQUIPMENT** | **30** | **2,618** | **602** | **2,618** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **INFORMATION SYSTEMS** | | | | | | |
| **SOFTWARE APPLICATIONS** | | | | | | |
| **NEW INFRASTRUCTURE** | | | | | | |
| Perform Minor Application Enhancements - Hydro Place | | 121 | 61 | 121 | 0 | |
| Cost Recoveries | | (39) | (19) | (39) | 0 | |
| **UPGRADE OF TECHNOLOGY** | | | | | | |
| Corporate Application Environment - Upgrade Microsoft Products | | 864 | 552 | 864 | 0 | |
| Cost Recoveries | | (237) | (177) | (237) | 0 | |
| Replace iSeries Computer and Upgrade Operating System - Hydro Place | | 643 | 526 | 643 | 0 | |
| Cost Recoveries | | (206) | (168) | (206) | 0 | |
| **TOTAL SOFTWARE APPLICATIONS** | **0** | **1,147** | **775** | **1,147** | **0** | |
| **COMPUTER OPERATIONS** | | | | | | |
| **INFRASTRUCTURE REPLACEMENT** | | | | | | |
| PC Replacement Program - Hydro Place | | 404 | 122 | 404 | 0 | |
| Replace Peripheral Infrastructure - Various Sites | | 258 | 119 | 258 | 0 | |
| Upgrade Enterprise Storage Capacity - Hydro Place | | 227 | 15 | 227 | 0 | |
| Cost Recoveries | | (73) | (5) | (73) | 0 | |
| **NEW INFRASTRUCTURE** | | | | | | |
| Develop Learning Management System Courses - Hydro Place | | 123 | 2 | 123 | 0 | |
| Cost Recoveries | | (40) | (1) | (40) | 0 | |
| **UPGRADE OF TECHNOLOGY** | | | | | | |
| Upgrade Server Technology Program - Hydro Place | | 209 | 151 | 209 | 0 | |
| Cost Recoveries | | (67) | (48) | (67) | 0 | |
| **TOTAL COMPUTER OPERATIONS** | **0** | **1,042** | **355** | **1,042** | **0** | |
| **TOTAL INFORMATION SYSTEMS** | **0** | **2,189** | **1,130** | **2,189** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **TELECONTROL** | | | | | | |
| **NETWORK SERVICES** | | | | | | |
| **INFRASTRUCTURE REPLACEMENT** | | | | | | |
| Replace MDR 6000 Microwave Radio (West) - Various Sites | | 72 | 4 | 72 | 0 | |
| Refurbish Microwave Site - Deer Lake | | 207 | 3 | 207 | 0 | |
| Replace Radomes - Various Sites | | 196 | 5 | 196 | 0 | |
| Purchase Tools and Equipment less than $50,000 | | 86 | 0 | 86 | 0 | |
| Public Address System - Holyrood | 662 | 1,008 | 676 | 1,008 | 0 | |
| Install Fibre Optic Cable - Hinds Lake | 468 | 224 | 97 | 224 | 0 | |
| Upgrade Remote Terminal Units - Various Sites | 398 | 70 | 17 | 70 | 0 | |
| **NETWORK INFRASTRUCTURE** | | | | | | |
| Replace Battery Banks and Chargers - Various Sites | | 978 | 70 | 978 | 0 | |
| Replace Network Communications Equipment - Various Sites | | 667 | 51 | 667 | 0 | |
| **UPGRADE OF TECHNOLOGY** | | | | | | |
| Install Tower Ice Protection - Chapel Hill Microwave Site | | 294 | 25 | 294 | 0 | |
| Replace Telephone Keyset - Wabush | | 80 | 19 | 80 | 0 | |
| Upgrade Site Facilities - Various Sites | | 48 | 7 | 48 | 0 | |
| **TOTAL TELECONTROL** | **1,528** | **3,930** | **974** | **3,930** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **TRANSPORATION** | | | | | | |
| Replace Vehicles and Aerial Devices 2011 - Various Sites | | 2,351 | 140 | 2,351 | 0 | |
| Replace Vehicles and Aerial Devices 2010 - Various Sites | | 833 | 813 | 833 | 0 | |
| **TOTAL TRANSPORATION** | **0** | **3,184** | **953** | **3,184** | **0** | |
| **ADMINISTRATION** | | | | | | |
| Remove Safety Hazards - Various Sites | | 252 | 0 | 252 | 0 | |
| Replace Humidifiers in Air Handling Units - Hydro Place | | 76 | 0 | 76 | 0 | |
| Purchase Tools and Equipment less than $50,000 | | 79 | 9 | 79 | 0 | |
| Upgrade System Security 2009 - Various Sites | 1,783 | 141 | 303 | 141 | 0 | |
| Replace Humidifiers in Air Handling Units - Hydro Place | 14 | 61 | 47 | 61 | 0 | |
| **TOTAL ADMINISTRATION** | **1,797** | **609** | **359** | **609** | **0** | |
| **TOTAL GENERAL PROPERTIES** | **3,325** | **9,911** | **3,416** | **9,911** | **0** | |

| | Expenditures Prior To 2011 | PUB Approved Budget 2011 | 2011 Expenditures To June 30 | Expected Total Expenditures 2011 | Var. from Approved to Expected Expenditures | Variance Explanation Ref. Page |
|---|---|---|---|---|---|---|
| **ALLOCATION FOR UNFORESEEN EVENTS** | | | | | | |
| Increase Generation Capacity - Charlottetown | | 1,000 | 1,266 | 1,000 | 0 | |
| **TOTAL ALLOCATION FOR UNFORESEEN EVENTS** | **0** | **1,000** | **1,266** | **1,000** | **0** | |
| **PROJECTS APPROVED BY PUB** | | | | | | |
| **CARRYOVER** | | | | | | |
| Confined Space Isolation (Blanks & Blinds) - Holyrood | 139 | 1,665 | 106 | 1,665 | 0 | |
| Replace Unit 565 - Little Bay Islands | | 468 | 34 | 468 | 0 | |
| **TOTAL PROJECTS APPROVED BY PUB** | **139** | **2,133** | **140** | **2,133** | **0** | |
| **NEW PROJECTS LESS THAN $50,000 APPROVED BY HYDRO** | | | | | | |
| Replace Domestic Service Water Pump in Powerhouse Upper Salmon | | 28 | 0 | 28 | 0 | |
| Replace Generator Unit 2073 - Port Hope Simpson | | 26 | 0 | 26 | 0 | |
| **TOTAL PROJECTS LESS THAN $50,000 APPROVED BY HYDRO** | **0** | **54** | **0** | **54** | **0** | |

**1. Replace Static Excitation System – Upper Salmon, Holyrood and Hinds Lake**

The 2011 expenditure was budgeted for $1,214,300 however, this has been reduced by $727,000 to $487,300 due to some of the work planned for 2011 now scheduled to be done in future years. Also see Section E: Multi Year Projects, Page E - 2 Item 1.

**2. Install Compressor for Frazil Ice Removal – Upper Salmon**

The location of the compressor to be installed has been changed from Upper Salmon to Granite Canal where, a greater need has been identified. The scope of work and project cost will not change. Both locations have frazil ice removal systems consisting of horizontal perforated pipes which allow compressed air to bubble through the trash racks. In the case of Upper Salmon Lake, a portable compressor has been installed to supply compressed air to the system. This project was to replace that compressor and return the portable compressor to general use. However, the portable compressor will now remain permanently installed for the Upper Salmon Lake frazil ice removal system. A separate budget proposal will be considered for procurement of a new portable air compressor for general use. In the case of Granite Canal Lake, there are two sub-standard, small capacity air compressors installed which are ineffective in that they do not have the capacity to pump enough air into the frazil ice removal system. These two compressors will be replaced with one compressor of adequate capacity.

**3. Install Automatic Meter Reading – Labrador City and Port au Choix**

The implementation for Port au Choix has been cancelled since the proposal was based on a meter reader position becoming vacant. This did not occur and the benefit anticipated from the implementation of this project would not be realized. Also see Section E: Multi Year Projects, Page E - 22 Item 26.




# Plan of Projected Operating

# Maintenance Expenditures

# 2012 - 2021

# For Holyrood Generating Station

**Newfoundland and Labrador Hydro**

**July 2011**

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## INTRODUCTION

In the Decision and Order No. P. U.14 (2004) of the Board of Commissioners of Public Utilities ("the Board"), dated May 4, 2004, (the 'Order) Newfoundland and Labrador Hydro ("Hydro") is required to **"file a ten year plan of maintenance expenditures for the Holyrood Generating Station with its annual capital budget application, until otherwise directed by the Board" (**p. 64 and Paragraph 12, p. 166 of the Order).

This requirement is specifically related to system equipment maintenance (SEM) costs; therefore, capital expenditures have not been included in the following report. Capital expenditures for Holyrood are submitted annually to the Board with other Hydro capital proposals as part of annual capital budget applications, and vary from year to year.

This report addresses the identified and expected maintenance expenditures for the years 2012 to 2021 inclusive. With respect to these expenditures it must be noted that Unit No's. 1 and 2, as well as two of the main fuel storage tanks and other associated ancillary equipment, are in excess of forty (40) years old. Unit No. 3 is in excess of thirty (30) years old, along with its associated equipment, including the other two main fuel storage tanks. While many components of this equipment have been replaced and additional items added through the maintenance and capital program over the years, numerous pieces of equipment and components are original.

An accurate, uniform ten year plan of SEM is difficult to complete given the harsh operating environment, varied production requirements and the age of units which may trigger a revision of the maintenance plan to control unforeseen events. Though future expenses for major overhauls are proposed to be included in capital rather than operating budgets with the adoption of International Financial Reporting System (IFRS) standards, some variability in the annual budget will remain as a result of the complexity of numerous components and integrated systems that form a fossil fired thermal

electric generating system. This report will endeavor to identify the regular variations in the annual operating costs for the Holyrood Thermal plant.

## MAINTENANCE PHILOSOPHY

The Board, in its Order as related to the Holyrood Thermal Plant, noted at p. 64 that **"The Board will require NLH's 10 year plan of maintenance expenditures for the Holyrood Generating Station to be updated annually to reflect changing operating circumstances."**

In 2007, the Asset Maintenance Strategy (AMS) Process was developed by Engineering Services as a means to streamline, make uniform and permit the continual improvement of a maintenance program that could be applied company wide. Since that time an Asset Management Review process has been progressing on the assets of Holyrood Thermal Generating Station (HTGS) where information regarding past asset maintenance, both preventative and corrective, is being compared with recommended practices, manufacturer or industry standard, in order to establish best practice.

The entire maintenance effort can be seen as a means to mitigate failure and its consequences. All failures have a cost and, to varying degrees, hinder progress in meeting the corporate goals and objectives, whether they are impediments to safety and health, environmental protection, production or financial performance. But recognizing there is a trade-off between the cost of failure and the cost of preventing failure, Hydro must make clearly guided decisions on the type and amount of preventive action to undertake. Such decisions are made within the confines of the following basic framework: philosophy - strategy - tactic.

It would be useful to first review the three main types or categories of maintenance undertaken at Holyrood:

## 1) Preventive Maintenance

While it is true that any plant will incur greater maintenance costs as it ages, Holyrood has used, and continues to use, up-to-date maintenance techniques and practices to maintain plant efficiency, availability and reliability. These include preventive, predictive and condition-based maintenance techniques, which are usually referred to by the overall term of "Preventive Maintenance". The basic principle underlying this approach to maintenance is timely intervention to prevent imminent or catastrophic failure, which may cause a substantial safety exposure, an increase in cost or an extended unavailability of the unit or system.

Preventive maintenance, in its specific sense, comprises routine inspections, checks and component replacement at specific time intervals, to prevent failures known, or reasonably expected to occur within a definable time or operating hour interval during the life of the equipment (e.g. generator brush wear, air and oil filter replacements). This also includes discarding equipment or components rather than repairing them when it is less expensive to do so.

Predictive maintenance involves routine testing of equipment to determine deterioration rates and initiating and carrying out repairs in a timely manner before a failure occurs, (e.g. ultrasonic thickness checks on fluid lines to monitor erosion wear rates, non-destructive testing of boiler and turbine components to determine fatigue, wear or corrosion rates and remaining life). Predictive maintenance items include such things as boiler and auxiliary equipment annual overhaul, among other items, wherein an assessment is made of components or subsystems that are only accessible during these overhauls.

There is also regular or continual monitoring of equipment operating parameters with a comparison of the results with optimum conditions to determine the most

economic time to intervene and perform remedial work that is intended to return the equipment to optimum performance levels (e.g. air heater washes, generator winding insulation condition, oil sampling and testing).

Turbine major and minor overhauls are, effectively, long-term predictive and preventive maintenance activities. A turbine major overhaul is a major disassembly, inspection and repair of the whole turbine. Since this is a very expensive and time consuming activity, the time between these overhauls is extended to minimize the recurring cost and maximize the equipment operating time, and thus useful life of the internal wearing components. Prior to 1988, these major overhauls were carried out at four-year intervals; a subsequent assessment of the risk and cost savings resulted in extending these overhauls to six-year intervals.

In 2003, a study was undertaken by Hartford Steam Boiler Insurance Company, using their proprietary program called Turbine Overhaul Optimization Program (TOOP). This assesses the causes of failure, the risk of failure and the maintenance history of the Turbines, and then proposes the optimum frequency between major overhauls. This assessment concluded that the Turbine major overhaul interval could be extended to nine years from the major overhaul of Unit 1 in 2003, the major overhaul of Unit 2 in 2005 and the major overhaul of Unit 3 in 2007, providing that certain upgrades of internal components are made. These recommendations have been accepted and all upgrades are now completed.

Turbine valve overhauls are carried out at three-year intervals, between major overhauls or in some cases part of the major overhaul. This has been found necessary, due to the critical nature of the safety and reliability aspects of these valves to the turbine operation and integrity, and will continue to be maintained on this three-year interval between major overhauls.

As of 2008, the Preventive Maintenance program has been enhanced to include the extra costs associated with plant cleaning in areas where asbestos and heavy metals have been identified as potential health hazards.

**2) Corrective Maintenance**

In addition to the preventive maintenance tactics outlined in 1) above, there are also corrective maintenance requirements. These include repairs to equipment as it fails or reaches the point where preventive maintenance has identified that the equipment is approaching the end of its useful service life. Examples include wear and tear on pumps, pipes and valves in the main and auxiliary systems, motor rewinds due to failed or deteriorated winding insulation. Corrective maintenance conditions may also arise as a result of adverse conditions (humidity, salt laden atmosphere), or replacement of corroded piping equipment. In 2003, Unit 2 suffered three Superheater Tube failures and the analysis indicated a common tube failure problem had developed. An approved Capital Budget proposal saw the replacement of Unit 2 Boiler Superheater tubes in September 2007. Likewise, Unit 1 Boiler Superheater tubes were replaced in 2008.

**3) Projects**

Operating projects are those major cost repairs and inspections that are required to return structures and equipment to their original or near original condition, to maintain structural integrity, possibly extend plant life, improve efficiency, improve availability and prevent or reduce environmental risks. Such projects include repairs to building structural steel, roof repairs/replacement, fuel oil tank and pipeline inspection and coating, replacement of equipment or components no longer supported by the original manufacturer. A major asbestos abatement program commenced in 2005 and was completed over a three-year period. Due

to the significant cost ($11.3M), Hydro was given approval to treat this as an extraordinary repair, which will mean an annual cost will be recovered over an additional five years, bringing the total cash flow period to eight years, 2005 to 2012.

In 2006 a major failure of Unit 2 boiler waterwall tubing resulted in three months of unexpected down time plus extensive repairs that cost $2.5 million. This cost was amortized over a five year period (2007-2011) within the plant operating budget. A root cause analysis was conducted by an external consultant; the findings identified one of the major contributions to this failure as insufficient boiler chemical cleaning frequency (current industry practice is eight - ten years, regardless of tube loading condition). To perform future chemical cleaning of the Holyrood boilers, operating projects have been identified starting with Unit 2 in 2016, Unit 1 in 2017 and Unit 3 in 2018 with individual cost of approximately 380k.

In 2007 a major failure of the Unit 2 nozzle block assembly steam turbine resulted in two months of extended forced outage plus extensive repairs that cost $2.4 million.

## COST VARIABILITY

Preventive maintenance costs are generally incurred annually at a constant level and do not fluctuate significantly. This does not apply to corrective maintenance costs, which are unavoidable and unpredictable due to the changing energy production demands on the units from year to year. These changing demands give rise to changes in wear rates, the majority of which cannot be monitored close enough for reasonably accurate prediction, without incurring excessive inspection costs. Excessive inspection may in itself introduce increased risk of failure and thus additional cost, so all must be

considered in balancing the most appropriate amount of inspection with accepted levels of failure. These costs however, generally balance from one year to another.

Similarly, major operating projects, because of their extended maintenance intervals (years) or non-repeatability also add to the annual fluctuations of the system equipment maintenance costs and have to be executed when plant conditions allow.

Maintenance projects for the Holyrood Thermal plant are planned on a five-year basis, but as with any plan, it is not 'fixed' or definitive, as other events can cause a shift in the prioritization of such projects. This five-year maintenance plan is regularly updated as time progresses.

## DETAILED ANALYSIS

Attached are Appendices A to D, which set out the ten-year maintenance plan for the Holyrood Thermal Plant, as requested by the Board. Appendix A is a summary and indicates the expected expenditures in each of the major equipment groupings containing SEM costs for the years 2012 to 2021. Appendices B to D, inclusive, show the expected SEM costs categorized according to Preventive, Corrective, Overhauls and Major Operating Projects for each of the major equipment groupings containing SEM costs.

It should be noted that the ten year plan spans the period during which it is possible that the role of HTGS may change as a result of the proposed Labrador Interconnection. This significantly impacts cost and activity levels for HTGS. The section entitled Holyrood Thermal Generating Station Requirements 2011 -2020 in the 2012 Capital Plan section of this application, summarizes Hydro's approach to planning for Holyrood during this period. The context and approach outlined in the section are reflected in the judgment used to prepare this ten-year plan.

This plan was prepared using the 2011 preventive, corrective and overhaul data and the current 2012 to 2016 operating project lists from Hydro's five-year plan for the Holyrood Thermal Plant as the base data. Considerable judgment of plant personnel had to be used to prepare a ten-year plan.

Hydro does not normally use any escalation in its five-year operating plan at the Plant or regional level. The five-year plan is primarily used for internal purposes and generation of work plans rather than detailed financial planning. However, in the attached ten-year plan, an escalation factor has been used, the source of which is the Fall 2010 Hydro forecast. A single escalation rate was used in this exercise and assumed a 50% weighting of labour escalation and 50% of Material escalation, and is as follows:-

| Year | 2012 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| % | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

Appendix B lists the categories of SEM costs for generating units for the years 2012 to 2021 in each of the major equipment groupings. The categories listed are:

| | |
|---|---|
| Preventive | Routine preventive maintenance activities carried out every year |
| Corrective | Typical but unknown breakdown/ emergency repairs carried out during the year |
| Boiler | Boiler overhauls carried out annually with one unit per year overhauled on a reduced scope as a result of better fuel quality. |
| Operating Projects | Non-capitalized projects, justified on the basis of Safety, Environment, Reliability or Cost Benefit Analyses. |

Appendices C and D are for the remaining equipment groupings of Common Equipment, Building and Grounds, Water Treatment Plant, Waste Water Treatment Plant and Environmental Monitoring and use only Preventive, Corrective and Major Operating Projects.

It must be noted that the appendices do not itemize preventive and corrective items. The preventive maintenance program consists of approximately 1,200 preventative maintenance work orders performed on plant equipment annually. Corrective items include a large number of low cost jobs and some moderately expensive ones as well, the majority of which are largely unknown until they happen; thus, it is not practical to provide a breakout of the costs.

**SUMMARY**

This Plan is based on the 2012 system equipment maintenance budget and adjusted using the best available information including up to date maintenance tactics and known restoration and inspection work to establish a ten-year forecast of the maintenance projects for the Holyrood Plant. As with any forecast, it is subject to change depending on the operating demands of the plant, the results of inspections and assessments of changing equipment conditions.

# APPENDIX A

# APPENDIX A

## TOTAL HOLYROOD 10 YEAR SEM[1] EXPENDITURES[2]

*($000)*

| | Base Year 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| UNIT #1 Total SEM | $1,980 | $2,029 | $1,219 | $2,132 | $2,185 | $1,313 | $2,759 | $2,353 | $1,413 | $2,472 |
| UNIT #2 Total SEM | $1,160 | $2,029 | $2,080 | $1,249 | $2,185 | $2,691 | $1,345 | $2,353 | $2,412 | $1,449 |
| UNIT #3 Total SEM | $1,915 | $1,148 | $2,038 | $2,102 | $1,250 | $2,208 | $2,263 | $1,820 | $2,378 | $2,437 |
| Common Equipment Total SEM | $2,650 | $2,097 | $2,149 | $2,202 | $2,257 | $2,313 | $2,370 | $2,429 | $2,490 | $2,551 |
| Buildings and Grounds Total SEM | $565 | $579 | $594 | $609 | $624 | $640 | $655 | $672 | $689 | $706 |
| WT Plant Total SEM | $293 | $304 | $230 | $261 | $187 | $161 | $348 | $263 | $270 | $177 |
| WWT Plant Total SEM | $128 | $131 | $134 | $137 | $141 | $144 | $148 | $152 | $156 | $159 |
| Environmental Monitoring Total SEM | $316 | $324 | $483 | $340 | $348 | $395 | $494 | $375 | $426 | $394 |
| **Total Operating Projects** | $1,412 | $831 | $922 | $827 | $766 | $1,244 | $1,548 | $1,361 | $949 | $831 |
| Total Operating Projects Less Asbestos Abatement | $808 | $831 | $922 | $827 | $766 | $1,244 | $1,548 | $1,361 | $949 | $831 |
| **Total Holyrood SEM** | $9,006 | $8,641 | $8,927 | $9,033 | $9,177 | $9,865 | $10,384 | $10,418 | $10,232 | $10,347 |

**[1] System Equipment Maintenance**

**[2] 2010 Escalated costs**

# APPENDIX B

# APPENDIX B

## 10 YEAR SEM[1] EXPENDITURES[2] FOR GENERATING UNITS

*($000)*

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Unit No. 1** | | | | | | | | | | |
| Preventive – Yearly | $420 | $431 | $441 | $452 | $464 | $475 | $487 | $499 | $512 | $525 |
| Corrective – Yearly | $490 | $502 | $515 | $528 | $541 | $554 | $568 | $582 | $597 | $612 |
| Boiler Annual Overhaul | $1,030 | $1,055 | $221 | $1,109 | $1,136 | $238 | $1,194 | $1,224 | $256 | $1,286 |
| **Operating Projects** | | | | | | | | | | |
| Boiler Chemical Clean | | | | | | | $463 | | | |
| Projects – Lump Sum for Future Years | $40 | $41 | $42 | $43 | $44 | $45 | $46 | $48 | $49 | $50 |
| Total Operating Projects Unit 1 | $40 | $41 | $42 | $43 | $44 | $45 | $509 | $48 | $49 | $50 |
| Total – Unit No. 1 | $1,980 | $2,029 | $1,219 | $2,132 | $2,185 | $1,313 | $2,759 | $2,353 | $1,413 | $2,472 |
| **Unit No. 2** | | | | | | | | | | |
| Preventive – Yearly | $420 | $431 | $441 | $452 | $464 | $475 | $487 | $499 | $512 | $525 |
| Corrective – Yearly | $490 | $502 | $515 | $528 | $541 | $554 | $568 | $582 | $597 | $612 |
| Boiler Annual Overhaul | $210 | $1,055 | $1,082 | $226 | $1,136 | $1,165 | $244 | $1,224 | $1,254 | $262 |
| **Operating Projects** | | | | | | | | | | |
| Boiler Chemical Clean | | | | | | $452 | | | | |
| Projects – Lump Sum for Future Years | $40 | $41 | $42 | $43 | $44 | $45 | $46 | $48 | $49 | $50 |
| Total Operating Projects Unit 1 | $40 | $41 | $42 | $43 | $44 | $497 | $46 | $48 | $49 | $50 |
| Total – Unit No. 2 | $1,160 | $2,029 | $2,080 | $1,249 | $2,185 | $2,691 | $1,345 | $2,353 | $2,412 | $1,449 |
| **Unit No. 3** | | | | | | | | | | |
| Preventive – Yearly | $420 | $431 | $441 | $452 | $464 | $475 | $487 | $499 | $512 | $525 |
| Corrective – Yearly | $490 | $502 | $515 | $528 | $541 | $554 | $568 | $582 | $597 | $612 |
| Boiler Annual Overhaul | $1,005 | $215 | $1,082 | $1,109 | $232 | $1,165 | $1,194 | $250 | $1,254 | $1,286 |
| **Operating Projects** | | | | | | | | | | |
| Boiler Chemical Clean | | | | | | | | $475 | | |
| Projects – Lump Sum for Future Years | | | | $13 | $13 | $14 | $14 | $14 | $15 | $15 |
| Total Operating Projects Unit 1 | $0 | $0 | $0 | $13 | $13 | $14 | $14 | $489 | $15 | $15 |
| Total – Unit No. 3 | $1,915 | $1,148 | $2,038 | $2,102 | $1,250 | $2,208 | $2,263 | $1,820 | $2,378 | $2,437 |

[1] **System Equipment Maintenance**

[2] **2010 Escalated costs**

# APPENDIX C

## APPENDIX C

## 10 YEAR SEM[1] EXPENDITURES[2] FOR ANCILLARY UNITS

*($000)*

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Common Equipment** | | | | | | | | | | |
| Preventive - Yearly | $293 | $300 | $308 | $316 | $324 | $332 | $340 | $348 | $357 | $366 |
| Corrective - Yearly | $1,683 | $1,725 | $1,768 | $1,812 | $1,858 | $1,904 | $1,952 | $2,001 | $2,051 | $2,102 |
| **Operating Projects** | | | | | | | | | | |
| Asbestos Abatement | $604 | | | | | | | | | |
| Pipe Surveillance | $54 | $55 | $57 | $58 | $60 | $61 | $63 | $64 | $66 | $67 |
| Plant Color Coding | $16 | $16 | $16 | $16 | $16 | $16 | $16 | $16 | $16 | $16 |
| Total Operating Projects for Common Equipment | $674 | $71 | $73 | $74 | $76 | $77 | $79 | $80 | $82 | $83 |
| Total Common Equipment | $2,650 | $2,097 | $2,149 | $2,202 | $2,257 | $2,313 | $2,370 | $2,429 | $2,490 | $2,551 |
| **Buildings Grounds** | | | | | | | | | | |
| Preventive - Yearly | $183 | $188 | $192 | $197 | $202 | $207 | $212 | $218 | $223 | $229 |
| Corrective - Yearly | $132 | $136 | $139 | $142 | $146 | $150 | $153 | $157 | $161 | $165 |
| **Operating Projects** | | | | | | | | | | |
| Protective Coating | $150 | $154 | $158 | $162 | $166 | $170 | $174 | $178 | $183 | $187 |
| Exhaust Stack Repair and Maintenance | $100 | $103 | $105 | $108 | $110 | $113 | $116 | $119 | $122 | $125 |
| Total Operating Projects for Buildings and Grounds | $250 | $256 | $263 | $269 | $276 | $283 | $290 | $297 | $305 | $312 |
| Total - Buildings and Grounds | $565 | $579 | $594 | $609 | $624 | $640 | $655 | $672 | $689 | $706 |
| **Water Treatment Plant** | | | | | | | | | | |
| Preventive - Yearly | $56 | $57 | $59 | $60 | $62 | $63 | $65 | $67 | $68 | $70 |
| Corrective - Yearly | $86 | $88 | $90 | $93 | $95 | $97 | $100 | $102 | $105 | $108 |
| **Operating Projects** | | | | | | | | | | |
| Resin Replacement (A Train) | | $81 | | | | | | $94 | | |
| Resin Replacement (B Train) | $75 | | | | | | $92 | | | |
| Resin Replacement (C Train) | | | $81 | | | | | | | |
| Resin Replacement (Mixed Bed A) | | | | $29 | | | | | | |
| Resin Replacement (Mixed Bed B) | | | | | $30 | | | | | |
| Resin Replacement (U1 Polisher) | $75 | | | | | | $92 | | | |
| Resin Replacement (U2 Polisher) | | | | $79 | | | | | $96 | |
| Resin Replacement (U3 Polisher) | | $77 | | | | | | | | |
| Total Operating Projects WT Plant | $151 | $158 | $81 | $108 | $30 | $0 | $184 | $94 | $96 | $0 |
| Total Water Treatment Plant | $293 | $304 | $230 | $261 | $187 | $161 | $348 | $263 | $270 | $177 |

[1] **System Equipment Maintenance**

[2] **2010 Escalated costs**

# APPENDIX D

# APPENDIX D

## 10 YEAR SEM[1] EXPENDITURES[2] FOR ANCILLARY UNITS

*($000)*

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Environmental Monitoring** | | | | | | | | | | |
| Preventive - Yearly | $27 | $27 | $28 | $29 | $29 | $30 | $31 | $32 | $32 | $33 |
| Corrective - Yearly | $54 | $56 | $57 | $59 | $60 | $61 | $63 | $65 | $66 | $68 |
| **Operating Projects** | | | | | | | | | | |
| Emissions Monitoring | $162 | $166 | $170 | $174 | $179 | $183 | $188 | $193 | $197 | $202 |
| Stack Emissions Testing and Dispersion Modelling | | | $116 | | | | $128 | | | |
| CEMS RATA testing | $67 | $68 | $70 | $72 | $74 | $75 | $77 | $79 | $81 | $83 |
| OPEP Exercise | $6 | $6 | $6 | $7 | $7 | $7 | $7 | $7 | $7 | $8 |
| Tube Bundle Replacement-All units | | | $35 | | | $38 | | | $41 | |
| Total Operating Projects for Common Equipment | $235 | $241 | $398 | $253 | $259 | $304 | $400 | $279 | $327 | $293 |
| Total Environmental Monitoring | $316 | $324 | $483 | $340 | $348 | $395 | $494 | $375 | $426 | $394 |
| **Waste Water treatment Plant** | | | | | | | | | | |
| Preventive - Yearly | $74 | $76 | $78 | $79 | $81 | $83 | $86 | $88 | $90 | $92 |
| Corrective - Yearly | $32 | $33 | $33 | $34 | $35 | $36 | $37 | $38 | $39 | $40 |
| **Operating Projects** | | | | | | | | | | |
| WWTP Periodic Basin Cleaning & Inspection | $22 | | $23 | | $24 | | $26 | | $27 | |
| WWTP Continuous Basin Clean-Out | | $23 | | $24 | | $25 | | $26 | | $28 |
| Total Operating Projects for WWTP | $22 | $23 | $23 | $24 | $24 | $25 | $26 | $26 | $27 | $28 |
| Total - Waste Water Treatment Plant | $128 | $131 | $134 | $137 | $141 | $144 | $148 | $152 | $156 | $159 |

[1] **System Equipment Maintenance**

[2] **2010 Escalated costs**

**Newfoundland and Labrador Hydro**
**Return on Rate Base**
**($ 000s)**
**Year Ended December 31**

| | | 2010 | 2009 |
|---|---|---|---|
| (a) | Corporate Net Income - Return 1 | 83,691 | 66,374 |
| | Deduct: Unregulated Earnings | 77,087 | 49,163 |
| | Regulated Net Income * | 6,604 | 17,211 |
| | Add: Regulated Interest - Return 16 | 86,766 | 83,440 |
| (b) | Regulated Return | 93,370 | 100,651 |
| (c) | Average Rate Base - Return 3 | 1,484,659 | 1,473,478 |
| (d) | Rate of Return on Average Rate Base | 6.29% | 6.83% |
| | Lower end of approved range -.15 | 7.29% | 7.29% |
| | Higher end of approved range +.15 | 7.59% | 7.59% |

** Includes increased recovery of $126K related to Iron Ore Company of Canada Cost of Service Adjustment (2009- $798K decrease)*

A REPORT TO

THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

| | |
|---|---|
|  | Electrical |
| | Mechanical |
| | Civil |
| | Protection & Control |
| | Transmission & Distribution |
| | Telecontrol |
| | System Planning |

# REPLACEMENT OF STATOR WINDINGS

## At The Bay d'Espoir
## Hydroelectric Generating Station

July 2011

newfoundland labrador hydro
a nalcor energy company

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# 1 INTRODUCTION

Newfoundland and Labrador Hydro's (Hydro) largest hydroelectric generating station on the Island Interconnected System is located at Bay d'Espoir. The Bay d'Espoir Hydroelectric Generating Station consists of seven generating units producing a total capacity of 604 MW which is approximately 39 percent of the Island Interconnected System's installed capacity. Units 1 through 3 and Unit 4 were commissioned in 1967 and 1968, respectively, and each unit has a rated capacity of 75 MW.

The dimensions of generating Units 1 through 4 are approximately three meters high with an approximate diameter of six meters. A generator consists of two main parts: a rotor and a stator. The rotor is connected to a turbine and rotates because of the force of moving water on the turbine runner blades. The stator is the stationary part of the generator which is composed of a series of copper coils that complete the stator winding. When the rotor, which is a series of large magnets, rotates inside the stator's ring of copper coils, electricity is produced. The stator windings for Units 1 through 4 use asphalt tape to insulate the copper coils. The insulation system is required to prevent the copper coils from coming in contact with each other. Because of age, the asphalt tape insulation on the stator coils has become dry and brittle, reducing the mechanical and dielectric (insulation) strength of the insulation and making it more susceptible to failure. The repair or replacement of any one stator winding is quite complex and involves the removal of approximately 25 additional coils due to the inter-twining winding design of the stator winding and its coils. Due to aging and the brittle nature of the coils, any stator winding repairs are expected to lead to additional failures in other adjoining stator coils because of disturbance caused by their removal.

An independent engineering consultant has been engaged to prepare a condition assessment report for Bay D'Espoir units 1, 3 & 4 generators. This report is scheduled for completion in time to forward to the Public Utilities Board by the end of September 2011.

Figure 1 is a picture of new stator coils for Unit 2. Figure 2 is a picture of Unit 2 stator that has been rewound with new stator coils.

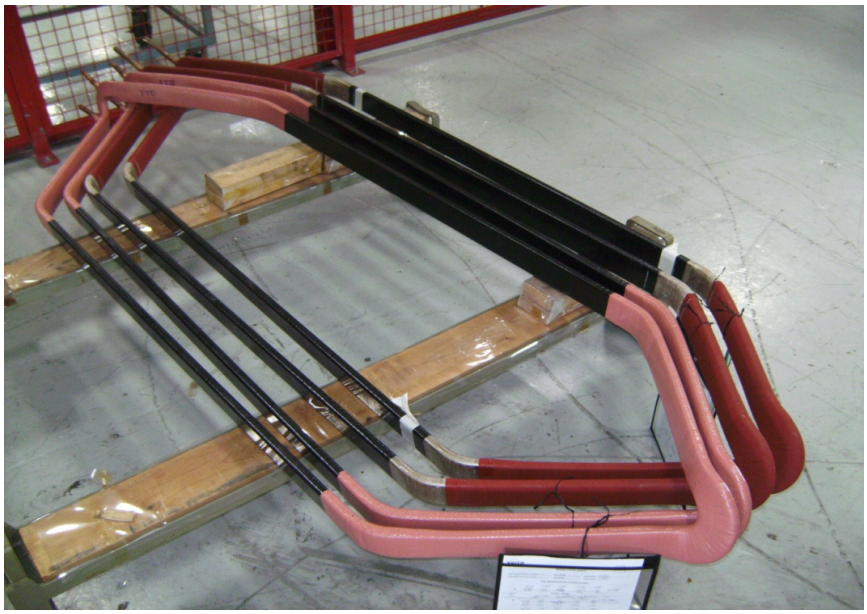

**Figure 1 – Stator Coils (4 individual coils are shown)**

In 2010, Hydro received an approval under Board Order No. P.U. 1 (2010) to replace the stator winding on Unit 2. The work completed on Unit 2 provides the basis for the replacement of the remaining three generating units.



**Figure 2 – Stator at Bay d' Espoir with Rotor Removed**

The operating lifecycle of Units 1, 3 and 4 are similar to Unit 2. The units have similar indicators of deterioration. The insulation on the windings is cracking in places, with asphalt seeping from within the windings indicating impending insulation breakdown. Therefore, the stator windings on the remaining three units are reaching their end of serviceable life and are at risk of failure. Hydro is taking a proactive approach to the replacement of the stator windings on Units 1, 3 and 4. This report describes the justification for the replacement of the stator windings of Units 1, 3 and 4 for continued reliability of the Bay d'Espoir Hydroelectric Generating Station.

# 2 PROJECT DESCRIPTION

In Board Order No. P.U. 36 (2008), Hydro received approval from the Board of Commissioners of Public Utilities to purchase a new stator winding in 2009 for delivery to the Bay d'Espoir Hydroelectric Generating Station in early 2010. Originally, it was proposed that this stator winding would be tested and stored, on site, as a spare to be installed when a winding failure occurred. However, after further consideration of the maintenance test results and the condition and age of the stator, it was prudent that a strategically planned stator winding replacement project be initiated to ensure reliability of the Island Interconnected System. Hydro determined that Unit 2 was in greatest jeopardy of winding failure, and its stator winding was replaced in 2010.

This proposal is to continue this work on Units 1, 3 and 4. The sequence for the remaining units would involve the purchase of a stator winding in one year and its installation in the following year. The order of the stator winding replacements is based on maintenance data and unit criticality. The proposed sequence is Unit 4 in 2012, Unit 1 in 2013 and Unit 3 in 2014. The work would also include an upgrade to the generator protection and the refurbishment of rotor components. This work is required to ensure the new stators will operate to their full capability. Both Units 2 and 4 have high levels of partial discharge activity. In 2008 Unit 2 failed an over-potential insulation resistance test and was replaced in 2010. In 2011, Unit 4 failed the same over-potential test and is deemed to have the next highest potential for imminent failure. Units 1 and 3 are critical to the overall reliability of the powerhouse since they provide station service power to the generating station. Unit 1 is prior to Unit 3 in the sequence because it has more starts and stops than Unit 3 and thus has likely deteriorated at a faster rate.

The stator windings involve a series of tensioning components (called the packing system) to mount and secure the stator coils against the stator core. The Bay d'Espoir stator winding

in Units 1 through 4 each contains 360 coils. An overview of the packing system for one section is shown in Figure 3.

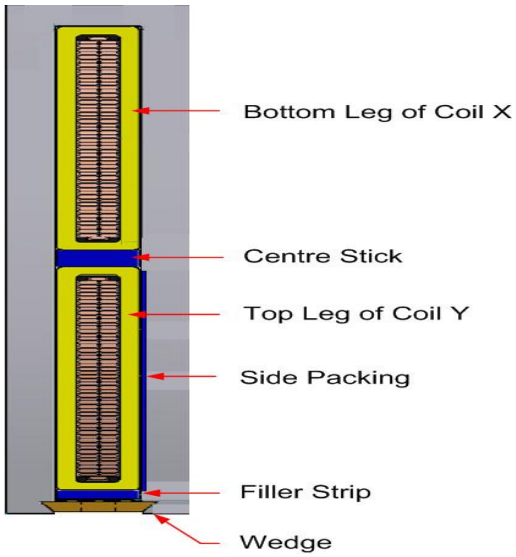


**Figure 3 – Overview of Packing System on One Section of Stator Winding**

As asbestos is present in this vintage of stator, its removal is part of the scope of this project. The asbestos is located in the center stick and side packing of the stator winding.

# 3 EXISTING SYSTEM

Regular preventative maintenance work indicated signs of wear in critical locations within the windings of Unit 2. Electrical partial discharge and over-potential tests indicated Unit 2 was closer to failure than Units 1, 3 and 4. The Unit 2 stator was removed and replaced in 2010. During this work, other signs of wear were found, that raised concern about the condition of the remaining units' stators. Specifically, stator core lamination plates were shown to have migrated into some of the stator coils which would eventually lead to insulation failure. Broken rotor bus bars were also identified. Both of these conditions cannot be detected without a major rebuild, so Hydro cannot test for these conditions on the other three units.

As Unit 2 showed signs of reduced insulation levels, Hydro had concerns with the remaining usability of Units 1, 3 and 4 due to similar deterioration of the insulation. Units 1, 3 and 4 all have insulation that is cracking and brittle when dry and once the insulation is heated, liquid asphalt drips from the insulation, reducing the insulation or dielectric properties and physically covering the surrounding area in asphalt. Both of these factors are visual indications that the insulation is degrading and losing its dielectric strength.



**Figure 4 – Existing Stator Windings**

Upon removal of Unit 2, the stator was found to have its stator core slots migrating or moving out of alignment. The stator core is a mechanical structure compiled of a series of steel laminations that physically supports the stator coils in slots. With the removal of Unit 2, it was discovered that the laminations have shifted and are moving out of alignment. The timeframe for stator core migration is over the life of a unit. The concern with stator core migration is the stator core slots contain tightly packed stator windings and with the misalignment of the steel laminations tension begins between the steel lamination and stator winding. Thus, the laminations begin to cut into the stator windings creating a condition whereby if allowed to continue, could create an electrical fault and failure of the winding. The situation is analogous to cables chafing against each other and wearing through the insulation.

To ensure improved functionality of all generator components, the generator protection equipment should be upgraded from electro-mechanical relaying to electronic relaying. In

the event of an electrical fault, the speed of operation for a protection relay is directly proportional to the level of damage mitigation on a faulted generating unit. With modern electronic relaying having response times approximately 10 times faster than the existing electro-mechanical relays and considering the asset cost of a new stator winding, it would be prudent to upgrade the generator protection with each stator winding rewind.

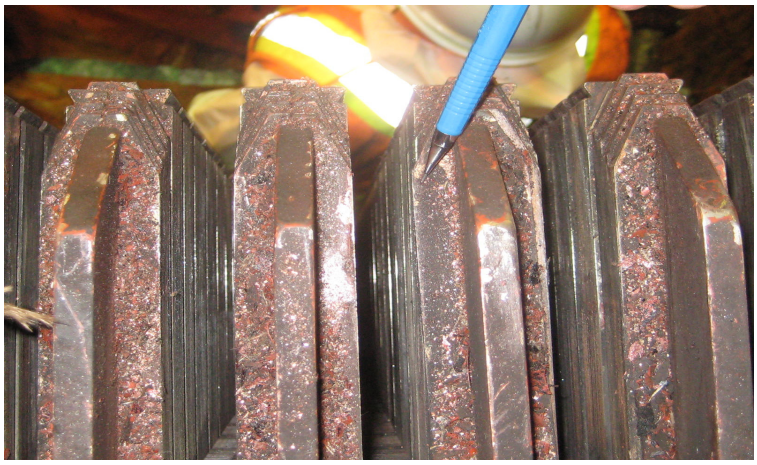

**Figure 4 – Stator Core Laminations Migration**

## 3.1 Age of Equipment or System

Generating Units 1 through 3 and Unit 4 were installed and commissioned in 1967 and 1968 respectively. They are 43-44 years old.

## 3.2 Major Work and/or Upgrades

Table 1 shows the upgrades that have occurred on the generating units since installation.

**Table 1 -Major Work Upgrades**

| Year | Major Work/Upgrade | **Cost ($000)** |
|---|---|---|
| 2001 | Unit 1 Repair of Stator Windings | 88.2 |
| 1998 | Unit 1 DC Exciter Replacement | 330.6 |
| 1998 | Unit 4 DC Exciter Replacement | 330.6 |
| 1997 | Unit 2 DC Exciter Replacement | 333.6 |
| 1997 | Unit 3 DC Exciter Replacement | 333.6 |
| 1996 | Unit 1 Runner Replacement | 1,578.0 |
| 1994 | Unit 3 Runner Replacement | 1,449.0 |
| 1994 | Unit 4 Runner Replacement | 1,387.0 |
| 1993 | Unit 2 Runner Replacement | 1,381.0 |

## 3.3 Anticipated Useful life

Hydroelectric generator stator windings have an anticipated useful service life of 40 years depending on operating conditions and maintenance.

## 3.4 Maintenance History

Since their installation in 1967 and 1968, the stator windings of Units 1 through 4 of the Bay d'Espoir Hydroelectric Generating Station have had minimal preventive maintenance costs associated with them. Typically, the preventive maintenance costs associated with the stator of each unit averaged $1,000 annually, and the maintenance was performed during scheduled outages. This preventative maintenance generally included a visual inspection and the standard electrical tests. The most recent corrective maintenance took place in 2001, when a failure during testing resulted in damage to a single stator winding coil in Unit 1. This repair involved the removal and replacement of one of the 360 coils which make up the stator. The cost of this repair was $88,175. Similar repairs were performed on Unit 1 in 1986 and Unit 2 in 1992. Besides these three major repairs, the only maintenance

performed on the stators of Units 1 through 4 has been cleaning and replacing wedges that keep the stator coils in place.

## 3.5 Outage Statistics

There have been no outages which were the direct result of the stator windings.

## 3.6 Industry Experience

The asphalt insulated, multi-turn coil stator winding was manufactured by General Electric (GE) between the years 1930 and 1968 and is called a Class B winding. This was a common design and is used in most hydroelectric generators built during this period.

Multi-turn coil windings with asphalt insulation have varying service lives, which are dependent on operating conditions and regular maintenance. If the stator coils are not overstressed and the manufacturer's recommended maintenance is performed regularly, the service life of the coils could range from 40 to 50 years. However, generally this type of coil, operating under normal conditions will need to be rewound within 40 years. GE has indicated that the majority of generators of this type throughout the world have already undergone a stator rewind.

## 3.7 Maintenance or Support Arrangements

All maintenance performed on the stator windings has been done by Hydro personnel, with support and technical advice being provided by the manufacturer, GE.

## 3.8 Vendor Recommendations

General Electric is the manufacturer of the Unit 1, 3 and 4 stator windings and has

participated in various inspections throughout the life of these units. The latest inspection for Units 1 through 4 was completed in 2007. Based on past inspections and the results of testing performed by Hydro, General Electric has maintained that the end of serviceable life for these units is near and their replacement should be considered in the short term. The most prudent action is to replace the windings on Units 4, 1 and 3 in 2012 through 2014 respectively.

## 3.9 Availability of Replacement Parts

General Electric halted production of this particular type of winding in 1969, shortly after Bay d'Espoir Units 1 through 4 were installed. GE as well as the other large generator manufacturers can provide replacement stator coils designed specifically for the Bay d'Espoir units and provide delivery times suitable to meet the schedule for this project.

## 3.10 Safety Performance

There are no specific safety issues related to this project.

## 3.11 Environmental Performance

As part of the removal procedure, asbestos abatement methods will be followed. There are no other specific environmental issues related to this project.

## 3.12 Operating Regime

Units 1 through 4 of the Bay d'Espoir Generating Station are designed for continuous operation with varying loads to meet system requirements. With the exception of maintenance outages, these four units have been operating continuously, within their design capabilities, since they were commissioned in 1967 and 1968.

# 4 JUSTIFICATION

This project is justified on the need to maintain system reliability by replacing Units 1, 3 and 4 stator coils before a failure occurs. Should a stator fail in service, it would cause significant damage to the stator and its rotor. Based on 2010 figures repair work for such a failure would cost $450,000 and require 100 days of effort. Thus, failure to replace the stators in Units 1, 3 and 4 will impair Hydro's ability to provide least-cost, reliable electricity.

The life expectancy for asphalt insulated stator windings is 40 years. However, this varies based on such operating conditions as temperature, number of starts and stops, maintenance and care and unit loading. Since the stators of Units 1, 3 and 4, have reached the end of their 40 year useful service life, stator replacements are necessary.

As with the discovery of the stator core migration issue on Unit 2, it is difficult to verify the level of this problem in Units 1, 3 and 4. The risk of electrical fault is high as one or more steel laminations could possibly create an electrical short with one or more stator coils, thus rendering a generator unusable. The condition of the stator windings and the issue of core migration present a risk of imminent failure to the stator windings of Units 1, 3 and 4. If failure occurs it is very likely that damage to the stator and its rotor will result. The current electro-mechanical protection equipment cannot prevent this potential damage and therefore, must be upgraded. In order to prevent damage due to failure, the stator windings of Units 1, 3 and 4 must be replaced.

The removal of asbestos from the stator packing system would remove an environmental concern from the workplace.

## 4.1 Net Present Value

A net present value calculation was not performed in this instance as there is no viable alternative to replacing the stator windings.

## 4.2 Levelized Cost of Energy

This project will have no direct effect on the levelized cost of energy.

## 4.3 Cost Benefit Analysis

A cost benefit analysis is not applicable for this project as there are no quantifiable benefits.

## 4.4 Legislative or Regulatory Requirements

There are no specific legislative or regulatory requirements which affect this project.

## 4.5 Historical Information

There is no historical information associated with this proposal.

## 4.6 Forecast Customer Growth

The forecasted customer load on the system has no effect on this project.

## 4.7 Energy Efficiency Benefits

There are no energy efficiency benefits anticipated from this project.

## 4.8 Losses during Construction

As the stator windings of the generators will be rewound during scheduled outages typically occurring during the summer months, there will be no losses during construction.

## 4.9 Status Quo

The stator windings of Units 1, 3 and 4 of the Bay d'Espoir Hydroelectric Generating Station are operating beyond their expected useful service lives. Inspections and testing have confirmed that a coil or complete winding could fail at any time. Therefore the status quo of operating without a replacement plan is not an option.

## 4.10 Alternatives

There are no viable alternatives to this project.

# 5 CONCLUSION

Units 1, 3 and 4 of the Bay d'Espoir Hydroelectric Generating Station have been in service since their commissioning in 1967 and 1968. The stator windings of these units are now past the end of their useful service live of 40 years. If the windings for Units 1, 3 and 4 are left in service and run to failure, it is likely that the machine stator core will be damaged when the stator fails. For these reasons, the stator windings of Units 1, 3 and 4 should be replaced.

## 5.1 Budget Estimate

The budget estimate for the rewind of stator windings 1, 3, and 4 is $13.6 million over the years 2012 through 2014. The budget estimate is shown in Table 2.

**Table 2: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 190.0 | 190.0 | 190.0 | 570.0 |
| **Labour** | 592.0 | 592.0 | 592.0 | 1,776.0 |
| **Consultant** | 144.1 | 143.9 | 147.7 | 435.7 |
| **Contract Work** | 3,290.0 | 3,290.0 | 2,025.0 | 8,605.0 |
| **Other Direct Costs** | 40.0 | 40.0 | 40.0 | 120.0 |
| **Interest and Escalation** | 272.1 | 372.7 | 340.4 | 985.2 |
| **Contingency** | 425.6 | 425.6 | 299.5 | 1,150.7 |
| **TOTAL** | **4,953.8** | **5,054.2** | **3,634.6** | **13,642.6** |

## 5.2 Project Schedule

The anticipated schedule for this project is shown in Table 3 below.

**Table 3a – Project Schedule for Unit 4 in 2012**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Request and Project Planning for Unit 4. | January 2012 | March 2012 |
| Procurement | Tendering, Equipment Ordering and Delivery for 2013<br>FAT Testing for Unit 1 | April 2012 | November 2012 |
| Construction | Install Stator Winding, Rotor Upgrades, Generator Protection on Unit 4 | May 2012 | September 2012 |
| Commissioning | Commissioning Unit 4 | October 2012 | October 2012 |
| Closeout | Project Closeout Unit 4 | November 2012 | December 2012 |

**Table 3b – Project Schedule for Unit 1 in 2013**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Request and Project Planning for Unit 1. | January 2013 | March 2013 |
| Procurement | Tendering, Equipment Ordering and Delivery for 2014<br>FAT Testing for Unit 3 | April 2013 | November 2013 |
| Construction | Install Stator Winding, Rotor Upgrades, Generator Protection on Unit 1 | May 2013 | September 2013 |
| Commissioning | Commissioning Unit 1 | October 2013 | October 2013 |
| Closeout | Project Closeout Unit 1 | November 2013 | December 2013 |

**Table 3c – Project Schedule for Unit 3 in 2014**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Outage Request and Project Planning for Unit 3. | January 2014 | March 2014 |
| Construction | Install Stator Winding, Rotor Upgrades, Generator Protection on Unit 3 | May 2014 | September 2014 |
| Commissioning | Commissioning Unit 3 | October 2014 | October 2014 |
| Closeout | Project Closeout Unit 3 | November 2014 | December 2014 |

**A Report to**

**The Board of Commissioners of Public Utilities**

| | |
|---|---|
|  | Electrical |
| | Mechanical |
| | Civil |
| | Protection & Control |
| | Transmission & Distribution |
| | Telecontrol |
| | System Planning |

# UNIT 1 AND UNIT 2 GENERATOR STATOR REWIND

## Holyrood Thermal Generating Station

July 2011

newfoundland labrador hydro
a nalcor energy company

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# 1 INTRODUCTION

Newfoundland and Labrador Hydro's (Hydro) Holyrood Thermal Generating Station has a total capacity of 500MW. The Holyrood Thermal Generating Station consists of three oil fuelled generating units which produce approximately 33 percent of the Island Interconnected system's installed capacity. Units 1, 2 and 3 were commissioned in 1969, 1970, and 1979, respectively. Units 1 and 2 are 175 MW and Unit 3 is rated at 150 MW. Unit 3 has synchronous condensing capability.



**Figure 1 - Unit 1 Generator End of Steam Turbine Generator**




**Figure 2 - Unit 2 Generator End of Steam Turbine Generator**

The generator of each generating unit is approximately five meters in diameter. A generator consists of two main parts: a rotor and a stator. The rotor is connected to a steam turbine and rotates because of the force of high pressure, high temperature steam on the turbine blades. The stator is the stationary part of the generator. As the rotor spins inside the stator, electricity is produced.

The stator is composed of a series of copper wire bars (stator bars) that form the stator winding. Each copper wire bar is mechanically secured into a slot around the perimeter of the stator. This support structure for the winding is the stator core. Along with being mechanically connected, each bar is electrically connected. The generator is three phase and as such has a bar for each of the three phases, with each individual phase being electrically connected together to form the stator winding. For the purposes of nomenclature, the electrical phases are usually represented as A phase, B phase and C phase or in the case of the AMEC condition assessment they are stated as left phase, center phase and right phase.

The stator core is constructed of a series of stacked steel plates each containing slots for the placement of two stacked stator bars. The stator bars are embedded into these slots along the perimeter of the stator to form the stator winding. The copper bars are multi-strand strips of copper and have a packing system that secure the bars in each slot as shown in Figure 3.

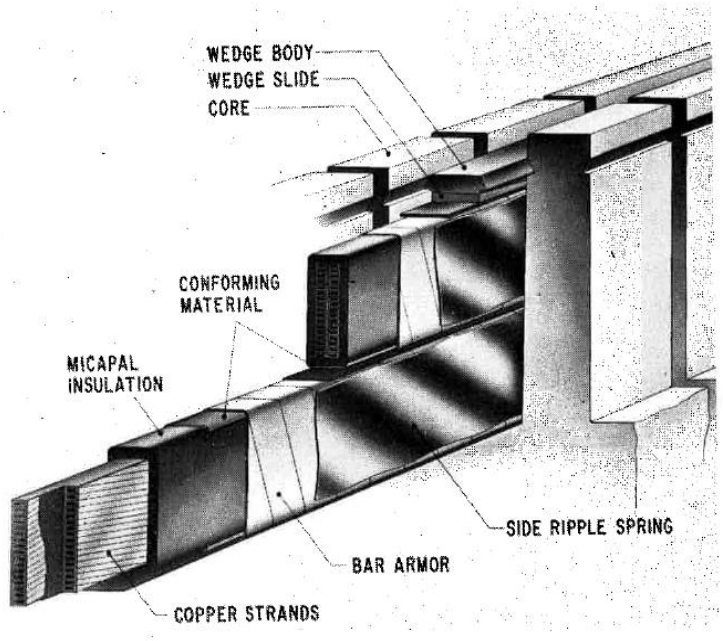



**Figure 3 – Stator Bars - Packing System**
**(Photo from GE Turbine-Generator Manual - S.G.E.I. 3025)**

The insulation is used to isolate the current carrying copper material from contact with the stator core, which without insulation would produce an electrical fault. As such, the condition of the insulation is a key monitoring component to the health of the stator winding. The insulation material, like all materials, will deteriorate with time and use. This proposal is based on the lifecycle point for the stator bar insulation of Units 1 and 2 having reached their end-of-life.

As the insulation levels are diminished, the occurrences of electrical fault become increasingly more probable which will eventually lead to the complete failure of the generating unit. Ideally, the replacement of the stator windings is completed before a

failure occurs with the generating unit. Failure of a generating unit is unplanned and results in the unavailability of the generating unit with costly repairs and the requirement for additional sources of power to replace the failed unit.

Inspections completed on Units 1 in 2003 and 2 in 2005 by GE Energy Services (GE) provided recommendations on the condition of the stator windings. From the 2005 report, it recommends "that the stator be rewound in near future"[1]. Although a precise time of failure cannot be predicted, it is likely the stator windings on Units 1 and 2 will fail prior to the anticipated decommissioning of the facility.

As part of a 2009/10 approved capital project titled "Condition Assessment & Life Extension – Holyrood Generating Station", Hydro commissioned the engineering consultant AMEC to assess the condition of the existing major plant systems, including the generators and their stator windings, for generating Units 1 through 3 at the Holyrood Generating Station. The AMEC review was based on historical overhaul, inspection, maintenance, and testing data. The intent was to state the present condition of the equipment. AMEC used Robert Jefferys,[2] an independent generator expert to determine these results. Among other items, the AMEC report stated it would be "considered appropriate to proceed with the installation of a new stator winding at the next major outage in 2012"[3]. This report is based on a review of all relevant data for these windings and is generally consistent with the GE Energy Services recommendations of 2003 and 2005 for Unit 1 and Unit 2 respectively.

The anticipated mode of operation for Holyrood Generating Station is gradual reduction in the available generation starting in 2017 until 2020 when the plant becomes a synchronous condenser facility. The process of changing a unit to a synchronous condenser involves reversing the rotation of the unit and making the unit a motor rather than a generator. As such the stator windings would be required for each unit as a generating station or a

[1] GE Energy Services – Steam Turbine Inspection Report, FSR# 20350952, August 9, 2005, Pg 8. (Attached as Appendix C)
[2] See Resume – Appendix A.
[3] AMEC – Condition Assessment & Life Extension Study, 6.4 Actions XI (Attached as Appendix E)

synchronous condenser facility. Thus, this proposal is aligning with the anticipated mode of operation for Holyrood facility for 2020 onward.

# 2 PROJECT DESCRIPTION

The proposed schedule of replacement is based around planned major unit outages. As such, Hydro's intention is to replace the stator windings of Unit 2 in 2014 and of Unit 1 in 2015.

The proposal work schedule includes:

I. In 2012, tendering for the procurement and installation of two generator stator windings;
II. In 2013, completing the purchase order for two stator windings for Unit 2 and Unit 1 with delivery in 2014 and 2015 respectively; and
III. The delivery and installation of the stator windings for Unit 2 in 2014 and Unit 1 in 2015 during their summer outage periods coincident with the planned major turbine generator maintenance. The work will also include an upgrade to the generator protection and refurbishment of other generator components to ensure the new windings operate to their full capability.

It should be noted, that changes in the proposed work schedule can occur, including the order of unit installation work. Changes could occur due to the lack of available outage time, emergency work on units or the availability of new technical information on a unit's parameters.

As part of other work at Holyrood Generating Station in 2012, Unit 1 has a planned generator inspection. This inspection will produce a detailed condition assessment report of Unit 1 generator providing greater analysis into the level of deterioration of this unit since its last condition report in 2003.

As part of the preventative maintenance process, some monitoring equipment is included

with the stator winding. This equipment includes: Resistive Temperature Detectors (RTDs) for temperature monitoring and Partial Discharge (PD) couplers for the measurement of insulation deterioration through the measurement of electrical corona on the insulation. These devices aid in the conditioning monitoring to aid in reducing the probability of an in-service failure.

This proposal also includes an upgrade of the generator protection equipment. The existing generator protection equipment consists of electromechanical relays which are slow to operate in comparison to the newest electronic technologies, which operate ten times faster than the older relaying technology. This improved time performance would provide better response time to protect the generator; as well the newer technologies have improved output response data of a generator fault event. During a fault situation the speed of isolating the generating equipment usually minimizes the level of damage to the equipment and its time and cost to repair.

The ordering of two stator windings is being pursued to mitigate the risk of a Unit 1 failure before a planned installation could be completed. A failure on Unit 1 would create a risk to planned Unit 2 work and would cause budget overruns. In addition, the ordering of two stators for delivery in different years does provide the least cost option for the supply of these items.

Based on the manufacturer manuals for Unit 1 and Unit 2, the manufacturer has stated that asbestos was used during the original installation of these units. Hydro has no record or indication of any asbestos removal on Unit 1 or Unit 2 over the past 40 years. This proposal will include the remediation of asbestos for Unit 1 and Unit 2.

# 3 EXISTING SYSTEM

The existing windings on Unit 1, and Unit 2, are nearing the end of their useful lives and are in poor condition, consistent with similar units of their design and age. General Energy Services (GE) has produced inspection reports for Unit 1 in 2003 and Unit 2 in 2005.

In 2003, Unit 1 inspections found serious indications of a potential winding failure. The results of the stator winding electrical tests indicate a low dielectric strength of the insulation; Unit 1 winding is closer to failure than the winding of the other generating units.

The electrical testing completed by General Electric included: insulation testing, a polarization index of each phase and a DC high voltage leakage test. The results of the insulation testing and the polarization index were satisfactory. However, the results were considerably lower on two of the three phases. This indicates that considerable deterioration has occurred on the insulation of these two phases. Based on these initial results, General Electric took the unusual step of repeating the insulation test and polarization index testing, to ensure the initial results were accurate.

The results of the second insulation testing showed further reduced insulation dielectric from the previous testing. The results of the second polarization index also showed a reduced insulation level from the previous testing. These results indicate that the winding insulation contains a serious weakness, has excessive dirt and moisture present or is a combination of both conditions.

Due to the known condition of the windings, the DC high potential leakage test was conducted at reduced levels from those recommended by the manufacturer. The stator winding passed the DC high potential leakage test. The results did indicate satisfactory results for the left phase, but the centre and the right phases had high levels of leakage current. This differing result confirms the results of the other testing, that two phases are in significantly poorer condition than the third phase.

From inspection testing in 2003, General Electric concluded that the results of the electrical tests are "a good indication of deteriorated condition of the ground wall insulation"[4]. The report stated that "Based on results of the visual inspection, high-voltage testing, and age of the winding I recommend to plan a full generator stator rewind with new bars in the near future…"[5].

In 2005, General Electric inspected and tested the Unit 2 stator windings and reported they were in very poor condition. The condition reported extensive loosening of the stator bars in their slots, and in the end-winding supports. Oil was found throughout the generator and extensive greasing had developed in the end-windings, and in parts of the slot teeth. Further condition details can be found in the 2005 GE report. (See Appendix C).

The insulation resistance measurements showed that the dielectric strength of the insulation on two of the three phases was significantly weaker. The DC high potential test showed that all three phases had high leakage current and there was a large spread in testing results between one phase and the other two phases. This confirmed the poor condition of the right phase. The polarization index results proved satisfactory indicating dry insulation on the stator windings.

From the results of the visual findings and poor electrical testing, General Electric recommended a replacement of the Unit 1 stator winding and the Unit 2 stator winding as stated in Appendices B and C respectively. As an interim least cost measure, Hydro has installed improved stator ground fault equipment on each generator to indicate the presence of a winding failure condition on a unit. This fault indication is used to minimize stator winding damage.

[4] GE Energy Services – Generator Inspection Report FSR# 20350670 September 18, 2003, Pg. 5.
[5] GE Energy Services – Generator Inspection Report FSR# 20350670 September 18, 2003, Pg. 5.

In addition, like the deteriorating stator windings, elements of the existing monitoring equipment on Unit 1 and Unit 2 have also deteriorated and are problematic for preventative maintenance on the stator winding. This equipment includes the RTD thermocouples for temperature detection which are embedded in the stator windings and the Partial Discharge Couplers (PDA) which measure electrical spark or corona activity and provide a condition level of the stator winding insulation also known as dielectric strength.

The General Electric manuals for Unit 1 and Unit 2 have referenced the use of asbestos within the stator winding. Hydro has no record or recount of asbestos removal within the generating units and is considered to be the existing condition of the stator winding until substance testing can be completed during stator winding removal.

The existing stator winding has Class B insulation which was the standard insulation for the late 1960's. Class B insulation has a temperature level of 133°C and is known to soften as the temperature rises. This can be problematic, as with rising temperature the insulation softens to the point that it liquefies and drips, diminishing the insulation over time. A new stator winding would be of the present insulation standard which is Class F insulation, this insulation has a temperature level of 155°C and remains rigid over its temperature range.

## 3.1 Age of Equipment or System

Generating Units 1 and 2 were installed and commissioned in 1969 and 1970 respectively. Their maximum continuous rating (MCR) output was increased in 1988 and 1989 respectively from 150 MW to 175 MW. This increase to Unit 1 and Unit 2 did not replace the stator winding.

The Unit 1 operating hours to the end of February 2011 were 171,951 which is equivalent to approximately 20 years continuous operation. It is expected to attain approximately 179,000 hours before the next major inspection in 2012. The unit averages about four starts

per year, which should have negligible deteriorating effect on the generator.

The Unit 2 operating hours to the end of February 2011 were 163,732 which is equivalent to approximately 19 years continuous operation. It is expected to attain approximately 179,000 hours before the next major inspection in 2014. The unit averages about thirteen starts per year, which should have negligible deteriorating effect on the generator.

The generating units and in particular the stator windings, have increased forces and loading induced upon them during severe system events, such as storm or lightning conditions where power lines may trip or reclose. Unit 1 and Unit 2 generators are no exception and do encounter numerous system faults and swings in load during system events. During these system events, the increased forces are induced on the stator windings which stress and deteriorate the winding components. In particular, faults on the power system will result in over-current and large mechanical forces on the stator windings. Thus, with the reduced stator winding insulation levels and the possibility of system events on the generator, there is an increased risk of a generator failure.

**Table 1 – Holyrood Unit 1, Unit 2 and Plant Performance**

| Five Year Average 2005-2009 | All Causes | | |
|---|---|---|---|
| **Unit** | **Capability Factor (%)** | **DAFOR (%)** | **Failure Rate** |
| Holyrood Unit 1 | 59.24 | 23.19 | 14.05 |
| Holyrood Unit 2 | 62.38 | 11.85 | 5.94 |
| | | | |
| Holyrood Plant | 60.04 | 14.43 | 9.69 |
| | | | |
| CEA | 74.74 | 10.31 | 8.91 |

Capability Factor is defined as unit available time. It is the ratio of the unit's available time to the total number of unit hours.

DAFOR is defined as Derated Adjusted Forced Outage Rate. It is the ratio of equivalent forced outage time to equivalent forced outage time plus the total equivalent operating time.
Failure Rate is defined as the rate at which the generating unit encounters a forced outage. It is calculated by dividing the number of transitions from an Operating state to a forced outage by the total operating time.

## 3.2 Major Work and/or Upgrades

Major work and upgrades completed on Units 1 and Unit 2 are shown in Table 2:

**Table 2-Steam Turbine Generator -Major Work**

| Unit | Year | Major Work |
|---|---|---|
| 1 | 2009 | Fast dump of generator hydrogen installed. |
| 1 | 2008 | Stator winding ground fault protection improved. |
| 1 | 2003 | Hydrogen dryer and purity meter replaced. |
| 1 | 2003 | Stator slot wedges replaced and end-winding support system re-tightened;<br>Defective RTD repaired;<br>Digital multi-functional generator protection relay installed (for improved winding ground protection, alarms connected, and sequence of events);<br>Four new cold gas RTD's in stator installed;<br>Realigned hydrogen seal housing and rotor shaft line. |
| 1 | 2000 | ABB static exciter and AVR replaced. |
| 1 | 1997 | New 18 %Mn/18 %Cr retaining rings.<br>Partial discharge monitoring installed - stator windings. |
| 1 | 1988/92 | Uprated from 174.160 MVA at 30 psi hydrogen pressure, to 194.445 MVA at 45 pounds per square inch (psi) hydrogen pressure;<br>Retaining rings polished and NDE inspected in situ. |
| 2 | 2005 | Fast dump of generator hydrogen added;<br>Generator hydrogen dryer and purity meter replaced. |
| 2 | 2005 | Stator slot wedges replaced and slot couplers re-installed;<br>Stator end-winding support system re-tightened;<br>RTD's checked - 3 broken and 4 > 20 % inaccurate;<br>Realigned hydrogen seal housing; hydrogen coolers cleaned;<br>Installed 4 new cold gas RTD's in stator;<br>Digital multi-functional generator protection relay installed, (improved winding ground protection, alarms connected, and sequence of events monitoring);<br>Hydrogen seal rings lapped and clearances re-set to lower limits to minimize future oil leaks. |
| 2 | 1999 | Installed slot couplers for partial discharge monitoring;<br>ABB excitation system installed;<br>Hydrogen seal ring segments replaced;<br>Hydrogen coolers cleaned. |
| 2 | 1994 | Retaining rings replaced;<br>Stator end-windings and end-wedges re-tightened. |
| 2 | 1989/90 | Up-rated from 174.160 MVA at 30 psi hydrogen pressure, to 194.445 MVA at 45 psi hydrogen pressure;<br>New hydrogen seal set installed;<br>Retaining rings polished and NDE inspected in situ;<br>PCB excitation transformer drained, cleaned and re-filled. |

## 3.3 Anticipated Useful Life

Holyrood's Unit 1 and Unit 2 stator windings are depreciated over 25 years. However, generator windings typically have an estimated service life of approximately 35 years depending on operating conditions and maintenance. In its 2010 Holyrood Condition Assessment, AMEC stated the following regarding the condition of the Unit 1 and Unit 2 generators "… the visual inspections of the stator windings have shown that they are in a fairly advanced state of deterioration."[6] AMEC further stated to the remaining life of the units "In view of the next planned outage in 2012 there is little time left to write a specification for a new winding, place the contract for the work, and have new coils delivered ….It is probably more appropriate to proceed planning work for a rewind now, …."[7].

The life cycle curves for the Unit 1 and Unit 2 generators from the AMEC report are illustrated below.

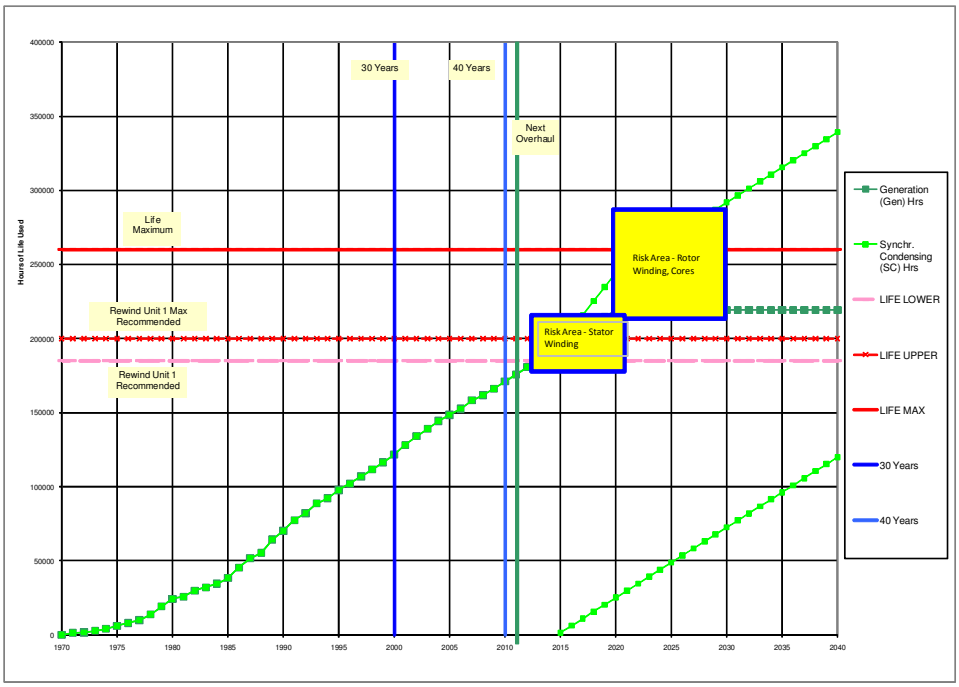



**Figure 4 – Unit 1 Generator Life Cycle Curve**

[6] AMEC – Condition Assessment & Life Extension Study, 6.1.1.3 Assessment
[7] AMEC – Condition Assessment & Life Extension Study, 6.1.1.3 Assessment

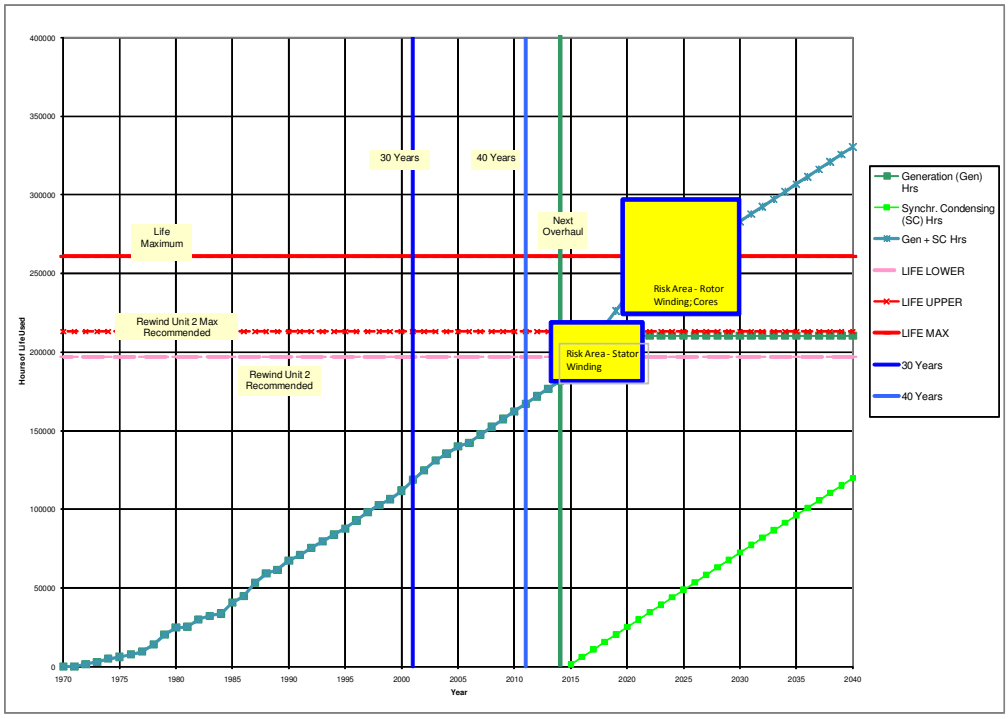



**Figure 5 – Unit 2 Generator Life Cycle Curve**

## 3.4 Maintenance History

Since their installation in 1969 and 1970 respectively, the stator windings of Unit 1 and Unit 2 have had regular inspections, which include testing and replacement of faulty or worn components. Typically, the inspections were performed every six to seven years until 2003 when the interval was increased to nine years, consistent with the general direction of the industry. The cost of the typical inspection for the generator portion of a full steam turbine generator is about $1 million. The annual incremental preventive maintenance cost for the Holyrood generators has not been captured but is estimated to be less than $1,000 annually. Due to the deteriorated condition of the existing RTD and PD components on Unit 1 and Unit 2 generators, this portion of preventative maintenance is not monitored.

## 3.5 Outage Statistics

In the last five years, there have been no outages which were the direct result of the stator windings.

## 3.6 Industry Experience

The Unit 1 and Unit 2 stator windings were manufactured by General Electric using a proprietary insulation called Micapal, the windings are multi-turn coil. This design was manufactured in the 1960's and 1970's and is a common design used in many steam turbine generators built during this period.

Multi-turn coil windings with Micapal insulation have varying service lives, which are highly dependant on operating conditions and regular maintenance. If the stator windings are not overstressed and the manufacturer's recommended maintenance is performed regularly, the service life of the windings is typically 30 to 40 years. However, this type of winding operating under normal conditions will normally need to be rewound within 40 years. AMEC indicated in its condition assessment report that many generators of this type throughout Canada have already undergone a stator rewind. Although a listing was not provided with the report, its author; Robert Jefferys has provided a partial listing as shown in Appendix G.

## 3.7 Maintenance or Support Arrangements

All maintenance performed on the stator windings has been supervised since 1986 by GE using contracted staff and experts with the support and supervision by Hydro personnel. GE also provides ongoing support and technical advice under a service contract.

## 3.8 Vendor and Third Party Engineer Recommendations

GE is the original manufacturer of these stator windings and participated in the inspection and testing of the Unit 1 windings in 2003 and Unit 2 windings in 2005. Based on their inspections and the results of the tests performed, GE Energy Services has recommended the rewind of the Unit 1 and Unit 2 stators in the near future. In addition, the condition assessment in 2010 by AMEC determined that the more prudent option is to replace the stator windings of Unit 2 at its next steam turbine generator overhaul in 2014 and in a dedicated Unit 1 generator outage in 2015.

## 3.9 Availability of Replacement Parts

GE halted production of this particular type of winding in the 1970's. GE as well as the other large generator manufacturers can provide replacement windings designed specifically for the Holyrood units and provide delivery times suitable to meet the schedule outlined in this proposal. Hydro shall solicit bids from qualified vendors of stator windings.

## 3.10 Safety Performance

The generators at the Holyrood Generating Station use hydrogen gas as a coolant. Hydrogen gas is used as its heat transfer properties are better than air. Hydrogen is highly flammable and will burn with a concentration of four percent to 75 percent by volume. As such, careful operating and handling precautions must be followed when operating and working with hydrogen gas. The potential risk of fire to a hydrogen cooled generator is always present, especially in abnormal operating conditions (eg. stator winding failure).

Another area with thermal generating units that could pose a safety concern is the high rotation speeds of these units should a mechanical failure occur. Although the probability of mechanical failure is low the risk would be high and catastrophic if the condition were to happen. Unit 1 and Unit 2 rotate at 3,600 revolutions per minute, at these speeds there is a

large amount of kinetic energy should a failure occur. This energy combined with the energy of hydrogen gas would create a situation that could possibly produce fatalities and injuries from flying shrapnel and falling projectiles.

A third point that cannot be overlooked is the importance of Unit 1 and Unit 2 to the system and the safety of having a reliable energy source. As Unit 1 and Unit 2 in Holyrood are the largest single units on the island interconnected system they each play a pivotal role in establishing an energy balance on this system.

## 3.11 Environmental Performance

The possible presence of asbestos will be remedied in a safe and prudent manner. There are no other known environmental issues related to this project.

## 3.12 Operating Regime

Unit 1 and Unit 2 of the Holyrood Generating Station are designed for continuous operation with varying loads. They are typically operated as seasonally loaded in the November to March period to meet system peak winter requirements. The three Holyrood units together can provide about 33 percent of the Island Interconnected System load during the crucial winter peak period. Maintenance outages are typically taken during the summer months when their capacity requirements are less. These units have been operating in this mode, within their design capabilities, since they were commissioned in 1969 and 1970.

The anticipated operational schedule for the Holyrood Thermal Generating Station during the period 2011 to 2041 is:

**Table 3: Holyrood Generating Station**
**Anticipated Mode of Operation 2011 through 2041**

| |
|---|
| 2011 through 2013 - Generation:<br>Capacity factor between 30% and 75%; Availability of 90% to 95%. |
| 2014 through 2016 - Generation:<br>Capacity factor between 50% and 100%; Availability of 95%. |
| 2017 through 2020 - Generation Standby / Synchronous Condenser Mode:<br>Capacity factor between 30% and 75%; Availability of 90% to 95%. |
| 2020 Onward - Synchronous Condenser Mode:<br>Synchronous Condenser Operation – All three units; Capacity factor (MVARs only) 50% to 100%. Availability of 95%. |

The three Holyrood Generating Station units continue their current operating regime until sometime after 2016. Units 1 and 2 will be retrofitted to be able to operate as synchronous condensers for system VAR support prior to DC in-feed, similar to Unit 3 which was retrofitted with synchronous condensing capability in 1986. Unit 3 typically provides that support during the summer season.

# 4 JUSTIFICATION

This proposal is justified to maintain system reliability by replacing the Unit 1 and Unit 2 generator stator windings before a failure occurs. The most appropriate timing would see the Unit 1 stator winding replaced in 2015 and the Unit 2 stator winding at next generator outage in 2014. Should a winding fail while in service, it could cause significant damage to the stator core and the generating unit, thus, impairing Hydro's ability to provide cost effective power and reliable electrical service to the Island Interconnected System. The emergency replacement time on such equipment could potentially be up to eighteen months.

The life expectancy for Micapal insulated stator windings is approximately 35 years. However, this number varies based on such operating conditions as temperature, number of starts and stops, maintenance and care and unit loading. The windings of Units 1 and 2, and especially Unit 1, have reached the end of their useful service lives, supporting the fact that winding replacements are required.

Two independent condition assessments of the stator windings were completed in 2003 and 2005 by GE Services. GE assessed Unit 1 in 2003 and Unit 2 in 2005. The 2003 report stated "…I recommend to plan a full generator stator rewind…"[8] while the 2005 report stated "It is therefore recommended that stator be rewound in the near future."[9]

During 2010, the independent AMEC assessment, reviewed the historical test and maintenance data and industry experience and confirmed the GE findings and stated "…there is no doubt that the windings have deteriorated extensively in service. All test results show the right phase is in very weak condition. It has operated for a further 7 years to date, without a failure, but further deterioration can be expected, …it is considered

[8] GE Energy Services – Generator Inspection Report FSR# 20350670 September 18, 2003, Pg. 5.
[9] GE Energy Services – Generator Inspection Report FSR# 20350952 August 9, 2005, Pg. 8.

appropriate to proceed with the installation of a new stator winding…"[10] The AMEC report considered the mode of operation for the Holyrood Generating Station in its assessment recommendations.

Taking the above recommendations into consideration, the Unit 1 and Unit 2 stator windings have an increased likelihood of failure over the next three years. Hydro has upgraded some of the generator protection systems, but some of the critical temperature monitoring instrumentation is inoperative and repair is not feasible, as these measuring devices are embedded in the stator winding. If a failure was to occur with the current protection in place, the possible damage to the stator core and rotor that could occur would result in possibly costs in the $13 to $20 million range. The generator protection is intended to prevent or reduce damage to the stator core and rotor when a failure occurs by eliminating the fault condition from the system, but with the age and deteriorated state of Unit 1 and Unit 2 the risk of stator damage is high. In order to prevent unnecessary damage to this generating unit and the potential system impacts of a long operational downtime during the winter peak period, the stator windings of Units 1 and Unit 2 must be replaced. The timing of the stator rewind will be reviewed once bids and delivery schedule are received following the tendering process to determine if an earlier rewind would be possible.

## 4.1 Net Present Value

A net present value calculation was performed in this instance based on the following three options:

1. Base Case: Replace Unit 2 stator winding in 2014 as part of planned steam turbine generator overhaul/testing. Replace Unit 1 stator winding in 2015 as part of dedicated generator stator rewind outage.

[10] AMEC – Condition Assessment & Life Extension Study, 6.1.1.2 Condition

2. Case 1 - Status Quo: Replace Unit 2 stator winding in 2019 as part of dedicated generator stator winding replacement outage. Replace Unit 1 stator winding in 2018 as part of dedicated generator stator winding replacement outage.

3. Case 2 – Median Option: Replace Unit 2 stator winding in 2017 as part of dedicated generator stator winding replacement outage. Replace Unit 1 stator winding in 2016 as part of dedicated generator stator winding replacement outage.

All cases assume that the Unit 1 generator inspection in 2012 will allow testing to be undertaken to confirm the condition of the balance of the generator and to allow generator vendors to be able to take measurements necessary for rewinds to take place in 2014 for Unit 2 and 2015 for Unit 1.

The assumption is that there would be a 30 percent risk of stator winding failure in the year after the base case rewind date, and growing by ten percent per year to the year of the stator rewind for the option being considered. An in-service failure is assumed to involve substantial damage to the stator and possibly the rotor at a cost of about $10 million (2011 dollars). In addition, the failure probability is applied to increased generation replacement fuel costs from the stand-by simple cycle gas turbine and diesel plants on the Avalon Peninsula (approximately $28,250,000 over the period 2015 through 2019 inclusive). Given the limited stand-by generation capability the analysis indicates a significant amount of unsupplied energy with outages to customers on the Island Interconnected System ranging from 200 to 490 hours over the period 2015 to 2019 inclusive with the loss of Unit 1 or Unit 2 at Holyrood Generating Station. A summary is shown in Table 4.

**Table 4 – Summary of Unsupplied Load Implementations**

| Year | Total Gas Turbine Cost ($M CAD) | Unsupplied Load (MWh) | Unsupplied Hours |
|---|---|---|---|
| 2015 | $3.05 | 10,200 | 200 |
| 2016 | $4.93 | 19,600 | 340 |
| 2017 | $5.86 | 24,500 | 400 |
| 2018 | $6.77 | 30,110 | 440 |
| 2019 | $7.64 | 36,500 | 490 |

**Table 5 - Present Value Analysis**

| **HRD - Rewind Generators Unit 1** | | |
|---|---|---|
| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2041** | | |
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Unit 1 in 2015<br>Unit 1 in 2016<br>Unit 1 in 2018 | 10,119,456<br>11,793,741<br>12,922,248 | 0<br>1,674,285<br>2,802,792 |

| **HRD - Rewind Generators Unit 2**<br>**Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2041** | | |
|---|---|---|
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Unit 2 in 2014<br>Unit 2 in 2017<br>Unit 2 in 2019 | 9,770,913<br>11,238,255<br>15,323,932 | 0<br>1,467,342<br>5,553,020 |

The results of the above table are summarized in Appendix D.

Economically given the costs, the potential system impacts and the required life of the equipment, the base case stator winding replacement scenario is the only reasonably viable alternative.

## 4.2 Levelized Cost of Energy

Levelized Unit Energy Cost (LUEC) is not readily applicable to this proposal, given the fact that a large part of the generator value will be during its role as a synchronous condenser producing reactive power (MVARS) for system support and not electrical energy (MWh).

## 4.3 Cost Benefit Analysis

A cost benefit analysis is not applicable for this proposal, except as may be inferred from the Present Value analysis.

## 4.4 Legislative or Regulatory Requirements

There are no specific legislative or regulatory requirements which affect this proposal.

## 4.5 Historical Information

There is no historical information associated with this proposal.

## 4.6 Forecast Customer Growth

The forecasted customer load on the system has no effect on this proposal. The relevance to both its generation role during peak winter periods in the short term and its synchronous condensing support of generation from Labrador via HVDC transmission in the period 2017 to 2041 is significant.

## 4.7 Energy Efficiency Benefits

There are no significant energy efficiency benefits anticipated from this proposal; although Hydro will continue to examine all energy efficiencies that are cost effective.

## 4.8 Losses during Construction

The stator rewind of the units will take about three to four months. The rewind will be done in parallel with the scheduled 2014 steam turbine generator outage for Unit 2 and in 2015 for Unit 1 in a dedicated generator stator rewind outage.

The work would be planned for the late spring through to the early fall, there will be no system loss impacts during the rewind.

## 4.9 Status Quo

The stator windings of Unit 1 and Unit 2 of the Holyrood Generating Station are operating beyond the expected useful service lives. Inspections and testing in 2003 and 2005 have confirmed that a stator winding failure is increasing more probable. While some protection systems are in place to mitigate the potential for major consequential damage, there is a significant potential for such damage. Further assessment by an independent expert in 2010 confirmed the need to rewind Unit 1 and Unit 2 generators. Therefore the status quo of operating without a replacement plan is not a reasonable option considering the operating regime for these units, their power system role, and the impact of long forced outages.

## 4.10 Alternatives

See Section 4.1.

# 5.0 CONCLUSION

Unit 1 and Unit 2 of the Holyrood Generating Station have been in service since their commissioning in 1969 and 1970. The stator windings of these units are now past the end of the useful service lives of approximately 35 years. According to testing and inspections of Unit 1 in 2003 and Unit 2 in 2005, there is a significant potential for winding failures. If the windings for the Units 1 and 2 are left in service and run to failure, it is likely that the machine stator cores and rotor windings and core could be damaged when the stator windings fail. For these reasons, the stator windings of Unit 1 and Unit 2 should be replaced during the planned outage seasons in 2015 and 2014 respectively. This project will see the installation of a new winding in Unit 1 and Unit 2. Proposals for rotor rewinds and Unit 3 rework will be made in future years - Unit 3 being installed 10 years after Unit 1.

The replacement of stator windings on Unit 1 and Unit 2 would improve the reliability of the generating units and ultimately the generating station. The possibility of Unit 1 or Unit 2 failure through system faults or end of useful service life would be minimized or eliminated. The improved reliability would make Unit 1 and Unit 2 available for the anticipated life of the Holyrood Generating Station until 2041.

The replacement of Unit 1 and Unit 2 stator winding and a protection upgrade would minimize the safety risk of fire created from hydrogen cooled generators, as the possibility of a stator winding failure would be minimized.

## 5.1 Budget Estimate

The estimate for the proposal is $11.9 million. The budget estimate is shown in Table 6.

**Table 6: Budget Estimate**

| Project Cost: ($x1,000) | 2012 | 2013 | 2014 | 2015 | TOTAL |
|---|---|---|---|---|---|
| **Material Supply** | 10.0 | 850.0 | 1,650.0 | 850.0 | 3,360.0 |
| **Labour** | 80.0 | 80.0 | 85.0 | 95.0 | 340.0 |
| **Consultant** | 9.1 | 55.3 | 0.0 | 0.0 | 64.4 |
| **Contract Work** | 0.0 | 0.0 | 2,500.0 | 2,500.0 | 5,000.0 |
| **Other Direct Costs** | 5.0 | 15.0 | 9.8 | 14.9 | 44.7 |
| **Interest and escalation** | 8.1 | 107.3 | 640.9 | 1,508.9 | 2,265.2 |
| **Contingency** | 0.0 | 0.0 | 0.0 | 826.9 | 826.9 |
| **TOTAL** | **112.2** | **1,107.6** | **4,885.7** | **5,795.7** | **11,901.2** |

## 5.2 Project Schedule

The anticipated schedule for this proposal is shown in Table 7 below.

**Table 7: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | • Unit 1 Maintenance, Condition Assessment. | April 2012 | September 2012 |
| | • Outage Request, Project Planning Unit 2 | January 2014 | March 2014 |
| | • Outage Request, Project Planning Unit 1 | January 2015 | March 2015 |
| Procurement | • Tendering and Award for Unit 1 and 2. | November 2012 | March 2013 |
| | • Unit 2 Equipment Ordering and Delivery for Unit 2 in 2013 | April 2013 | November 2013 |
| | • FAT Testing for Unit 2 | September 2013 | October 2013 |
| | • Unit 1 Equipment Ordering and Delivery for Unit 1 in 2014 | April 2014 | November 2014 |
| | • FAT Testing for Unit 1 | September 2014 | October 2014 |
| Construction | • Install Stator Winding, Generator Protection on Unit 2 | May 2014 | October 2014 |
| | • Install Stator Winding, Generator Protection on Unit 1 | May 2015 | October 2015 |
| Commissioning | • Commissioning Unit 2 | October 2014 | November 2014 |
| | • Commissioning Unit 1 | October 2015 | November 2015 |
| Closeout | • Unit 2 Closeout | November 2014 | December 2014 |
| | • Unit 1 Closeout and Project Completion | November 2015 | December 2015 |

# APPENDIX A

## Resume – Robert Jeffreys Amec Generator Expert

# Robert Jeffreys, P.Eng.

**Generator Specialist**

## Professional summary

Design and manufacture of large turbine generators

Application of generators at new hydraulic, fossil and nuclear plants

Installation, commissioning and performance evaluation of plant

Testing and inspections of generators and auxiliaries

Resolution of operating and maintenance shortcomings

Major repairs, rehabilitations, reliability upgrades, life extension programs

## Professional qualifications

Association of Professional Engineers of Ontario (Electrical)
Institution of Electrical Engineers (UK)

## Education

Bachelor of Science in Mechanical (and Electrical) Engineering, 1960
University of Durham, England

## Memberships/Affiliations

Member of Institution of Mechanical Engineers (UK), 1961-1978
Member and Chairman, Rotating Machines Sub-Committee, CEA, 1970-1987
Convenor of Generator Reliability working group, CIGRE, 1980-1984
Member of Generation Research and Development Committee, CEA, 1980-1984
Co-chairman, hydraulic turbine generator alignment guide, CEA, 1984-1987

## Selected Publications, Awards, Presentations

Twelve lectures/seminars on generator and motor topics for EPIC, 1995-2008
(Electrical equipment, gas turbines, co-generation and combined cycle plants, emergency generators, electric motor applications, variable speed drives)

Operation of stator cores, for IRIS generator conference, 2006

New technology award for generator expert monitoring system, for EPRI, 1993

Generator rehabilitation - experience at Lakeview, for CIGRE, 1992

Failure analysis of large motors, CEA research report,1988

Up-rating Bruce B generators, for CEA, 1987

Improving reliability of large generators, for AIM conference, 1985

Canada's R & D program for large hydraulic plant, for CIGRE, 1983

Mechanical problems of turbo-generators, for CEA, 1979

## Languages

English

## Employment history

AMEC, Oakville, Ontario (2010 – Present – Contract Basis)
Jeffreys Generator Services, Owner (1994-Present)
Ontario Hydro, Toronto, Ontario, (1967-1993):
Section Head-Power Equipment, Mechanical Engineering Dept, Toronto, ON (1975-1993)
Supervising Design Engineer-Rotating Machinery, Equipment and Materials Dept, (1967-1975)
Montreal Engineering Company, Design Engineer (1965-1967)
Parsons, England, Generator Design Engineer (1960-1965)

## Representative projects

### AMEC

Holyrood Condition Assessment and Life Extension Study – Generator condition review and assessment

### Jeffreys Generator Services

Detailed major inspections of 60 MW and 150 MW generators at fossil plants

Annual inspections of two 35 MVA generators, now over 60 years old

Inspection of an 18.8 MW hydraulic generator in Newfoundland

Inspection and test of two used 60 MW combustion turbine generators before purchase

Failure analyses of 150 MW and 66 MW generator rotors, with a ground fault

Health assessment of emergency power generators at a nuclear plant

Review of a major power system disturbance (blackout) in Saskatchewan

Review of settings of new generator protection relays at Boundary Dam GS

Study of turbine generator vibration levels and trends over several years

Draft specification for a spare 60 MW combustion turbine generator

Review of failure and repair reports for a 15 MW generator rotor

Conversion studies for 300 MW and 490 MW generators to synchronous condenser duty

Draft generic specifications for rewinding a stator and a rotor

Purchase, installation and inspection of a replacement 300 MW stator

### Ontario Hydro

**Mechanical Engineering Dept.**

Developed generator expertise similar to suppliers, with user focus

Design reviews caught weaknesses and improved features at all plants

Developed reliability measurement and analysis, to justify improvements

Set up regular performance feedback with suppliers, to update quality

Implemented continuous improvement program for Nanticoke generators

Uprated each Bruce B generator by 80 MW, with no adverse reliability

Developed and implemented life extension program at Lakeview, Lambton

Pioneered use of static exciters with stabilizers to enhance stability, output

Pioneered use of EL-CID core inspections, and PDA winding evaluation

Completed EPRI research projects e.g. expert monitor, insulation tests

Led failure investigation of Nanticoke retaining ring, modified other rings

Participated in hydraulic generator monitoring project for EPRI

**Equipment and Materials Dept.**

25/60 Hz frequency conversions of hydro-generators at Abitibi and Beck

Implemented prototype generator designs at new generating stations.

Developed accelerated aging test for new generator insulation systems

Partial rotor rewinds at Lambton. Rebuilt synchronous condenser

Bought spare rotors and stators to facilitate repairs e.g. Lakeview, Pickering

Rewound sixteen 10 MW primary coolant pump motors

### Montreal Engineering Company

Design of electrical systems and major equipment for a 300 MW thermal power plant at Wabamun, Alberta

Inspected generator and motors during manufacture and test

Provided consulting services on electrical machinery to other projects and to utilities

### Parsons

Carried out electrical and mechanical designs of generators from 10 to 660 MW

Participated in research and development of features for large generators

Evaluated and improved designs through analysis of factory tests and operating experience

Taught electrical machines and power systems to Higher National Certificate students at local technical college (night classes)

# APPENDIX B

## GE 2003 Unit 1 Generator Inspection Report Summary





**JOB SUMMARY**

This report covers test, inspection, and emergency repair activities performed in June 2003 on Unit 1.

Field

1. Visual inspection of the generator field was conducted. The field was found dirty and was cleaned with dry air prior to reassembly.

Stator

1. Visual inspection of the stator was conducted and all information on the findings is included in this report. While CE endwinding was found in good condition TE endwinding was found in very deteriorated condition. Attention needs to be given to the stator winding condition, stator wedges, and ties. Oil was noted on the endwinding and in the stator slots. It is clear that as result of oil spill in the past the bar slot system is saturated with oil and the friction component of the side ripple spring is reduced and its effectiveness is diminished. Deterioration of any part in the bar restraining system may lead to accelerated wear of stator winding insulation. Series loops 9 and 10 on the TE were found covered with thick layer of grease and dust, paint coat on this series loops caps cracked.
2. A complete stator wedge tightness test was performed and numerous wedges were found loose or hollow. The complete wedge map is included in this report. For longer-term reliability a full rewedge with improved-design top ripple spring system was performed.
3. Retorquing of stator axial supports, and hand cleaning of the endwinding on TE was performed. Red eye epoxy was applied to the endwinding ties for additional stiffness.
4. DC leakage tests were performed before and after the rewedge work with similar results. High leakage current was observed in all 3 phases, especially phase T1. This is good indication of deteriorated condition of the ground wall insulation.
5. All repairs performed during this outage will slow process of winding insulation deterioration but can't reverse damage already caused to the winding insulation as result of slot support system looseness, shaky endwinding support and oil ingression. Based on results of the visual inspection, high-voltage testing and age of the winding I recommend to plan a full generator stator rewind with new bars in the near future to correct insulation degradation of the stator winding system and assure long-term reliability.

# APPENDIX C

## Ge 2005 Unit 2 Generator Inspection Report Summary





## RECOMMENDATIONS

### SHOULD BE DONE AT THE NEXT OUTAGE...

1. Stator; Winding;

GE recommended AC hipot test voltage for this machine is 24 KV. In case customer decides to perform a DC hipot test then the recommended voltage for this machine is 40.8 KV. These values are based on suitability to service voltage for a reliable operation. A DC hipot test at 34 KV was carried out. Testing at this voltage does not give the level of confidence for reliable operation of the unit for long time. It is therefore recommended that a full AC hipot test at 24 KV AC be performed.

2. Stator; Winding;

Based on units past maintenance history it is quite immanent that condition of the winding and support hardware has deteriorated. Any maintenance that is being performed is to slow the further degradation process in short run. In the long run reliability of the unit is in question. It is therefore recommended that stator be rewound in near future.

3. Instrumentation; Rtd;

Hot and cold gas RTD's needs to be replaced.

# APPENDIX D

## Amec Unit 1 Generator Condition Report Summary

**HTGS CONDITION ASSESSMENT AND LIFE EXTENSION STUDY**
**REPORT -**
**UNIT 1 GENERATOR CONDITION ASSESSMENT**

amec

**Report No. AM060/RP/001** **Revision: 00**

## 3.0 CONDITION SUMMARY

**Summary:**

- Stator core: satisfactory, based on El-cid results.
- Stator Windings: Poor, based on Megger test and DC hipot test.
- Rotor Forging: Not known. (Appears not checked in past 20 years).
- Field Winding: Satisfactory, but few details available (concerns are based on repairs made to similar GE rotors)

**Stator core and Frame:** The stator core and frame are reported to be in good condition, with no loose ness or fretting damage at the bore, or at the outside flexible mounting. GE reported that El-cid readings taken before and after the re-wedging of the stator bars in 2003 show no significant core deterioration, and the stator core is fit to be re-wound.

Excessive greasing of the stand-off insulators, and the flexible line leads to the potential transformers has occurred in the past, which required their replacement. The alignment of the stator was changed in 2003, which is expected to have reduced the vibration and stress on these components.

**Stator Windings:** The stator windings were inspected and tested at the start of the 2003 major outage by GE, and were reported to be in very poor condition. Extensive loosening had occurred of the bars in the slots, and in the end –winding supports. Oil was found throughout the generator and extensive greasing had developed in the end-windings, and in parts of the slot teeth.

The electrical tests, (insulation resistance, polarization index and a DC high potential step voltage of 34 KV confirmed that two of the phases were significantly weaker than the third phase, and had high leakage current and low polarization index, indicating insulation weakness (or wetness). (Further details of these tests and results are given below)

On the basis of the visual findings and poor electrical test results GE recommended that the stator windings be fully replaced. This has not been done to date. Improved stator ground fault protection has been installed, to minimize consequential core damage from a winding failure.

To repair the loose windings, the stator slots were fully re-wedged with an improved support system using top ripple springs. An El-cid test was carried out before and after the re-wedging operation, to show that no core iron damage occurred during the re-wedging operation. The oil, fretting dust and "grease" were cleaned off the end-windings and the loose areas were re-glued with penetrating epoxy. The end-winding support brackets were re-tightened, before the generator was returned to service.

No inspection of the stator windings has been carried out since 2003. It is expected that the ripple springs will provide improved support and retain the support for the stator coils for at least 12 years. However, the end-windings are likely to come loose again during operation, due

to the thermal movement of the windings under daily cyclic load, and the loosening effects of system faults on the windings.

The operating time to the next major inspection in 2012 has been increased from 7 years to 9 years. This does not appear logical, given the poor condition of the stator windings and the progressive nature of the loosening mechanism. It is anticipated that more extensive loosening, fretting, and greasing of the end-windings will be found at the next inspection.

No additional measures were taken in 2003 to prevent the end-windings looseness from re-occurring. If the winding is not to be replaced in 2012 it is recommended that a "bump" test be carried out on the end-winding coils, and extra support blocks be added, to remove any high vibration responses, or resonances near the 120 Hz magnetic force in operation. This has been done on several other units in Canada, with good success.

**Monitoring:** The RTD's measuring the stator winding temperatures are in poor condition, and the four RTD's logged in the control room do not read credible temperatures (At half load, they are colder than the cold gas which cools them). When GE measured the 15 RTD's in 2003, 5 were broken, and the rest had temperature variations of up to 25 %, when measuring the "room temperature". They are embedded in the windings, and cannot be replaced unless the windings are removed. All four cold gas temperature detectors had failed and new RTD have been installed. The DAS monitoring should be moved to the most accurate RTD's.

**Rotor and Field Winding:** The condition of the rotor was reported as "dirty" by GE at the 2003 inspection. It was reported that the rotor was inspected visually by GE and "no serious defects were found". The insulation resistance measurement of the field winding to ground gave a good result of 11.4 Gig-ohms. The collector ring dimensions show there is plenty of wear allowance left. However, the retaining rings were not removed, so there was limited access for inspection.

An examination of the field winding connections, end-windings, and ventilation passages could have been done, using a boroscope, but it is not stated in their report. Some permanent deformation (creep) of the field windings is expected after 34 years. This tends to overstress the flexible coil connections, especially of the longest coil, and of the connections of the windings to the leads, (the flexible interconnections of the longest coil are often replaced every 16 years, per a GE electrical supervisor). GE TIL 1292 recommends inspection of the rotor dovetails and another TIL requires checking the rotor slot wedges for cracks. It is expected that these checks would have been done in 1997 when the retaining rings were replaced. They should be done again in 2012.

# APPENDIX E

## Amec Unit 2 Generator Condition Report Summary

## 3.0 CONDITION SUMMARY

**Summary:**

- Stator core: satisfactory, based on El-cid results.
- Stator Windings: Poor, based on Megger test and DC hipot test.
- Rotor Forging: Not known. (Appears not checked in past 20 years).
- Field Winding: Satisfactory, but few details available (concerns are based on repairs made to similar GE rotors)

**Stator core and Frame:** The stator core and frame are reported to be in good condition, with no loose ness or fretting damage at the bore, or at the outside flexible mounting. GE reported that El-cid readings taken before and after the re-wedging of the stator bars in 2005 show no significant core deterioration, and the stator core is fit to be re-wound.

Excessive greasing of the stand-off insulators, and the flexible line leads to the potential transformers has occurred in the past, which required their replacement. The alignment of the stator was changed in 2005, which is expected to have reduced the vibration and stress on these components.

**Stator Windings:** The stator windings were inspected and tested at the start of the 2005 major outage by GE, and were reported to be in very poor condition. Extensive loosening had occurred of the bars in the slots, and in the end –winding supports. Oil was found throughout the generator and extensive greasing had developed in the end-windings, and in parts of the slot teeth.

The electrical insulation resistance measurements showed that two of the phases were significantly (20 % and 26 %) weaker than the third phase. The DC high potential step voltage of 34 KV showed that all three phases had high leakage current (30, 26 and 48 micro-amps), and the large spread (85%) between phases confirmed the poor condition of the right phase. The polarization index was satisfactory, showing the insulation was dry. However, the high relative humidity of 80% during the High potential test is expected to have contributed to the high leakage current.

On the basis of the visual findings and poor electrical test results GE stated that the stator windings will soon need to be replaced. This has not been done to date. Improved stator ground fault protection has been installed, to minimize consequential core damage from a winding failure. GE recommended an AC high potential test be carried out on the stator windings, but fortunately that was not done, as there is a high risk that the insulation would have failed, due to the aggravating effects of high humidity and dirt and grease, on the weak winding insulation.

To repair the loose windings, the stator slots were fully re-wedged with an improved support system using top ripple springs. An El-cid test was carried out before and after the re-wedging operation, to show that no core iron damage occurred during the re-wedging operation. The oil, fretting dust and "grease" were cleaned off the end-windings and the loose areas were re-glued

with penetrating epoxy. The end-winding support brackets were re-tightened, before the generator was returned to service.

No inspection of the stator windings has been carried out since 2005. It is expected that the ripple springs will provide improved support and retain the support for the stator coils for at least 12 years. However, the end-windings are likely to come loose again during operation, due to the thermal movement of the windings under daily cyclic load, and the loosening effects of system faults on the windings.

The operating time to the next major inspection in 2014 has been increased from 7 years to 9 years. This does not appear logical, given the poor condition of the stator windings and the progressive nature of the loosening mechanism. It is anticipated that more extensive loosening, fretting, and greasing of the end-windings will be found at the next inspection. The partial discharge readings should be checked annually, to detect excessive greasing, and identify whether the next planned inspection should be brought forward.

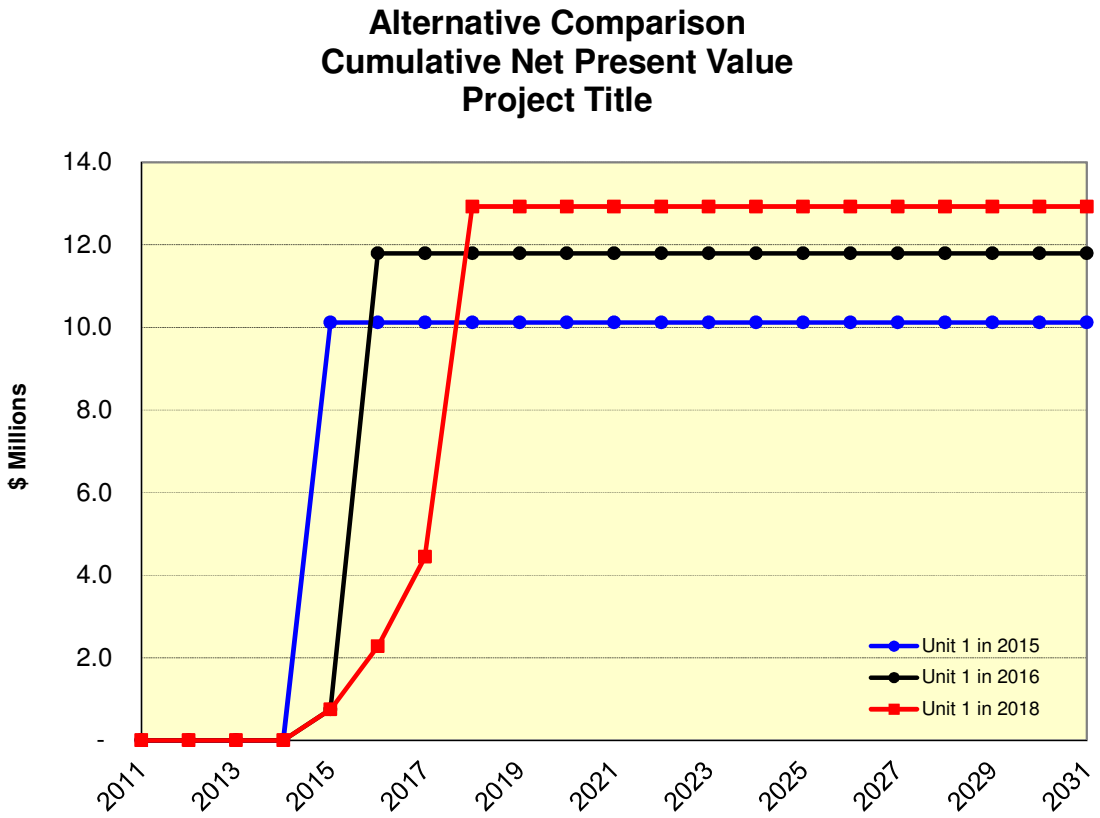
No additional measures were taken in 2005 to prevent the end-windings looseness from re-occurring. If the winding is not to be replaced in 2014 it is recommended that a "bump" test be carried out on the end-winding coils, and extra support blocks be added, to remove any high vibration responses, or resonances near the 120 Hz magnetic force in operation. This has been done on several other units in Canada, with good success.

**Monitoring:** The RTD's measuring the stator winding temperatures are in poor condition. The unit was shut down at the time of the plant visit, but it is expected that the four RTD's logged in the control room will not read credible temperatures (similar to the finding of unit 1). When GE measured the 15 RTD's in 2005, 3 were broken, and 4 more had temperature variations of greater than 25 % of the average, when measuring the "room temperature". They are embedded in the windings, and cannot be replaced unless the windings are removed. All four cold gas temperature detectors had failed and new RTD have been installed. The DAS monitoring should be moved to the most accurate RTD's remaining, preferably near the centre of the generator where the temperatures are the highest.

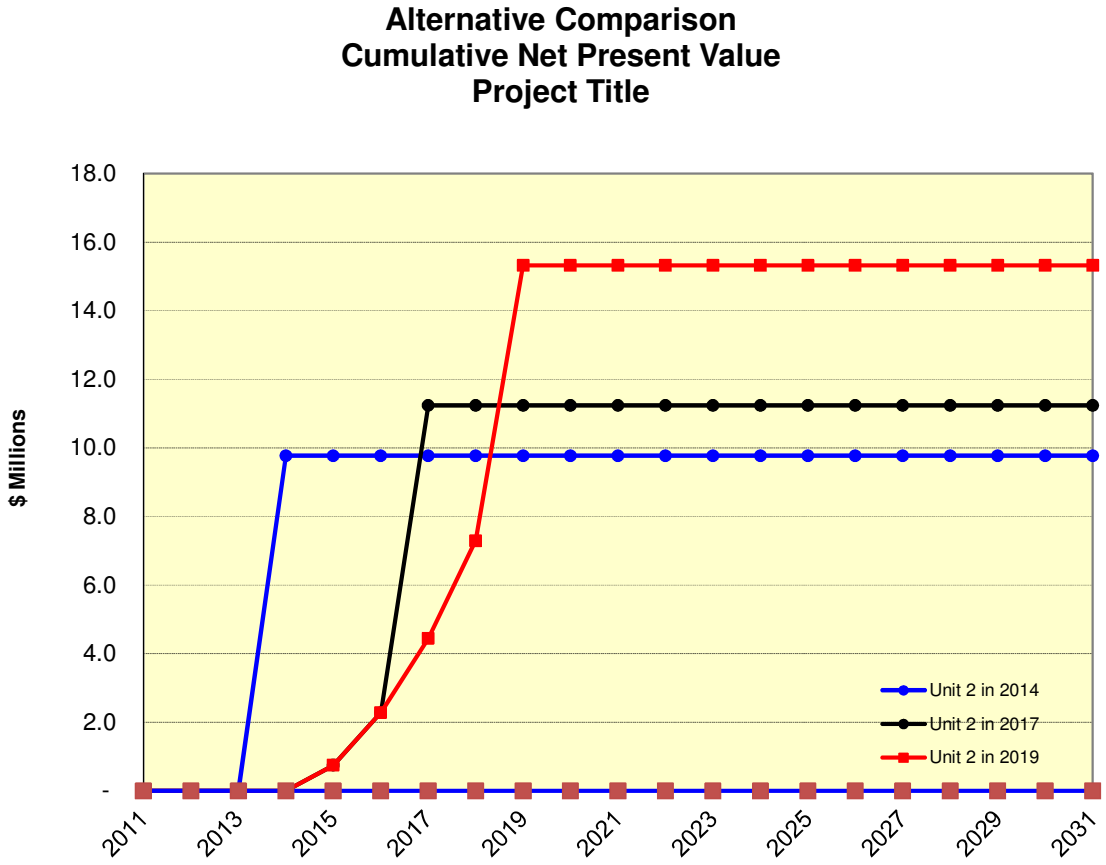
**Rotor and Field Winding:** The condition of the rotor was reported as "wet" by GE at the 2005 inspection. The insulation resistance was only 0.042 Gig-ohms and the polarization index was less than 1. Several attempts were made to dry the winding, and after 4 days GE reported that the insulation resistance and polarization index were satisfactory, (although they were still barely acceptable at 0.5 Gig-ohms and 1.3). There is no report or check sheet on the condition of the field windings, the rotor forging, or the collector rings and brushgears. GE stated that considerable corrosion was found on the collector distribution rings, which was cleaned off. The recommendation was made that the rotor should be kept warm and dry during future outages, (which is often considered to be the Contractor's responsibility!). The impedance measurements showed there are no shorted field turns on the rotor (at standstill!).

It is believed that the retaining rings were not removed, so there was limited access for inspection of the field winding. An examination of the field winding connections, end-windings, and ventilation passages would have been useful. Some permanent deformation (creep) of the field windings is expected after 34 years. This tends to overstress the flexible coil connections, especially of the longest coil, and of the connections of the windings to the leads. (the flexible interconnections of the longest coil are often replaced every 16 years, per a GE electrical supervisor). GE TIL 1292 recommends inspection of the rotor dovetails and another TIL requires checking the rotor slot wedges for cracks. There is no record of this work being done in the GE inspection reports of 1999 or 2005. This work should be done in 2014. The GE report states that the rotor has 18Mn/18Cr non-magnetic retaining rings, but it is not known when they were installed – it is not mentioned in the 1999 or the 2005 reports.

# APPENDIX F
## Present Value Analysis Details




| HRD - Rewind Generators Unit 1 | | |
|---|---|---|
| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2041** | | |
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Unit 1 in 2015<br>Unit 1 in 2016<br>Unit 1 in 2018 | 10,119,456<br>11,793,741<br>12,922,248 | 0<br>1,674,285<br>2,802,792 |




| HRD - Rewind Generators Unit 2 | | |
|---|---|---|
| **Alternative Comparison**<br>***Cumulative Net Present Value***<br>***To The Year***<br>**2041** | | |
| **Alternatives** | **Cumulative Net Present Value (CPW)** | **CPW Difference between Alternative and the Least Cost Alternative** |
| Unit 2 in 2014<br>Unit 2 in 2017<br>Unit 2 in 2019 | 9,770,913<br>11,238,255<br>15,323,932 | 0<br>1,467,342<br>5,553,020 |

# APPENDIX G
## Partial Listing Of Rewinds In Canada

**Stator Rewind Work on Generators of Similar Size in Canada**

| Utility | Plant / Unit No. | MW Rating/ Manufacturer | In-service/ Years | Comments |
|---|---|---|---|---|
| BC Hydro | Burrard #1 | 150 AEI | 1960 2001 | Siemens coils, PGE installed. |
| BC Hydro | Burrard #2 | 150 AEI | 1961 2002 | Planned |
| OPG | Hearn #3/4 | 100 Parsons | 1956 1986 | Rewound by CGE |
| Saskpower | BoundaryDam #1 | 66 Parsons | 1960 1972 | Rewound by NEC |
| Saskpower | BoundaryDam #2 | 66 Parsons | 1960 1986 | Replaced with Hitachi stator |
| Saskpower | BoundaryDam #3 | 150 CGE | 1969-70 | No rewind. End windings re-furbished in 1983 and 2000, re-wedged in 2000. |
| Saskpower | BoundaryDam #5 | 150 Hitachi | 1973 | No rewind. Re-wedged in 2004 with epoxy-glass top ripple springs. Extra end-winding and lead supports added. Core is good |
| APL | Battle River #3/4 | 150 CGE | 1969 1996 | Winding repairs made. Rewound |
| APL | Milner | 150 Hitachi | 1971 ? | Stator O.K in 2000. Rotor poor |
| Transalta | Wabamun #1/2 | 66 AEI | 1956 1990 | New coils undersized, loosened |
| Transalta | Wabamun #3 | 150 AEI | 1962 1975 | Stator core failure, rewind by W |
| OPG | Lakeview #1/2 | 4x150 Parsons | 1965 -2007 | No rewinds, but some winding repairs |
| OPG | Atikoken #1 | 230 ABB | 1988 1992 | Stator replaced, high winding vibration |
| OPG | Thunder Bay #3 | 100 E-E | 1965 1990 | Stator rewound (Synch. Cond. conv.) |
| DMI | Peace River Pulp Mill | 40 Toshiba | 1990 1997 | Core/winding damage. CGE attempted major repair, not completed. Stator replaced by Toshiba. |

**General Notes**

Canadian General Electric's (CGE) generators in Canada have performed as well or better than those of other suppliers. Many of CGE's stator rewind jobs have been associated with generators made by other suppliers.

Some generators made by CGE in the 1970's and 1980's were sub-contracts from other manufacturers, e,g, AEI (Wabamun 3 and 4) and English Electric (Rapp). Others were sub-contracts from GE, USA, (Ontario Hydro's Lambton and Lennox generators). The insulation systems used for the stator windings were similar, but not identical, to the GE Schenectady products (Micapal 1 and Micapal 2); they were geared to the capability of the CGE manufacturing shop in Peterborough.

The Micapal 1 windings were made in Peterborough, Ont. And the later Micapal 2 stator windings were made in USA (Schenectady). The Canadian facilities in Peterborough, Ont, and in Lachine, Que, are capable of making high quality windings for turbo-generators up to 18 KV.

A significant proportion of the rewind work done by CGE and other suppliers, (either partial or full winding repairs/replacement), was the result of stator core failures that proceeded until the stator winding insulation failed.

It is quite common for utilities to replace the whole stator, rather than just to rewind the stator, especially if both the stator core and the windings are in poor condition.
When a stator is rewound by a non-OEM (original equipment manufacturer), there is a significantly increased risk of encountering difficulties, delays, and extra costs, usually when installing the windings, due to variations in core slot dimensions, changes in end-winding support systems, incorrect end-winding involute shape, stator attachments etc. Shipping problems are also common.

Fewer generators have been re-wound in Canada than in the USA, mainly because in USA it is common practice to carry out AC maintenance high-potential tests at 1.5 x rated voltage for 1 minute, or a DC high potential tests at even higher voltage, per the IEEE standards. These pass-fail tests seek out and often destroy weak insulation. In Canada it is more common to use Doble test at up to rated voltage, or DC ramp tests to locate weaknesses, without resulting in insulation failure.

Most units are taken out of service after 40-50 years, due to ageing issues with the boiler or turbine, e.g. OPG's Hearn and Lakeview units and Transalta's plant at Wabamun. The generator stator windings, cores and rotors may be capable of longer life. However, it would be a large stretch of the envelope to expect the existing stator windings at Holyrood to perform reliably for 70-80 years.

This list was provided from the discussions with Robert Jefferys.

**A REPORT TO**
**THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES**

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# REFURBISHMENT OF THE MARINE TERMINAL

## Holyrood Thermal Generating Station

July 2011

newfoundland labrador hydro
a nalcor energy company

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# 1 INTRODUCTION

The Holyrood Marine Terminal Facility is an integral component of the fuel oil handling system, and is the single point of entry for all of the No.6 (Bunker C) fuel oil utilized by the plant. The marine terminal's initial design accounted for 35,000 dead weight ton (DWT) vessels, which were the industry norm during the 1970's. Today's vessels range from 46,700 DWT to 71,345 DWT. The larger, modern ships which dock at the Holyrood marine terminal to offload fuel oil are often challenged to conduct the offloading procedure in a safe and efficient manner due to limitations and system constraints such as inoperable and inadequate docking components, limited fuel oil offloading capacity and various other safety concerns.

The Holyrood marine terminal is located in Conception Bay, as indicated in Figure 1. Appendix A contains photographs of the marine terminal.




**Figure 1 – Holyrood Marine Terminal Location Map**

The primary concern with the Holyrood Marine Terminal Facility is the inability of the

structure to provide a safe docking environment for the vessels which utilize it to offload fuel oil. Throughout the years the structure has aged and the condition of the gravity fender system (see Photo 2 in Appendix A) has deteriorated. This has resulted in missing, worn, and inoperable gravity fenders. The fenders serve to protect the hulls of the vessel from damage during docking and fuel oil offloading operations and are a critical component in the safe docking and fuel oil offloading processes.

In addition to the marine terminals docking capacity, there are challenges when offloading tankers with the existing fuel oil offloading system. These challenges stem, from the limited reach of the existing fuel oil off-loading arms (see Photo 4 in Appendix A) and an outdated coupling system at the end of the arms which does not match the current industry standard. The existing loading arms in Holyrood are equipped with 12 inches flange connectors. Current industry standards see ships manifold connections ranging from 12 – 16 inches. Each vessel contains onboard reducers to permit connection of the loading arm flange connector to the manifold, however, increasing the connection size from 12 to 16 inches requires the use of a special coupling system. With this in mind the current industry standard would suggest that a 16 inch flange is required on the loading arms.

The issues with the fuel oil system increase the offloading time as vessels are forced to take on ballast water to reduce freeboard[1], lowering it to an elevation that the loading arms are able to accommodate. The ballast water cools the No.6 (Bunker C) fuel oil and this cooling effect creates a higher viscosity and, thus, making the fuel oil more difficult to pump/transfer through the pipeline. The loading arm coupler must also be modified with an adapter during each offload to facilitate a secure connection with the docked vessel – the required adapters are currently supplied by the offloading vessels. This hinders the offloading process and results in significantly longer docking times. As the potential for a spill into the waters of Conception Bay increases significantly during the offloading process, this poses an environmental concern.

[1] Freeboard (Nautical) refers to the height of a ship's deck above the water level

Connecting and disconnecting to vessels with the existing coupling system adds an additional six hours (three hours to connect and three hours to disconnect) to the offloading process. From a monetary perspective this equates to approximately $5000 in additional costs per ship. Added to this, there are often instances whereby the ships are forced to cease offloading and disconnect due to high winds. The ships are reconnected once the winds subside so that offloading may continue. This increases the number of connections required, thereby, adding to the increase in time. Holyrood personnel have indicated that this occurs during approximately 20% of the fuel deliveries. Furthermore, the ability to properly disconnect quickly, in the event of an emergency is not possible.

Life safety concerns related to the Holyrood Marine Terminal Facility are primarily attributed to the presently non-existent man-overboard retrieval/recovery system, limited support vessel access to marine terminal facility, and the lack of an emergency release system for the off-loading arms which would provide vessels with the ability to rapidly disconnect and move away from the jetty in the event of an emergency. Additional concerns with the current inadequate deck lighting also create safety issues. Given the harsh environment they are exposed to, the bulbs in these lighting stands are continuously failing (replacement is necessary every six months) and must be replaced. The existing lighting stands measure approximately 35 feet in height. Given the height of the fixtures combined with the high winds and icy conditions which frequent the jetty, replacement of failed bulbs often has to be carried out in less than ideal conditions. High winds and icy conditions can make these replacements hazardous to employees. This creates a significant safety risk to the personnel carrying out the work. New lighting stands installed at a lower height and equipped with two marine rated fixtures would prove beneficial in multiple areas. Not only would they reduce the risk associated with the completion of required maintenance work they would also provide additional lighting on the jetty deck.

The marine terminal deficiencies are a product of the original design and the age of the system and its individual components. The existing system is inadequate, as it is unable to properly facilitate the ships which currently serve Holyrood's fuel oil needs. Given the age

and condition of the structure, combined with the fact that the vessels currently utilizing the jetty exceed the original design criteria for both size and weight, the completion of significant upgrades and/or a complete jetty replacement would typically be pursued as the preferred alternatives. The costs for these two scenarios were estimated at $20,000,000 and $27,940,200 respectively. Both of these scenarios were determined to be cost prohibitive as they would enable the jetty to function for 35 years when only eight years are required until the planned infeed.

The planned development of Muskrat Falls will include a Labrador-Island transmission link. The construction of this transmission line to transport hydro electric power from the new development to the island will satisfy the power requirements on the Avalon Peninsula thereby eliminating the need for Holyrood to continue as a generating station. The shut-down of the generating units will negate any requirements for fuel oil delivery. It is anticipated that the new in-feed into Holyrood will be commissioned and placed in service in the year 2020. For this reason, the scope of work outlined in this proposal has been refined to address only the essential deficiencies from both safety and environmental perspective and to extend the jetty service life an additional ten years, at which time electrical generation at Holyrood will cease.

A study completed by Hatch (Engineering Consultants) entitled “Holyrood Marine Terminal 10 Year Life Extension Study”, Draft Report, dated March 22, 2011 (attached as Appendix B) summarizes the many deficiencies and lists the recommended corrective actions to remediate the deficiencies and extend the marine terminal service life another ten years. The findings of the report formed the basis of this budget proposal.

# 2 PROJECT DESCRIPTION

This project involves the completion of repairs, upgrades, and modifications to the existing marine terminal facility at the Holyrood Thermal Generating Station for the purpose of extending its useful life, ensuring system reliability, and increasing the level of safety within the facility. The scope of work has been generated from the findings of a condition assessment report, completed by Hatch (Engineering Consultants). A copy of this report can be found in Appendix B. Work will include the following:

1. Inspection, assessment and repairs to the swinging gravity fender system;
2. Replacement of detached swinging gravity fender;
3. Modifications to fuel oil offloading components to improve their offloading capabilities;
4. Inspection and assessment of steel casing for pile foundations, with repairs completed as required;
5. Inspection, assessment and replacement of anodes and attachment brackets as required; and
6. Improvements to life safety through the installation of devices such as a Support Vessel Access system, a Man-Overboard recovery system and improvements to the jetty deck lighting system.

# 3 EXISTING SYSTEM

The Holyrood Marine Terminal Facility Jetty is an integral component of the fuel oil handling system and is the single point of entry for all of the No.6 (Bunker C) fuel oil utilized at the plant.

The marine terminal consists of a 125m shore arm link that bridges the jetty to the adjacent land (see Photo 3 in Appendix A). The jetty is approximately 74 meters long by 12 meters wide and supports the fuel oil offloading arms and associated pipeline and controls related to the fuel oil offloading process. Both the shore arm link and jetty consist of a concrete superstructure supported on concrete filled circular steel piles (see Photo 5 in Appendix A). The superstructure of the jetty also supports the gravity fender system that absorbs the forces created from the vessels as they approach the marine terminal. The vessels are secured to the Holyrood marine terminal using four mooring dolphins located on the shore and mooring bollards located on the jetty superstructure.

When the vessel arrives and is secured at the marine terminal, fuel oil is offloaded from the vessel into the fuel oil offloading arms located on the jetty and pumped through a pipeline into the fuel oil storage facility which is located approximately one kilometer from the marine terminal (see Figure 2 below).

This system for the transfer of fuel oil consists of two fuel oil offloading arms, valves, a network of pipes and associated controls which are located on the marine terminal. The pumping force for the transfer of the fuel oil is generated from pumps located on the vessel.




**Figure 2 – Holyrood Site Layout**

## 3.1 Age of Equipment or System

The marine terminal was completed during the first construction phase of the Holyrood Thermal Generating Station in 1969. The jetty is 42 years of age.

## 3.2 Major Work and/or Upgrades

There have been no major upgrades to the Holyrood marine terminal since initial construction.

## 3.3 Anticipated Useful life

The anticipated useful life of a marine terminal facility is 35 years. Thus, the current facility has exceeded its design life. The recommended upgrades to the marine terminal are expected to extend the life of the facility by ten years.

## 3.4 Maintenance History

The Holyrood Marine Terminal maintenance history is summarized in Table 1 below. It includes both preventative and corrective maintenance performed on the Holyrood Marine Terminal from 1996 to present.

**Table 1: Maintenance History**

| YEAR | MAINTENANCE ACTIVITY | COST($000) |
|---|---|---|
| 2009 | Replacement of timber, bolts, and High Density Polyethylene wear strips on gravity fenders (corrective) | 15 |
| 2008 | Emergency Repairs to reinforce connection of gravity fenders to marine terminal structure (corrective) | 777 |
| 2007 | Maintenance of fuel oil offloading arms (preventive) | 180 |

## 3.5 Outage Statistics

There have been no outages related to the Holyrood Marine Terminal.

## 3.6 Industry Experience

The Holyrood Marine Terminal is located in a high energy sea state[2], as a result of its exposure to the Atlantic Ocean and prevailing onshore winds in the area. Typically marine terminals are located in a sheltered bay. Thus, industry experience is limited for this unique situation.

## 3.7 Maintenance or Support Arrangements

General maintenance for the marine terminal facility has been performed by Hydro personnel. Major maintenance such as epoxy coatings, structural steel repair, concrete repair work, diving inspections, and installation of sacrificial anodes has been carried out by

[2] Sea state is determined through the measurement of marine conditions including wind speed and wave height.

outside contractors. Sacrificial anodes serve to reduce the effects of rust on the steel fender casing. The anodes are, essentially, made from a metal alloy with a more "active" voltage (more negative electrochemical potential) than the metal of the structure. The difference in potential between the two metals means that the galvanic anode corrodes, so that the anode material is consumed in preference to the structure.

## 3.8 Vendor Recommendations

There are no relevant vendor recommendations with respect to the improvements to the marine terminal facility.

## 3.9 Availability of Replacement Parts

The availability of replacement parts is not applicable to this project.

## 3.10 Safety Performance

While the Holyrood Marine Terminal has never been out of commission due to any safety issues some major deficiencies do exist. The two major safety concerns highlighted in the Hatch report[3] consist of emergency evacuation from the jetty and man-overboard rescue procedures. The existing marine terminal lighting system also raises a number of safety concerns. These issues are further discussed below.

At present there is no adequate method for emergency evacuation from the south end of the jetty. In an emergency situation such as a fire at the unloading arms, there is no direct means for an escape to shore. The only method of evacuation requires personnel to utilize chain ladders to climb down the jetty where they could be forced to enter the water should there be no rescue craft available.

[3] See Pages 23 – 25 of HATCH report

Furthermore, in the event of an emergency such as a man-over-board situation, there are limited means to rescue personnel from the ocean. There are two chain ladders which are located on the shore side of the jetty; an inflatable boat is stored in the control room building; and a life ring is mounted to the railing system. Despite the implementation of these measures, the system is inappropriate as it places the entire effort on the person who has fallen into the water to travel to the nearest ladder before pulling himself out of the water and onto the ladder where he or she is required to climb ten meters to safety with no fall protection available. While there have been no reports of anyone falling into the water, to date, given the cold temperatures and high energy of Conception Bay waters a person stands a very small chance of surviving in the event that a fall were to occur.

Adding to the safety deficiencies highlighted above, there is currently no mechanism in place to dock a smaller vessel (such as a tug boat) at the terminal. Such a vessel could serve as a rescue craft in the event of an emergency situation. With this in mind, the current fuel oil offloading procedure utilizes a support vessel to assist during the offloading process. Some of the support vessels duties include deployment of the oil boom and distribution of the mooring ropes and spring lines to the mooring dolphins.

While the support vessel is available to assist in an emergency during offloading operations, when the probability of an emergency situation is greatest, the interface between the marine terminal and the vessel is not ideal. The problem with utilizing the support vessel in a rescue operation lies in the current means of access between the marine terminal and the support vessel. At present, the single point of access from vessel to the jetty, consists of a chain ladder, which given the nature of the installation can not equipped with fall protection. The implementation of a new support vessel access system would provide a safe means of transport from the vessel to the jetty. It is anticipated that a solution for both the man over board recovery system and emergency evacuation process can be incorporated with the implementation of such a system.

While the Marine Terminal's lighting system provides adequate lighting level when all

fixtures are operational, the harsh marine environment takes a toll on the fixtures and regular replacement is required. It is during the regular maintenance operations required to keep the fixtures illuminated that the majority of the safety concerns are generated. The existing lighting stands measure approximately 35 feet in height and contain a single fixture mounted at the top. Given the height of the fixtures, combined with the high winds and icy conditions which frequent the jetty, maintenance and replacement of fixtures is often carried out in less than ideal conditions, which creates a significant safety risk to the personnel carrying out the work. In the past repairs to failed fixtures have been delayed for weeks at a time while waiting for conditions to permit the safe completion of required repairs. A reduction in the number of operational light fixtures reduces the deck lighting levels thereby increasing the probability of accidents as a result of poor lighting conditions. New marine rated fixtures installed at a lower elevation would prove beneficial in multiple ways. The marine rated fixtures would provide a longer service life which reduces the maintenance effort and the lower light stands would make the completion of any required maintenance work much easier to carry out.

## 3.11 Environmental Performance

The Holyrood Marine Terminal has never been out of commission as the result of an environmental issue, however, potential for a serious environmental impact does exist while docking and offloading fuel oil from modern vessels. While Hydro does have a contingency plan (see Appendix C) in place, if a spill was to occur, spill prevention is clearly the preferred option.

The marine terminal facility was originally designed to accommodate 35,000 DWT vessels. Throughout the years, economics and logistics have dictated that modern fuel storage vessels be much larger, thereby enabling them to carry more fuel. To maintain a competitive edge within the industry and meet the growing demand for fuel supply, agencies have transitioned to larger vessels thereby making the smaller vessels obsolete. The vessels currently available for offloading fuel at the Holyrood marine terminal facility

range in size from 46,700 DWT (Motor Tanker (M/T) Kandilousa) to 71,345DWT (M/T Chauler Bay). This creates significant risk and a potential for damage to the marine terminal and the vessel itself during offloading operations as the aged fender system is unable to adequately withstand the forces it is subject to by the larger vessels.

For example, in the fall of 2008, a 70 tonne concrete gravity fender fell from the marine terminal superstructure. An engineering consultant was engaged to complete an assessment of the facility and determine the mode of failure. The assessment found that, given the location of the center of gravity for each concrete fender, the mechanism of failure was a plunge and roll that would almost certainly create a situation whereby the rear portion of the concrete fender could penetrate the hull of a vessel docked at the Holyrood Marine Terminal. The result of such an event could amount to a significant hydrocarbon spill into Conception Bay.

Another environmental concern stems from the limitations of the fuel oil offloading arms. During the fuel oil offloading process, the supply vessels are often required to take on ballast water to reduce the freeboard to accommodate the limited reach of the existing fuel oil offloading arms. The ballast water cools the heavy No.6 (Bunker C) fuel oil and this cooling effect creates a higher viscosity and, thus, makes the fuel oil more difficult to pump/transfer through the pipeline. This slows down the offloading process and results in longer docking times. Modifications to the existing loading arm system would raise the arms to a sufficient height, thereby, eliminating the current ship ballasting requirements for the larger modern vessels. The elimination of these intermediate steps will improve the efficiency of the offloading process which will reduce the timeframe for which the vessel remains docked. The risk of a spill is greatest during the fuel oil offloading process. Reducing the timeframe required to complete this process significantly reduces the associated spill risks.

Furthermore, the existing fuel oil system is unable to completely dispel all of the residual waste oil which remains in the arms after the offloading process is complete. Over time the

oil cools and solidifies forming an obstruction within the loading arms. The solidified oil poses a serious environmental concern as, if undetected, the blockage can restrict the flow of fuel oil which subjects the lines to potentially damaging pressure levels. This over pressurization can ultimately result in a line break which could lead to a significant fuel oil spill. The proposed installation of an air compressor would allow the fuel lines to be charged purges the remaining oil from the loading arms. Purging the line eliminates the potential for blockages and, thus, significantly reduces the potential for a fuel oil spill.

## 3.12 Operating Regime

The Holyrood Marine Terminal is typically utilized between September and April to receive fuel oil, although tankers have arrived year round from time to time. An average year consists of eight fuel deliveries with as many as twelve being required during years in which heavy loads are encountered.

# 4 JUSTIFICATION

This project is justified on the requirement to upgrade inadequate and deteriorated marine terminal infrastructure. These upgrades are required to provide the Holyrood Thermal Generating Station with the ability to provide safe, environmentally responsible, least-cost, reliable electrical service.

The existing marine terminal has deteriorated to the state where it no longer meets the requirements of the vessels utilizing the facility. Vessels offloading fuel oil have required the facility to function outside of its original design limitations which has elevated the risk of damage to both the marine terminal and the vessel.

The Holyrood Marine Terminal Facility is an integral component of the fuel oil handling system, and is the single point of entry for all of the No.6 (Bunker C) fuel oil utilized by the plant. The failure of any component of the Holyrood marine terminal facility will result in a complete cutoff of fuel oil supply.

## 4.1 Net Present Value

A net present value calculation was not performed for this project as there are no viable alternatives.

## 4.2 Levelized Cost of Energy

This project does not involve analyzing a new energy generation source or enhancing the existing Holyrood.

## 4.3 Cost Benefit Analysis

A cost benefit analysis is not applicable for this project as there are no quantifiable benefits.

## 4.4 Legislative or Regulatory Requirements

There are a number of acts and regulations that define the requirements for constructing components similar to those at the Holyrood Marine Terminal. These include:

- Navigation Waters Protection Act – Transport Canada
- Canadian Environmental Assessment Act
- The Fisheries Act
- Species at Risk Act
- Transportation of Dangerous Goods Act
- Canadian Shipping Act

These acts and regulations pertain to the actual construction and implementation of the proposed upgrades and modifications. They are not applicable to the selection of the work scope.

## 4.5 Historical Information

The refurbishment of the Holyrood Marine Terminal is not a recurring project, thus no historical information is available.

## 4.6 Forecast Customer Growth

There are no anticipated customer growth implications that can be attributed to this project. The projected Holyrood production requirements for 2011-2020 can be seen in Table 2 below.

**Table 2: Holyrood Production Requirements (2011-2020)**

| Year | MW | GWh | Avg. MW | Conversion Rate | BBLS x 1000 |
|---|---|---|---|---|---|
| 2011 | 350 | 926 | 73 | 605 | 1533 |
| 2012 | 370 | 1198 | 80 | 610 | 1964 |
| 2013 | 440 | 1432 | 86 | 615 | 2328 |
| 2014 | 500 | 1639 | 97 | 621 | 2639 |
| 2015 | 500 | 1962 | 114 | 629 | 3119 |
| 2016 | 500 | 2001 | 116 | 630 | 3176 |
| 2017 | 150 | 20 | 114 | 629 | 32 |
| 2018 | 150 | 20 | 114 | 629 | 32 |
| 2019 | 150 | 20 | 114 | 629 | 32 |
| 2020 | 70 | 210 | 70 | 602 | 345 |

## 4.7 Energy Efficiency Benefits

There are no energy efficiency benefits associated with this project.

## 4.8 Losses during Construction

There will be no losses during construction as this project will not require the Holyrood generating station to be out of service.

## 4.9 Status Quo

The Holyrood Marine Terminal currently offers a substandard ability to properly dock and offload fuel oil from modern vessels.

The consequence of not completing this project is the continued reliance on an outdated fuel oil offloading facility. This creates significant and unacceptable safety and environmental hazards, as discussed in the previous sections.

## 4.10 Alternatives

Given its age and the current docking and offloading issues, with the marine terminal facility, the risks to both life safety and the environment are significant. For this reason completion of the recommended upgrades is the only viable option.

# 5 CONCLUSION

The existing marine terminal has deteriorated to the state where it no longer meets the requirements of the larger, modern vessels utilizing the facility. Vessels offloading fuel oil, in recent years, have required the facility to function outside of its original design limitations which have elevated the risk of damage to both the marine terminal and the vessel.

The Holyrood Marine Terminal Facility is an integral component of the fuel oil handling system, and is the single point of entry for all of the No.6 (Bunker C) fuel oil utilized by the plant. The failure of any component of the HTGS marine terminal facility will result in a complete cutoff of fuel oil supply.

The existing system can be refurbished and upgraded. The preferred alternative will extend the life of the marine terminal facility, while enabling it to accommodate the larger, modern vessels presently using it.

## 5.1 Budget Estimate

The budget estimate for this project is shown in Table 3.

**Table 3: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 132.0 | 0.0 | 0.0 | 132.0 |
| **Consultant** | 605.4 | 0.0 | 0.0 | 605.4 |
| **Contract Work** | 4,330.0 | 0.0 | 0.0 | 4,330.0 |
| **Other Direct Costs** | 38.0 | 0.0 | 0.0 | 38.0 |
| **Interest and escalation** | 243.7 | 0.0 | 0.0 | 243.7 |
| **Contingency** | 510.5 | 0.0 | 0.0 | 510.5 |
| **TOTAL** | **5,859.6** | **0.0** | **0.0** | **5,859.6** |

## 5.2 Project Schedule

The anticipated project schedule is shown in Table 4.

**Table 4: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Design Transmittal, Discussions with Holyrood personnel, etc. | Jan 2012 | Jan 2012 |
| Design | Preparation of Tender Package | Jan 2012 | Apr 2012 |
| Procurement | Tender and Award | Apr 2012 | Apr 2012 |
| Construction | Completion of Marine Terminal Upgrades | May 2012 | Aug 2012 |
| Commissioning | Final Inspection & Commissioning | Aug 2012 | Aug 2012 |
| Closeout | Contract Closeout | Sept 2012 | Oct 2012 |

# APPENDIX A
## Photographs



**Photo 1: HTGS & Fuel Oil Storage Site**

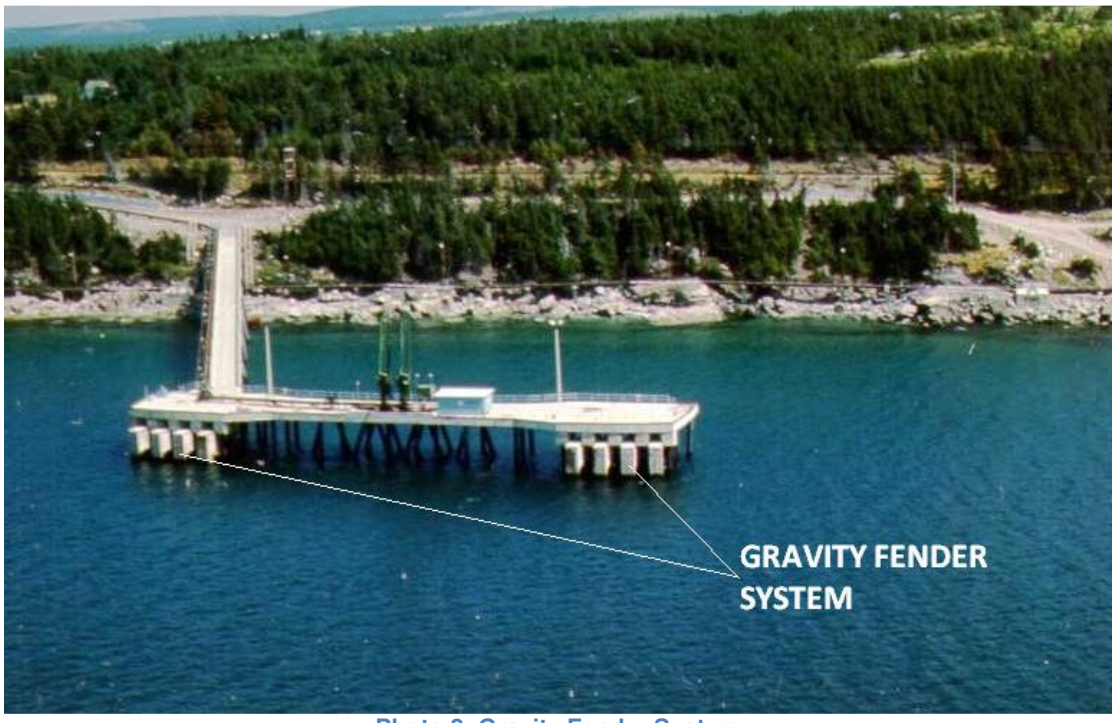


**Photo 2: Gravity Fender System**




**Photo 3: Jetty & Shore Arm Link**

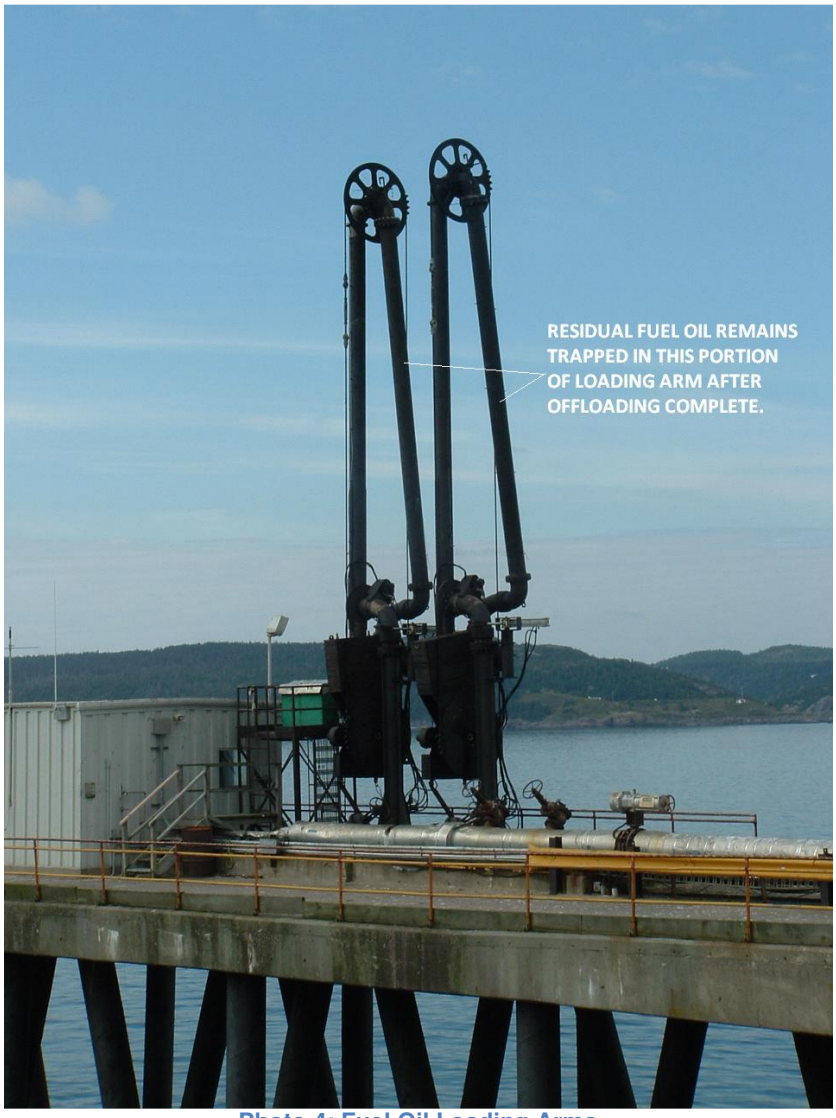


**Photo 4: Fuel Oil Loading Arms**



**Photo 5: Jetty Pile System**

# APPENDIX B

## Holyrood Marine Terminal 10 Year Life Extension Study

HATCH™

Newfoundland and Labrador Hydro
Holyrood, NL

Final Report

# Holyrood Marine Terminal 10 Year Life Extension Study

H337965-0000-50-124-0001
Rev. 0
April 29, 2011

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**Newfoundland and Labrador Hydro**

# Holyrood Marine Terminal 10 Year Life Extension Study

## Final Report

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Newfoundland and Labrador Hydro

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# 1. Introduction

## 1.1 General

The purpose of this study was driven by Newfoundland and Labrador Hydro (Hydro) as a result of the following:

- The noted increase in vessel size since the Jetty was originally designed including:
  - vessels up to 55,000 deadweight tonnes (DWT), docking at the facility designed for 35,000 deadweight tonnes (DWT); and
  - double hull vessels which have a greater freeboard range than the facility's original design for single hull vessels.
- A 70 tonne concrete gravity fender had fallen off the Jetty structure in 2008.
- The remaining gravity fenders had deficiencies such as worn rotation support arms and pins.
- Two of the fenders, have been for some time, slightly retracted and seized in place.
- In the last number of years, there have been a number of protest letters from the incoming vessels on the condition of structure and the fuel offloading system.

Based on the above, Hydro requested Hatch complete an assessment for the Marine Terminal based on a 10 year life expectancy and provide recommendations for upgrades to the Holyrood Marine Terminal.

This work is performed in accordance with the proposal letter presented by Hatch dated December 23, 2010. As outlined in the proposal, the scope included:

1. Review the requirements for making the inside four (4) gravity, fenders No's. 3, 4, 5 and 6, functional and safe. The work will also include the preparation of a cost estimate and timeline for design and construction.
2. Review the expected vessel sizes that will be available to service the generating plant over the next 10-year period. Review the loading arm requirements and make recommendations for modification or replacement. The work will also include the preparation of a cost estimate and timeline for design and construction.
3. Prepare a methodology for inspection of steel pile and anodes.
4. Review life safety issues, in consultation with NLH, to determine minimum requirements for the life extension period. The work will also include the preparation of a cost estimate and timeline for design and construction.

While the existing marine terminal layout/location is unusual as per today's standards, it is not unique. Industry experience will not be a problem for this site.


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## 1.2 Contacts and Resources Assisting with the Study

Hatch acknowledges and thanks the following Hydro personnel for providing information for input into the study.

- Terry LeDrew, P.Eng., Holyrood Plant Manager
- Gerard Piercy, P.Eng., Manager, Civil Engineering
- Jabe Hunter, P.Eng., Project Manager
- Mike Manual, Asset Manager
- Mike Flynn, Operations Manager
- Ron LeDrew, Emergency Response Coordinator
- Matthew Leonard, P.Eng, Civil Engineer

## 1.3 Documentation Available for Review

Information provided by Hydro for this study included:

- Letter dated December 11, 2009 from Atlantic Pilotage Authority RE: Mooring Equipment Guidelines.
- Newfoundland and Labrador Power Commission, Holyrood Generating Station, Specifications, Construction of Marine Landing Facility, April 1969.
- Newfoundland and Labrador Contract for Diving Services for Holyrood Marine Terminal, May 1984.
- Generation Operations Engineering Services (Mech). Holyrood Marine Terminal Anode and Pipe Inspection, September 1991.
- Report on Investigation of Damage and Proposed Repairs to Shore Arm, May 1983.
- Newfoundland and Labrador Power Commission, Holyrood Generating Station, Specifications, Marine Terminal Civil Works, October 1969.
- Engineering Report 1, Holyrood Newfoundland Marine Terminal, Damage of August 31, 1972. During currency of wharf repairs Contract and various internal memos from NL Hydro dated 1982-1983.
- Memo from Newfoundland and Labrador Hydro RE: Corrosion Survey of Pilings on the Offloading Dock dated, 1981.
- Memo from Wayne Rice dated 1988-11-25, RE: Inspection of Anodes on Holyrood Marine Terminal.
- Various Photos and Drawings: Dwg. Holyrood Generating Station, Plan 7 Profile of 18" diameter Fuel Oil Delivering & Trace Heating, 1970. Dwg: Holyrood Generating Station, Stage 1 – Fuel Handling Facility, Pipeline Grade from Dock to Tank 1987, Dwg: Pile Repairs details, 1972.


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- Dwg: Existing Concrete Details, 1972. Dwg: Investigation of Wharf Damage at Holyrood\ Generating Station, 1971.
- Letter dated February 1988, Shaw Mont NL Limited RE: Holyrood Marine Terminal.
- Information from Owner, Internal memo from Kevin Skebo to Greg Saunders, March 15, 2010.
- Proposal to Hydro, Holyrood Dock, January 29, 2010.
- Request for Quotation of Loading Arms, 1969.
- Jetty Survey, 1972.
- Photos Tanker Collision Jetty 1 and 2, 1972.
- Jetty Questions from Atlantic Pilotage Authority, April 2008.
- Continental-Emsco Medium range Loading Arm Maintenance Manual.
- Continental-Emsco Loading Arm Drawings, 1970.
- ERM-08 Rescue - Confined Space/High Angle/Difficult, 2010.
- Intertanko's Standard Tanker Chartering Questionnaire 88 (Q88).
- Temporary Fender Repairs Hatch Drawings H331421-M-D-001/002, 2008.
- Pile and Anode Inspection Report, Crotty Diving Services, October 2004.
- Crotty Video Fender Inspection, October 2008.

## 1.4 Published Standards and Guidelines

Published Standards and Guidelines used for this study are from the following sources:

- Port Designer's Handbook; Carl A. Thoresen
- Design of Marine Facilities for Berthing, Mooring, and Repair of Vessels; John W. Gaythwaite
- US Army Corp of Engineers Marine Design Manual
- Transport Canada – Termpol Review Process – TP743E
- Oil Companies International Marine Forum – (Standard acknowledged by Atlantic Pilotage Authority)
- Permanent International Association of Navigational Congress


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## 1.5 Acts and Regulations

Acts and Regulations that define requirements for constructing components similar to those at the Holyrood Marine Terminal include:

- Navigation Waters protection Act – Transport Canada.
- Canadian Environmental Assessment Act.
- The Fisheries Act.
- Species at Risk Act.
- Transportation of Dangerous Goods Act.
- Canadian Shipping Act.
- Pilotage Act – (Atlantic Pilotage Authority).


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## 2. General Description of the Existing Harbour and Facility

A general description of the Holyrood Marine Facility and the location is described as follows and is demonstrated in Figure No.'s 1, 2 and 3.

- The facility is located at the south end and along the eastern shore of Conception Bay.
- The facility is unprotected from the strong north winds and the rough seas created by the winds.
- The harbour is generally considered ice free. However, on rare occasions, a combination of constant northerly winds and arctic pack ice from the Labrador Sea ice has filled the bay.
- The Marine Facility was constructed in 1969 and consisted of a concrete deck supported on circular steel piles. The components of the Marine Facility include:
  - bridge support on piled bents;
  - combination two breasting dolphins and offloading platform;
  - an underdeck swinging gravity fenders system consisting of 8 - 70 tonne concrete fenders;
  - two fuel offloading arms; and
  - one 18 inch diameter offloading pipeline.
- The harbour shore consists of exposed granite bedrock.
- The harbour bottom consists of a till overlay on top of the granite.

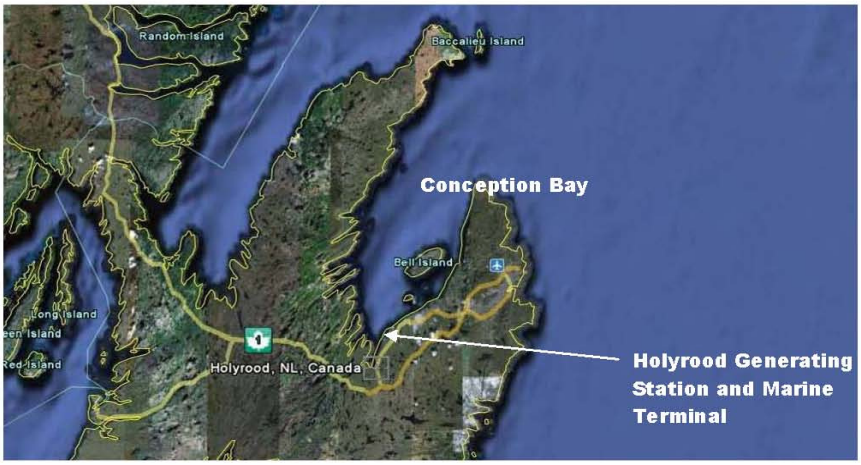


**Figure No. 1**


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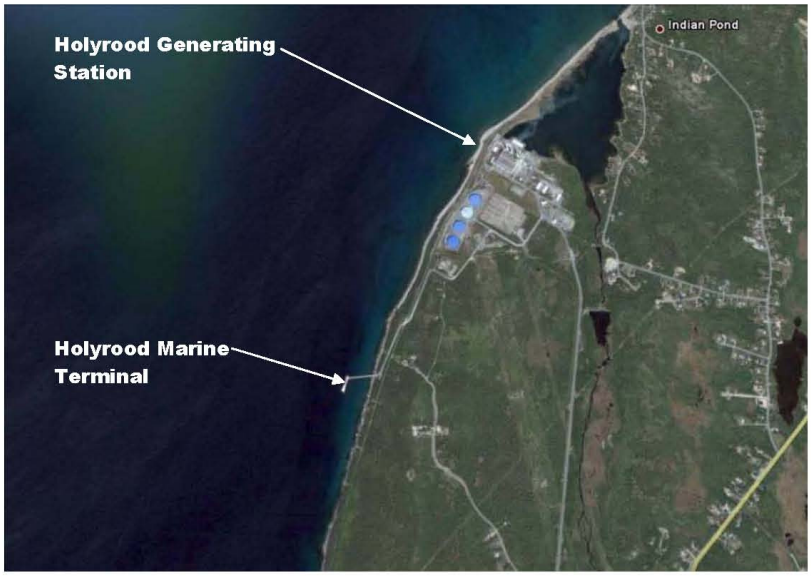


**Figure No. 2**




**Figure No. 3**


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# 3. Jetty Condition Review and Recommendations

## 3.1 General

The Holyrood Marine Terminal was designed and constructed in 1969 to meet the standard practices and sizes of vessels of that time. Its purpose is the offloading of No. 6 fuel oil from incoming tankers for the Holyrood Generating Station.

The Marine Facility is a "L" shaped configured structure comprised of:

- A shore link access bridge of approximately 410 ft in length and a 20.6 ft wide concrete deck.
- A 241.7 ft long by 39.4 ft wide Jetty structure for ship berthing, breasting and mooring.
- A system of four shore mooring dolphins each equipped with two bollards and one capstan.

The layout of the facility can be found in Appendix A.

Major incidents requiring repairs to the bridge and Jetty have included:

- The north dolphin portion of the Jetty structure required a major repair in 1972 as a result of a vessel impact.
- Several of the bridge piled support bents required a major repair in 1983 as a result of heavy ice flow damage.
- In 2008, Gravity Fender No. 4 became disengaged from the supporting deck structure and fell to the bottom of the harbour. An investigation into the condition of the other three fender supports required immediate temporary repairs.

## 3.2 Berthing Structure

The existing Jetty structure was designed to accommodate the 35,000 DWT tanker vessels and the structure consists of a 241.7 ft long by 39.4 ft wide, 2 to 3.5 ft thick, concrete deck supported on eighty-two 600 mm diameter concreted filled steel piles.

The north and south quartiles of the Jetty project out beyond the centre portion of the structure and act as the breasting and mooring façade for the vessels. Each of these breasting points engages 25 of the piles and four 70 tonne swinging concrete gravity fenders. These structural components absorb the forces from the vessels impact.

The four gravity fenders at each end of the Jetty are aligned on a circular arc to ensure a least one of the fenders is engaged by the ships hull as it approaches and makes contact on an 11° angle with the Jetty.

The centre fifty percent of the Jetty structure, which supports the fuel offloading system, is set back approximately 6.5 ft from the breasting face. Although this section is set back, so not to take any impact forces from a berthing ship, the 30 supporting piles are designed to accommodate longitudinal berthing loads. In our opinion, this arrangement is contrary to current practice as piled


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structures used for loading platforms should be free from normal berthing forces (Port Designers Handbook – Carl A. Thoresen).

Based on observations from the deck surface, the overall physical condition of the 42-year old Jetty structure is in good condition and piles appear well maintained. The gravity fenders are in poor condition, with one fender missing having fallen to the harbour bottom and two of the remaining seven fenders seized in a retracted position. See Section 4 for fender assessment.

### 3.2.1 *Capacity of Existing Structure*

Hatch completed a review of the "1988 Shawmont Letter Report" and reviewed their methodology regarding their calculation of the Jetty's structural ability to take impacts from 65,000 DWT tankers.

Hatch subsequently completed a review of the Jetty structure to confirm the conclusions identified in the "1988 Shawmont Letter Report". The structural review was completed using modern computer and analysis techniques of the energy absorption capacity of the gravity fenders, an analysis of the pile loading and capacity and tension capacity of the support arms. Appendix B contains the report findings and recommendations of the analytical model that encompasses the following:

- The absorption and transfer of forces into the structure from a properly functioning gravity fender system (50 percent transfer of energy to deck in 1988).
- The absorption and transfer of forces into the structure from a seized functioning gravity fender system (possibly 100 percent transfer of energy to deck due to seized gravity fenders).
- The number of piles under compression and load under impact.
- The number of piles under tension and the load under impact (1988 letter report identifies 14 piles under tension; Hatch's review indicates this could be as low as 11 piles).
- Identifies piles that take deck loading instead of assuming only piles in tension that take full weight of the concrete deck.
- Evaluated the impact velocities noting:
  - An increase of velocity impact from 0.7 ft/sec to 0.9 ft/sec increases the energy to the structure by 65 percent.
  - A decrease to the velocity impact from 0.7 ft/sec to 0.5 ft/sec decreases the energy to the structure by 50 percent.

Due to the condition of the Jetty's gravity fenders, the Jetty structure is incapable to take a design impact load from any vessel that is docking at the facility today.

Currently, vessels of less than 55,000 DWT and shorter than 656 ft long are able to dock at the Jetty, as docking is being performed in a controlled manner with a very low impact velocity.

Therefore, until reinstatement of the fendering system is completed, the docking of ships should be completed under very controlled parameters such as moderate to low wind speeds and the use of tractor tug(s).


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A detailed structural analysis of the concrete deck was not considered necessary as the thinnest part is approximately 3.3 ft. A manual calculation of the deck's punching shear capacity was completed and it was found to be satisfactory.

### *3.2.2 Approach Velocity of Docking Vessels*

The analysis of the Jetty structure determined vessels larger that those used in the original design of 35,000 DWT can be safely docked at the facility but the approach velocity has to be controlled. For vessels of 55,000 DWT the recommended approach velocity is 0.410 ft/s.

There are no records at the Marine Terminal of the required approach velocity or any means of measuring and recording this velocity. Any velocity records are currently the property of the vessel operators.

To assist Hydro control and record vessel velocities, we recommend the installation of a laser sensor, display and recording system be installed. A typical laser docking system can be found in Appendix K.

## 3.3 Breasting Fender Spacing

The breasting system was designed and constructed to accommodate 35,000 DWT tankers that would engage four of the eight gravity fenders.

Once the gravity fenders neutralize the impact of the vessel and the vessel is stabilized at the Jetty face, the vessel centres itself about the loading arms and the vessel breasts against the inner two gravity fenders on the north and south mooring face. The vessels generally do not breast against the outer four fenders as they are on an arc which falls away from the tangent.

This operation of centering the vessel on the breasting dolphins and tying up to equal positions on both bow and stern ends gives the vessel the most stability during offloading operations at the Jetty face.

The vessels are designed with flat parallel faces to accommodate the breasting position and these sections are located in the centre 40 percent of the vessel at light ship conditions.

The range for the distance between breasting points, for a stabile vessel at the Jetty face, is between 0.25 LOA (overall length) and 0.4 LOA with the ideal breasting position being 0.3 LOA.

Given the distance between breasting gravity fenders that the vessel may contact is 178.4 ft (see Appendix A), the length of ships using the Holyrood Marine Facility should be as follows.

Minimum Length - 439.5 ft

Ideal Length - 595.3 ft

Maximum Length - 715.0 ft

Based on records provided (Appendix C), it is noted that all ships docking at the facility in 2009 and 2010 were near the ideal length for the existing Jetty.


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To meet the requirements of stabilizing vessels at the Jetty face, it is recommended Hydro adopt measures restricting the docking tankers to a minimum length of 525 ft and a maximum length of 656 ft.

### 3.3.1 *Vessels Docking at the Holyrood Marine Terminal*

A review of the data presented in Appendix C of this report, Intertanko's Standard Tanker Chartering Questionnaire 88 (Q88) Summary, indicates the following range of vessel size's that are safely docking at the facility since 2009 (questionnaires reported in metric):

*Typical Smallest* – Kandilousa – 600 ft LOA (overall length) – 105.6 ft Beam – 40,000 Maximum Assigned DWT.

*Typical Largest* – Aris – 611.5 ft LOA (overall length) – 105.6 ft Beam – 53,000 Maximum Assigned DWT.

## 3.4 Mooring System

### 3.4.1 *Bollard Capacity*

According to the original drawings, the mooring system was designed to accommodate 35,000 DWT vessels using a combination of four shore and four berth 70 tonne mooring bollard systems.

The original 1969 specification did not require a pull test on these bollards and there is no evidence that a pull test was ever completed to certify their capacity. There is no evidence that the capacity of the bollards was ever issued to the Masters of vessels before docking at the facility.

It is noted there are additional 15 tonne capacity bollards on the Jetty but their purpose is undefined. In our opinion, their purpose is excluded from mooring vessels.

After 42 plus years service, due to environmental deterioration, the bollards could have a reduced capacity. In particular, there is a risk of bollard failure either from the use of high capacity vessel winches or from a vessel using several mooring lines on the same bollard.

#### 3.4.1.1 *Bollard Capacity Investigation*

Ships of approximately 50,000 displacement tonnes would generally expect a bollard capacity in the order of 90 tonnes (according to Port Designers Handbook – Carl A. Thoresen).

It is recommended Hydro design a procedure and complete a pull test on all bollards to certify the bollards for a specific rating. Upon preliminary review, our recommendation would be certification for a rated capacity of 70 tonnes. Further investigation into the required bollard rated capacity based on vessels that are safely docking at the facility today should be validated prior to certification.

The rated capacity of the bollards should be visibly posted for docking vessels.

### 3.4.2 *Bollard / Mooring Line spacing*

The mooring system was designed and constructed to accommodate 35,000 DWT vessels using four shore dolphins complete with two bollards each and four bollards on the Jetty.


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The Marine Terminal uses a variety of vessels under charter services and the Masters and Pilots guiding the ships have different preferences for mooring configurations. We would like to point out, however, OCIMF recommends the bow and stern mooring lines to be located 15 degrees off the perpendicular of the vessel.

During meetings held with the APA, we have been given varying opinions of the required mooring arrangements. These conflicting preferences are outlined below:

- In addition to meeting the OCIMF guidelines, consideration should be given to the addition of separate bow and stern lines set at 45 degrees off the perpendicular (May 2010).
- The only requirement is having the bow and stern line arrangement conform to the OCIMF guidelines as stated above, located 15 degrees of the perpendicular (October 2010).

Hydro representatives noted the long mooring lines from the ship to the shore presented a number of challenges and hazards and they are listed as follows.

1. The mooring lines on some ships are not long enough to reach the shoreline bollards. This means there are challenges tying up the vessels as the mooring lines must be extended by tying to shore tender lines.
2. The mooring lines sometimes get stuck on the rocks along the shore and on the harbour bottom and there are safety concerns when trying to untangle the lines.
3. It was noted the walkways along the shoreline are embedded into a steep slope and there have been periodic landslides damaging the walkway. These incidents affect the tying of mooring lines and safety of the workers.

The current mooring arrangement does not meet either the OCIMF standards or the APA's preference for berthing a vessel. The possibility exists that a Master of a vessel could refuse berthing if the mooring configuration is not updated to meet today's industry standards.

Hydro to correspond with vessel owner's to obtain their acceptance for docking under the existing mooring arrangement. If a new mooring arrangement is required, a complete mooring system design and installation program is recommended based on the requirements of today's standards. The new design should comply with the requirements of OCIMF and wherever possible meet the requirements of the Atlantic Pilot Association.

Appendix J shows a new mooring configuration (not priced in the estimate) that will meet OCIMF standards for 600 ft long tanker vessels (vessels near the ideal length for the existing Jetty) with capacities of 55,000 DWT. The mooring configuration gives consideration to local tide and wind conditions.


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# 4. Fender Refurbishment and Replacement

## 4.1 Description of Existing Fenders

As described above, the Jetty was originally constructed with four gravity fenders at each end of the Jetty aligned on a circular arc to ensure at least one of the fenders is engaged by the ships hull as it approaches and makes contact with the Jetty.

Based on the following, it has been determined that only gravity fenders No. 3, 4, 5 and 6 (see Appendix H for fender numbering) are utilized during docking given:

- The current size of the vessels (Appendix C);
- The current docking procedure with the assistance of tractor tugs and the requirement to dock parallel to the Jetty façade, and;
- The recommended approach velocity.

## 4.2 Fender Deficiencies

Gravity fender No. 4 fell off the super structure in 2008 from a failure in the support arm. Due to this failure, temporary work has taken place over the past few years to keep the remaining fenders operational.

The impact to the structure of another gravity fender falling from the superstructure could be catastrophic as a fender could fall against a pile and cause a portion of the supporting pile structure to collapse or it could fall against a ship and cause a puncture in the vessel. A further detailed investigation of the fenders existing condition is required to assess the required remedial work.

Two of the fenders, have been for some time, slightly retracted and seized in place. These fenders are not critical and will not be looked at in the scope.

## 4.3 Proposed Inspection, Modifications and Replacement

### *4.3.1 Fender Inspection*

The proposed work involves a complete review of the fenders functionality with key aspects of the inspection to include:

- The integrity of the timbers: look for pieces of timber cracked or split off, ensure HDPE rubbing strips are intact against the timbers.
- Suspension / Retraction brackets: visually inspect all embedded connections and supports for noticeable wear, NDE inspection on critical components or parts that have wear.
- Support pins: the support trunnion pins have been gouged severely and analysis of a case by case is required to determine if they are still suitable.
- Support Arms: the clevis and linkage arms that support the pins in the front and back of the fender have been worn considerably. Tolerance and thickness checks will be required.


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As part of the inspection, scaffolding will be required around the perimeter of each fender to allow for a proper inspection of the fender from all sides.

### *4.3.2 Fender Modifications*

Prior to completing any fender modifications, all critical supports and components shall be water blast cleaned before performing NDE thickness readings. The required work will require extensive scaffolding to be erected.

A complete list of recommended repairs will be generated as a result of the inspections listed in 4.3.1. Based on current knowledge, the following will be required as a minimum.

#### *4.3.2.1 Fender No. 3*

The front support suspension arms were replaced in 2008. Inspect, and repair as necessary, the support arms for the back suspension as well as all the pins and associated nuts. Replace all chains.

#### *4.3.2.2 Fender No. 5 & 6*

Replace support suspension arms at the front of fenders No. 5 and 6. These components are known to be quite worn and are currently using a temporary support to hold them in place. Inspect and repair the back support brackets and all support pins and associated nuts. Replace all chains.

### *4.3.3 Fender Replacement*

Fender No. 4 detached and broke free from the Marine Terminal. This is one of the critical fenders required for safely mooring the vessel alongside the Jetty. Video analysis by divers show the fender lying on the ocean floor with severe structural damage to the supports and the back of the fender.

From the videos we know that the fallen fenders are not near the piles and are in deep water. There is no harm in leaving them where they fell as they pose no risk to the jetty piles or the docking vessels. These fenders are quite heavy and it could pose a risk in trying to lift the large odd shape concrete fender onto a barge and bring to shore for repair. Based on past experience, the cost to recover, clean, inspect and repair the damaged fender, would be significantly higher than the price to replace it.

We anticipate the following steps to replace the lost fender.

- A scaffold will have to be setup to inspect the area around the missing fender and verify the integrity of the embedded support components.
- If the existing components are structurally sound they can be reused. If not then the supports will have to be replaced. New stabilizing and retraction chains will be required.
- To replace the fender a steel box frame, in the shape of the fender, is prepared and brought to the Jetty on a flat bed. A crane with a minimum capacity of 20 tonnes will be required to lift the fender frame. The crane then lowers the frame vertically over the side of the Jetty, where chains are attached to the retraction bracket with chain falls. This permits the chain fall to pull the fender frame into the horizontal position while simultaneously lowering the frame with the crane. The fender frame is then secured in its final position with the suspension brackets and


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support pins. Concrete is then poured into the frame to form the fender. Four (4) timbers are then attached to the front side as the point of contact with the vessels.


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# 5. Loading Arm Modification or Replacement

## 5.1 General

As part of the 10 year life extension study of the Marine Terminal, Hatch has completed a detailed review of the existing loading arm operating envelope and recommended least cost modifications to meet the design requirements of vessels that are docking at the facility today.

## 5.2 Description of Existing Fuel Offloading System

The existing marine facilities two fuel loading arms were manufactured by Continental-Emsco and classified as medium range load arms and are original to the facility. The load arm size specifications were based on single hull ships of 35,000 DWT and an off loading rate of approximately 5000 BBL/h, per arm, for a total design rate into the pipeline of 10,000 BBL/h.

The loading arms are summarized as follows:

- A 12 inch flange connection which accommodated the original 35,000 DWT tankers;
- Stripping capabilities for the Jetty side portion of the arm;
- Gravity drainage to the tanker for the vessel portion of the arm, and;
- The arms are not insulated nor heat traced.

The offloading arms are connected to an existing 18 inch diameter pipeline which transfers the No. 6 fuel oil to a four tank fuel storage field. The furthest tank is located approximately 4000 ft from the Jetty.

During the site visit, there was no offloading activity and the load arms were secured in the storage position. The load arms appeared to be in good repair as a result of a preventative maintenance program.

## 5.3 Design Considerations

The design conditions outlined below were assumed to remain unchanged from the original construction of the Marine Terminal:

- Jetty deck is 22.5 feet above the low water level;
- Fore and aft drift is 30 feet total;
- Fluid Characteristics: No. 6 fuel oil with a viscosity 500 S.S.F. @ 122°F and specific gravity 0.96;
- Product temperature is 120°F minimum;
- Tanker discharge pressure is 100 psig with maximum pressure drop through loading arm at 10 psi;
- Ambient temperature variation -21 to 93°F;


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- Design wind velocity 100 mph in stored position;
- Distance between loading arm support columns C/L and edge of Jetty is 4.5 feet;
- Maximum tidal variation is 5.25 feet, and;
- Distance between Jetty and tanker at rest (ie. Berthing line) is 12 feet.

Tidal information as published by the Department of Fisheries and Oceans for St. John's during the year of 2010 was reviewed and compared against tidal data during the original design (Appendix D). The original design information of 5.25 feet between low and high water level is accurate today.

The following original design considerations are documented for a comparison basis of the operating envelopes below:

- Tanker freeboard when loaded is 11 feet;
- Tanker freeboard when unloaded is 35 feet, and;
- Tanker manifold location: 4-5 feet above freeboard and 15-20 feet inboard from side.

## 5.4 Loading Arm Deficiencies

### *5.4.1 Review of Expected Vessel Sizes*

A review of the freeboard data for vessels that have frequented the facility in the last couple of years is presented in Appendix C of this report, Intertanko's Standard Tanker Chartering Questionnaire 88 (Q88) Summary.

The operating envelope is defined from the data presented for 40,000-55,000 DWT vessels as follows:

- Smallest tanker freeboard when loaded is 25.4 feet (including height from ship deck to manifold centerline);
- Largest tanker freeboard when unloaded is 60.2 feet (including height from ship deck to manifold centerline);
- Average tanker freeboard at normal ballast is 45.1 feet (including height from ship deck to manifold centerline), and;
- Tanker manifold location ranges: 5.4-7.2 feet above ship deck and 15–17 feet inboard from ships side.

Based on the information presented in the manufactures "Marine Loading Arm Description" drawing and the vessel questionnaires, Hatch Drawing. No. 337965-M-A3-001 "Holyrood Marine Terminal Loading Arm Layout" (Appendix E) provides a comparison of the existing loading arm operating envelope and the required operating envelope (Appendix C). This illustration indentifies the limits of the loading arms can be severely exceeded during offloading operations if the ship is not ballasted properly.


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For simplicity, the following is provided as a summary of the existing and required operating envelopes:

- The existing loading arm operates between 7.5 feet below to 22.75 feet above the Jetty deck;
- The required safe operating envelope is 2.9 to 43 feet above the Jetty deck (based on Appendix C);
- During normal ballast condition the ships manifold flange connection is located 27.9 feet above the Jetty deck (Appendix C), and;
- The location of the ships manifold flange connection inboard from the ships side (based on Appendix C) is within the existing loading arms operating envelope of 15 to 20 feet.

When the unloaded (lightship) occurs at high tide, the range of the loading arm is exceeded by approximately 20 feet requiring vessels to bring onboard ballast to prevent the loading arms from being over extended.

When the vessels are at normal ballast freeboard, the loading arms range limit is exceeded by approximately 5 feet. When the normal loading arm range is exceeded there is difficulty in disconnecting the lines from the ship which could lead to a spill.

Both above noted situations can and are being dealt with by taking on ballast water. It should be noted however, taking on cold ballast water for certain vessel tank configurations can be problematic because of the cooling effect and the consequential increasing of the viscosity of the fuel being transferred.

Due to the flanged connections at the ship, it takes several hours to complete a fuel line disconnection. This creates a potential for severe consequences in the following emergency situations:

- a fire and the ship must leave the Jetty;
- rapid deterioration in weather;
- the ship breaks away from its mooring position, and;
- or the ship extends its freeboard past it's reach.

In all cases there is a possibility of damaging the existing loading arms and causing a hydrocarbon spill.

The loading arms present a significant hydrocarbon spill risk. The current environmental response, as a preventative measure, is to install a boom around the vessel during the offloading process. This can only be employed during favourable weather conditions and is stored a considerable distance away in the town of Holyrood.

Any other hydrocarbon spill response is sub-contracted and located off site. Hydro should review the risks, their procedures and response times for potential environmental spills.


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## 5.5 Proposed Modifications or Replacement

### *5.5.1 Investigation*

To meet the operating envelope of vessels frequenting the facility today, Hatch reviewed the possibilities of:

a) Providing a structural foundation to raise the loading arm base to match the new low point reach (smallest tanker freeboard) of 2.9 feet above the Jetty deck, and;

b) Providing arm extensions to the existing loading arms to match the new high point reach (largest tanker freeboard) of 43 feet above the Jetty deck.

A requisition was forwarded to the loading arm manufacture, presently known as Emco Wheaton, for permissible modifications to the existing loading arms. The basis of the request outlined: the loading arm original design with its operating envelope, the condition of the loading arms, the change in vessel size docking at the facility with the updated safe operating envelope, the plans to raise the base support to meet the new low point reach and the request for budgetary pricing for arm extensions to meet the new high point reach.

Upon review of the design, the manufacturer's representative responded with their concern of the age of the loading arms coupled with such factors as unforeseen stresses that may have been applied to the arm, corrosion in the piping and the fact that these arms were originally not designed for this length of service. Adding additional length to the arms would result in more counterweights and thus additional loading on the base swivels. The general consensus appears that modifications to the loading arm is not advised, however the manufacture does not oppose raising the load arm base with a structural support.

Based on the manufacturer's recommendations, Hatch is proposing to raise the loading arms as outlined below and advise Hydro to ballast, as required, with water to prevent the loading arms from being over extended. Raising the base support 10 feet to meet the new low point reach requirements will bring the new operating envelope to approximately 2.5 to 32.75 feet above the Jetty deck. Ballasting would commence only after the ships manifold connection is beyond 32.75 feet above the Jetty deck. The questionnaires indicated that all vessels docking at the facility today have ballasting capabilities.

The existing loading arms are equipped with 12 inch flange connectors which require an adapter to couple to the ships manifold connection. A review of the data presented in the vessel questionnaires indicates the ships manifold connections are 12/14/16 inch with on-board reducer's capable of mating to the loading arm flanges.

### *5.5.2 Loading Arm Modifications*

As discussed above, in order to raise the loading arms the required height of approximately 10 feet, it is proposed to install a new column pedestal, which could be anchored to the main deck using the existing anchor bolt arrangement. Preliminarily, it is proposed to use a 24" STD pipe for the pedestal, with gusset plates at the top and bottom for stiffening (see sketch located in Appendix F). Design loadings at the base will need to be confirmed prior to final design and drawing preparation.


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The proposed modifications assume the load arms are in good repair as a result of a preventative maintenance program.

The modifications to the loading arm base will require minimal changes to the existing piping configuration. A flanged spool piece will be added from the base of the loading arm to the Jetty piping tie point and supported mid-way from the new pedestal foundation. It is assumed the ship's cargo pumps have the additional capacity for the change in elevation head and the pipe friction losses approximated at less than 1 foot.

Hatch will perform an investigation of installing a quick coupler release to the exiting loading arms. An analysis and physical simulation will be required to determine the suitability of adding the additional weight to the existing 42 year old loading arms. If the loading arms are deemed structurally adequate for this modification, it will reduce the time to connect / disconnect to the ships flange and provide a better method of spill prevention.

Market research has been conducted for a commercially available quick coupler release product(s) to connect to the existing loading arm flanges. An acceptable coupler has not been sourced to date.

### *5.5.3 Loading Arm Replacement*

To meet the requirements for the proper reach of the loading arms for the largest 55,000 DWT tankers and to simplify the draining of the loading arms after each use, we recommend Hydro budget for the replacement of the existing systems with two new long range loading arms capable of 15,000 BBL/hr (2400 m3/hr) each. The loading arms would be equipped with the following features:

- 16 inch (400 mm) coupler connection;
- Isolation flange;
- Hydraulic operation;
- Quick coupler release;
- Nitrogen purge line;
- Vacuum breaker;
- Emergency release system;
- Drain connections;
- Heat traced and insulated; and
- Control systems.

The over capacity offloading arms would be beneficial on a life cycle basis should it be decided in the near future to upgrade or twin the existing 18 inch (450 mm) diameter transfer main to the storage tanks.

Should the facility upgrade the loading arms, we recommend determining if the existing 18 inch transfer line can operate at an increased pressure and thus increase the overall transfer rate of the


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product. A full investigation of the existing piping and valve sizing and functionality with the new loading arms will need to be completed as part of the new installation.

### *5.5.4 Loading Arm Cleanout System*

Currently after the vessel has offloaded the fuel oil, the loading arms remain full. Over time the oil can harden causing problems to occur during the next operation. At present there is no way to expunge the left over oil to the storage tanks or return it to the ship. An investigation will be performed to determine a method of removing the oil from the loading arms after the system is shut down. Any new system will require upgrades to the electrical system including the existing MCC's in the marine terminal enclosure.


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# 6. Pile Inspection & Anode Replacement

## 6.1 General

The existing Jetty structure was designed to accommodate the 35,000 DWT tanker vessels; the concrete deck is supported on eighty-two 600 mm diameter concreted filled steel piles. The breasting points engages 25 of the piles and four 70 tonne swinging concrete gravity fenders; these structural components absorb the forces from the vessels impact.

## 6.2 Condition Review

As mentioned previously, the overall physical condition of the 42-year old Jetty structure is good and piles appear well maintained.

Even though the Jetty's structural piles appear well maintained, a visual inspection from the deck noted that the splash zone coating system is starting to degrade. This will lead to surface pitting corrosion. The last thickness survey of the piles was performed in 1980. We understand that in 1983 anodes were installed to the piles to reduce their corrosion rate and the anodes are inspected on a periodic basis with the last inspection completed in 2004.

## 6.3 Proposed Inspection and Replacement

### *6.3.1 Inspection*

Based on the information presented above, it is recommended to complete a site inspection and perform a steel measurement program on the Jetty piles.

Hatch recommends to complete a detailed inspection of the metal thickness of the piles and a visual inspection of the underside of the deck. Hatch has prepared and issued, under a separate cover, a specification for a complete metal thickness measurement program for the Jetty piles and a complete inspection of the underside of concrete deck (Appendix I). These inspections will provide a representative view of the integrity of the structure.

### *6.3.2 Anode Replacement*

In 2004, Crotty Diving Services performed a complete visual inspection of each pile and anode on both the Jetty head and shore arm from seabed to splashzone and recorded the amount of deterioration on each. The results are in Appendix G.

From Appendix G, assuming no anodes were replaced following the 2004 inspection, we can conclude that 107 anodes either need immediate replacement or will need to be replaced within 10 years. It is anticipated, the remaining 125 anodes will surpass the expected life of 10 years for the Marine Terminal and replacement is not required.

It is recommended that an underwater video and visual inspection of each anode and all attachment brackets on each pile be performed to confirm / verify the conclusions stated above. The inspection, using methodologies outlined in Appendix I, will provide a representative view of the current integrity of the anodes, confirm the number of anodes to be replaced and help plan the required work. The plan and methodology shall be developed in conjunction with a certified diving


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contractor in strict accordance with all Newfoundland and Labrador Hydro, Provincial and Federal diving regulations. As noted above, thickness measurements of the steel piles shall be recorded at time of inspection.

During the inspection, review the requirement of painting exposed piles on a case by case basis to reduce the corrosion rate to meet the expected life of the Marine Terminal. Painting of the piles shall only be considered if the associated pile anode is not being replaced.


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# 7. Safety Upgrades

## 7.1 Emergency Evacuation

Presently if an incident or accident occurs at the offloading arm location, due to fire for example, there is no adequate method of emergency evacuation from the south end of the Jetty. Currently the only method of evacuation is the using the Jetty ladders to evacuate to the water.

***Risk No.1***

There is the possibility of personnel injury or death if a person was trapped at the south end of the Jetty due to a major fire at the offloading arms.

***Mitigation of Risk No.1***

***No. 1:*** Install 2 fixed platforms at separate ends of the Jetty, facing the shore. The platform system will also allow access to the Jetty from a docking and undocking support vessel. The approximately 8 ft x 12 ft platform will be located 6.5 feet above the high tide water line with a set of stairs up to the top of the Jetty. Hatch will further investigate other requirements with Hydro including final location and method of support. A hinged gangway with a float at the bottom will be used to bring the walkway down to the water level. Lighting will be provided along with manual winch, to secure the gangway up to the platform height when not in use. See Appendix H for schematic (Drawing No. H337965-M-A1-002).

***No. 2:*** Install an Ovatek (or approved equivalent) 4 persons rigid fibreglass life raft complete with mounting cradle that is secured to the Jetty at the south end. Individuals who would be trapped from the main egress would get into the life raft, pull the internal lever and drop safely into the bay where they would be picked by another vessel.

## 7.2 Man Overboard

Ongoing maintenance, periodic inspections and fuel offloading all require personnel to be located in the Jetty area. This activity can lead to the potential of someone falling into the water. Man overboard scenarios include:

***Risk No. 1***
***Vessel offloading***

In the event a vessel is on route, moored or departing the Jetty, personnel will be present at the Marine Terminal.


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***Mitigation of Risk No.1***

Should an individual fall overboard, Hydro's Emergency Response team does have a procedure in place to facilitate a rescue.

- Shout "Man Overboard" three (3) times and immediately deploy the site life rings and Mustang Rescue Sticks located on dock. One person will maintain visual contact and physically point at the person in the water.
- If tanker is approaching the dock, contact the pilot to cease approach to the dock. If already alongside, instruct tanker captain to cease transfer of fuel if pumping operations are in effect.
- Instruct tanker captain to assist by deploying additional life-saving equipment and drop vessel's cargo netting down the outboard side of the dock.
- Contact Shift Supervisor to declare Man Overboard. Give location, number of persons in the water and general situation (i.e.; conscious/responsive).
- Shift Supervisor immediately contacts ER Technicians, 911, Canadian Coast Guard and RCMP informing them of the man overboard situation.
- Alert the boom deployment support vessel, if available.
- ER Techs will deploy the HTGS boom deployment craft only if marine weather conditions are determined safe by the OSC-1.
- Apply First Aid.
- Call for medical assistance as required.

***Risk No. 2***
***Jetty Construction Maintenance***

When ongoing maintenance/repairs are being made at the Marine Terminal there is the risk of a worker falling into the water.

***Mitigation of Risk No.2***

The Marine Terminal is treated as a confined space and workers must be wearing life jackets and tied off when near the edge of the Jetty.

Hydro's emergency response team will have 2 members of their team fully set up in survival gear for the duration of the work. The emergency response deployment support vessel is prepared and placed in the water for immediate assistance. Radio communication is required to call for help in the event someone falls overboard.


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***Risk No. 3***
***Maintenance Inspection***

When travelling to the Jetty for general inspection, a minimum of two (2) workers are required. Life jackets again are mandatory as well as a radio to call for help.

This scenario presents the highest risk as the sole means to call for help, in the event that someone falls overboard, is the radio. There are a couple chain ladders on the Jetty to allow a responsive victim a chance to get out of the water, however they do not extend all the way into the water at low tide. In the event the victim is unconscious, the partner would have little chance to get the victim out of the water by themselves. There is an inflatable boat inside a locked building on the Jetty, but there is no adequate method to place the boat in the water with rescuers aboard. Besides calling for help the individual would keep an eye on the victim as the normal current in the area tends to flow down the bay towards the town of Holyrood.

***Mitigation of Risk No.3***

*No.* 1: Install a fall restraint system in critical areas near the edge of the Jetty. This would require personnel working in high risk locations to be tied-off to prevent anyone from going over. Recessed connect plates will be installed on the bay side of the Jetty. In the event of a trip or strong wind near the Jetty edge, the individual would be held back by their lanyard and prevent them from falling into the ocean. A review of Hydro's practice and procedures at the Marine Terminal will be required.

*No.2*: A rescue winch to be located on top of the Jetty near each of the 2 existing hand ladders to aid rescuers in recovering any injured personnel who have fallen overboard.

*No. 3*: Provide staff members with water activated locator beacons to alert the emergency response team in the event someone falls overboard.

## 7.3 Lighting upgrades

The existing light fixtures on the jetty are extremely high, making replacement of the bulbs difficult in good weather, let alone in nasty conditions. A new style of fixture with improved maintenance accessibility is recommended to ease in the replacement of the bulbs, but still provide adequate lighting for the workers on the jetty.


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# 8. Regulatory Approvals

## 8.1 General

As detailed in previous sections, the scope of work of the project could include the following proposed modifications:

- installation of structures along the shoreline;
- Modification/repair to piled structures in the harbour bottom; and/or
- demolition over and in the harbour.

The undertaking will trigger the provincial and federal environmental assessment process. Several departments will be involved to address the potential effects of the project. The following sections describe the triggers and the anticipated departments and agencies that will be involved.

## 8.2 NL Department of Environment and Conservation

A project that must be registered for the provincial environmental assessment process is referred to as an undertaking. As per the *NL Environmental Protection Act* an undertaking is defined as:

> "an enterprise, activity, project, structure, work or proposal and a modification, abandonment, demolition, decommissioning, rehabilitation and an extension of them that may, in the opinion of the minister, have a significant environmental effect".
> *Section 2 (mm)*

The purpose of the environmental assessment process is to: (a) protect the environment and quality of life of the people of the province; and (b) facilitate the wise management of the natural resources of the province (*NL Environmental Protection Act, Section 46*).

The provincial assessment process is triggered by the Environmental Assessment Regulations (*NL Regulation 54/03*), Section 35(a) which states the following:

> "An undertaking that will be engaged in the construction of a breakwater structure where the breakwater will be more than 100 m in length."

## 8.3 Transport Canada

Transport Canada will be involved in the approval process under *The Navigable Waters Protection Act* and as a Responsible Authority under the *Canadian Environmental Assessment Act.*

***Navigable Waters Protection Act***

Section 5 of the NWPA states the following:

> "No work shall be built or placed in, on, over, under, through or across any navigable water without the Minister's prior approval of the work, its site and the plans for it."

Section 16 of the NWPA states the following:


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"The Minister may cause any wreck, vessel or part of a vessel resulting from the wrecking, sinking, partial sinking, lying ashore or grounding of a vessel, or may cause any other thing, to be secured, removed or destroyed in the manner that the Minister considers appropriate if, in the Minister's opinion,

a. the navigation of any navigable water over which Parliament has jurisdiction is obstructed, impeded or rendered more difficult or dangerous for more than 24 hours by the wreck, vessel, part of a vessel or thing;

b. the wreck, vessel, part of a vessel or thing has been in a position for more than 24 hours that is likely to obstruct, impede or render more difficult or dangerous the navigation of any such navigable water; or

c. the wreck, vessel, part of a vessel or thing is cast ashore, stranded or left on any property belonging to Her Majesty in right of Canada and has been an obstruction or obstacle, for more than 24 hours, to the use of that property as may be required for the public purposes of Canada."

Historical knowledge indicates that there may be shipwrecks present at or near the proposed work location. During preliminary discussions with regional Transport Canada representatives, it was confirmed that the provincial archaeologist must be consulted prior to any proposed dredging operations.

The application process and required documentation is determined by the regional Navigable Waters Protection Program (NWPP) office. The application will include at a minimum:

1. Details of work:
   a. clearly identify the proponent; this must be a single body, company, etc.
   b. proposed construction schedule
   c. description of work
   d. status of work (existing, proposed or both)
   e. name of waterway, including width and depth
   f. chart and topographic map number
   g. latitude and longitude of the work site
   h. legal description (section, lot number, concession etc)
   i. identification of upland property owners
   j. method of construction (i.e. equipment to be used etc)

2. Plans:
   a. drawings completed to scale with all dimensions
   b. indicate if any plans have been registered/deposited at your local land registry; if so, include registration number
   c. identify which government regulatory agencies have been forwarded copies of the plans

3. Additional information:
   a. history of the waterway, including all navigational uses
   b. characteristics of the waterway
   c. pictures of the work location, as well as upstream and downstream views


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The above is intended to provide an overview of information that may be required for the application; again, the specific application requirements must be confirmed with the regional NWPP office.

Canadian Environmental Assessment Act

Part V of the Inclusion List Regulations (SOR/94-637), Transportation, Section 36 states the following:

> "Dredge or fill operations in a navigation channel of a historic canal or other navigable water for the purpose of ensuring the navigability of the historic canal or other navigable water."

This will trigger the federal EA process and include Transport Canada as a Responsible Authority.

## 8.4 Fisheries and Oceans Canada

The Department of Fisheries and Oceans (DFO) will be involved in the approval process under *The Fisheries Act* and as a Responsible Authority under the *Canadian Environmental Assessment Act*. DFO will also be included under the *Species at Risk Act*; this is discussed further in Section 5.5.

The Fisheries Act

Section 35 of the Fisheries Act addresses the harmful alteration, disruption or destruction of fish habitat, Subsections (1) and (2) state the following:

1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.

2) No person contravenes subsection (1) by causing the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act.

While all efforts and best practices will be incorporated into the project planning phase to minimize any impact on fish or fish habitat, some disturbance may be unavoidable. As per the requirements of DFO, and in accordance with the *Proponent's Guide to Information Requirements for Review under the Fish Habitat Protection Provisions of the Fisheries Act (April 2009)*, the proponent will prepare a Development Proposal. The document will include the following:

1. Contact information for proponent, contractor and consultants
2. location of the proposed development:
   a. nearest community
   b. name of watercourse likely to be impacted
   c. coordinates of the proposed development
   d. map to show how to access the proposed development
   e. illustrate location on a nautical chart if requested
3. description of the aquatic environment:
   a. type of watercourse, water body
   b. biophysical characteristics of the site:
      - channel width


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- type of flow
- tides
- water depth
- substrate type and density
- aquatic vegetation type and density
- other aquatic organisms
- presence of fish species

c. drawings and/or photos of the aquatic environment

4. description of the proposed development:
   a. components (permanent and temporary structures, project activities)
   b. methods, materials and equipment
   c. affected area
   d. plans, maps and/or drawings
   e. fish and fish habitat protection measures
   f. implementation schedule
   g. life expectancy

The submission of the Development Proposal will allow the DFO to assess the undertaking and the impact on fish and fish habitat.

Canadian Environmental Assessment Act

Part VII of the Inclusion List Regulations (SOR/94-637), Fisheries, Sections 42, 43 and 45 state the following:

> (42) The destruction of fish by any means other than fishing, where the destruction requires the authorization of the Minister of Fisheries and Oceans under section 32 of the Fisheries Act or authorization under regulations made by the Governor in Council under that Act.
>
> (43) The harmful alteration, disruption or destruction of fish habitat by means of physical activities carried out in a water body, including dredge or fill operations, that require the authorization of the Minister of Fisheries and Oceans under subsection 35(2) of the Fisheries Act or authorization under regulations made by the Governor in Council under that Act.
>
> (45) The harmful alteration, disruption or destruction of fish habitat by means of erosion control measures adjacent to a water body that require the authorization of the Minister of Fisheries and Oceans under subsection 35(2) of the Fisheries Act or authorization under regulations made by the Governor in Council under that Act.

The proposed undertaking may involve one or all of the above and will trigger the federal environmental assessment process and include the Department of Fisheries and Oceans as a Responsible Authority.

It is expected that there will be some overlap between the *Fisheries Act* requirements and the Environmental Assessment document. Specifically, regarding mitigation measures with respect to the protection of fish habitat. The Department of Fisheries and Oceans strives to achieve no net loss,


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this is intended to balance unavoidable habitat losses with habitat replacement on a project-specific basis.

## 8.5 Environment Canada

Environment Canada will be involved in the approval process under *The Canadian Environmental Protection Act* and *The Species at Risk Act*.

Species at Risk Act

Under Sections 32 and 33 the Species at Risk Act (SARA—2002, c. 29), it is an offence to:

- kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened;
- possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened, or its part or derivative;
- damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction into the wild in Canada.

The Act allows the issuance of a permit or agreement authorizing a person to affect a listed species so long as certain conditions are first met. Under Section 73 of SARA, the Minister of Fisheries and Oceans may enter into an agreement with a person, or issue a permit to a person, authorizing the person to engage in an activity affecting a listed aquatic species, any part of its critical habitat, or the residences of its individuals.

Under section 73(2) of SARA, the agreement may be entered into, or the permit issued, only if the Minister is of the opinion that:

- the activity is scientific research relating to the conservation of the species and conducted by qualified persons;
- the activity benefits the species or is required to enhance its chance of survival in the wild; or
- affecting the species is incidental to the carrying out of the activity.

*http://www.dfo-mpo.gc.ca/species-especes/permits-permis/guidelines-directives-eng.htm*

The above refers to all species at risk, not just aquatic. It is understood that all potential species at risk will be considered in the review (mammals, birds, aquatic etc). This will involve both DFO and Environment Canada as Responsible Authorities. All requirements under the Species at Risk Act will be incorporated into the EA document.

## 8.6 Summary

Transport Canada, the Department of Fisheries and Oceans, the NL Department of Environment and Conservation and Environment Canada are anticipated to be the primary contributors to the approval and permitting processes required for the proposed undertaking. It is recognized that through the Federal Coordination Regulations, other departments/ agencies will potentially be involved in the


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review process. It is also recognized that there may be overlap in submission requirements, the proponent will maintain continuous contact with regulators, and the Lead Responsible Authority, to minimize duplication of effort and facilitate streamlining the process. Based on the various permit applications, surveys and environmental assessment documentation, it is estimated that the process will take approximately 6 months from initiation to final approval.


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# 9. Cost Estimates for Jetty Upgrades

## 9.1 General

To assist Hydro with their assessment of risk mitigation at the Holyrood Marine Terminal, we have completed an order of magnitude cost estimate for the upgrading of individual components.

The order of magnitude construction cost estimates are based on similar types of work completed in Atlantic Canada and on costs supplied by contractors who are familiar with this type of work.

| | |
|---|---|
| **Fender Replacement/Repairs** | **$1,874,300** |
| • Fender No. 4 complete replacement | $633,500 |
| • Repairs to Fenders No. 3,5&6 | $1,139,500 |
| • Engineering | $101,300 |
| **Vessel Approach/Loading Arms** | **$711,800** |
| • Modify existing loading arms. | $211,500 |
| • Radar System | $110,000 |
| • Loading Arm Drainage System | $280,000 |
| • Engineering | $110,300 |
| **Anode Inspection/Replacement** | **$504,800** |
| • Inspect all anodes and replace as required | $473,400 |
| • Engineering | $31,400 |
| **Life Safety Issues** | **$832,225** |
| • Install a 4 persons evacuation life raft. Install 2 fixed platforms below deck to allow access to vessels | $592,000 |
| • Lighting Upgrades | $65,000 |
| • Engineering | $175,225 |
| **General** | **$1,624,506** |
| • Mobilization/Demobilization | $50,000 |
| • On-Site Facilities | $581,225 |
| • Contingency | $595,968 |
| • Overhead and Profit | $397,313 |
| **Total** | **$5,547,631** |

A detailed breakdown of the estimated construction cost is attached in Appendix L.


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# 10. Schedule

## 10.1 General

From the cost estimate Hatch approximates two (2) to three (3) months of engineering from design to tendering.

Based on Hatch's preliminary assessment of the existing structures and previous experience, we anticipate approximately four (4) months to complete the construction phase. This work will take place during Hydro's construction season, May to October.




The final schedule will require the delivery times for long lead items that may delay or prolong the construction stage.

Depending on climate conditions, construction may commence earlier than May given that engineering is completed one month after the start of construction.


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# Appendix A

## Holyrood Terminal Station Jetty Head Existing Breasting Mooring Arrangement


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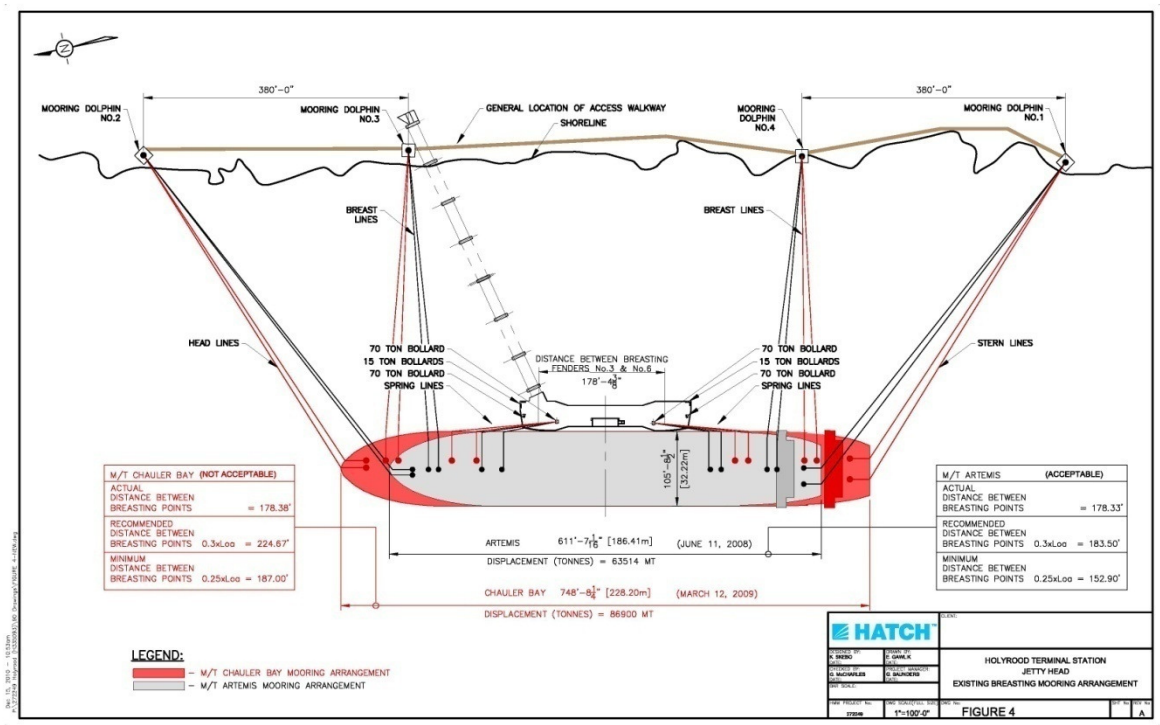
MOORING DOLPHIN NO.2
380'-0"
MOORING DOLPHIN NO.3
GENERAL LOCATION OF ACCESS WALKWAY
SHORELINE
MOORING DOLPHIN NO.4
380'-0"
MOORING DOLPHIN NO.1
BREAST LINES
BREAST LINES
HEAD LINES
70 TON BOLLARD
15 TON BOLLARDS
70 TON BOLLARD
SPRING LINES
DISTANCE BETWEEN BREASTING FENDERS No.3 & No.6
178'-4 3/8"
70 TON BOLLARD
15 TON BOLLARDS
70 TON BOLLARD
SPRING LINES
STERN LINES
105'-6 1/2" [32.22m]
M/T CHAULER BAY (NOT ACCEPTABLE)
ACTUAL DISTANCE BETWEEN BREASTING POINTS = 178.38'
RECOMMENDED DISTANCE BETWEEN BREASTING POINTS 0.3xLoa = 224.67'
MINIMUM DISTANCE BETWEEN BREASTING POINTS 0.25xLoa = 187.00'
ARTEMIS 611'-7 1/16" [186.41m] (JUNE 11, 2008)
DISPLACEMENT (TONNES) = 63514 MT
CHAULER BAY 748'-8 1/4" [228.20m] (MARCH 12, 2009)
DISPLACEMENT (TONNES) = 86900 MT
M/T ARTEMIS (ACCEPTABLE)
ACTUAL DISTANCE BETWEEN BREASTING POINTS = 178.33'
RECOMMENDED DISTANCE BETWEEN BREASTING POINTS 0.3xLoa = 183.50'
MINIMUM DISTANCE BETWEEN BREASTING POINTS 0.25xLoa = 152.90'
LEGEND:
– M/T CHAULER BAY MOORING ARRANGEMENT
– M/T ARTEMIS MOORING ARRANGEMENT
HATCH
HOLYROOD TERMINAL STATION
JETTY HEAD
EXISTING BREASTING MOORING ARRANGEMENT
1"=100'-0"
FIGURE 4
A

# Appendix B

## Design Check of Structural Capacity of Piles and Calculation of Recommended Vessel Approach Velocity


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## 1. Introduction

At the request of Newfoundland and Labrador Hydro, Hatch has carried out structural analyses of the jetty structure at the Holyrood Marine Terminal for the purpose of determining acceptable vessel berthing practices, specifically as it relates to 55,000 DWT tanker vessels. The following report summarizes the details of the analyses along with the conclusions derived from them. The capacity of the jetty when vessels are in a moored condition was not part of the scope of work.


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## 2. Description of Work

To perform these analyses, several assumptions were required and are listed below:

- The gravity fenders and their support mechanisms are in good working order;
- The driving resistances of the piles, as noted on the original design drawings, are valid. A factor of safety of 2.0 was used to derive an allowable bearing load from these driving resistances;
- The point of pile base fixity was determined to be approximately 10' (3.0m) below the seabed. The average depth to the seabed below the underside of concrete deck was assumed to be approximately 65' (20m) based on original borehole survey data;
- The mass of each gravity fender is 66 tonnes (calculated);
- The berthing energy of a vessel will be absorbed by a minimum of two (2) concrete gravity fenders and these fenders will deflect the same amount during berthing;
- In accordance with established practice, an eccentricity (berthing) coefficient of 0.5 and a safety factor for abnormal berthing of 2.0 were applied to the calculated berthing energies;
- The lateral movement of the fenders is only significant in the direction perpendicular to the fender's berthing face; i.e. there is no appreciable side to side movement during vessel berthing;
- A deck live loading of 12.5 kPa (250 psf).

A 3-dimensional STAAD model of the jetty deck and pile structure was created for the structural analyses. Capacities were then checked manually using limit states design in accordance with CSA S16.1.

Analyses were run for 45,000 and 55,000 DWT vessels with berthing velocities of 0.10 m/s, 0.15 m/s, and 0.20 m/s perpendicular to the face of the jetty. For the purpose of creating a baseline for the results, an analysis was run for a 35,000 DWT vessel, the original design vessel displacement, berthing at 0.10 m/s and 0.15 m/s. An equivalent static force was determined based on the required energy absorption for each case. This force was divided into two (2) equal parts for both fenders and applied directly to the concrete deck.

The following procedure was carried out for each berthing (loading) condition:

- The allowable energy absorption of two (2) fenders was compared with the berthing energy for each vessel at each berthing velocity. The allowable energy absorption was determined based on the potential energy of each fender rising up to the level of the underside of the jetty deck.
- The maximum tension and compression loads in the piles were determined from the results of the STAAD model. The pile compression capacity was calculated as the minimum of either the


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structural capacity of the pile or the final driving resistance indicated on the drawings. Punching shear through the concrete deck was also calculated and it was found not to govern the design. The driven tensile capacity of the piles is not indicated on the original drawings, nor is there any construction detail showing a tensile resistance connection of the pile and deck. It was decided to determine the maximum pile tension based on the original design condition of 35,000 DWT at 0.15 m/s and limit the allowable tensile forces for the other analyses to this value.

- The axial load in each of the fender support arms was determined based on static equilibrium at the point of maximum fender deflection. This axial load was then compared with the tensile and shear capacities of the support arms. The clevis plates' capacities were not checked as they are thicker than the support arms and each plate only carries approximately half the load of the support arms. The concrete embedment capacity of the clevis plates was not checked.



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# 3. Results

## 3.1 Energy Absorption Capacity of Fenders

It was found that at 0.10 m/s and 0.15 m/s, two fenders were capable of absorbing the energy of all three vessel sizes analyzed. At 0.20 m/s, however, the fenders would rotate far enough under 45,000DWT and 55,000 DWT vessel berthing that they could strike the underside of the concrete deck. As this was considered the limiting case, this berthing velocity was not considered as an option. Table 3.1 shows the raised heights of the fenders required to fully dissipate the berthing energies.

**Table 3.1: Raised Height Required for Energy Dissipation**

| DWT<br>t | Displaced Tonnage<br>t | Velocity<br>m/s | Required Height<br>mm | Allowable Height<br>mm | Energy U/R |
|---|---|---|---|---|---|
| 55000 | 65000 | 0.100 | 454 | 1362 | 0.33 |
| | | 0.125 | 709 | 1362 | 0.52 |
| | | 0.150 | 1021 | 1362 | 0.75 |
| | | 0.200 | 1815 | 1362 | 1.33 |
| 45000 | 55000 | 0.100 | 371 | 1362 | 0.27 |
| | | 0.150 | 834 | 1362 | 0.61 |
| | | 0.200 | 1483 | 1362 | 1.09 |
| 35000 | 46000 | 0.100 | 315 | 1362 | 0.23 |
| | | 0.150 | 709 | 1362 | 0.52 |
| | | 0.200 | 1261 | 1362 | 0.93 |

Note: Highlighted regions indicate cases that exceed the allowable limits

## 3.2 Tension/Compression Capacity of Piles

The 55,000 DWT vessel at 0.15 m/s was found to produce compression loads in the piles that overloaded the allowable driving resistance with a utilization ratio of approximately 1.07. The 0.10 m/s berthing velocity was found to produce acceptable compression loads with a utilization ratio of 1.0.

Using the tension loads from the baseline analysis of the 35,000 DWT vessel, a velocity was determined for the 55,000 DWT vessel that would produce similar tensile pile loads in the jetty. This velocity was determined to be 0.125 m/s, which produces berthing loads that are nearly identical to the baseline analysis. Tables 3.2 and 3.3 show the compression and tension utilization ratios of the piles, respectively.


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**Table 3.2: Compression Capacity of Piles**

| DWT t | Displaced Tonnage t | Velocity m/s | Critical Compression Load Case | Critical Pile Type | Max Comp. in Piles kN | Comp. Capacity (driving) kN | Comp. Capacity (piles) kN | Comp. U/R (driving) | Comp. U/R (piles) |
|---|---|---|---|---|---|---|---|---|---|
| 55000 | 65000 | 0.100 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.125 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.150 | DL + FBL + LL | 1 to 2.5 | 1190 | 1112 | 2094 | 1.07 | 0.57 |
| | | 0.200 | - | - | - | - | - | - | - |
| 45000 | 55000 | 0.100 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.150 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.200 | - | - | - | - | - | - | - |
| 35000 | 46000 | 0.100 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.150 | DL + LL | Vert | 1117 | 1112 | 1919 | 1.00 | 0.58 |
| | | 0.200 | - | - | - | - | - | - | - |

Note: Highlighted regions indicate cases that exceed allowable limits

**Table 3.3: Tension Capacity of Piles**

| DWT t | Displaced Tonnage t | Velocity m/s | Critical Tension Load Case | Critical Pile Type | Max Tens. in Piles kN | Tens. Capacity kN | Tension U/R |
|---|---|---|---|---|---|---|---|
| 55000 | 65000 | 0.100 | DL + FBL | 1 to 2.5 | 115 | 334 | 0.34 |
| | | 0.125 | DL + FBL | 1 to 2.5 | 118 | 334 | 0.35 |
| | | 0.150 | DL + FBL | 1 to 6 | 315 | 334 | 0.94 |
| | | 0.200 | - | - | - | - | - |
| 45000 | 55000 | 0.100 | DL + FBL | 1 to 2.5 | 113 | 334 | 0.34 |
| | | 0.150 | DL + FBL | 1 to 6 | 147 | 334 | 0.44 |
| | | 0.200 | - | - | - | - | - |
| 35000 | 46000 | 0.100 | DL + FBL | 1 to 2.5 | 113 | 334 | 0.34 |
| | | 0.150 | DL + FBL | 1 to 2.5 | 118 | 334 | 0.35 |
| | | 0.200 | - | - | - | - | - |

Note: Highlighted regions indicate cases that exceed the baseline results

### 3.3 Fender Support Arms

The loading in each of the fender support arms was compared with their tensile and shear capacities and in all cases the loading was below the calculated safe operating capacity. The results are summarized in Table 3.4.

**Table 3.4: Support Arm Utilization Ratios**

| DWT<br>t | Displaced Tonnage<br>t | Velocity<br>m/s | Max Tens. in Arms<br>kN | Resistance Factor | Tensile Capacity<br>kN | Arm U/R |
|---|---|---|---|---|---|---|
| 55000 | 65000 | 0.100 | 393 | 2.0 | 2204 | 0.36 |
| | | 0.125 | 503 | 2.0 | 2204 | 0.46 |
| | | 0.150 | 755 | 2.0 | 2204 | 0.69 |
| | | 0.200 | - | - | - | - |
| 45000 | 55000 | 0.100 | 366 | 2.0 | 2204 | 0.33 |
| | | 0.150 | 581 | 2.0 | 2204 | 0.53 |
| | | 0.200 | - | - | - | - |
| 35000 | 46000 | 0.100 | 351 | 2.0 | 2204 | 0.32 |
| | | 0.150 | 503 | 2.0 | 2204 | 0.46 |
| | | 0.200 | - | - | - | - |


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## 4. Conclusions

Based on the structural analysis of the jetty, it was determined that the jetty is capable of withstanding the berthing forces from a 55,000 DWT vessel at a maximum berthing velocity of 0.125 m/s without exceeding the capacity of the piles, support arms, or available potential energy in two simultaneously displaced fenders. The 55,000 DWT vessel at 0.125 m/s produces very similar results to the assumed original design criteria of a 35,000 DWT vessel at 0.15 m/s. This determination includes a safety factor to account for abnormal berthing energy due to the occurrence of docking problems caused by human error, malfunctions, exceptional weather conditions, or a combination of these factors.

As mentioned in the description of work, the results of these analyses are dependent on the fenders and their support mechanisms being in good working order. If any of these components are not in good working order, these less than ideal conditions will increase the loads on the jetty, which could cause it to be overloaded for a 55,000 DWT vessel berthing at 0.125 m/s.

An analysis while the vessel is in a moored condition may also be required to determine the capacities of mooring aids such as bollards and capstans.


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# Appendix A

## STAAD Model Printouts


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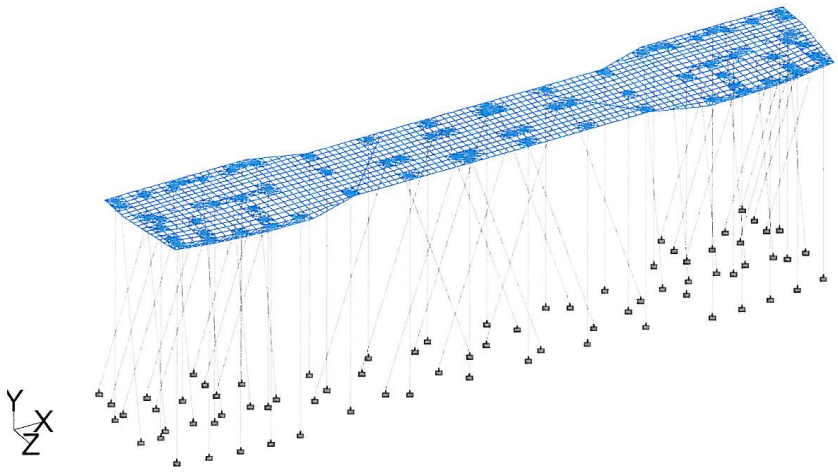
| | | | |
|---|---|---|---|
| Software licensed to Hatch | Job No H335093 | Sheet No 1 | Rev 08e |
| | Part | | |
| Job Title Holyrood Jetty | Ref Metric | | |
| | By SWR | Date 14-May-10 | Chd |
| Client NL Hydro | File Jetty - 65000 DT - 125 mr | Date/Time 15-Jun-2010 09:32 | |

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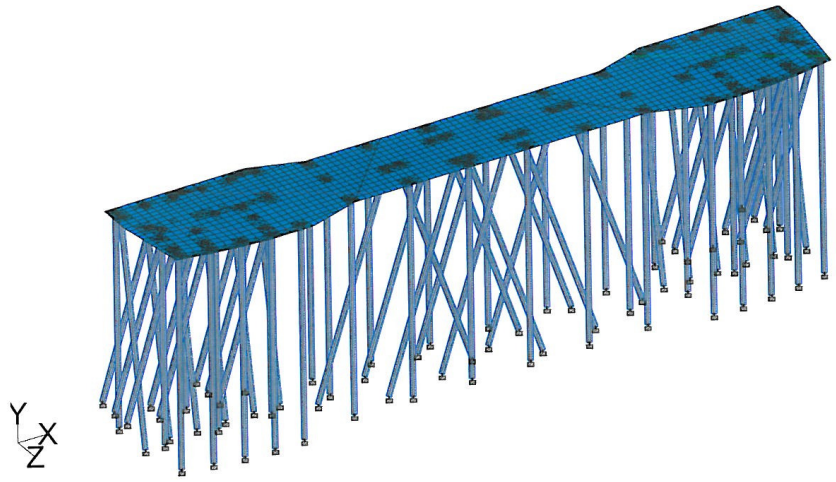


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| Job Title Holyrood Jetty | Ref Metric | | |
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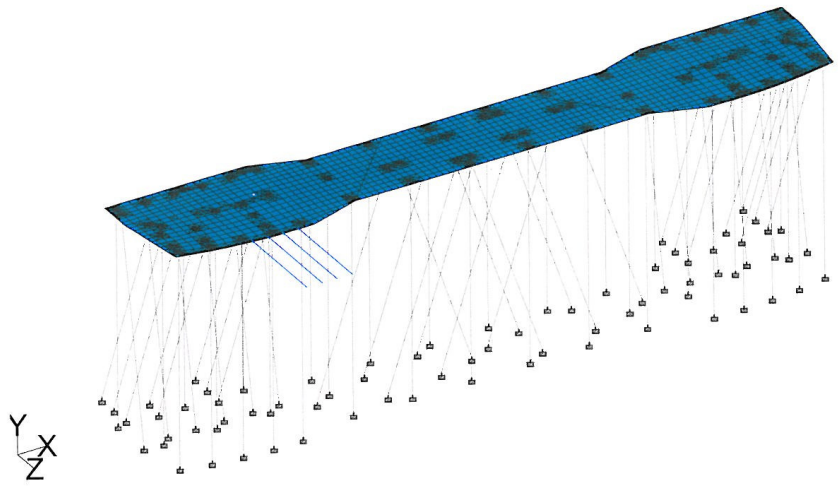
| Client NL Hydro | File Jetty - 65000 DT - 125 mr | Date/Time 15-Jun-2010 09:32 | |

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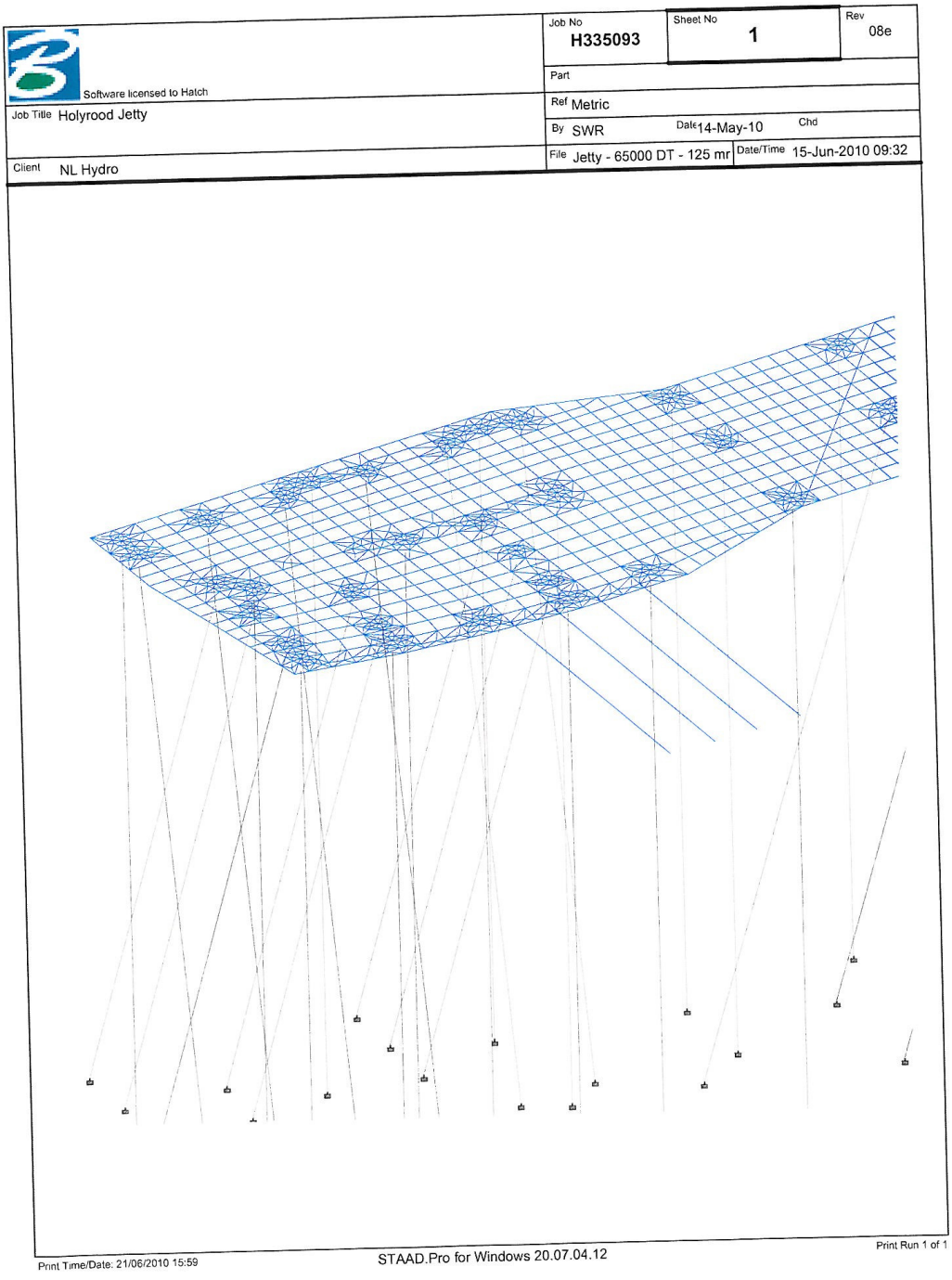
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Job No H335093
Sheet No 1
Rev 08e
Part
Ref Metric
Job Title Holyrood Jetty
By SWR
Date 14-May-10
Chd
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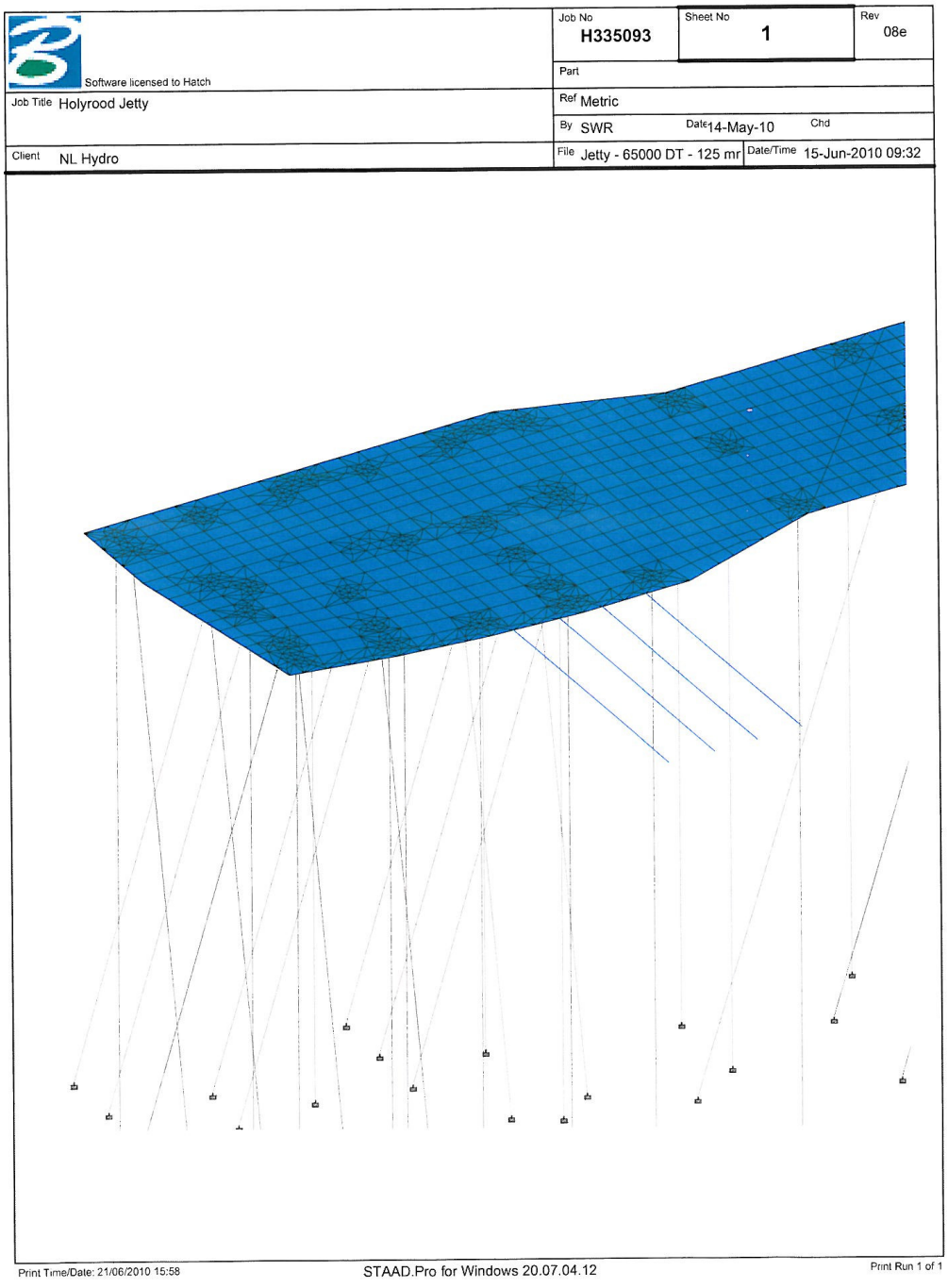
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Job No H335093
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Rev 08e
Part
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Ref Metric
By SWR
Date 14-May-10
Chd
Client NL Hydro
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- June 16, 2010

# Appendix B

## Fender Berthing Loads Calculation


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**NL Hydro - Holyrood Jetty**
**Berthing Forces**

**Project No:** H335093

**Created by:** Steve Routledge
**Date:** 21/06/2010
**Checked by:** _____
**Date:** _____

## ENERGY CALCULATIONS FOR BERTHING OF SHIP

### 1.0 - Vessel Details

$m_v := 65000\text{tonne}$ — *Displaced tonnage of vessel*

$v_v := 0.125\,\frac{m}{s}$ — *Velocity of vessel*

$\text{Draft} := 13.0\text{m}$ — *Max draft of vessel*

$\text{Beam} := 32.2\text{m}$ — *Beam of vessel*

$L_v := 200\text{m}$ — *Length of vessel*

### 2.0 - Fender Details

$n_f := 2$ — *Number of fenders activated in resisting vessel impact*

$m_c := 66\text{tonne}$ — *Mass of one concrete fender*

$W_c := m_c \cdot g$ $\quad W_c = 647.24\,\text{kN}$ — *Weight of one concrete fender*

$L_{arm} := 5.5\text{ft}$ — *Length of steel arms (c/c of pins)*

### 3.0 - Energy Calculations

$C_B := 0.5$ — *Berthing factor*

$F_s := 2.0$ — *Safety factor for abnormal berthings (as recommended in Trelleborg book - p.12-12)*

$\phi_{hmf} := 1 + 2 \cdot \frac{\text{Draft}}{\text{Beam}}$ $\quad \phi_{hmf} = 1.81$ — *Hydraulic mass factor*

$K_{ev} := \frac{1}{2} \cdot m_v \cdot v_v^{\,2}$ $\quad K_{ev} = 507.81\,\text{kN}\cdot\text{m}$ — *Kinetic energy of vessel*

$K_e := F_s \cdot C_B \cdot \phi_{hmf} \cdot K_{ev}$ $\quad K_e = 917.85\,\text{kN}\cdot\text{m}$ — *Total kinetic energy*

$P_e := K_e$ $\quad P_e = 917.85\,\text{kN}\cdot\text{m}$ — *Required potential energy (potential must equal kinetic energy assuming no other energy losses in the system)*

$y_{c\_max} := 4\text{ft} + 5\frac{5}{8}\text{in}$ $\quad y_{c\_max} = 1362.08\,\text{mm}$ — *Maximum vertical distance fender can travel before impacting underside of jetty*

$P_{e\_max} := n_f \cdot W_c \cdot y_{c\_max}$ $\quad P_{e\_max} = 1763.18\,\text{kN}\cdot\text{m}$ — *Maximum potential energy available before activated fenders impact underside of jetty*

$$\text{Energy\_Check} := \begin{cases} \text{"Activated fenders can resist the load"} & \text{if } P_e \le P_{e\_max} \\ \text{"Activated fenders are impacting the jetty!!!"} & \text{otherwise} \end{cases}$$

Energy_Check = "Activated fenders can resist the load"

**NL Hydro - Holyrood Jetty**
**Berthing Forces**

**Project No:** H335093

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## 4.0 - Displacement Calculations

$y_c := \frac{P_e}{n_f \cdot W_c}$ $\quad y_c = 709.05\,mm$ — *Total required vertical rise of activated fenders from equilibrium (when arms are vertical)*

$\theta := \operatorname{acos}\left(1 - \frac{y_c}{L_{arm}}\right)$ $\quad \theta = 54.76 \cdot deg$ — *Total required arm rotation from vertical*

$x_c := L_{arm} \cdot \sin(\theta)$ $\quad x_c = 1369.14\,mm$ — *Total required horizontal displacement of fender*

$x_{ci} := 7in$ $\quad x_{ci} = 177.8\,mm$ — *Initial horizontal displacement of fender due to retraction chains*

$\Delta_x := x_c - x_{ci}$ $\quad \Delta_x = 1191.34\,mm$ — *Relative horizontal displacement of fender*

## 5.0 - Static Force Calculations

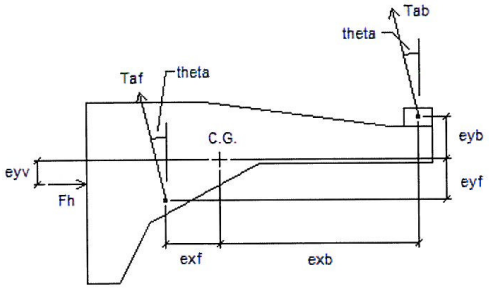
$e_{xf} := 3ft + 4\frac{5}{8}in$ $\quad e_{xf} = 1031.88\,mm$

$e_{yf} := 2ft + 7\frac{5}{8}in$ $\quad e_{yf} = 803.27\,mm$

$e_{xb} := 20ft + 0\frac{3}{8}in$ $\quad e_{xb} = 6105.52\,mm$

$e_{yb} := 3ft + 10\frac{3}{8}in$ $\quad e_{yb} = 1177.93\,mm$

$e_{yv} := 2ft + 7\frac{5}{8}in$ $\quad e_{yv} = 803.27\,mm$




### 5.1 - Summation of moments about front support hinge

$T_{ab} := \frac{W_c \cdot e_{xf}}{(e_{xf} + e_{xb}) \cdot \cos(\theta) + (e_{yf} + e_{yb}) \cdot \sin(\theta)}$ — *<--- $e_{yv} = e_{yf}$, therefore $F_h$ has no component in the summation of moments calculation*

$T_{ab} = 116.42\,kN$ — *Axial force in rear arm*

### 5.2 - Summation of forces in Y-axis

$T_{af} := \frac{\frac{W_c}{\cos(\theta)} - T_{ab}}{2}$

$T_{af} = 502.61\,kN$ — *Axial force in each front arm*

### 5.3 - Summation of forces in X-axis

$F_h := 2 \cdot T_{af} \cdot \sin(\theta) + T_{ab} \cdot \sin(\theta)$

$F_h = 916.07\,kN$ — *Horizontal force on each fender at max displacement*

NL Hydro - Holyrood Jetty
Berthing Forces

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## 6.0 - Fender Arm Capacity

$t := 1\frac{3}{8}in$ — *Thickness of arm*

$b := 18in$ — *Width of arm*

$d := 6in$ — *Diameter of pin*

$d_h := 6\frac{1}{16}in$ — *Diameter of hole for pin*

$e_p := 10in$ — *Distance from centre of pin to end of arm*

$F_y := 230MPa$ — *Yield strength of arm*

$F_u := 400MPa$ — *Ultimate strength of arm*

$\phi_s := 0.9$ — *Steel resistance factor*

$\phi_{br} := 0.67$ — *Bearing resistance factor*

### 6.1 - Gross Tension

$A_{tg} := t \cdot b$ $\quad A_{tg} = 15967.71\ mm^2$ — *Gross tensile area*

$T_{tg} := \phi_s \cdot A_{tg} \cdot F_y$ $\quad T_{tg} = 3305.32\ kN$ — *Gross tensile capacity*

### 6.2 - Net Tension

$A_{tn} := t \cdot (b - d_h)$ $\quad A_{tn} = 10589.7\ mm^2$ — *Net tensile area*

$T_{tn} := 0.85 \cdot \phi_s \cdot A_{tn} \cdot F_u$ $\quad T_{tn} = 3240.45\ kN$ — *Net tensile capacity*

### 6.3 - Shear/Tension

$A_{tn} := t \cdot \frac{(b - d_h)}{2}$ $\quad A_{tn} = 5294.85\ mm^2$ — *Net tensile area*

$A_{vg} := t \cdot e_p$ $\quad A_{vg} = 8870.95\ mm^2$ — *Gross shear area*

$A_{vn} := t \cdot \left(e_p - \frac{d_h}{2}\right)$ $\quad A_{vn} = 6181.94\ mm^2$ — *Net shear area*

$T_{tvg} := \phi_s \cdot A_{tn} \cdot F_u + 0.6 \cdot \phi_s \cdot A_{vg} \cdot F_y$ $\quad T_{tvg} = 3007.92\ kN$ — *Net tensile / gross shear tear-out capacity*

$T_{tvn} := \phi_s \cdot A_{tn} \cdot F_u + 0.6 \cdot \phi_s \cdot A_{vn} \cdot F_u$ $\quad T_{tvn} = 3241.45\ kN$ — *Net tensile / net shear tear-out capacity*

**NL Hydro - Holyrood Jetty**
**Berthing Forces**

**Project No:** H335093

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**Date:** _____

6.4 - Shear

$A_{vg} := 2 \cdot t \cdot e_p$ $\quad A_{vg} = 17741.9\ mm^2$ *Gross shear area*

$A_{vn} := 2 \cdot t \cdot \left( e_p - \frac{d_h}{2} \right)$ $\quad A_{vn} = 12363.89\ mm^2$ *Net shear area*

$T_{vg} := 0.6 \cdot \phi_s \cdot A_{vg} \cdot F_y$ $\quad T_{vg} = 2203.54\ kN$ *Gross shear capacity*

$T_{vn} := 0.6 \cdot \phi_s \cdot A_{vn} \cdot F_u$ $\quad T_{vn} = 2670.6\ kN$ *Net shear capacity*

6.5 - Bearing

$B_r := 3 \cdot \phi_{br} \cdot t \cdot d \cdot F_u$ $\quad B_r = 4279.35\ kN$ *Bearing capacity*

6.6 - Governing Capacity

$T_r := \min(T_{tg}, T_{tn}, T_{tvg}, T_{tvn}, T_{vg}, T_{vn}, B_r)$

$T_r = 2203.54\ kN$ *Governing tear-out capacity of arm*

$\phi_r := 2.0$ *Resistance factor of arm*

$T_a := \max(T_{af}, T_{ab})$ $\quad T_a = 502.61\ kN$ *Maximum force in any arm*

$\frac{\phi_r \cdot T_a}{T_r} = 0.46$ *Max utilization of arm*

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# Appendix C

## Pile Capacity Calculation


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NL Hydro - Holyrood Jetty
Concrete Filled Pile Capacity

**Project No:** H335093

**Created by:** Steve Routledge
**Date:** 21/06/2010
**Checked by:** _____
**Date:** _____

## CAPACITY OF CONCRETE FILLED CIRCULAR HSS COLUMN

### 1.0 - Input Variables

| | | |
|---|---|---|
| $k := 1.0$ | | *Effective length factor* |
| $L_n := 22.9m$ | | *Column length* |
| $D_s := 24in$ | $D_s = 609.6\ mm$ | *OD of steel* |
| $t_s := \frac{7}{16}in$ | $t_s = 11.11\ mm$ | *Thickness of steel* |
| $D_c := D_s - 2 \cdot t_s$ | $D_c = 23.12 \cdot in$ | *OD of concrete (ID of steel)* |
| $\phi_s := 0.9$ | | *Steel resistance factor (S16.1 - Cl. 13.1)* |
| $F_y := 230MPa$ | | *Steel yield strength (assumed)* |
| $E_s := 200GPa$ | | *Steel modulus of elasticity (S16.1 - Cl. 2.2)* |
| $A_s := \frac{\pi}{4} \cdot \left( D_s^2 - D_c^2 \right)$ | $A_s = 20893.77\ mm^2$ | *Steel area* |
| $I_s := \frac{\pi \cdot \left( D_s^4 - D_c^4 \right)}{64}$ | $I_s = 935.81 \times 10^6\ mm^4$ | *Steel moment of inertia* |
| $\phi_c := 0.6$ | | *Concrete resistance factor (S16.1 - Cl. 13.1)* |
| $f_c := 20MPa$ | | *Concrete compressive strength* |
| $E_c := 4500 \cdot \sqrt{\frac{f_c}{MPa}} \cdot MPa$ | $E_c = 20.12 \cdot GPa$ | *Concrete modulus of elasticity (S16.1 - Cl. 2.1)* |
| $A_c := \frac{\pi}{4} \cdot D_c^2$ | $A_c = 270969.74\ mm^2$ | *Concrete area* |
| $I_c := \frac{\pi \cdot D_c^4}{64}$ | $I_c = 5.84 \times 10^9\ mm^4$ | *Concrete moment of inertia* |
| $n := 1.80$ | | *Compression factor* |

$$Slenderness\_Check := \begin{cases} \text{"Calculations are applicable"} & \text{if } \frac{D_s}{t_s} \le \frac{28000}{\left( \frac{F_y}{MPa} \right)} \\ \text{"COLUMN TOO SLENDER FOR VALID CALCULATION!"} & \text{otherwise} \end{cases}$$

Slenderness_Check = "Calculations are applicable"

NL Hydro - Holyrood Jetty
Concrete Filled Pile Capacity

**Project No:** H335093

**Created by:** Steve Routledge
**Date:** 21/06/2010
**Checked by:** _____
**Date:** _____

## 2.0 - Calculate Compressive Resistance (S16.1 - Cl. 18.2.2)

### 2.1 - Computed Variables

$$\rho := 0.02\cdot\left(25 - \frac{L_n}{D_s}\right) \qquad \rho = -0.25$$

*Compression factor*

$$\tau := \begin{cases} \left(\frac{1}{\sqrt{1 + \rho + \rho^2}}\right) & \text{if } \frac{L_n}{D_s} < 25 \\ 1.0 & \text{otherwise} \end{cases}$$

$\tau = 1$

*Compression factor for steel*

$$\tau' := \begin{cases} \left[1 + \left[\frac{25\cdot\rho^2\cdot\tau}{\left(\frac{D_s}{t_s}\right)}\right]\cdot\left(\frac{F_y}{0.85 f_c}\right)\right] & \text{if } \frac{L_n}{D_s} < 25 \\ 1.0 & \text{otherwise} \end{cases}$$

$\tau' = 1$

*Compression factor for concrete*

$$C_p := \left[\tau\cdot(1.0)\cdot A_s\cdot F_y + \tau'\cdot 0.85\cdot(1.0)\cdot A_c\cdot f_c\right]\cdot\left[1 + (0)^{2\cdot n}\right]^{-\frac{1}{n}}$$

$C_p = 9412.05\ \text{kN}$

*Idealized compression resistance*

$\%DL_f := \frac{2}{3}$

*Ratio of sustained (dead) load to total load (assumed)*

$$EI_e := E_s\cdot I_s + \frac{0.6\cdot E_c\cdot I_c}{1 + \%DL_f} \qquad EI_e = 229.49 \times 10^{12}\cdot N\cdot mm^2$$

*Effective inertia for column*

$$C_{ec} := \frac{\pi^2\cdot EI_e}{\left(k\cdot L_n\right)^2} \qquad C_{ec} = 4319.15\ \text{kN}$$

*Euler compression resistance*

$$\lambda := \sqrt{\frac{C_p}{C_{ec}}} \qquad \lambda = 1.48$$

*Compression factor*

### 2.2 - Compression Resistance

$$C_{rc} := \left(\tau\cdot\phi_s\cdot A_s\cdot F_y + \tau'\cdot 0.85\cdot\phi_c\cdot A_c\cdot f_c\right)\cdot\left(1 + \lambda^{2\cdot n}\right)^{-\frac{1}{n}}$$

$C_{rc} = 2878.79\ \text{kN}$

*Compression resistance of composite column*

$\phi_r := 1.5$

*Overall compression resistance factor*

**NL Hydro - Holyrood Jetty**
**Concrete Filled Pile Capacity**

**Project No:** H335093

**Created by:** Steve Routledge
**Date:** 21/06/2010
**Checked by:** _____
**Date:** _____

$C_d := 500kip$ $C_d = 2224.11\ kN$ *Minimum driving resistance of pile into soil (from drawings)*

$\phi_d := 2.0$ *Factor for driving resistance*

$C_{rp} := \min\left(\frac{C_{rc}}{\phi_r}, \frac{C_d}{\phi_d}\right)$ $C_{rp} = 1112.06\ kN$ *Governing compression resistance of piles (allowable)*

**3.0 - Calculate Flexural Resistance (S16.1 - Cl. 18.2.3)**

$$h_n := \frac{\phi_c \cdot A_c \cdot f_c}{2 \cdot D_c \cdot \phi_c \cdot f_c + 4 \cdot t_s \cdot (2 \cdot \phi_s \cdot F_y - \phi_c \cdot f_c)}$$

$Z_s := \frac{1}{6} \cdot (D_s^3 - D_c^3)$ *Plastic section modulus of steel section*

$$M_{rc} := \left(Z_s - 2 \cdot t_s \cdot h_n^2\right) \cdot \phi_s \cdot F_y + \left[\frac{2}{3} \cdot (0.5 \cdot D_s - t_s)^3 - (0.5 \cdot D_s - t_s) \cdot h_n^2\right] \cdot \phi_c \cdot f_c$$

$M_{rc} = 942.61\ kN \cdot m$ *Moment capacity of piles*

$M_{rp} := \frac{M_{rc}}{\phi_r}$ $M_{rp} = 628.41\ kN \cdot m$

**4.0 - Calculate Tensile Resistance (S16.1 - Cl. 13.2)**

**** Assume steel section is the only component resisting tensile loads ****

$T_{rs} := \phi_s \cdot A_s \cdot F_y$ $T_{rs} = 4325.01\ kN$ *Tensile capacity of pile*

$T_d := (30\%) \cdot C_d$ $T_d = 667.23\ kN$ *Tensile capacity of embedment (based on past experience)*

$T_{rp} := \min\left(\frac{T_{rs}}{\phi_r}, \frac{T_d}{\phi_d}\right)$ $T_{rp} = 333.62\ kN$ *Governing tensile resistance of piles*

**5.0 - Check Axial Capacities**

$C_a := 918kN$ *Max allowable compression in piles (STAAD)*

$T_a := 50kN$ *Max allowable tension in piles (STAAD)*

$\frac{C_a}{C_{rp}} = 0.83$ *Utilization ratio for compression loads*

$\frac{T_a}{T_{rp}} = 0.15$ *Utilization ratio for tension loads*

# Appendix C

## Intertanko's Standard Tanker Chartering Questionnaire 88 (Q88) Summary


® Hatch 2011/05

HATCH™

## Vessel Questionnaire Summary - Appendix A

| Tanker | ARIS JAN/2010 | CHANG HANG TAN SUO DEC/2009 | INDIAN POINT NOV/2009 | KANDILOUSA OCT/2009 | NORTH POINT FEB/2009 | AJAX FEB/2009 | MINERVA VASO DEC/2009 |
|---|---|---|---|---|---|---|---|
| **Overall Length (LOA)** | 186.41 Metres | 184.95 Meters | 183 Metres | 182.76 Metres | 183 M | 186.41 M | 183 Metres |
| **Maximum Assigned Deadweight** | 53,000 DWT | 47,000 DWT | 51,000 DWT | 40,000 DWT | 51,000 DWT | 53,000 DWT | 51,000 DWT |
| **Bow to Center Manifold (BCM) / Stem to Center Manifold (SCM)** | 93.22 Metres/93.19 Metres | 92.15 Metres/92.8 Metres | 91.31 Metres/91.69 Metres | 90.2 Metres/92.56 Metres | 91.31 M/91.69M | 93.22 M/93.19M | 91.618 Metres/91.382 Metres |
| **Loadline** | | | | | | | |
| Winter (Freeboard) - Metres | 5.784 | 6.465 | - | 6.668 | - | 5.784 | 5.842 |
| Lightship (Freeboard) - Metres | 15.960 | 15.425 | 16.140 | 16.259 | 16.000 | 15.960 | 16.368 |
| Normal Ballast (Freeboard) - Metres | 11.650 | 11.715 | 12.100 | 11.790 | 12.000 | 11.570 | 11.678 |
| **Pumping Systems** | | | | | | | |
| Cargo Pumps (No./Capacity - Type) | 12/600 & 2/300 Cu. Metres/Hour - Framo | 6/600 Cu. Metres/Hour - Framo | 122/600&300 Cu. Metres/Hour - Framo | 3/1500 M3/HR - Centrifugal<br>1/300 Cu. Metres/Hour - Screw<br>1/400 Cu. Metres/Hour | 12/600 Cu. Metres/Hour - Framo | 12/600 & 2/300 Cu. Metres/Hour - Centrifugal | 12/600 & 2/300 Cu. Metres/Hour - Framo |
| Stripping | | | 2/80 Cu. Metres/Hour | | | | |
| Eductors | | | | | | | |
| Ballast | 2/750 Cu. Metres/Hour - Centrifugal | 2/1300 Cu. Metres/Hour - Framo | 2/750 Cu. Metres/Hour - Framo | 2/1,000 Cu. Metres/Hour - Centrifugal | 2 - Centrifugal | 2/750 Cu. Metres/Hour - Centrifugal | 2/750 Cu. Metres/Hour |
| How many cargo pumps can be run simultaneously at full capacity | 6 | 6 | 6 | 3 | | | 6 |
| **Cargo Manifolds** | | | | | | | |
| What is the number of cargo connections per side | 6 | 6 | 7 | 3 | 7 | 7 | 7 |
| What is the size of cargo connections | 300 Millimetres | 300 Millimetres | 350 Millimetres | 400 Millimetres | 400 Millimetres | 300 Millimetres | 400 Millimetres |
| **Manifold Arrangement** | | | | | | | |
| Distance between cargo manifold centers (Metres) | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 |
| Distance manifold to ships side (Metres) | 4.600 | 4.600 | 4.600 | 4.600 | 5.200 | 4.600 | 4.563 |
| Distance main deck to center of manifold (Metres) | 2.057 | 2.200 | 1.650 | 2.100 | 1.900 | 2.050 | 1.856 |
| Manifold height above the waterline in normal ballast (Metres) | 13.562 | 9.2 Metres | 13.39 Metres | 13.89 Metres | 13.39 Metres | 13.552 M | 13.77 Metres |
| Number / size reducers | 6 x 300/200mm (12/8") | 350 to 400 mm =4 | 2 x 400/200mm (16/8") | 6 x 400/400mm (16/16") | 2 x 400/200mm (16/8") | 6 x 300/200mm (12/8") | 6 x 250/350mm (8/14") |
| | 6 x 300/250mm (12/10") | 350 to 350 mm =4 | 12 x 400/350mm (16/14") | 3 x 400/300mm (16/12") | 12 x 400/350mm (16/14") | 6 x 300/250mm (12/10") | 6 x 250/350mm (10/14") |
| | 6 x 300/300mm (12/12") | 350 to 300 mm =4 | 6 x 200/350mm (8/14") | 3 x 400/250mm (16/10") | 6 x 200/350mm (8/14") | 6 x 300/300mm (12/12") | 6 x 300/350mm (12/14") |
| | 1 x 200/200mm (8/8") | 350 to 250 mm =4 | 6 x 250/350mm (10/14") | 3 x 400/200mm (16/8") | 6 x 250/350mm (10/14") | 1 x 200/200mm (8/8") | 1 x 200/250mm (8/10") |
| | 1 x 200/250mm (8/10") | 350 to 200 mm =4 | 6 x 300/350mm (12/14") | | 6 x 300/350mm (12/14") | 1 x 200/250mm (8/10") | 1 x 200/300mm (8/12") |
| **SUMMARY** | | | | | | | |
| **Loadline + Ship Deck to C/L Manifold** | | | | | | | |
| Winter - Metres | 7.841 | 8.865 | - | 8.768 | - | 7.834 | 7.740 |
| Lightship - Metres | 18.017 | 17.625 | 17.790 | 18.359 | 17.900 | 18.010 | 18.266 |
| Normal Ballast - Metres | 13.707 | 13.915 | 13.750 | 13.890 | 13.900 | 13.620 | 13.576 |
| **Vessel Safe Operating Envelope** | | | | | | | |
| Winter - Metres | 7.740 | | | | | | |
| Lightship - Metres | 18.359 | | | | | | |
| Normal Ballast (Average) - Metres | 13.765 | | | | | | |
| **Distance from Jetty Fender to Ship Manifold - Metres** | 4.563 - 5.2 | | | | | | |
| **Cargo Connection Sizes** | 2 -300 Millimetres (12")<br>2 -350 Millimetres (14")<br>3 - 400 Millimetres (16") | | | | | | |

**Notes:**
Heavy Ship with LWL will give the low point reach requirement
Light Ship with HWL will give the high point reach requirement

# Appendix D

## Holyrood Tide Information


® Hatch 2011/05

**ST JOHN'S** NST Z+3.5 **2010** **TIDE TABLES**

**January-janvier**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0107 | **1.3** | 0.4 | **16** | 0158 | **1.3** | 0.4 |
| | 0743 | **5.2** | 1.6 | | 0813 | **4.6** | 1.4 |
| FR | 1423 | **0.7** | 0.2 | SA | 1448 | **1.3** | 0.4 |
| VE | 2013 | **3.9** | 1.2 | SA | 2050 | **3.6** | 1.1 |
| **2** | 0203 | **1.3** | 0.4 | **17** | 0232 | **1.3** | 0.4 |
| | 0832 | **5.2** | 1.6 | | 0840 | **4.6** | 1.4 |
| SA | 1510 | **0.7** | 0.2 | SU | 1514 | **1.3** | 0.4 |
| SA | 2106 | **3.9** | 1.2 | DI | 2121 | **3.9** | 1.2 |
| **3** | 0259 | **1.3** | 0.4 | **18** | 0303 | **1.3** | 0.4 |
| | 0919 | **5.2** | 1.6 | | 0906 | **4.6** | 1.4 |
| SU | 1557 | **0.7** | 0.2 | MO | 1539 | **1.3** | 0.4 |
| DI | 2155 | **4.3** | 1.3 | LU | 2150 | **3.9** | 1.2 |
| **4** | 0353 | **1.3** | 0.4 | **19** | 0336 | **1.6** | 0.5 |
| | 1006 | **4.9** | 1.5 | | 0934 | **4.6** | 1.4 |
| MO | 1645 | **1.0** | 0.3 | TU | 1605 | **1.3** | 0.4 |
| LU | 2242 | **4.3** | 1.3 | MA | 2217 | **3.9** | 1.2 |
| **5** | 0447 | **1.3** | 0.4 | **20** | 0410 | **1.6** | 0.5 |
| | 1051 | **4.6** | 1.4 | | 1005 | **4.3** | 1.3 |
| TU | 1732 | **1.0** | 0.3 | WE | 1633 | **1.6** | 0.5 |
| MA | 2326 | **4.3** | 1.3 | ME | 2246 | **3.9** | 1.2 |
| **6** | 0540 | **1.6** | 0.5 | **21** | 0448 | **1.6** | 0.5 |
| | 1137 | **4.3** | 1.3 | | 1039 | **4.3** | 1.3 |
| WE | 1819 | **1.3** | 0.4 | TH | 1704 | **1.6** | 0.5 |
| ME | | | | JE | 2317 | **3.9** | 1.2 |
| **7** | 0011 | **3.9** | 1.2 | **22** | 0532 | **1.6** | 0.5 |
| | 0633 | **1.6** | 0.5 | | 1118 | **3.9** | 1.2 |
| TH | 1226 | **3.9** | 1.2 | FR | 1739 | **1.6** | 0.5 |
| JE | 1906 | **1.6** | 0.5 | VE | 2354 | **3.6** | 1.1 |
| **8** | 0057 | **3.9** | 1.2 | **23** | 0629 | **2.0** | 0.6 |
| | 0733 | **2.0** | 0.6 | | 1203 | **3.6** | 1.1 |
| FR | 1323 | **3.3** | 1.0 | SA | 1822 | **2.0** | 0.6 |
| VE | 1952 | **1.6** | 0.5 | SA | | | |
| **9** | 0151 | **3.9** | 1.2 | **24** | 0042 | **3.6** | 1.1 |
| | 0846 | **2.0** | 0.6 | | 0743 | **2.0** | 0.6 |
| SA | 1440 | **3.0** | 0.9 | SU | 1301 | **3.3** | 1.0 |
| SA | 2041 | **2.0** | 0.6 | DI | 1916 | **2.0** | 0.6 |
| **10** | 0255 | **3.9** | 1.2 | **25** | 0150 | **3.6** | 1.1 |
| | 1013 | **2.0** | 0.6 | | 0909 | **2.0** | 0.6 |
| SU | 1611 | **3.0** | 0.9 | MO | 1421 | **3.0** | 0.9 |
| DI | 2136 | **2.0** | 0.6 | LU | 2020 | **2.0** | 0.6 |
| **11** | 0406 | **3.9** | 1.2 | **26** | 0315 | **3.9** | 1.2 |
| | 1129 | **1.6** | 0.5 | | 1030 | **2.0** | 0.6 |
| MO | 1722 | **3.0** | 0.9 | TU | 1556 | **3.0** | 0.9 |
| LU | 2239 | **2.0** | 0.6 | MA | 2133 | **2.0** | 0.6 |
| **12** | 0515 | **3.9** | 1.2 | **27** | 0438 | **3.9** | 1.2 |
| | 1226 | **1.6** | 0.5 | | 1135 | **1.6** | 0.5 |
| TU | 1815 | **3.0** | 0.9 | WE | 1714 | **3.3** | 1.0 |
| MA | 2343 | **1.6** | 0.5 | ME | 2251 | **1.6** | 0.5 |
| **13** | 0614 | **4.3** | 1.3 | **28** | 0546 | **4.6** | 1.4 |
| | 1310 | **1.3** | 0.4 | | 1230 | **1.3** | 0.4 |
| WE | 1859 | **3.3** | 1.0 | TH | 1816 | **3.6** | 1.1 |
| ME | | | | JE | | | |
| **14** | 0037 | **1.6** | 0.5 | **29** | 0004 | **1.6** | 0.5 |
| | 0702 | **4.3** | 1.3 | | 0644 | **4.9** | 1.5 |
| TH | 1347 | **1.3** | 0.4 | FR | 1319 | **1.0** | 0.3 |
| JE | 1939 | **3.3** | 1.0 | VE | 1911 | **3.9** | 1.2 |
| **15** | 0121 | **1.6** | 0.5 | **30** | 0106 | **1.3** | 0.4 |
| | 0741 | **4.6** | 1.4 | | 0735 | **5.2** | 1.6 |
| FR | 1419 | **1.3** | 0.4 | SA | 1406 | **0.7** | 0.2 |
| VE | 2016 | **3.6** | 1.1 | SA | 2003 | **4.3** | 1.3 |
| | | | | **31** | 0202 | **1.0** | 0.3 |
| | | | | | 0822 | **5.2** | 1.6 |
| | | | | SU | 1451 | **0.7** | 0.2 |
| | | | | DI | 2052 | **4.3** | 1.3 |

**February-février**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0253 | **1.0** | 0.3 | **16** | 0247 | **1.3** | 0.4 |
| | 0907 | **5.2** | 1.6 | | 0843 | **4.6** | 1.4 |
| MO | 1535 | **0.7** | 0.2 | TU | 1503 | **1.3** | 0.4 |
| LU | 2137 | **4.6** | 1.4 | MA | 2119 | **3.9** | 1.2 |
| **2** | 0343 | **1.0** | 0.3 | **17** | 0319 | **1.3** | 0.4 |
| | 0951 | **4.9** | 1.5 | | 0911 | **4.6** | 1.4 |
| TU | 1618 | **0.7** | 0.2 | WE | 1526 | **1.3** | 0.4 |
| MA | 2219 | **4.6** | 1.4 | ME | 2145 | **4.3** | 1.3 |
| **3** | 0431 | **1.0** | 0.3 | **18** | 0352 | **1.3** | 0.4 |
| | 1032 | **4.6** | 1.4 | | 0942 | **4.3** | 1.3 |
| WE | 1659 | **1.0** | 0.3 | TH | 1550 | **1.3** | 0.4 |
| ME | 2258 | **4.6** | 1.4 | JE | 2213 | **4.3** | 1.3 |
| **4** | 0518 | **1.3** | 0.4 | **19** | 0429 | **1.3** | 0.4 |
| | 1112 | **4.3** | 1.3 | | 1015 | **3.9** | 1.2 |
| TH | 1740 | **1.3** | 0.4 | FR | 1614 | **1.6** | 0.5 |
| JE | 2336 | **4.3** | 1.3 | VE | 2243 | **3.9** | 1.2 |
| **5** | 0607 | **1.6** | 0.5 | **20** | 0511 | **1.6** | 0.5 |
| | 1151 | **3.6** | 1.1 | | 1050 | **3.6** | 1.1 |
| FR | 1821 | **1.6** | 0.5 | SA | 1639 | **1.6** | 0.5 |
| VE | | | | SA | 2317 | **3.9** | 1.2 |
| **6** | 0014 | **4.3** | 1.3 | **21** | 0606 | **2.0** | 0.6 |
| | 0702 | **2.0** | 0.6 | | 1130 | **3.3** | 1.0 |
| SA | 1235 | **3.3** | 1.0 | SU | 1715 | **2.0** | 0.6 |
| SA | 1904 | **2.0** | 0.6 | DI | | | |
| **7** | 0058 | **3.9** | 1.2 | **22** | 0001 | **3.9** | 1.2 |
| | 0814 | **2.0** | 0.6 | | 0720 | **2.0** | 0.6 |
| SU | 1340 | **3.0** | 0.9 | MO | 1223 | **3.3** | 1.0 |
| DI | 1953 | **2.0** | 0.6 | LU | 1820 | **2.0** | 0.6 |
| **8** | 0201 | **3.6** | 1.1 | **23** | 0106 | **3.9** | 1.2 |
| | 0952 | **2.0** | 0.6 | | 0846 | **2.0** | 0.6 |
| MO | 1550 | **2.6** | 0.8 | TU | 1345 | **3.0** | 0.9 |
| LU | 2057 | **2.3** | 0.7 | MA | 1949 | **2.0** | 0.6 |
| **9** | 0338 | **3.6** | 1.1 | **24** | 0245 | **3.6** | 1.1 |
| | 1121 | **2.0** | 0.6 | | 1007 | **2.0** | 0.6 |
| TU | 1716 | **3.0** | 0.9 | WE | 1541 | **3.0** | 0.9 |
| MA | 2218 | **2.0** | 0.6 | ME | 2121 | **2.0** | 0.6 |
| **10** | 0510 | **3.9** | 1.2 | **25** | 0428 | **3.9** | 1.2 |
| | 1217 | **1.6** | 0.5 | | 1113 | **1.6** | 0.5 |
| WE | 1806 | **3.0** | 0.9 | TH | 1707 | **3.3** | 1.0 |
| ME | 2335 | **2.0** | 0.6 | JE | 2250 | **2.0** | 0.6 |
| **11** | 0609 | **4.3** | 1.3 | **26** | 0539 | **4.3** | 1.3 |
| | 1257 | **1.6** | 0.5 | | 1208 | **1.3** | 0.4 |
| TH | 1846 | **3.3** | 1.0 | FR | 1805 | **3.6** | 1.1 |
| JE | | | | VE | | | |
| **12** | 0029 | **1.6** | 0.5 | **27** | 0004 | **1.6** | 0.5 |
| | 0651 | **4.3** | 1.3 | | 0634 | **4.6** | 1.4 |
| FR | 1328 | **1.3** | 0.4 | SA | 1257 | **1.0** | 0.3 |
| VE | 1922 | **3.6** | 1.1 | SA | 1856 | **3.9** | 1.2 |
| **13** | 0110 | **1.3** | 0.4 | **28** | 0103 | **1.0** | 0.3 |
| | 0724 | **4.6** | 1.4 | | 0721 | **4.9** | 1.5 |
| SA | 1355 | **1.3** | 0.4 | SU | 1342 | **0.7** | 0.2 |
| SA | 1955 | **3.6** | 1.1 | DI | 1944 | **4.3** | 1.3 |
| **14** | 0145 | **1.3** | 0.4 | | | | |
| | 0752 | **4.6** | 1.4 | | | | |
| SU | 1418 | **1.3** | 0.4 | | | | |
| DI | 2026 | **3.9** | 1.2 | | | | |
| **15** | 0216 | **1.3** | 0.4 | | | | |
| | 0817 | **4.6** | 1.4 | | | | |
| MO | 1440 | **1.3** | 0.4 | | | | |
| LU | 2053 | **3.9** | 1.2 | | | | |

**March-mars**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0154 | **1.0** | 0.3 | **16** | 0157 | **1.0** | 0.3 |
| | 0806 | **4.9** | 1.5 | | 0750 | **4.3** | 1.3 |
| MO | 1425 | **0.7** | 0.2 | TU | 1359 | **1.0** | 0.3 |
| LU | 2029 | **4.6** | 1.4 | MA | 2018 | **4.3** | 1.3 |
| **2** | 0241 | **0.7** | 0.2 | **17** | 0229 | **1.0** | 0.3 |
| | 0849 | **4.9** | 1.5 | | 0818 | **4.3** | 1.3 |
| TU | 1506 | **0.7** | 0.2 | WE | 1423 | **1.0** | 0.3 |
| MA | 2112 | **4.6** | 1.4 | ME | 2045 | **4.3** | 1.3 |
| **3** | 0327 | **0.7** | 0.2 | **18** | 0302 | **1.0** | 0.3 |
| | 0930 | **4.9** | 1.5 | | 0848 | **4.3** | 1.3 |
| WE | 1545 | **0.7** | 0.2 | TH | 1448 | **1.3** | 0.4 |
| ME | 2150 | **4.9** | 1.5 | JE | 2114 | **4.3** | 1.3 |
| **4** | 0411 | **1.0** | 0.3 | **19** | 0337 | **1.0** | 0.3 |
| | 1009 | **4.3** | 1.3 | | 0921 | **3.9** | 1.2 |
| TH | 1622 | **1.0** | 0.3 | FR | 1513 | **1.3** | 0.4 |
| JE | 2226 | **4.6** | 1.4 | VE | 2145 | **4.3** | 1.3 |
| **5** | 0455 | **1.3** | 0.4 | **20** | 0417 | **1.3** | 0.4 |
| | 1046 | **3.9** | 1.2 | | 0955 | **3.9** | 1.2 |
| FR | 1658 | **1.3** | 0.4 | SA | 1537 | **1.3** | 0.4 |
| VE | 2259 | **4.6** | 1.4 | SA | 2218 | **4.3** | 1.3 |
| **6** | 0541 | **1.6** | 0.5 | **21** | 0502 | **1.6** | 0.5 |
| | 1121 | **3.6** | 1.1 | | 1032 | **3.6** | 1.1 |
| SA | 1734 | **1.6** | 0.5 | SU | 1604 | **1.6** | 0.5 |
| SA | 2333 | **4.3** | 1.3 | DI | 2255 | **4.3** | 1.3 |
| **7** | 0633 | **2.0** | 0.6 | **22** | 0558 | **1.6** | 0.5 |
| | 1159 | **3.3** | 1.0 | | 1115 | **3.3** | 1.0 |
| SU | 1815 | **2.0** | 0.6 | MO | 1646 | **2.0** | 0.6 |
| DI | | | | LU | 2339 | **3.9** | 1.2 |
| **8** | 0013 | **3.9** | 1.2 | **23** | 0708 | **2.0** | 0.6 |
| | 0742 | **2.3** | 0.7 | | 1212 | **3.3** | 1.0 |
| MO | 1253 | **3.0** | 0.9 | TU | 1811 | **2.0** | 0.6 |
| LU | 1910 | **2.3** | 0.7 | MA | | | |
| **9** | 0111 | **3.6** | 1.1 | **24** | 0044 | **3.9** | 1.2 |
| | 0923 | **2.3** | 0.7 | | 0827 | **2.0** | 0.6 |
| TU | 1532 | **3.0** | 0.9 | WE | 1339 | **3.0** | 0.9 |
| MA | 2024 | **2.3** | 0.7 | ME | 1948 | **2.3** | 0.7 |
| **10** | 0307 | **3.6** | 1.1 | **25** | 0230 | **3.6** | 1.1 |
| | 1058 | **2.3** | 0.7 | | 0941 | **2.0** | 0.6 |
| WE | 1700 | **3.0** | 0.9 | TH | 1535 | **3.3** | 1.0 |
| ME | 2158 | **2.3** | 0.7 | JE | 2121 | **2.0** | 0.6 |
| **11** | 0458 | **3.6** | 1.1 | **26** | 0420 | **3.9** | 1.2 |
| | 1152 | **2.0** | 0.6 | | 1045 | **1.6** | 0.5 |
| TH | 1744 | **3.3** | 1.0 | FR | 1651 | **3.6** | 1.1 |
| JE | 2321 | **2.0** | 0.6 | VE | 2250 | **1.6** | 0.5 |
| **12** | 0550 | **3.9** | 1.2 | **27** | 0526 | **4.3** | 1.3 |
| | 1227 | **1.6** | 0.5 | | 1139 | **1.3** | 0.4 |
| FR | 1820 | **3.6** | 1.1 | SA | 1744 | **3.9** | 1.2 |
| VE | | | | SA | 2358 | **1.3** | 0.4 |
| **13** | 0013 | **1.6** | 0.5 | **28** | 0616 | **4.6** | 1.4 |
| | 0626 | **4.3** | 1.3 | | 1228 | **1.0** | 0.3 |
| SA | 1254 | **1.6** | 0.5 | SU | 1832 | **4.3** | 1.3 |
| SA | 1853 | **3.6** | 1.1 | DI | | | |
| **14** | 0052 | **1.3** | 0.4 | **29** | 0052 | **1.0** | 0.3 |
| | 0656 | **4.3** | 1.3 | | 0702 | **4.6** | 1.4 |
| SU | 1316 | **1.3** | 0.4 | MO | 1312 | **0.7** | 0.2 |
| DI | 1923 | **3.9** | 1.2 | LU | 1918 | **4.6** | 1.4 |
| **15** | 0125 | **1.3** | 0.4 | **30** | 0140 | **0.7** | 0.2 |
| | 0723 | **4.3** | 1.3 | | 0745 | **4.6** | 1.4 |
| MO | 1338 | **1.3** | 0.4 | TU | 1354 | **0.7** | 0.2 |
| LU | 1951 | **3.9** | 1.2 | MA | 2001 | **4.6** | 1.4 |
| | | | | **31** | 0225 | **0.7** | 0.2 |
| | | | | | 0827 | **4.6** | 1.4 |
| | | | | WE | 1432 | **0.7** | 0.2 |
| | | | | ME | 2042 | **4.9** | 1.5 |

**TABLE DES MARÉES** **2010** **ST JOHN'S** HNTN Z+3.5

**April-avril**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0308 | **0.7** | 0.2 | **16** | 0245 | **0.7** | 0.2 |
| | 0907 | **4.3** | 1.3 | | 0826 | **3.9** | 1.2 |
| TH | 1509 | **1.0** | 0.3 | FR | 1415 | **1.0** | 0.3 |
| JE | 2120 | **4.9** | 1.5 | VE | 2048 | **4.6** | 1.4 |
| **2** | 0351 | **1.0** | 0.3 | **17** | 0325 | **1.0** | 0.3 |
| | 0946 | **3.9** | 1.2 | | 0903 | **3.9** | 1.2 |
| FR | 1543 | **1.3** | 0.4 | SA | 1446 | **1.3** | 0.4 |
| VE | 2154 | **4.9** | 1.5 | SA | 2125 | **4.6** | 1.4 |
| **3** | 0433 | **1.3** | 0.4 | **18** | 0408 | **1.0** | 0.3 |
| | 1022 | **3.6** | 1.1 | | 0943 | **3.6** | 1.1 |
| SA | 1617 | **1.6** | 0.5 | SU | 1519 | **1.3** | 0.4 |
| SA | 2227 | **4.6** | 1.4 | DI | 2203 | **4.6** | 1.4 |
| **4** | 0516 | **1.6** | 0.5 | **19** | 0456 | **1.3** | 0.4 |
| | 1058 | **3.6** | 1.1 | | 1026 | **3.6** | 1.1 |
| SU | 1652 | **2.0** | 0.6 | MO | 1601 | **1.6** | 0.5 |
| DI | 2259 | **4.3** | 1.3 | LU | 2243 | **4.3** | 1.3 |
| **5** | 0604 | **2.0** | 0.6 | **20** | 0552 | **1.6** | 0.5 |
| | 1135 | **3.3** | 1.0 | | 1116 | **3.3** | 1.0 |
| MO | 1736 | **2.0** | 0.6 | TU | 1707 | **2.0** | 0.6 |
| LU | 2338 | **3.9** | 1.2 | MA | 2331 | **4.3** | 1.3 |
| **6** | 0708 | **2.3** | 0.7 | **21** | 0657 | **1.6** | 0.5 |
| | 1227 | **3.0** | 0.9 | | 1218 | **3.3** | 1.0 |
| TU | 1836 | **2.3** | 0.7 | WE | 1828 | **2.0** | 0.6 |
| MA | | | | ME | | | |
| **7** | 0030 | **3.6** | 1.1 | **22** | 0036 | **3.9** | 1.2 |
| | 0834 | **2.3** | 0.7 | | 0805 | **2.0** | 0.6 |
| WE | 1438 | **3.0** | 0.9 | TH | 1341 | **3.3** | 1.0 |
| ME | 1950 | **2.3** | 0.7 | JE | 1951 | **2.0** | 0.6 |
| **8** | 0203 | **3.6** | 1.1 | **23** | 0218 | **3.6** | 1.1 |
| | 1001 | **2.3** | 0.7 | | 0911 | **1.6** | 0.5 |
| TH | 1620 | **3.0** | 0.9 | FR | 1515 | **3.3** | 1.0 |
| JE | 2120 | **2.3** | 0.7 | VE | 2117 | **2.0** | 0.6 |
| **9** | 0414 | **3.6** | 1.1 | **24** | 0358 | **3.6** | 1.1 |
| | 1057 | **2.0** | 0.6 | | 1011 | **1.3** | 0.4 |
| FR | 1706 | **3.3** | 1.0 | SA | 1623 | **3.6** | 1.1 |
| VE | 2247 | **2.0** | 0.6 | SA | 2238 | **1.6** | 0.5 |
| **10** | 0510 | **3.6** | 1.1 | **25** | 0502 | **3.9** | 1.2 |
| | 1133 | **1.6** | 0.5 | | 1105 | **1.3** | 0.4 |
| SA | 1742 | **3.6** | 1.1 | SU | 1715 | **3.9** | 1.2 |
| SA | 2343 | **1.6** | 0.5 | DI | 2343 | **1.3** | 0.4 |
| **11** | 0548 | **3.9** | 1.2 | **26** | 0553 | **3.9** | 1.2 |
| | 1200 | **1.6** | 0.5 | | 1154 | **1.0** | 0.3 |
| SU | 1813 | **3.6** | 1.1 | MO | 1803 | **4.3** | 1.3 |
| DI | | | | LU | | | |
| **12** | 0025 | **1.3** | 0.4 | **27** | 0037 | **1.0** | 0.3 |
| | 0620 | **3.9** | 1.2 | | 0639 | **4.3** | 1.3 |
| MO | 1225 | **1.3** | 0.4 | TU | 1239 | **1.0** | 0.3 |
| LU | 1842 | **3.9** | 1.2 | MA | 1848 | **4.6** | 1.4 |
| **13** | 0100 | **1.0** | 0.3 | **28** | 0124 | **0.7** | 0.2 |
| | 0650 | **3.9** | 1.2 | | 0723 | **4.3** | 1.3 |
| TU | 1250 | **1.3** | 0.4 | WE | 1321 | **1.0** | 0.3 |
| MA | 1911 | **4.3** | 1.3 | ME | 1932 | **4.6** | 1.4 |
| **14** | 0134 | **1.0** | 0.3 | **29** | 0208 | **0.7** | 0.2 |
| | 0720 | **3.9** | 1.2 | | 0805 | **3.9** | 1.2 |
| WE | 1317 | **1.0** | 0.3 | TH | 1359 | **1.0** | 0.3 |
| ME | 1941 | **4.3** | 1.3 | JE | 2013 | **4.9** | 1.5 |
| **15** | 0209 | **0.7** | 0.2 | **30** | 0251 | **0.7** | 0.2 |
| | 0752 | **3.9** | 1.2 | | 0847 | **3.9** | 1.2 |
| TH | 1346 | **1.0** | 0.3 | FR | 1436 | **1.3** | 0.4 |
| JE | 2014 | **4.6** | 1.4 | VE | 2052 | **4.9** | 1.5 |

**May-mai**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0332 | **1.0** | 0.3 | **16** | 0313 | **1.0** | 0.3 |
| | 0926 | **3.6** | 1.1 | | 0852 | **3.6** | 1.1 |
| SA | 1512 | **1.3** | 0.4 | SU | 1434 | **1.3** | 0.4 |
| SA | 2127 | **4.9** | 1.5 | DI | 2112 | **4.9** | 1.5 |
| **2** | 0412 | **1.3** | 0.4 | **17** | 0359 | **1.0** | 0.3 |
| | 1004 | **3.6** | 1.1 | | 0939 | **3.6** | 1.1 |
| SU | 1547 | **1.6** | 0.5 | MO | 1521 | **1.3** | 0.4 |
| DI | 2200 | **4.6** | 1.4 | LU | 2154 | **4.9** | 1.5 |
| **3** | 0452 | **1.6** | 0.5 | **18** | 0448 | **1.3** | 0.4 |
| | 1041 | **3.6** | 1.1 | | 1028 | **3.6** | 1.1 |
| MO | 1625 | **2.0** | 0.6 | TU | 1618 | **1.6** | 0.5 |
| LU | 2234 | **4.3** | 1.3 | MA | 2239 | **4.6** | 1.4 |
| **4** | 0537 | **2.0** | 0.6 | **19** | 0542 | **1.3** | 0.4 |
| | 1119 | **3.3** | 1.0 | | 1120 | **3.6** | 1.1 |
| TU | 1710 | **2.0** | 0.6 | WE | 1724 | **1.6** | 0.5 |
| MA | 2310 | **4.3** | 1.3 | ME | 2329 | **4.3** | 1.3 |
| **5** | 0630 | **2.0** | 0.6 | **20** | 0640 | **1.6** | 0.5 |
| | 1206 | **3.3** | 1.0 | | 1218 | **3.6** | 1.1 |
| WE | 1804 | **2.3** | 0.7 | TH | 1832 | **2.0** | 0.6 |
| ME | 2355 | **3.9** | 1.2 | JE | | | |
| **6** | 0733 | **2.3** | 0.7 | **21** | 0031 | **3.9** | 1.2 |
| | 1322 | **3.0** | 0.9 | | 0740 | **1.6** | 0.5 |
| TH | 1909 | **2.3** | 0.7 | FR | 1327 | **3.6** | 1.1 |
| JE | | | | VE | 1943 | **2.0** | 0.6 |
| **7** | 0059 | **3.6** | 1.1 | **22** | 0156 | **3.6** | 1.1 |
| | 0838 | **2.3** | 0.7 | | 0838 | **1.6** | 0.5 |
| FR | 1507 | **3.3** | 1.0 | SA | 1441 | **3.6** | 1.1 |
| VE | 2025 | **2.3** | 0.7 | SA | 2059 | **2.0** | 0.6 |
| **8** | 0238 | **3.6** | 1.1 | **23** | 0324 | **3.6** | 1.1 |
| | 0931 | **2.0** | 0.6 | | 0933 | **1.3** | 0.4 |
| SA | 1608 | **3.3** | 1.0 | SU | 1546 | **3.9** | 1.2 |
| SA | 2150 | **2.0** | 0.6 | DI | 2218 | **1.6** | 0.5 |
| **9** | 0406 | **3.6** | 1.1 | **24** | 0432 | **3.6** | 1.1 |
| | 1014 | **2.0** | 0.6 | | 1026 | **1.3** | 0.4 |
| SU | 1648 | **3.6** | 1.1 | MO | 1642 | **3.9** | 1.2 |
| DI | 2259 | **1.6** | 0.5 | LU | 2326 | **1.3** | 0.4 |
| **10** | 0458 | **3.6** | 1.1 | **25** | 0528 | **3.6** | 1.1 |
| | 1051 | **1.6** | 0.5 | | 1117 | **1.3** | 0.4 |
| MO | 1723 | **3.6** | 1.1 | TU | 1733 | **4.3** | 1.3 |
| LU | 2350 | **1.3** | 0.4 | MA | | | |
| **11** | 0538 | **3.6** | 1.1 | **26** | 0021 | **1.0** | 0.3 |
| | 1127 | **1.6** | 0.5 | | 0618 | **3.6** | 1.1 |
| TU | 1756 | **3.9** | 1.2 | WE | 1206 | **1.3** | 0.4 |
| MA | | | | ME | 1821 | **4.6** | 1.4 |
| **12** | 0031 | **1.0** | 0.3 | **27** | 0110 | **1.0** | 0.3 |
| | 0615 | **3.6** | 1.1 | | 0704 | **3.6** | 1.1 |
| WE | 1202 | **1.3** | 0.4 | TH | 1251 | **1.3** | 0.4 |
| ME | 1831 | **4.3** | 1.3 | JE | 1908 | **4.6** | 1.4 |
| **13** | 0110 | **1.0** | 0.3 | **28** | 0154 | **1.0** | 0.3 |
| | 0651 | **3.6** | 1.1 | | 0749 | **3.6** | 1.1 |
| TH | 1237 | **1.3** | 0.4 | FR | 1334 | **1.3** | 0.4 |
| JE | 1909 | **4.6** | 1.4 | VE | 1951 | **4.9** | 1.5 |
| **14** | 0149 | **0.7** | 0.2 | **29** | 0236 | **1.0** | 0.3 |
| | 0728 | **3.6** | 1.1 | | 0831 | **3.6** | 1.1 |
| FR | 1314 | **1.3** | 0.4 | SA | 1414 | **1.3** | 0.4 |
| VE | 1949 | **4.6** | 1.4 | SA | 2031 | **4.9** | 1.5 |
| **15** | 0230 | **0.7** | 0.2 | **30** | 0315 | **1.0** | 0.3 |
| | 0808 | **3.6** | 1.1 | | 0912 | **3.6** | 1.1 |
| SA | 1352 | **1.3** | 0.4 | SU | 1452 | **1.6** | 0.5 |
| SA | 2030 | **4.9** | 1.5 | DI | 2108 | **4.9** | 1.5 |
| | | | | **31** | 0353 | **1.3** | 0.4 |
| | | | | | 0949 | **3.6** | 1.1 |
| | | | | MO | 1529 | **1.6** | 0.5 |
| | | | | LU | 2140 | **4.6** | 1.4 |

**June-juin**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0429 | **1.6** | 0.5 | **16** | 0435 | **1.0** | 0.3 |
| | 1025 | **3.6** | 1.1 | | 1026 | **3.9** | 1.2 |
| TU | 1606 | **2.0** | 0.6 | WE | 1625 | **1.3** | 0.4 |
| MA | 2211 | **4.6** | 1.4 | ME | 2235 | **4.6** | 1.4 |
| **2** | 0506 | **2.0** | 0.6 | **17** | 0525 | **1.3** | 0.4 |
| | 1101 | **3.6** | 1.1 | | 1115 | **3.9** | 1.2 |
| WE | 1646 | **2.0** | 0.6 | TH | 1723 | **1.6** | 0.5 |
| ME | 2244 | **4.3** | 1.3 | JE | 2323 | **4.3** | 1.3 |
| **3** | 0547 | **2.0** | 0.6 | **18** | 0617 | **1.3** | 0.4 |
| | 1140 | **3.3** | 1.0 | | 1205 | **3.9** | 1.2 |
| TH | 1732 | **2.0** | 0.6 | FR | 1822 | **1.6** | 0.5 |
| JE | 2322 | **3.9** | 1.2 | VE | | | |
| **4** | 0633 | **2.0** | 0.6 | **19** | 0017 | **3.9** | 1.2 |
| | 1228 | **3.3** | 1.0 | | 0709 | **1.3** | 0.4 |
| FR | 1826 | **2.3** | 0.7 | SA | 1259 | **3.9** | 1.2 |
| VE | | | | SA | 1924 | **1.6** | 0.5 |
| **5** | 0010 | **3.6** | 1.1 | **20** | 0122 | **3.6** | 1.1 |
| | 0723 | **2.0** | 0.6 | | 0801 | **1.6** | 0.5 |
| SA | 1328 | **3.3** | 1.0 | SU | 1400 | **3.9** | 1.2 |
| SA | 1930 | **2.3** | 0.7 | DI | 2035 | **2.0** | 0.6 |
| **6** | 0115 | **3.6** | 1.1 | **21** | 0240 | **3.3** | 1.0 |
| | 0811 | **2.0** | 0.6 | | 0853 | **1.6** | 0.5 |
| SU | 1437 | **3.3** | 1.0 | MO | 1505 | **3.9** | 1.2 |
| DI | 2046 | **2.0** | 0.6 | LU | 2155 | **1.6** | 0.5 |
| **7** | 0237 | **3.3** | 1.0 | **22** | 0359 | **3.3** | 1.0 |
| | 0858 | **2.0** | 0.6 | | 0946 | **1.6** | 0.5 |
| MO | 1536 | **3.6** | 1.1 | TU | 1607 | **3.9** | 1.2 |
| LU | 2205 | **2.0** | 0.6 | MA | 2310 | **1.6** | 0.5 |
| **8** | 0354 | **3.3** | 1.0 | **23** | 0507 | **3.3** | 1.0 |
| | 0944 | **2.0** | 0.6 | | 1042 | **1.6** | 0.5 |
| TU | 1626 | **3.6** | 1.1 | WE | 1707 | **4.3** | 1.3 |
| MA | 2311 | **1.6** | 0.5 | ME | | | |
| **9** | 0452 | **3.3** | 1.0 | **24** | 0010 | **1.3** | 0.4 |
| | 1030 | **1.6** | 0.5 | | 0603 | **3.3** | 1.0 |
| WE | 1713 | **3.9** | 1.2 | TH | 1139 | **1.6** | 0.5 |
| ME | | | | JE | 1803 | **4.3** | 1.3 |
| **10** | 0003 | **1.3** | 0.4 | **25** | 0100 | **1.3** | 0.4 |
| | 0540 | **3.3** | 1.0 | | 0653 | **3.3** | 1.0 |
| TH | 1117 | **1.6** | 0.5 | FR | 1232 | **1.6** | 0.5 |
| JE | 1759 | **4.3** | 1.3 | VE | 1854 | **4.6** | 1.4 |
| **11** | 0048 | **1.0** | 0.3 | **26** | 0144 | **1.0** | 0.3 |
| | 0624 | **3.3** | 1.0 | | 0737 | **3.6** | 1.1 |
| FR | 1204 | **1.3** | 0.4 | SA | 1319 | **1.3** | 0.4 |
| VE | 1846 | **4.6** | 1.4 | SA | 1939 | **4.6** | 1.4 |
| **12** | 0132 | **1.0** | 0.3 | **27** | 0223 | **1.3** | 0.4 |
| | 0709 | **3.6** | 1.1 | | 0819 | **3.6** | 1.1 |
| SA | 1253 | **1.3** | 0.4 | SU | 1401 | **1.3** | 0.4 |
| SA | 1932 | **4.9** | 1.5 | DI | 2019 | **4.6** | 1.4 |
| **13** | 0216 | **1.0** | 0.3 | **28** | 0259 | **1.3** | 0.4 |
| | 0756 | **3.6** | 1.1 | | 0858 | **3.6** | 1.1 |
| SU | 1342 | **1.3** | 0.4 | MO | 1439 | **1.3** | 0.4 |
| DI | 2018 | **4.9** | 1.5 | LU | 2052 | **4.6** | 1.4 |
| **14** | 0301 | **1.0** | 0.3 | **29** | 0332 | **1.3** | 0.4 |
| | 0846 | **3.9** | 1.2 | | 0934 | **3.6** | 1.1 |
| MO | 1433 | **1.3** | 0.4 | TU | 1515 | **1.6** | 0.5 |
| LU | 2103 | **4.9** | 1.5 | MA | 2121 | **4.6** | 1.4 |
| **15** | 0347 | **1.0** | 0.3 | **30** | 0402 | **1.6** | 0.5 |
| | 0936 | **3.9** | 1.2 | | 1007 | **3.6** | 1.1 |
| TU | 1527 | **1.3** | 0.4 | WE | 1548 | **1.6** | 0.5 |
| MA | 2149 | **4.9** | 1.5 | ME | 2149 | **4.6** | 1.4 |

**ST JOHN'S** NST Z+3.5 **2010** **TIDE TABLES**

**July-juillet**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0431 | **1.6** | 0.5 | **16** | 0501 | **1.0** | 0.3 |
| | 1037 | **3.6** | 1.1 | | 1058 | **4.3** | 1.3 |
| TH | 1622 | **1.6** | 0.5 | FR | 1712 | **1.3** | 0.4 |
| JE | 2218 | **4.3** | 1.3 | VE | 2309 | **4.6** | 1.4 |
| **2** | 0501 | **1.6** | 0.5 | **17** | 0548 | **1.3** | 0.4 |
| | 1108 | **3.6** | 1.1 | | 1142 | **4.3** | 1.3 |
| FR | 1700 | **2.0** | 0.6 | SA | 1804 | **1.6** | 0.5 |
| VE | 2252 | **4.3** | 1.3 | SA | 2355 | **3.9** | 1.2 |
| **3** | 0536 | **1.6** | 0.5 | **18** | 0635 | **1.3** | 0.4 |
| | 1141 | **3.6** | 1.1 | | 1227 | **4.3** | 1.3 |
| SA | 1745 | **2.0** | 0.6 | SU | 1901 | **1.6** | 0.5 |
| SA | 2332 | **3.9** | 1.2 | DI | | | |
| **4** | 0616 | **2.0** | 0.6 | **19** | 0046 | **3.6** | 1.1 |
| | 1221 | **3.6** | 1.1 | | 0722 | **1.6** | 0.5 |
| SU | 1841 | **2.0** | 0.6 | MO | 1317 | **3.9** | 1.2 |
| DI | | | | LU | 2009 | **2.0** | 0.6 |
| **5** | 0021 | **3.6** | 1.1 | **20** | 0153 | **3.3** | 1.0 |
| | 0701 | **2.0** | 0.6 | | 0812 | **1.6** | 0.5 |
| MO | 1312 | **3.6** | 1.1 | TU | 1418 | **3.9** | 1.2 |
| LU | 1952 | **2.0** | 0.6 | MA | 2133 | **2.0** | 0.6 |
| **6** | 0125 | **3.3** | 1.0 | **21** | 0329 | **3.0** | 0.9 |
| | 0750 | **2.0** | 0.6 | | 0908 | **2.0** | 0.6 |
| TU | 1417 | **3.6** | 1.1 | WE | 1534 | **3.9** | 1.2 |
| MA | 2115 | **2.0** | 0.6 | ME | 2259 | **2.0** | 0.6 |
| **7** | 0243 | **3.0** | 0.9 | **22** | 0457 | **3.0** | 0.9 |
| | 0842 | **2.0** | 0.6 | | 1014 | **2.0** | 0.6 |
| WE | 1529 | **3.6** | 1.1 | TH | 1652 | **3.9** | 1.2 |
| ME | 2234 | **2.0** | 0.6 | JE | | | |
| **8** | 0403 | **3.0** | 0.9 | **23** | 0004 | **1.6** | 0.5 |
| | 0939 | **2.0** | 0.6 | | 0557 | **3.0** | 0.9 |
| TH | 1636 | **3.9** | 1.2 | FR | 1124 | **2.0** | 0.6 |
| JE | 2337 | **1.6** | 0.5 | VE | 1757 | **4.3** | 1.3 |
| **9** | 0509 | **3.0** | 0.9 | **24** | 0053 | **1.3** | 0.4 |
| | 1041 | **1.6** | 0.5 | | 0644 | **3.3** | 1.0 |
| FR | 1736 | **4.3** | 1.3 | SA | 1224 | **1.6** | 0.5 |
| VE | | | | SA | 1848 | **4.3** | 1.3 |
| **10** | 0028 | **1.3** | 0.4 | **25** | 0133 | **1.3** | 0.4 |
| | 0604 | **3.3** | 1.0 | | 0726 | **3.6** | 1.1 |
| SA | 1144 | **1.6** | 0.5 | SU | 1311 | **1.6** | 0.5 |
| SA | 1831 | **4.6** | 1.4 | DI | 1930 | **4.6** | 1.4 |
| **11** | 0115 | **1.0** | 0.3 | **26** | 0208 | **1.3** | 0.4 |
| | 0656 | **3.6** | 1.1 | | 0805 | **3.6** | 1.1 |
| SU | 1243 | **1.3** | 0.4 | MO | 1351 | **1.3** | 0.4 |
| DI | 1921 | **4.9** | 1.5 | LU | 2005 | **4.6** | 1.4 |
| **12** | 0200 | **1.0** | 0.3 | **27** | 0238 | **1.3** | 0.4 |
| | 0748 | **3.9** | 1.2 | | 0840 | **3.9** | 1.2 |
| MO | 1339 | **1.3** | 0.4 | TU | 1427 | **1.3** | 0.4 |
| LU | 2009 | **5.2** | 1.6 | MA | 2034 | **4.6** | 1.4 |
| **13** | 0245 | **0.7** | 0.2 | **28** | 0304 | **1.3** | 0.4 |
| | 0839 | **3.9** | 1.2 | | 0912 | **3.9** | 1.2 |
| TU | 1433 | **1.0** | 0.3 | WE | 1459 | **1.3** | 0.4 |
| MA | 2055 | **5.2** | 1.6 | ME | 2059 | **4.6** | 1.4 |
| **14** | 0330 | **0.7** | 0.2 | **29** | 0328 | **1.3** | 0.4 |
| | 0927 | **4.3** | 1.3 | | 0941 | **3.9** | 1.2 |
| WE | 1526 | **1.0** | 0.3 | TH | 1529 | **1.3** | 0.4 |
| ME | 2140 | **4.9** | 1.5 | JE | 2124 | **4.6** | 1.4 |
| **15** | 0415 | **1.0** | 0.3 | **30** | 0351 | **1.3** | 0.4 |
| | 1014 | **4.3** | 1.3 | | 1006 | **3.9** | 1.2 |
| TH | 1619 | **1.3** | 0.4 | FR | 1559 | **1.6** | 0.5 |
| JE | 2225 | **4.9** | 1.5 | VE | 2152 | **4.3** | 1.3 |
| | | | | **31** | 0415 | **1.6** | 0.5 |
| | | | | | 1032 | **3.9** | 1.2 |
| | | | | SA | 1633 | **1.6** | 0.5 |
| | | | | SA | 2223 | **4.3** | 1.3 |

**August-août**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0441 | **1.6** | 0.5 | **16** | 0556 | **1.6** | 0.5 |
| | 1059 | **3.9** | 1.2 | | 1152 | **4.3** | 1.3 |
| SU | 1712 | **1.6** | 0.5 | MO | 1837 | **1.6** | 0.5 |
| DI | 2259 | **3.9** | 1.2 | LU | | | |
| **2** | 0511 | **1.6** | 0.5 | **17** | 0014 | **3.3** | 1.0 |
| | 1132 | **3.9** | 1.2 | | 0641 | **1.6** | 0.5 |
| MO | 1802 | **2.0** | 0.6 | TU | 1234 | **3.9** | 1.2 |
| LU | 2340 | **3.6** | 1.1 | MA | 1944 | **2.0** | 0.6 |
| **3** | 0549 | **2.0** | 0.6 | **18** | 0111 | **3.0** | 0.9 |
| | 1213 | **3.6** | 1.1 | | 0731 | **2.0** | 0.6 |
| TU | 1911 | **2.0** | 0.6 | WE | 1331 | **3.9** | 1.2 |
| MA | | | | ME | 2112 | **2.0** | 0.6 |
| **4** | 0031 | **3.3** | 1.0 | **19** | 0305 | **3.0** | 0.9 |
| | 0641 | **2.0** | 0.6 | | 0834 | **2.3** | 0.7 |
| WE | 1313 | **3.6** | 1.1 | TH | 1503 | **3.6** | 1.1 |
| ME | 2036 | **2.0** | 0.6 | JE | 2249 | **2.0** | 0.6 |
| **5** | 0143 | **3.0** | 0.9 | **20** | 0453 | **3.0** | 0.9 |
| | 0746 | **2.0** | 0.6 | | 0955 | **2.3** | 0.7 |
| TH | 1437 | **3.6** | 1.1 | FR | 1648 | **3.9** | 1.2 |
| JE | 2202 | **2.0** | 0.6 | VE | 2355 | **2.0** | 0.6 |
| **6** | 0320 | **3.0** | 0.9 | **21** | 0548 | **3.3** | 1.0 |
| | 0900 | **2.0** | 0.6 | | 1118 | **2.0** | 0.6 |
| FR | 1609 | **3.9** | 1.2 | SA | 1753 | **3.9** | 1.2 |
| VE | 2311 | **1.6** | 0.5 | SA | | | |
| **7** | 0448 | **3.0** | 0.9 | **22** | 0038 | **1.6** | 0.5 |
| | 1020 | **2.0** | 0.6 | | 0629 | **3.3** | 1.0 |
| SA | 1722 | **4.3** | 1.3 | SU | 1216 | **1.6** | 0.5 |
| SA | | | | DI | 1837 | **4.3** | 1.3 |
| **8** | 0006 | **1.3** | 0.4 | **23** | 0113 | **1.3** | 0.4 |
| | 0551 | **3.3** | 1.0 | | 0706 | **3.6** | 1.1 |
| SU | 1136 | **1.6** | 0.5 | MO | 1300 | **1.3** | 0.4 |
| DI | 1820 | **4.6** | 1.4 | LU | 1913 | **4.6** | 1.4 |
| **9** | 0054 | **1.0** | 0.3 | **24** | 0142 | **1.3** | 0.4 |
| | 0644 | **3.6** | 1.1 | | 0741 | **3.9** | 1.2 |
| MO | 1240 | **1.3** | 0.4 | TU | 1337 | **1.3** | 0.4 |
| LU | 1910 | **4.9** | 1.5 | MA | 1943 | **4.6** | 1.4 |
| **10** | 0139 | **0.7** | 0.2 | **25** | 0206 | **1.3** | 0.4 |
| | 0735 | **3.9** | 1.2 | | 0813 | **3.9** | 1.2 |
| TU | 1336 | **1.0** | 0.3 | WE | 1410 | **1.3** | 0.4 |
| MA | 1957 | **5.2** | 1.6 | ME | 2008 | **4.6** | 1.4 |
| **11** | 0223 | **0.7** | 0.2 | **26** | 0228 | **1.3** | 0.4 |
| | 0823 | **4.3** | 1.3 | | 0842 | **3.9** | 1.2 |
| WE | 1428 | **1.0** | 0.3 | TH | 1440 | **1.0** | 0.3 |
| ME | 2042 | **5.2** | 1.6 | JE | 2033 | **4.6** | 1.4 |
| **12** | 0306 | **0.7** | 0.2 | **27** | 0249 | **1.3** | 0.4 |
| | 0910 | **4.6** | 1.4 | | 0907 | **4.3** | 1.3 |
| TH | 1518 | **0.7** | 0.2 | FR | 1509 | **1.3** | 0.4 |
| JE | 2126 | **4.9** | 1.5 | VE | 2058 | **4.3** | 1.3 |
| **13** | 0349 | **0.7** | 0.2 | **28** | 0310 | **1.3** | 0.4 |
| | 0953 | **4.6** | 1.4 | | 0932 | **4.3** | 1.3 |
| FR | 1606 | **1.0** | 0.3 | SA | 1539 | **1.3** | 0.4 |
| VE | 2208 | **4.6** | 1.4 | SA | 2127 | **4.3** | 1.3 |
| **14** | 0432 | **1.0** | 0.3 | **29** | 0332 | **1.3** | 0.4 |
| | 1034 | **4.6** | 1.4 | | 0957 | **4.3** | 1.3 |
| SA | 1654 | **1.0** | 0.3 | SU | 1612 | **1.3** | 0.4 |
| SA | 2250 | **4.3** | 1.3 | DI | 2158 | **3.9** | 1.2 |
| **15** | 0514 | **1.3** | 0.4 | **30** | 0354 | **1.6** | 0.5 |
| | 1113 | **4.6** | 1.4 | | 1025 | **4.3** | 1.3 |
| SU | 1744 | **1.3** | 0.4 | MO | 1650 | **1.6** | 0.5 |
| DI | 2330 | **3.9** | 1.2 | LU | 2233 | **3.9** | 1.2 |
| | | | | **31** | 0418 | **1.6** | 0.5 |
| | | | | | 1056 | **3.9** | 1.2 |
| | | | | TU | 1740 | **1.6** | 0.5 |
| | | | | MA | 2310 | **3.6** | 1.1 |

**September-septembre**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0447 | **2.0** | 0.6 | **16** | 0042 | **3.0** | 0.9 |
| | 1135 | **3.9** | 1.2 | | 0656 | **2.3** | 0.7 |
| WE | 1848 | **2.0** | 0.6 | TH | 1249 | **3.9** | 1.2 |
| ME | 2357 | **3.3** | 1.0 | JE | 2046 | **2.3** | 0.7 |
| **2** | 0538 | **2.0** | 0.6 | **17** | 0242 | **3.0** | 0.9 |
| | 1229 | **3.9** | 1.2 | | 0806 | **2.3** | 0.7 |
| TH | 2010 | **2.0** | 0.6 | FR | 1428 | **3.6** | 1.1 |
| JE | | | | VE | 2222 | **2.3** | 0.7 |
| **3** | 0107 | **3.0** | 0.9 | **18** | 0433 | **3.0** | 0.9 |
| | 0709 | **2.0** | 0.6 | | 0936 | **2.3** | 0.7 |
| FR | 1357 | **3.6** | 1.1 | SA | 1633 | **3.6** | 1.1 |
| VE | 2133 | **2.0** | 0.6 | SA | 2325 | **2.0** | 0.6 |
| **4** | 0255 | **3.0** | 0.9 | **19** | 0523 | **3.3** | 1.0 |
| | 0842 | **2.0** | 0.6 | | 1102 | **2.0** | 0.6 |
| SA | 1549 | **3.9** | 1.2 | SU | 1732 | **3.9** | 1.2 |
| SA | 2241 | **1.6** | 0.5 | DI | | | |
| **5** | 0433 | **3.3** | 1.0 | **20** | 0006 | **1.6** | 0.5 |
| | 1013 | **2.0** | 0.6 | | 0601 | **3.6** | 1.1 |
| SU | 1709 | **4.3** | 1.3 | MO | 1159 | **1.6** | 0.5 |
| DI | 2337 | **1.3** | 0.4 | LU | 1812 | **3.9** | 1.2 |
| **6** | 0535 | **3.6** | 1.1 | **21** | 0037 | **1.6** | 0.5 |
| | 1132 | **1.6** | 0.5 | | 0636 | **3.6** | 1.1 |
| MO | 1806 | **4.6** | 1.4 | TU | 1241 | **1.3** | 0.4 |
| LU | | | | MA | 1844 | **4.3** | 1.3 |
| **7** | 0026 | **1.0** | 0.3 | **22** | 0102 | **1.3** | 0.4 |
| | 0626 | **3.9** | 1.2 | | 0708 | **3.9** | 1.2 |
| TU | 1234 | **1.3** | 0.4 | WE | 1316 | **1.3** | 0.4 |
| MA | 1854 | **4.9** | 1.5 | ME | 1912 | **4.3** | 1.3 |
| **8** | 0112 | **0.7** | 0.2 | **23** | 0124 | **1.3** | 0.4 |
| | 0714 | **4.3** | 1.3 | | 0738 | **3.9** | 1.2 |
| WE | 1327 | **1.0** | 0.3 | TH | 1348 | **1.0** | 0.3 |
| ME | 1940 | **4.9** | 1.5 | JE | 1938 | **4.3** | 1.3 |
| **9** | 0156 | **0.7** | 0.2 | **24** | 0145 | **1.0** | 0.3 |
| | 0801 | **4.6** | 1.4 | | 0805 | **4.3** | 1.3 |
| TH | 1416 | **0.7** | 0.2 | FR | 1418 | **1.0** | 0.3 |
| JE | 2024 | **4.9** | 1.5 | VE | 2005 | **4.3** | 1.3 |
| **10** | 0238 | **0.7** | 0.2 | **25** | 0207 | **1.0** | 0.3 |
| | 0845 | **4.9** | 1.5 | | 0831 | **4.3** | 1.3 |
| FR | 1503 | **0.7** | 0.2 | SA | 1449 | **1.0** | 0.3 |
| VE | 2106 | **4.9** | 1.5 | SA | 2033 | **4.3** | 1.3 |
| **11** | 0319 | **0.7** | 0.2 | **26** | 0231 | **1.3** | 0.4 |
| | 0927 | **4.9** | 1.5 | | 0858 | **4.3** | 1.3 |
| SA | 1550 | **0.7** | 0.2 | SU | 1522 | **1.0** | 0.3 |
| SA | 2148 | **4.6** | 1.4 | DI | 2105 | **3.9** | 1.2 |
| **12** | 0359 | **1.0** | 0.3 | **27** | 0255 | **1.3** | 0.4 |
| | 1006 | **4.9** | 1.5 | | 0928 | **4.3** | 1.3 |
| SU | 1636 | **1.0** | 0.3 | MO | 1558 | **1.3** | 0.4 |
| DI | 2229 | **3.9** | 1.2 | LU | 2138 | **3.9** | 1.2 |
| **13** | 0438 | **1.3** | 0.4 | **28** | 0319 | **1.3** | 0.4 |
| | 1042 | **4.6** | 1.4 | | 0959 | **4.3** | 1.3 |
| MO | 1723 | **1.3** | 0.4 | TU | 1640 | **1.3** | 0.4 |
| LU | 2308 | **3.6** | 1.1 | MA | 2214 | **3.6** | 1.1 |
| **14** | 0518 | **1.6** | 0.5 | **29** | 0346 | **1.6** | 0.5 |
| | 1118 | **4.3** | 1.3 | | 1033 | **4.3** | 1.3 |
| TU | 1814 | **1.6** | 0.5 | WE | 1731 | **1.6** | 0.5 |
| MA | 2349 | **3.3** | 1.0 | ME | 2255 | **3.6** | 1.1 |
| **15** | 0602 | **2.0** | 0.6 | **30** | 0421 | **2.0** | 0.6 |
| | 1157 | **4.3** | 1.3 | | 1113 | **4.3** | 1.3 |
| WE | 1919 | **2.0** | 0.6 | TH | 1835 | **2.0** | 0.6 |
| ME | | | | JE | 2346 | **3.3** | 1.0 |

**TABLE DES MARÉES** **2010** **ST JOHN'S** HNTN Z+3.5

**October-octobre**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0528 | **2.0** | 0.6 | **16** | 0156 | **3.0** | 0.9 |
| | 1207 | **3.9** | 1.2 | | 0735 | **2.3** | 0.7 |
| FR | 1949 | **2.0** | 0.6 | SA | 1334 | **3.6** | 1.1 |
| VE | | | | SA | 2125 | **2.3** | 0.7 |
| **2** | 0058 | **3.0** | 0.9 | **17** | 0346 | **3.3** | 1.0 |
| | 0706 | **2.3** | 0.7 | | 0859 | **2.3** | 0.7 |
| SA | 1332 | **3.6** | 1.1 | SU | 1543 | **3.6** | 1.1 |
| SA | 2102 | **2.0** | 0.6 | DI | 2226 | **2.0** | 0.6 |
| **3** | 0242 | **3.3** | 1.0 | **18** | 0441 | **3.3** | 1.0 |
| | 0837 | **2.0** | 0.6 | | 1026 | **2.0** | 0.6 |
| SU | 1529 | **3.6** | 1.1 | MO | 1650 | **3.6** | 1.1 |
| DI | 2207 | **1.6** | 0.5 | LU | 2309 | **2.0** | 0.6 |
| **4** | 0411 | **3.3** | 1.0 | **19** | 0521 | **3.6** | 1.1 |
| | 1007 | **2.0** | 0.6 | | 1129 | **1.6** | 0.5 |
| MO | 1650 | **3.9** | 1.2 | TU | 1732 | **3.6** | 1.1 |
| LU | 2303 | **1.3** | 0.4 | MA | 2342 | **1.6** | 0.5 |
| **5** | 0510 | **3.9** | 1.2 | **20** | 0556 | **3.6** | 1.1 |
| | 1123 | **1.3** | 0.4 | | 1213 | **1.3** | 0.4 |
| TU | 1745 | **4.3** | 1.3 | WE | 1807 | **3.9** | 1.2 |
| MA | 2354 | **1.0** | 0.3 | ME | | | |
| **6** | 0559 | **4.3** | 1.3 | **21** | 0009 | **1.3** | 0.4 |
| | 1222 | **1.0** | 0.3 | | 0627 | **3.9** | 1.2 |
| WE | 1833 | **4.6** | 1.4 | TH | 1250 | **1.3** | 0.4 |
| ME | | | | JE | 1837 | **3.9** | 1.2 |
| **7** | 0041 | **0.7** | 0.2 | **22** | 0034 | **1.3** | 0.4 |
| | 0647 | **4.6** | 1.4 | | 0657 | **4.3** | 1.3 |
| TH | 1314 | **0.7** | 0.2 | FR | 1323 | **1.0** | 0.3 |
| JE | 1918 | **4.6** | 1.4 | VE | 1907 | **3.9** | 1.2 |
| **8** | 0125 | **0.7** | 0.2 | **23** | 0100 | **1.3** | 0.4 |
| | 0734 | **4.6** | 1.4 | | 0727 | **4.3** | 1.3 |
| FR | 1401 | **0.7** | 0.2 | SA | 1356 | **1.0** | 0.3 |
| VE | 2003 | **4.6** | 1.4 | SA | 1938 | **3.9** | 1.2 |
| **9** | 0207 | **0.7** | 0.2 | **24** | 0128 | **1.3** | 0.4 |
| | 0818 | **4.9** | 1.5 | | 0758 | **4.6** | 1.4 |
| SA | 1447 | **0.7** | 0.2 | SU | 1431 | **1.0** | 0.3 |
| SA | 2046 | **4.3** | 1.3 | DI | 2010 | **3.9** | 1.2 |
| **10** | 0247 | **1.0** | 0.3 | **25** | 0158 | **1.3** | 0.4 |
| | 0859 | **4.9** | 1.5 | | 0831 | **4.6** | 1.4 |
| SU | 1532 | **0.7** | 0.2 | MO | 1508 | **1.0** | 0.3 |
| DI | 2129 | **3.9** | 1.2 | LU | 2046 | **3.9** | 1.2 |
| **11** | 0326 | **1.0** | 0.3 | **26** | 0228 | **1.3** | 0.4 |
| | 0938 | **4.9** | 1.5 | | 0906 | **4.6** | 1.4 |
| MO | 1617 | **1.0** | 0.3 | TU | 1548 | **1.0** | 0.3 |
| LU | 2210 | **3.9** | 1.2 | MA | 2124 | **3.6** | 1.1 |
| **12** | 0404 | **1.3** | 0.4 | **27** | 0301 | **1.3** | 0.4 |
| | 1014 | **4.9** | 1.5 | | 0943 | **4.6** | 1.4 |
| TU | 1702 | **1.3** | 0.4 | WE | 1633 | **1.3** | 0.4 |
| MA | 2251 | **3.6** | 1.1 | ME | 2206 | **3.6** | 1.1 |
| **13** | 0445 | **1.6** | 0.5 | **28** | 0340 | **1.6** | 0.5 |
| | 1049 | **4.6** | 1.4 | | 1021 | **4.6** | 1.4 |
| WE | 1752 | **1.6** | 0.5 | TH | 1724 | **1.6** | 0.5 |
| ME | 2332 | **3.3** | 1.0 | JE | 2253 | **3.6** | 1.1 |
| **14** | 0531 | **2.0** | 0.6 | **29** | 0434 | **2.0** | 0.6 |
| | 1127 | **4.3** | 1.3 | | 1104 | **4.3** | 1.3 |
| TH | 1851 | **2.0** | 0.6 | FR | 1823 | **1.6** | 0.5 |
| JE | | | | VE | 2347 | **3.3** | 1.0 |
| **15** | 0023 | **3.3** | 1.0 | **30** | 0550 | **2.0** | 0.6 |
| | 0627 | **2.3** | 0.7 | | 1158 | **3.9** | 1.2 |
| FR | 1215 | **3.9** | 1.2 | SA | 1927 | **2.0** | 0.6 |
| VE | 2005 | **2.3** | 0.7 | SA | | | |
| | | | | **31** | 0055 | **3.3** | 1.0 |
| | | | | | 0709 | **2.0** | 0.6 |
| | | | | SU | 1317 | **3.6** | 1.1 |
| | | | | DI | 2031 | **1.6** | 0.5 |

**November-novembre**

| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0221 | **3.3** | 1.0 | **16** | 0338 | **3.3** | 1.0 |
| | 0830 | **2.0** | 0.6 | | 0928 | **2.3** | 0.7 |
| MO | 1502 | **3.6** | 1.1 | TU | 1537 | **3.3** | 1.0 |
| LU | 2131 | **1.6** | 0.5 | MA | 2149 | **2.0** | 0.6 |
| **2** | 0339 | **3.6** | 1.1 | **17** | 0427 | **3.6** | 1.1 |
| | 0953 | **1.6** | 0.5 | | 1043 | **2.0** | 0.6 |
| TU | 1621 | **3.6** | 1.1 | WE | 1639 | **3.3** | 1.0 |
| MA | 2226 | **1.3** | 0.4 | ME | 2229 | **1.6** | 0.5 |
| **3** | 0439 | **3.9** | 1.2 | **18** | 0506 | **3.6** | 1.1 |
| | 1107 | **1.3** | 0.4 | | 1137 | **1.6** | 0.5 |
| WE | 1719 | **3.9** | 1.2 | TH | 1723 | **3.3** | 1.0 |
| ME | 2318 | **1.0** | 0.3 | JE | 2306 | **1.6** | 0.5 |
| **4** | 0531 | **4.3** | 1.3 | **19** | 0542 | **3.9** | 1.2 |
| | 1207 | **1.0** | 0.3 | | 1220 | **1.3** | 0.4 |
| TH | 1810 | **3.9** | 1.2 | FR | 1801 | **3.6** | 1.1 |
| JE | | | | VE | 2343 | **1.6** | 0.5 |
| **5** | 0008 | **1.0** | 0.3 | **20** | 0617 | **4.3** | 1.3 |
| | 0620 | **4.6** | 1.4 | | 1258 | **1.0** | 0.3 |
| FR | 1259 | **0.7** | 0.2 | SA | 1836 | **3.6** | 1.1 |
| VE | 1857 | **3.9** | 1.2 | SA | | | |
| **6** | 0054 | **1.0** | 0.3 | **21** | 0019 | **1.3** | 0.4 |
| | 0707 | **4.6** | 1.4 | | 0654 | **4.3** | 1.3 |
| SA | 1347 | **0.7** | 0.2 | SU | 1335 | **1.0** | 0.3 |
| SA | 1944 | **3.9** | 1.2 | DI | 1913 | **3.6** | 1.1 |
| **7** | 0138 | **1.0** | 0.3 | **22** | 0056 | **1.3** | 0.4 |
| | 0752 | **4.9** | 1.5 | | 0733 | **4.6** | 1.4 |
| SU | 1432 | **0.7** | 0.2 | MO | 1414 | **1.0** | 0.3 |
| DI | 2029 | **3.9** | 1.2 | LU | 1951 | **3.6** | 1.1 |
| **8** | 0219 | **1.0** | 0.3 | **23** | 0135 | **1.3** | 0.4 |
| | 0835 | **4.9** | 1.5 | | 0812 | **4.9** | 1.5 |
| MO | 1516 | **1.0** | 0.3 | TU | 1454 | **1.0** | 0.3 |
| LU | 2113 | **3.9** | 1.2 | MA | 2033 | **3.6** | 1.1 |
| **9** | 0259 | **1.3** | 0.4 | **24** | 0215 | **1.3** | 0.4 |
| | 0914 | **4.9** | 1.5 | | 0852 | **4.9** | 1.5 |
| TU | 1559 | **1.0** | 0.3 | WE | 1537 | **1.0** | 0.3 |
| MA | 2155 | **3.6** | 1.1 | ME | 2117 | **3.6** | 1.1 |
| **10** | 0340 | **1.6** | 0.5 | **25** | 0259 | **1.3** | 0.4 |
| | 0951 | **4.9** | 1.5 | | 0933 | **4.9** | 1.5 |
| WE | 1642 | **1.3** | 0.4 | TH | 1623 | **1.3** | 0.4 |
| ME | 2236 | **3.6** | 1.1 | JE | 2204 | **3.6** | 1.1 |
| **11** | 0421 | **1.6** | 0.5 | **26** | 0351 | **1.6** | 0.5 |
| | 1026 | **4.6** | 1.4 | | 1015 | **4.6** | 1.4 |
| TH | 1727 | **1.6** | 0.5 | FR | 1712 | **1.3** | 0.4 |
| JE | 2316 | **3.3** | 1.0 | VE | 2253 | **3.6** | 1.1 |
| **12** | 0507 | **2.0** | 0.6 | **27** | 0451 | **1.6** | 0.5 |
| | 1102 | **4.3** | 1.3 | | 1059 | **4.3** | 1.3 |
| FR | 1817 | **2.0** | 0.6 | SA | 1805 | **1.6** | 0.5 |
| VE | | | | SA | 2345 | **3.6** | 1.1 |
| **13** | 0001 | **3.3** | 1.0 | **28** | 0555 | **1.6** | 0.5 |
| | 0558 | **2.3** | 0.7 | | 1153 | **3.9** | 1.2 |
| SA | 1144 | **3.9** | 1.2 | SU | 1902 | **1.6** | 0.5 |
| SA | 1913 | **2.0** | 0.6 | DI | | | |
| **14** | 0102 | **3.3** | 1.0 | **29** | 0044 | **3.6** | 1.1 |
| | 0656 | **2.3** | 0.7 | | 0702 | **2.0** | 0.6 |
| SU | 1239 | **3.6** | 1.1 | MO | 1300 | **3.6** | 1.1 |
| DI | 2011 | **2.3** | 0.7 | LU | 1959 | **1.6** | 0.5 |
| **15** | 0228 | **3.3** | 1.0 | **30** | 0152 | **3.6** | 1.1 |
| | 0806 | **2.3** | 0.7 | | 0814 | **2.0** | 0.6 |
| MO | 1403 | **3.6** | 1.1 | TU | 1426 | **3.6** | 1.1 |
| LU | 2104 | **2.0** | 0.6 | MA | 2054 | **1.6** | 0.5 |

**December-décembre**

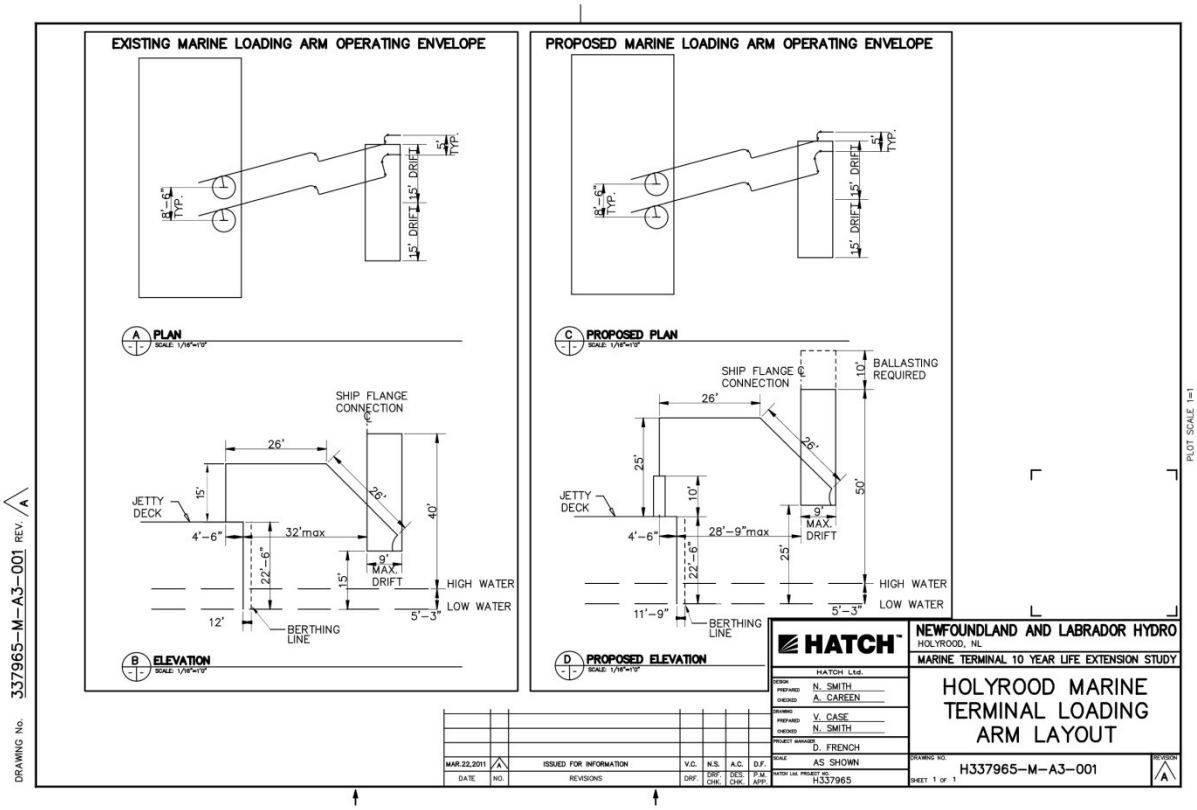
| Day | Time | Feet | Metres | jour | heure | pieds | mètres |
|---|---|---|---|---|---|---|---|
| **1** | 0302 | **3.9** | 1.2 | **16** | 0309 | **3.6** | 1.1 |
| | 0933 | **1.6** | 0.5 | | 0943 | **2.0** | 0.6 |
| WE | 1547 | **3.6** | 1.1 | TH | 1524 | **3.3** | 1.0 |
| ME | 2149 | **1.3** | 0.4 | JE | 2118 | **2.0** | 0.6 |
| **2** | 0405 | **3.9** | 1.2 | **17** | 0406 | **3.6** | 1.1 |
| | 1048 | **1.6** | 0.5 | | 1054 | **1.6** | 0.5 |
| TH | 1653 | **3.6** | 1.1 | FR | 1632 | **3.3** | 1.0 |
| JE | 2243 | **1.3** | 0.4 | VE | 2206 | **2.0** | 0.6 |
| **3** | 0502 | **4.3** | 1.3 | **18** | 0457 | **3.9** | 1.2 |
| | 1152 | **1.3** | 0.4 | | 1149 | **1.6** | 0.5 |
| FR | 1750 | **3.6** | 1.1 | SA | 1724 | **3.3** | 1.0 |
| VE | 2337 | **1.3** | 0.4 | SA | 2256 | **1.6** | 0.5 |
| **4** | 0555 | **4.3** | 1.3 | **19** | 0544 | **4.3** | 1.3 |
| | 1246 | **1.0** | 0.3 | | 1234 | **1.3** | 0.4 |
| SA | 1841 | **3.6** | 1.1 | SU | 1809 | **3.3** | 1.0 |
| SA | | | | DI | 2345 | **1.6** | 0.5 |
| **5** | 0028 | **1.3** | 0.4 | **20** | 0630 | **4.6** | 1.4 |
| | 0646 | **4.6** | 1.4 | | 1316 | **1.0** | 0.3 |
| SU | 1335 | **1.0** | 0.3 | MO | 1852 | **3.3** | 1.0 |
| DI | 1930 | **3.6** | 1.1 | LU | | | |
| **6** | 0116 | **1.3** | 0.4 | **21** | 0034 | **1.3** | 0.4 |
| | 0734 | **4.9** | 1.5 | | 0715 | **4.6** | 1.4 |
| MO | 1420 | **1.0** | 0.3 | TU | 1358 | **1.0** | 0.3 |
| LU | 2017 | **3.6** | 1.1 | MA | 1937 | **3.6** | 1.1 |
| **7** | 0201 | **1.3** | 0.4 | **22** | 0122 | **1.3** | 0.4 |
| | 0818 | **4.9** | 1.5 | | 0759 | **4.9** | 1.5 |
| TU | 1502 | **1.0** | 0.3 | WE | 1440 | **1.0** | 0.3 |
| MA | 2101 | **3.6** | 1.1 | ME | 2024 | **3.6** | 1.1 |
| **8** | 0243 | **1.3** | 0.4 | **23** | 0211 | **1.3** | 0.4 |
| | 0857 | **4.9** | 1.5 | | 0842 | **4.9** | 1.5 |
| WE | 1542 | **1.3** | 0.4 | TH | 1523 | **1.0** | 0.3 |
| ME | 2142 | **3.6** | 1.1 | JE | 2112 | **3.9** | 1.2 |
| **9** | 0323 | **1.6** | 0.5 | **24** | 0302 | **1.3** | 0.4 |
| | 0933 | **4.9** | 1.5 | | 0925 | **4.9** | 1.5 |
| TH | 1620 | **1.3** | 0.4 | FR | 1608 | **1.0** | 0.3 |
| JE | 2220 | **3.6** | 1.1 | VE | 2159 | **3.9** | 1.2 |
| **10** | 0403 | **1.6** | 0.5 | **25** | 0356 | **1.3** | 0.4 |
| | 1006 | **4.6** | 1.4 | | 1009 | **4.9** | 1.5 |
| FR | 1658 | **1.6** | 0.5 | SA | 1654 | **1.0** | 0.3 |
| VE | 2256 | **3.6** | 1.1 | SA | 2246 | **3.9** | 1.2 |
| **11** | 0443 | **2.0** | 0.6 | **26** | 0452 | **1.3** | 0.4 |
| | 1037 | **4.3** | 1.3 | | 1054 | **4.6** | 1.4 |
| SA | 1736 | **2.0** | 0.6 | SU | 1743 | **1.3** | 0.4 |
| SA | 2333 | **3.6** | 1.1 | DI | 2333 | **3.9** | 1.2 |
| **12** | 0525 | **2.0** | 0.6 | **27** | 0548 | **1.6** | 0.5 |
| | 1112 | **4.3** | 1.3 | | 1142 | **4.3** | 1.3 |
| SU | 1816 | **2.0** | 0.6 | MO | 1834 | **1.3** | 0.4 |
| DI | | | | LU | | | |
| **13** | 0013 | **3.6** | 1.1 | **28** | 0023 | **3.9** | 1.2 |
| | 0613 | **2.0** | 0.6 | | 0648 | **1.6** | 0.5 |
| MO | 1153 | **3.9** | 1.2 | TU | 1238 | **3.6** | 1.1 |
| LU | 1859 | **2.0** | 0.6 | MA | 1925 | **1.3** | 0.4 |
| **14** | 0103 | **3.3** | 1.0 | **29** | 0119 | **3.9** | 1.2 |
| | 0711 | **2.3** | 0.7 | | 0754 | **1.6** | 0.5 |
| TU | 1248 | **3.6** | 1.1 | WE | 1347 | **3.3** | 1.0 |
| MA | 1945 | **2.0** | 0.6 | ME | 2018 | **1.6** | 0.5 |
| **15** | 0204 | **3.3** | 1.0 | **30** | 0222 | **3.9** | 1.2 |
| | 0822 | **2.3** | 0.7 | | 0911 | **2.0** | 0.6 |
| WE | 1401 | **3.3** | 1.0 | TH | 1511 | **3.3** | 1.0 |
| ME | 2031 | **2.0** | 0.6 | JE | 2112 | **1.6** | 0.5 |
| | | | | **31** | 0330 | **3.9** | 1.2 |
| | | | | | 1033 | **1.6** | 0.5 |
| | | | | FR | 1633 | **3.3** | 1.0 |
| | | | | VE | 2211 | **1.6** | 0.5 |

# Appendix E

## Holyrood Marine Terminal Loading Arm Layout

## H337965-M-A3-001


® Hatch 2011/05


EXISTING MARINE LOADING ARM OPERATING ENVELOPE
PROPOSED MARINE LOADING ARM OPERATING ENVELOPE
8'-6" TYP.
15' DRIFT
5' TYP.
A PLAN
B ELEVATION
C PROPOSED PLAN
D PROPOSED ELEVATION
SHIP FLANGE CONNECTION
BALLASTING REQUIRED
JETTY DECK
26'
32'max
28'-9"max
4'-6"
22'-6"
9' MAX. DRIFT
HIGH WATER
LOW WATER
BERTHING LINE
12'
11'-9"
5'-3"
40'
50'
25'
10'
15'
DRAWING No. 337965-M-A3-001 REV. A
PLOT SCALE 1=1
HATCH
NEWFOUNDLAND AND LABRADOR HYDRO
HOLYROOD, NL
MARINE TERMINAL 10 YEAR LIFE EXTENSION STUDY
HOLYROOD MARINE TERMINAL LOADING ARM LAYOUT
HATCH Ltd.
N. SMITH
A. CAREEN
V. CASE
N. SMITH
D. FRENCH
AS SHOWN
H337965-M-A3-001
H337965
MAR.22,2011
ISSUED FOR INFORMATION
DATE
REVISIONS

# Appendix F

## Proposed Loading Arm Extension Sketch


® Hatch 2011/05

HATCH™

CALCULATION SHEET

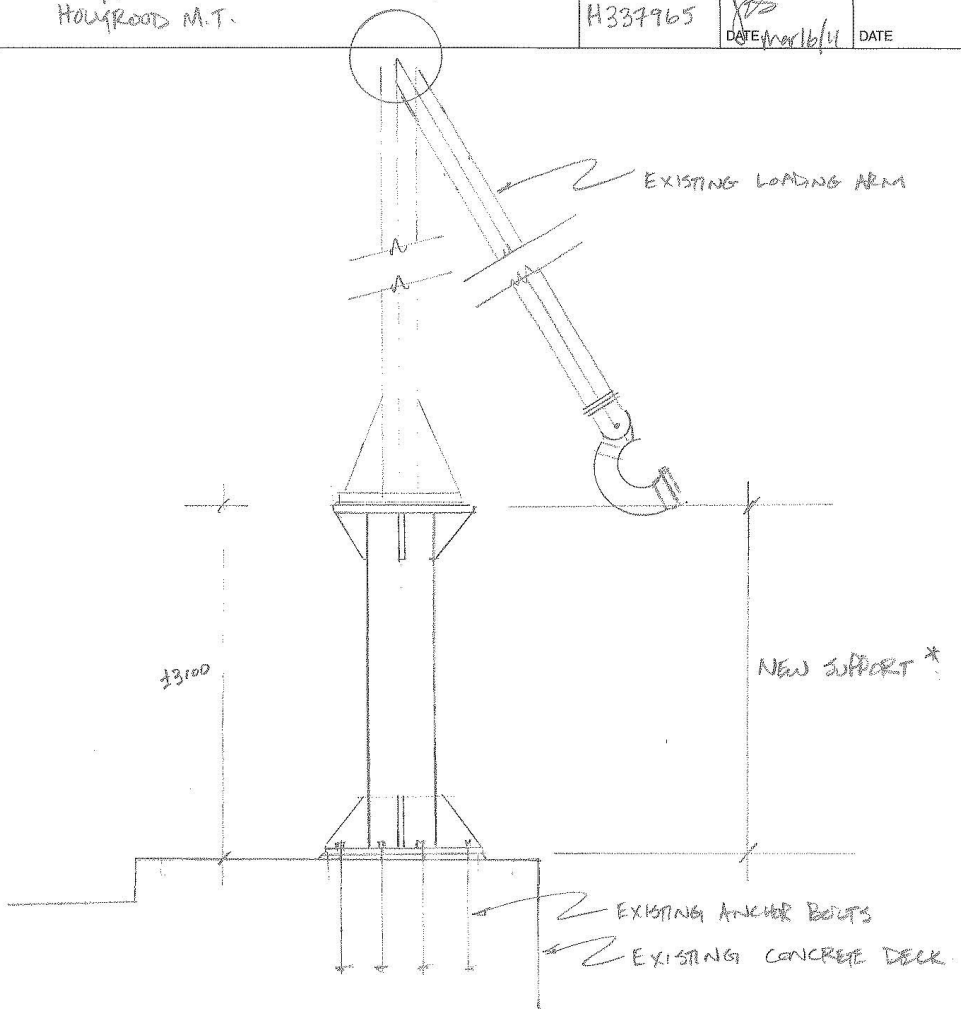
SHEET NO. 1 OF 1

DESCRIPTION 10 YEAR LIFE EXTENSION STUDY HOLYROOD M.T.

PROJECT NO H337965

MADE BY DATE Mar 16/11

CHECKED BY DATE




LOADING ARM SUPPORT A

1:50

* 24" PIPE SHOWN. FINAL SIZE T.B.D.

# Appendix G

## Summary of Pile and Anode Inspection Report (Crotty Diving Services, October 2004)


® Hatch 2011/05

In 2004, Crotty Diving Services performed a complete visual inspection of each pile and anode (including attachment brackets) on both the Jetty head and shore arm from seabed to splashzone and recorded the amount of deterioration on each.

The following tables summarize the results of the inspection for both the Jetty head anodes and the shore arm anodes and attempts to identify the current condition of each anode and estimate its remaining life.

**Table 6-1: Jetty Head Anodes (213 in total)**

| Quantity of Anodes | Amount of Anode Remaining in 2004 (%) | Year of Anode Installation | Estimated Deterioration per year* (%) | Remaining Life* (from 2004) | Remaining Life* (from 2011) |
|---|---|---|---|---|---|
| 8 | 80% | 1994 | 2% | 40 Years | 33 Years |
| 1 | 75% | 1994 | 2.5% | 30 Years | 23 Years |
| 110 | 70% | 1994 | 3% | 23 Years | 16 Years |
| 57 | 60% | 1994 | 4% | 15 Years | 8 Years |
| 32 | 50% | 1994 | 5% | 10 Years | 3 Years |
| 4 | 40% | 1994 | 6% | 6.7 Years | -0.3 Years |
| 1 | 30% | 1994 | 7% | 4.3 Years | -2.7 Years |

* Assuming that anode deterioration rate is linear.

**Table 6-2: Shore Arm Anodes (19 in total)**

| Quantity of Anodes | Amount of Anode Remaining in 2004 (%) | Year of Anode Installation | Estimated Deterioration per year* (%) | Remaining Life* (from 2004) | Remaining Life* (from 2011) |
|---|---|---|---|---|---|
| 5 | 95% | 2003 | 5% | 19 Years | 12 Years |
| 3 | 90% | 2003 | 10% | 9 Years | 2 Years |
| 1 | 70% | 1994 | 3% | 23 years | 16 Years |
| 3 | 50% | 1994 | 5% | 10 Years | 3 Years |
| 2 | 40% | 1994 | 6% | 6.7 years | -0.3 Years |
| 1 | 30% | 1994 | 7% | 4.3 years | -2.7 Years |
| 1 | 10% | 1994 | 9% | 1.1 years | -5.9 Years |
| 3 | 0% | 1994 | ≥10% | 0 Years | -10 Years |

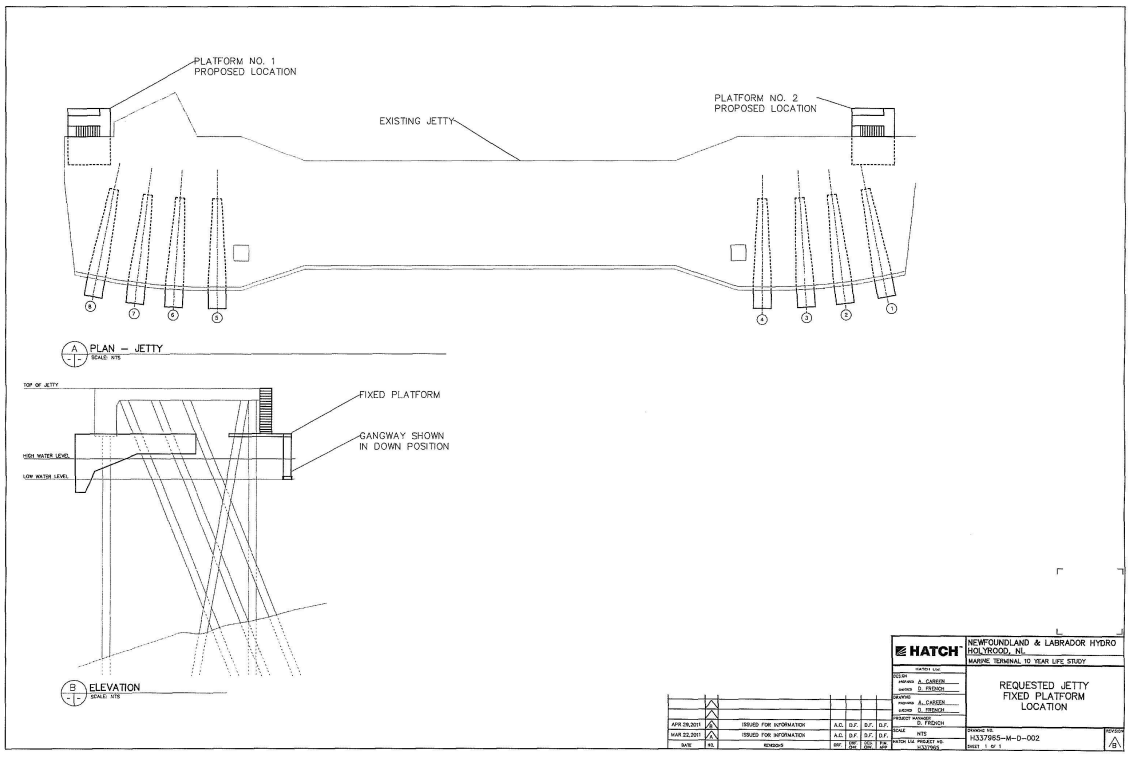
* Assuming that anode deterioration rate is linear.

# Appendix H

## Requested Jetty Platform Location Schematic

## H337965-M-A1-002


® Hatch 2011/05


PLATFORM NO. 1
PROPOSED LOCATION
EXISTING JETTY
PLATFORM NO. 2
PROPOSED LOCATION
PLAN – JETTY
SCALE: NTS
TOP OF JETTY
FIXED PLATFORM
GANGWAY SHOWN
IN DOWN POSITION
HIGH WATER LEVEL
LOW WATER LEVEL
ELEVATION
SCALE: NTS
HATCH
NEWFOUNDLAND & LABRADOR HYDRO
HOLYROOD, NL
MARINE TERMINAL 10 YEAR LIFE STUDY
REQUESTED JETTY
FIXED PLATFORM
LOCATION
SCALE NTS
H337965-M-D-002
ISSUED FOR INFORMATION
ISSUED FOR INFORMATION

# Appendix I

## Holyrood Terminal Station Marine Terminal Field Inspection Program

## Underside of Concrete Deck and Spiral Steel Piles Inspection Program


® Hatch 2011/05

**Holyrood Terminal Station**
**Marine Terminal**
**Field Inspection Program**
**Underside of Concrete Deck**
**and**
**Spiral Steel Piles.**

**Inspection Program**

Diving and boat operation is required to carry out the inspection.

Safety procedures shall be as required by Newfoundland and Labrador Hydro and applicable standards CAN/CSA-275.2-04, Occupational Safety Code for Diving Operations.

All underwater and above water inspection to be carried out during daylight hours and scheduled for predicted high and low tides.

**Pile Inspection**

The inspection steel of the piles includes the following:

*No.1*
Verification of drawings numbers and positioning with dimensions of positioning relative to a longitudinal and transverse axe or datum line or lows for the dock.

All piles an identification numbers according to drawing A1-238-05-4004-005 and AD 239-05-4004-25. – Pile Inspection report shall reference pile Numbers

*No. 2*
Complete an above and below water level visual inspection of all steel piles.

For the visual inspection of the piles the total length of the pile can be divided into 4 sections.

- Underside of the concrete deck down to 3' above high water.
- Between 3' above and below high water level.
- Between 3' above and below low water level.
- Between 3' below low water and harbour bottom.

*No. 3*
Complete an ultrasonic steel thickness measurement on representative piles at dock – 14 piles .

Ultrasonic inspection of steel piles shall include;

- Measure the residual thickness of selected steel piles using a watertight ultrasonic testing unit with direct readout, calibrate accordingly. Steel surface to be cleaned of marine growth and pile coating or rust. Any coating removed is to be repaired by touch up recoating once the readings are completed. Inspection spots are selected based on typical corrosion pattern of piles. Three test readings at each location identified.

Proposed location of test points on specified piles are as follows:

- 12.5' below top of deck slabat elevation (+) 8.8;.
- 18' below top of deck slab at elevation (+) 3.3.
- 21.3 below top of deck slab at elevation 0.0
- 25' below top of deck slab at elevation (-) 3.67'.
- 45' below the top of deck, slab at elevation (-) 23.67'.
- Mudline or harbour bottom.

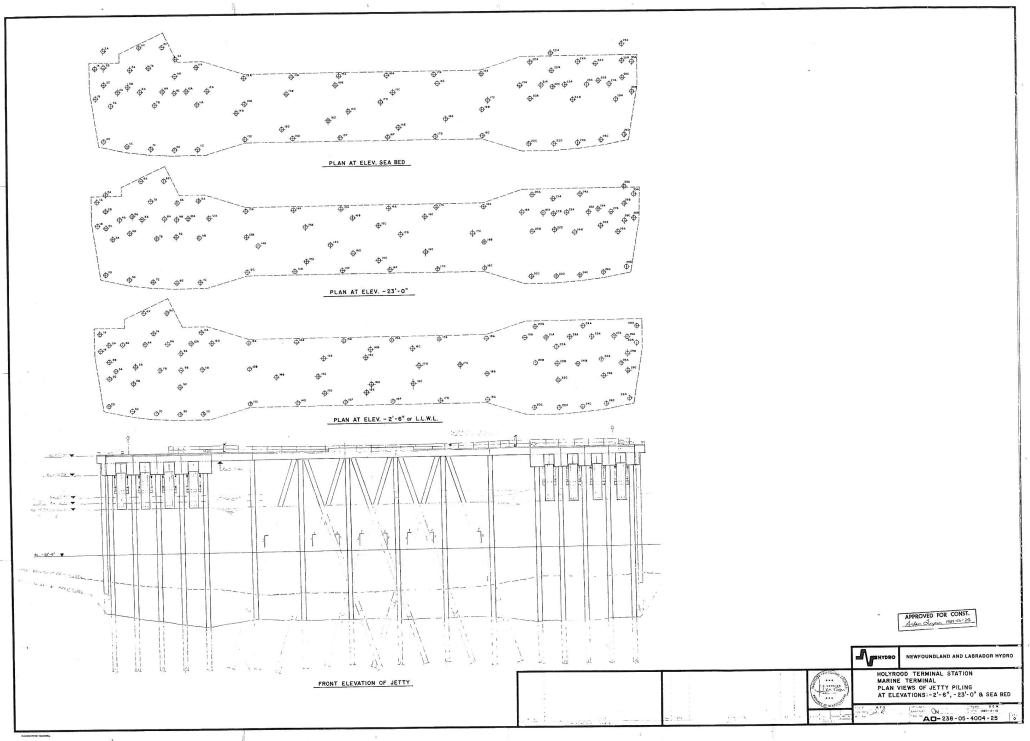
*No. 4*

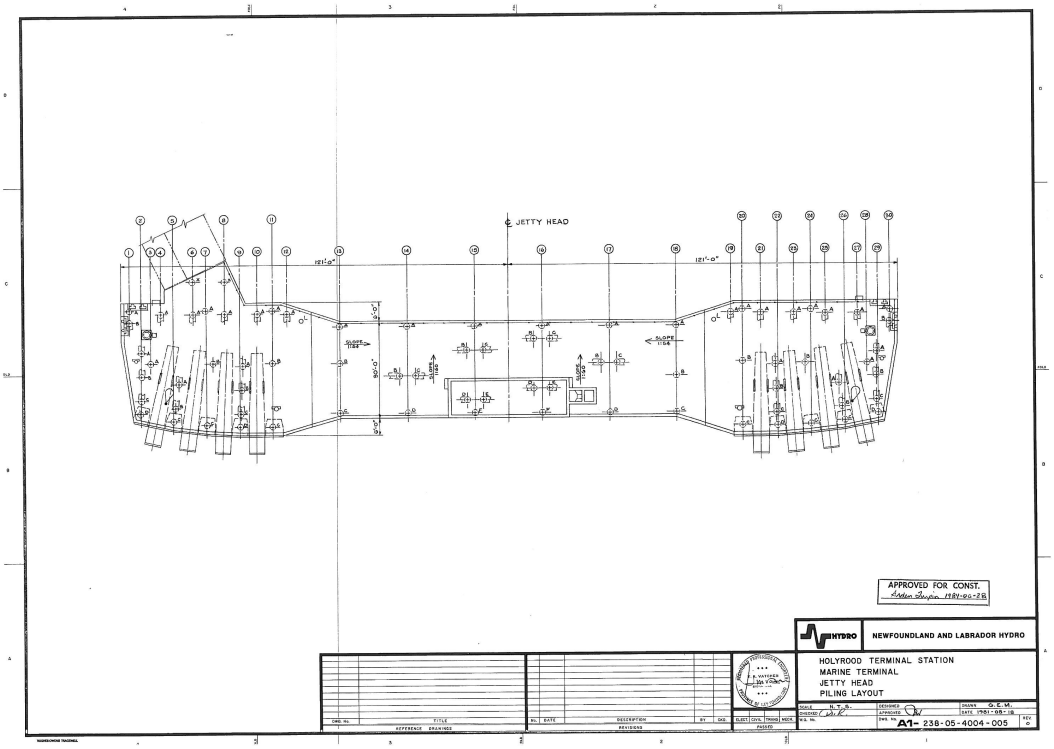
Inspected the condition of the anodes on the piles that have ultrasonic inspection specified.

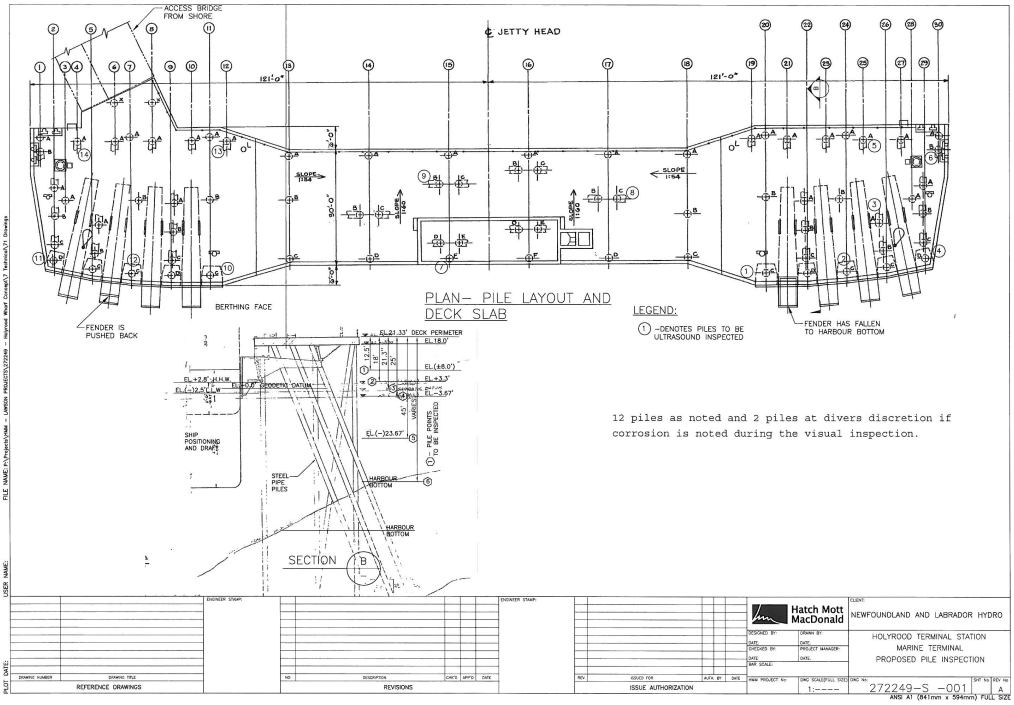
**Underside of Concrete Deck Inspection**

Visual inspection and comment on the condition of the undersize of the concrete deck along with the expanded concrete deck shoreline at the fenders. Complete a visual inspection of other appurtenances on the dock below deck level.

Photo record of dock from water level


PLAN AT ELEV. SEA BED
PLAN AT ELEV. -23'-0"
PLAN AT ELEV. -2'-6" or L.L.W.L.
FRONT ELEVATION OF JETTY
APPROVED FOR CONST.
NEWFOUNDLAND AND LABRADOR HYDRO
HOLYROOD TERMINAL STATION
MARINE TERMINAL
PLAN VIEWS OF JETTY PILING
AT ELEVATIONS:-2'-6",-23'-0" & SEA BED
AO-238-05-4004-25


℄ JETTY HEAD
121'-0"
121'-0"
APPROVED FOR CONST.
NEWFOUNDLAND AND LABRADOR HYDRO
HOLYROOD TERMINAL STATION
MARINE TERMINAL
JETTY HEAD
PILING LAYOUT
A1- 238-05-4004-005


ACCESS BRIDGE FROM SHORE
℄ JETTY HEAD
121'-0"
121'-0"
SLOPE 1:4
SLOPE 1:4
BERTHING FACE
FENDER IS PUSHED BACK
FENDER HAS FALLEN TO HARBOUR BOTTOM
PLAN— PILE LAYOUT AND DECK SLAB
LEGEND:
① -DENOTES PILES TO BE ULTRASOUND INSPECTED
12 piles as noted and 2 piles at divers discretion if corrosion is noted during the visual inspection.
EL.21.33' DECK PERIMETER
EL.18.0'
EL.(±0.0')
EL.+3.3'
EL.-3.57'
EL.(-)23.67'
SHIP POSITIONING AND DRAFT
STEEL PIPE PILES
HARBOUR BOTTOM
PILE POINTS TO BE INSPECTED
SECTION B
Hatch Mott MacDonald
NEWFOUNDLAND AND LABRADOR HYDRO
HOLYROOD TERMINAL STATION
MARINE TERMINAL
PROPOSED PILE INSPECTION
REFERENCE DRAWINGS
REVISIONS
ISSUED FOR
ISSUE AUTHORIZATION
1:-----
272249-S -001
A
ANSI A1 (841mm x 594mm) FULL SIZE

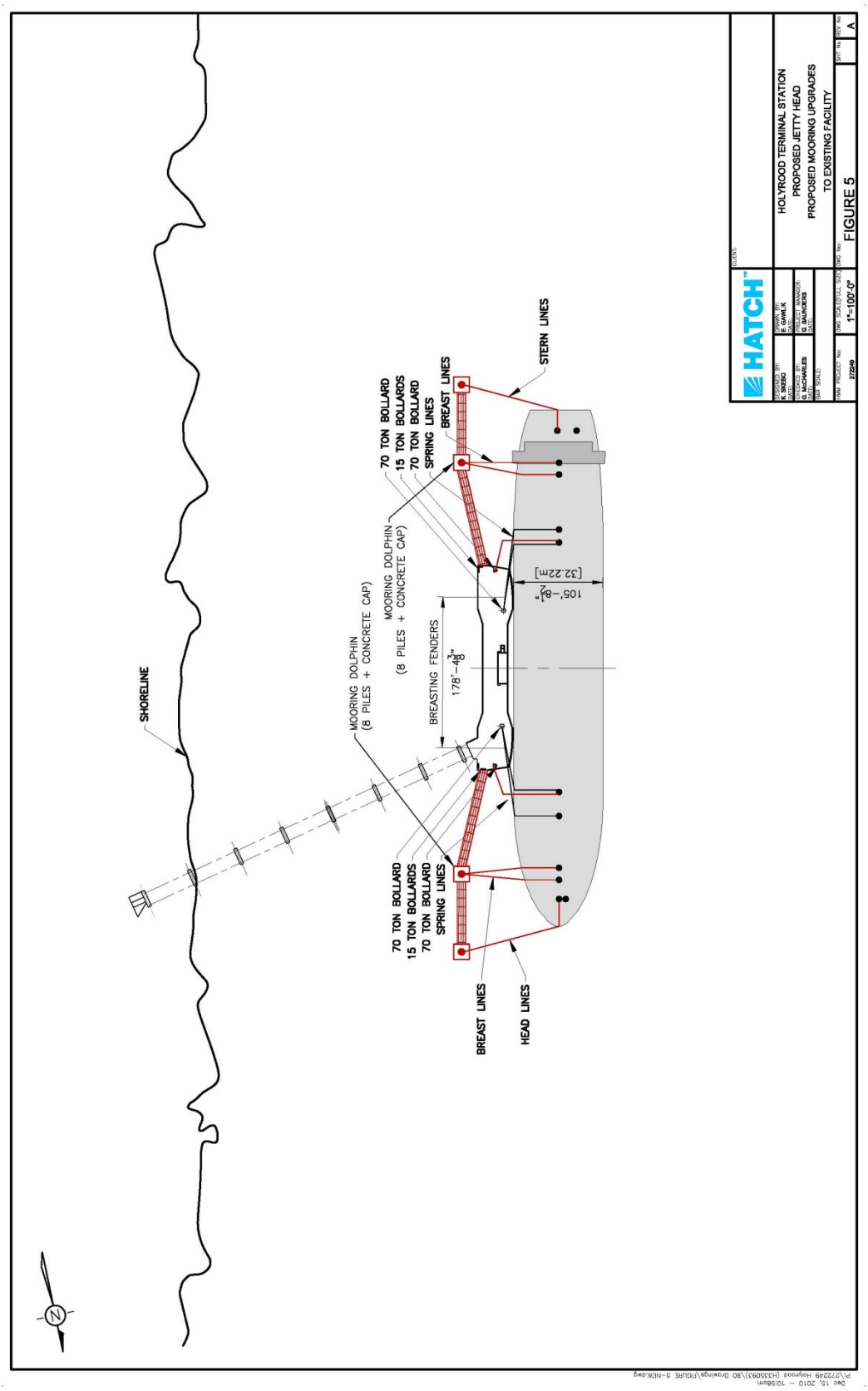
HATCH™

Newfoundland and Labrador Hydro -
Holyrood Marine Terminal 10 Year Life Extension Study
Final Report - April 29, 2011

# Appendix J

## Holyrood Terminal Station Proposed Jetty Head Proposed Mooring Upgrades to Existing Facility


® Hatch 2011/05


HATCH
HOLYROOD TERMINAL STATION
PROPOSED JETTY HEAD
PROPOSED MOORING UPGRADES
TO EXISTING FACILITY
FIGURE 5
1"=100'-0"
SHORELINE
MOORING DOLPHIN
(8 PILES + CONCRETE CAP)
MOORING DOLPHIN
(8 PILES + CONCRETE CAP)
70 TON BOLLARD
15 TON BOLLARDS
70 TON BOLLARD
SPRING LINES
BREAST LINES
STERN LINES
BREASTING FENDERS
178'-4 3/8"
105'-8 1/2"
[32.22m]
70 TON BOLLARD
15 TON BOLLARDS
70 TON BOLLARD
SPRING LINES
BREAST LINES
HEAD LINES
N

# Appendix K

## Laser Vessel Docking System


® Hatch 2011/05




**Strainstall UK Limited**
9/10 Mariners Way
Cowes
Isle Of Wight
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**STRAINSTALL UK LIMITED.**
**DockAlert** – LASER VESSEL DOCKING SYSTEM
Technical Description

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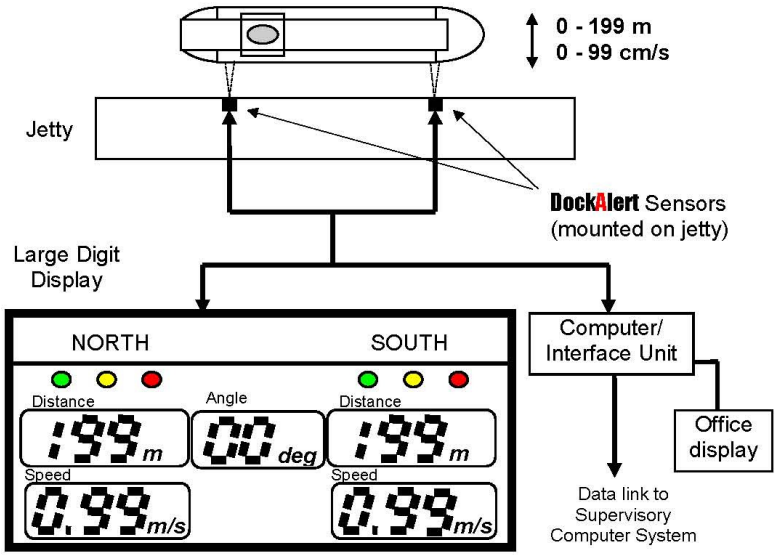
## 1. SYSTEM DESCRIPTION

The Strainstall **DockAlert** system is designed to give Harbour Authorities and Jetty Operators a clear and accurate reading of the speed and distance of a vessel as it approaches its berth, together with indication and alarm status of drift-off from the jetty once berthed.

**DockAlert** is a Dual Sensor system installed on the jetty, which transmits laser beams towards an incoming vessel, receiving reflections back from the Bow and Stern. The signals enable digital display of the vessel's approaching speed (Zero to ±99cm/s) and distance (-1 to 199m) from the berth.

A wide range of outputs is provided to maximise the system's flexibility - the **DockAlert** may be used in any configuration, from a simple high-visibility jetty display to a comprehensive data logging system integral with existing terminal control networks.

Optionally a small portable display (similar to a pager) can be provided. This is linked via radio to the main **DockAlert** system and provides a remote (e.g. on ship) display of the vessel's approach speed and distance. This unit may be supplied in an intrinsically safe version, enabling its use in a hazardous area.



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Key features of **DockAlert** include:

- Real-time display of approach speed and distance during berthing and drift-off when berthed.
- High accuracy, increasing during critical approach.
- Simple above-surface installation.
- Operation unaffected by weather conditions.
- Reliable low maintenance design.
- Explosion proof construction. EEx'd' II BT5, IP65.
- Small portable unit option for on ship display.

## 2. SYSTEM SPECIFICATION

| | |
|---|---|
| System | Laser transmission, 1.5 n sec. width pulse |
| Peak Power | High peak power Sensor (100W),<br>Pulsed $10^5$ times per sec |
| Safety | Eye safety, FDA Class 1 Laser. |
| Certification | Explosion proof construction to EEx'd' II BT5 |
| Sealing | IP65 |
| Distance Range<br>Accuracy<br>Minimum increment<br><br>Measuring Interval | 0 -199m<br>Better than 1cm<br>1.0m ( distances >10m)<br>0.1m ( distances <10m)<br>1s to 9s |
| Speed Range<br>Resolution | ±99cm/s (Approach/leaving)<br>1cm/s |
| Angle range<br>Resolution | ±15°<br>1° |
| Sensor size max. (mm) | W300×H450×D700 mm (one sensor each end of berth) |
| Operating temperature | -10 to 50°C |
| Data output | Analogue and digital selectable |
| Displays | a) VDU graphic display for Control Room<br>b) Large Digit Display for jetty<br>c) Optional 'carry-on' portable display |

The precision of the system increases with decreasing target distance, providing the highest accuracy when it is most needed.

The system measures speed and distance simultaneously, with no delays or interpolation errors.

Displays, outputs and peripherals can be configured to suit Customer requirements. Alarms can be 'zoned' so that a speed warning will be triggered by lower speeds at closer ranges.

Because the system is mounted above the waterline, it requires little maintenance and can be easily calibrated. The sensor unit is relatively small and can be mounted directly on a berth or fender dolphin..

**DockAlert** is unaffected by environmental conditions, including fog, rain and snow. It is packaged in a rugged weatherproof housing, and has no moving parts.

## 3. SUPPLY SCOPE

| No. | Item | Q'ty | Remarks |
|---|---|---|---|
| 1. | Laser Sensor | 2 | Explosion-proof (EEx'd' II BT5) |
| 2. | Interface Unit | 1 set | Non explosion-proof<br>800 x 800 x 2100mm panel |
| 3. | Cable for Power Supply | 1 | 3 core cable (10m length) |
| 4. | Large Digit Display | 1 | Explosion-proof (Ex 'p') |
| 5. | Accessories | 1 | |
| 6. | Optional Portable Display (including base station transmitter antennae, software etc.) | 1 | Display may be EEx'ia' certified. |

## 4. BRIEF DESCRIPTION OF EACH COMPONENT

### 4.1. LASER SENSOR

- Radiates ultra sharp laser pulse (1.5ns) with high peak power (100W), and receives reflection pulse easily from ship. Eye Safe, FDA Class 1 Laser.
- Self-supporting type and explosion proof construction. (EEx'd').
- Installed on the jetty for BOW and STERN, respectively.
- Easy maintenance as installed on dolphin platform. (above sea).

### 4.2. INTERFACE UNIT

- Enclosed in 800 x 800 x 2100mm panel and non-hazardous area use construction.
- Installed in the control room.
- Consist of Display Unit (VDU), Control Unit, Computer with keyboard and Power Unit.
- Process the input signals from LASER SENSOR and output the processed data.
- Measured data is saved in HD or FD. (3½")
- Optional Ethernet output for LAN connection.
- Optional serial and relay outputs for connection to site DCS etc.

### 4.3. LARGE DIGIT DISPLAY

- Installed on the jetty where captain can observe from ship's bridge.
- Self-supporting type, weather-proof and air pressurised hazardous protection.
- Display the distance BOW and STERN, ship approaching speed respectively.
- LED lamp digit display which can control light intensity.
- LED lamp alters the colour for three approaching speed levels.
  RED in dangerous speed.
  AMBER in cautionary speed.
  GREEN in safety speed.

### 4.4. PORTABLE DISPLAY

- Small and lightweight (similar to a pager).
- Provides numerical display of approach speed and distance.
- Provides internal alarm to warn of danger levels.
- Multiple displays may be used with a single base station transmitter.
- Intrinsically Safe (EEx'ia') version available for use in hazardous areas.

### 4.5. CABLES

#### 4.5.1. Purchaser Supply

- 3 pair twist cable individual screen 1.5mm$^2$, (use for Laser Sensor).
- 6 pair twist cable individual screen 1.5mm$^2$, (use for Large Digit Display).
- The recommended cable specification shall be provided at the detailed Contract planning stage.

#### 4.5.2. Strainstall Supply

- 3 core cable, (used for power supply to Interface Unit).

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## 5. DETAILED SPECIFICATION

### 5.1. GENERAL

| | |
|---|---|
| Measuring distance | -1 to 199m |
| Measuring speed | 0 to ±99cm/s (+:Approaching, -: Leaving) |
| Tilt of ship to the berthing line | within ±15°. Against berthing line |
| Increment of measurement (resolution of digit) | Distance : 1m at distance more than 10m<br>0.1m at distance less 9.9m |
| Speed: | 1cm/s |
| Angle: | 1° |
| Power consumption | AC 230V ±10% 50Hz 300VA<br>(excluding LIGHT BOARD DISPLAY) |

### 5.2. LASER SENSOR

#### 5.2.1. Construction

| | |
|---|---|
| Protection | EEx'd' II BT5 JIS : Explosion proof, IP65 |
| Materials | Anti corrosive aluminium & SUS |
| Painting (Colour) | Epoxy (Manufacturer standard) |
| Dimension | W250 × H403 × D650mm |
| Weight | ~ 30Kg |

#### 5.2.2. Laser Light

| | |
|---|---|
| Wave length | ~ 850nm |
| Peak power | 100W peak |
| Pulse width | 1.5ns |
| Pulse repeating | 100,000 times/s |
| Eye safe class | FDA Class 1 |
| Detective distance | More than 200m |
| Beam angle | ±0.13° |
| Distance accuracy | Less 1cm |

#### 5.2.3. Operating Conditions

| | |
|---|---|
| Ambient temperature | -10 to 50°C |
| Storage temperature | -10 to 70°C |
| Ambient humidity | 10 to 95% RH (non condensation) |

### 5.3. INTERFACE UNIT

An SVGA VDU (14" colour), computer, keyboard, power unit, control unit. Interface circuits are enclosed in a 800 x 800 x 2100mm panel and printer is on disk. I built diagnostics provide a maintenance function. Typical display screen layouts are provided in Appendix A.

#### 5.3.1. Distance measurement

| | |
|---|---|
| Measuring range | -1 to 199m |
| Number of digits | 3 digits |
| Minimum increment | 1m more than 10m distance (approach)<br>0.1m less than 9.9m distance (drift-off) |
| Measuring interval | 1s to 9s selectable |
| Indicating method | SVGA Colour VDU 14" |
| Zero reference offset | 0 to 9.99m |

#### 5.3.2. Speed measurement

| | |
|---|---|
| Measuring range | 0 to ±99cm/s |
| Number of digits | 2 digits |
| Minimum increment | 1cm/s |
| Measuring interval | 1s to 9s selectable |
| Indicating method | SVGA Colour VDU 14" |
| Symbol indication | +: when approaching -: when leaving |

#### 5.3.3. Angle measurement

| | |
|---|---|
| Measuring range | 15° |
| Number of digits | 2 digits |
| Minimum increment | 1° |
| Measuring interval | 1s |
| Indicating method | SVGA Colour VDU 14" |

#### 5.3.4. Alarms

| | |
|---|---|
| Speed alarm range | 0 to 99cm/s |
| Off berthing alarm range | 0 to 9.99m |
| Angle alarm range | 0 to 15° |

#### 5.3.5. Printer

An A4 colour InkJet printer is provided to provide an alarm/event log.

#### 5.3.6. Operating Conditions

| | |
|---|---|
| Ambient temperature | 0 to 45°C (main computer unit) |
| Storage temperature | -5 to 60°C |
| Ambient humidity | 10 to 80% RH (non condensation) |

### 5.4. LARGE DIGIT DISPLAY

#### 5.4.1. Construction

| | |
|---|---|
| Protection | Inner pressurised hazardous protection (Ex 'p') |
| Materials | Stainless Steel plate |
| Finish | Natural, unpainted |
| Dimension | W2800 × H1800 × D500mm |
| Weight | ~1040kg |

#### 5.4.2. Indication

| | |
|---|---|
| Range (Distance) | 0 to 199m |
| Range (Speed) | 0 to ±99cm/s |
| Number of digits (Distance) | 3 digits |
| Number of digits (Speed) | 2 digits |
| Min. increment distance | 1m at distance more than 10m<br>0.1m at distance less than 9.9m |
| Min. increment speed | 1cm/s |
| Lamp | LED lamp controlled light intensity |

#### 5.4.3. General

| | |
|---|---|
| Power consumption | AC 110V ±10%, 50Hz |
| Design wind velocity | Within 50m/s |
| Air consumption | 250l/m minimum |
| Name plate | [BOW] [STERN] |
| Turn swivel | ±45° remote controlled from MCR |
| Visible Range | 200m in clear weather |
| Visible Range | ±45° (horizontal)<br>±45° (vertical) |

#### 5.4.4. Operating Conditions

| | |
|---|---|
| Ambient temperature | -10 to 50°C |
| Storage temperature | -10 to 70°C |
| Ambient humidity | 10 to 85% RH (non condensation) |

## 5.5. PORTABLE DISPLAY

### 5.5.1. Construction

| | |
|---|---|
| Hazardous Area Certification | EEx 'ia' (option) |
| Dimensions | W57 × H82 × D17.5mm |
| Weight | ~90g |

### 5.5.2. Indication

| | |
|---|---|
| Display Type | Supertwist LCD |
| Visible display screen | 4 rows x 24 characters |
| Range (Distance) | 0 to 199m |
| Range (Speed) | 0 to ±99cm/s |
| Number of digits (Distance) | 3 digits |
| Number of digits (Speed) | 2 digits |
| Backlight | Electroluminescent backlight |
| Alarm | a) Internal vibrator motor, 80dB at 30cm<br>b) Red LED indicator |

### 5.5.3. Power Supply

| | |
|---|---|
| Battery life | 800 hours |
| Battery Type | Single AAA cell |

### 5.5.4. Operating Conditions

| | |
|---|---|
| Ambient temperature | -10 to 50°C |
| Storage temperature | -10 to 70°C |
| Ambient humidity | 10 to 85% RH (non condensation) |

Note. The portable Display requires a base station transmitter. This is incorporated into the Interface Unit.

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**DockAlert** – LASER VESSEL DOCKING SYSTEM
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**APPENDIX A**

**VDU Screen Displays**

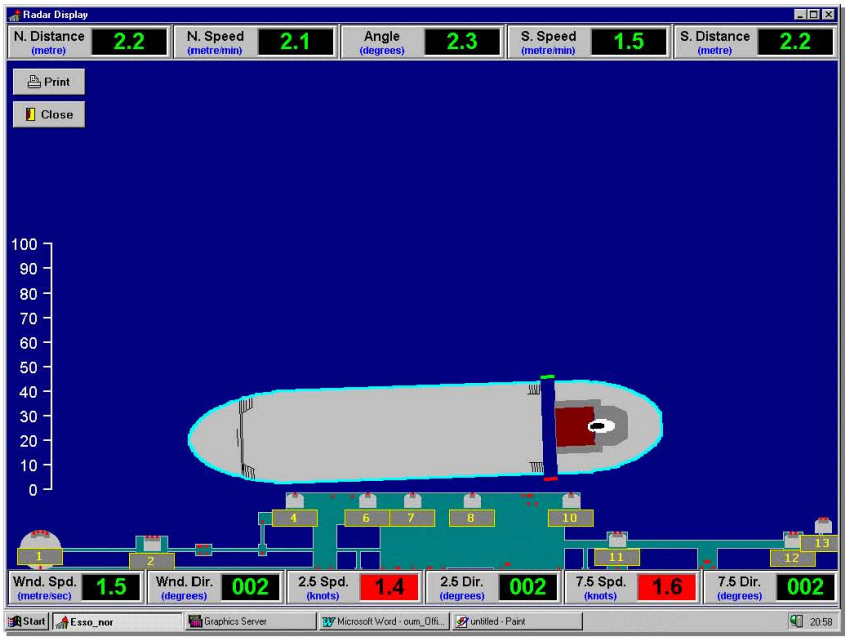


**Figure 1 – Vessel Approach Screen Graphic**

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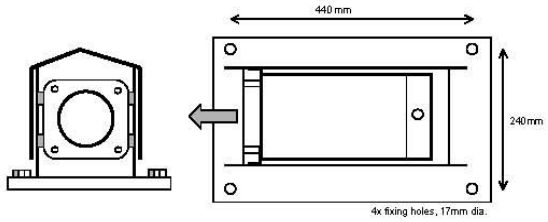
Technical Description




**Figure 2 – Alarm Setting VDU Screen**




ASDOC laser sensor

**Figure 3 – Laser Sensor Details**

HATCH™

Newfoundland and Labrador Hydro -
Holyrood Marine Terminal 10 Year Life Extension Study
Final Report - April 29, 2011

# Appendix L

## Construction Cost Estimate



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Hatch APPENDIX L 5/3/2011

| | | | |
|---|---|---|---|
| Estimate Description: | Holyrood Marine Terminal<br>10 Year Life Construction Estimate | Date: | 29-Apr-11 |
| Estimate Order: | Unit Rate +/-20% | Revision: | 0 |
| References: | | | |

| Item | Description | Quantity | Units | Materials/Equipment | | Sub-Con | | Sub-Total | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Price | Amount | Unit Price | Amount | | |
| 1 | Mobilization/Demobilization | 1 | ea | | $0.00 | 50000 | $50,000.00 | $50,000 | **$50,000** |
| 2 | **Fender Replacement/Repairs** | | | | | | | | |
| | *Fender Replacement* | | | | | | | | |
| | Concrete | 50 | cu m | 500 | $25,000.00 | $500.00 | $25,000.00 | $50,000 | |
| | Structural Steel | 12.5 | T | 6000 | $75,000.00 | $3,000.00 | $37,500.00 | $112,500 | |
| | Rebar | 4 | T | 3000 | $12,000.00 | $3,000.00 | $12,000.00 | $24,000 | |
| | Crane | 200 | hrs | 40 | $8,000.00 | $130.00 | $26,000.00 | $34,000 | |
| | Misc. Steel/Anchors/Pins/etc. | 1 | lot | 25000 | $25,000.00 | $0.00 | $0.00 | $25,000 | |
| | Contractor Labour | 2400 | hrs | 0 | $0.00 | $75.00 | $180,000.00 | $180,000 | |
| | Scaffolding | 1 | lot | 12000 | $12,000.00 | $120,000.00 | $120,000.00 | $132,000 | |
| | Temporary Support Beams | 1 | lot | 35000 | $35,000.00 | $5,000.00 | $5,000.00 | $40,000 | |
| | Safety Vessel | 200 | hrs | 0 | $0.00 | $80.00 | $16,000.00 | $16,000 | |
| | Safety Watch | 200 | hrs | 0 | $0.00 | $100.00 | $20,000.00 | $20,000 | |
| | **Sub-Total** | | | | | | | | **$633,500** |
| | *Fender Repair (x3)* | | | | | | | | |
| | Demolition | 1000 | hrs | 0 | $0.00 | $75.00 | $75,000.00 | $75,000 | |
| | Structural Steel | 6 | T | 6000 | $36,000.00 | $3,000.00 | $18,000.00 | $54,000 | |
| | Misc. Steel/Anchors/etc. | 3 | lot | 25000 | $75,000.00 | $0.00 | $0.00 | $75,000 | |
| | Contactor Labour | 5700 | hrs | 0 | $0.00 | $75.00 | $427,500.00 | $427,500 | |
| | Scaffolding | 3 | lot | 12000 | $36,000.00 | $120,000.00 | $360,000.00 | $396,000 | |
| | Temporary Support Beams | 1 | lot | 35000 | $35,000.00 | $5,000.00 | $5,000.00 | $40,000 | |
| | Safety Vessel | 400 | hrs | 0 | $0.00 | $80.00 | $32,000.00 | $32,000 | |
| | Safety Watch | 400 | hrs | 0 | $0.00 | $100.00 | $40,000.00 | $40,000 | |
| | **Sub-Total** | | | | | | | | **$1,139,500** |
| | *Engineering* | | | | | | | | |
| | Detailed Design | 300 | hrs | 0 | $0.00 | $135.00 | $40,500.00 | $40,500 | |
| | Tender Support | 80 | hrs | 0 | $0.00 | $135.00 | $10,800.00 | $10,800 | |
| | Construction Support | 400 | hrs | 0 | $0.00 | $125.00 | $50,000.00 | $50,000 | |
| | **Sub-Total** | | | | | | | | **$101,300** |
| 3 | **Loading Arms/Vessel Approach** | | | | | | | | |
| | Piping/Valves/fittings | 1 | lot | 24000 | $24,000.00 | $8,000.00 | $8,000.00 | $32,000 | |
| | Structural Steel | 3 | T | 6000 | $18,000.00 | $3,000.00 | $9,000.00 | $27,000 | |
| | Misc. Steel/Anchors/etc. | 1 | lot | 10000 | $10,000.00 | $0.00 | $0.00 | $10,000 | |
| | Contractor Labour | 1000 | hrs | 0 | $0.00 | $75.00 | $75,000.00 | $75,000 | |
| | Scaffolding | 1 | lot | 0 | $0.00 | $8,000.00 | $8,000.00 | $8,000 | |
| | Safety Vessel | 100 | hrs | 0 | $0.00 | $80.00 | $8,000.00 | $8,000 | |
| | Safety Watch | 100 | hrs | 0 | $0.00 | $100.00 | $10,000.00 | $10,000 | |
| | Coupler | 2 | ea | 8000 | $16,000.00 | $0.00 | $0.00 | $16,000 | |
| | Coupler | 300 | hrs | 0 | $0.00 | $85.00 | $25,500.00 | $25,500 | |
| | **Sub-Total** | | | | | | | | **$211,500** |
| | Radar System | 1 | lot | 100000 | $100,000.00 | $10,000.00 | $10,000.00 | $110,000 | |
| | Loading Arm Drainage System | 1 | lot | 50000 | $50,000.00 | $10,000.00 | $10,000.00 | $60,000 | |
| | Loading Arm Drainage Electrical Upgrades | 1 | lot | 200000 | $200,000.00 | $20,000.00 | $20,000.00 | $220,000 | |
| | **Sub-Total** | | | | | | | | **$390,000** |
| | *Engineering* | | | | | | | | |
| | Detailed Design | 300 | hrs | 0 | $0.00 | $135.00 | $40,500.00 | $40,500 | |
| | Tender Support | 230 | hrs | 0 | $0.00 | $135.00 | $31,050.00 | $31,050 | |
| | Construction Support | 310 | hrs | 0 | $0.00 | $125.00 | $38,750.00 | $38,750 | |
| | **Sub-Total** | | | | | | | | **$110,300** |
| 4 | **Anode Inspection/Replacement** | | | | | | | | |
| | Anode Inspection | 180 | hrs | 0 | $0.00 | $400.00 | $72,000.00 | $72,000 | |
| | Pile Inspection | 180 | hrs | 0 | $0.00 | $400.00 | $72,000.00 | $72,000 | |
| | Anode Replacement | 110 | ea | 500 | $55,000.00 | $2,200.00 | $242,000.00 | $297,000 | |
| | Safety Vessel | 180 | hrs | 0 | $0.00 | $80.00 | $14,400.00 | $14,400 | |
| | Safety Watch | 180 | hrs | 0 | $0.00 | $100.00 | $18,000.00 | $18,000 | |
| | **Sub-Total** | | | | | | | | **$473,400** |
| | *Engineering* | | | | | | | | |
| | Detailed Design | 60 | hrs | 0 | $0.00 | $135.00 | $8,100.00 | $8,100 | |
| | Tender Support | 80 | hrs | 0 | $0.00 | $135.00 | $10,800.00 | $10,800 | |
| | Construction Support | 100 | hrs | 0 | $0.00 | $125.00 | $12,500.00 | $12,500 | |
| | **Sub-Total** | | | | | | | | **$31,400** |
| 5 | **Life Safety Issues** | | | | | | | | |
| | Fall Arrest System(s) | 1 | lot | 50000 | $50,000.00 | $50,000.00 | $50,000.00 | $100,000 | |
| | Emergency Evacuation Vessel | 2 | ea | 10000 | $20,000.00 | $10,000.00 | $20,000.00 | $40,000 | |
| | Fixed Platforms (s) | 2 | ea | 50000 | $100,000.00 | $140,000.00 | $280,000.00 | $380,000 | |
| | Lighting Upgrades | 1 | lot | 50000 | $50,000.00 | $15,000.00 | $15,000.00 | $65,000 | |
| | Safety Vessel | 400 | hrs | 0 | $0.00 | $80.00 | $32,000.00 | $32,000 | |
| | Safety Watch | 400 | hrs | 0 | $0.00 | $100.00 | $40,000.00 | $40,000 | |
| | **Sub-Total** | | | | | | | | **$657,000** |
| | *Engineering* | | | | | | | | |
| | Practises and Procedures | 275 | hrs | 0 | $0.00 | $135.00 | $37,125.00 | $37,125 | |
| | Detailed Design | 400 | hrs | 0 | $0.00 | $135.00 | $54,000.00 | $54,000 | |
| | Tender Support | 160 | hrs | 0 | $0.00 | $135.00 | $21,600.00 | $21,600 | |
| | Construction Support | 500 | hrs | 0 | $0.00 | $125.00 | $62,500.00 | $62,500 | |
| | **Sub-Total** | | | | | | | | **$175,225** |
| | **Sub-Total** | | | | **$1,067,000.00** | | **$2,906,125.00** | **$3,973,125.00** | **$3,973,125** |
| | **Contractor - Onsite Facilities** | 20% | | | $0.00 | | $581,225.00 | $581,225.00 | $581,225 |
| | **Contingency** | 15% | | | $160,050.00 | | $435,918.75 | $595,968.75 | $595,969 |
| | **Overhead and Profit** | 10% | | | $106,700.00 | | $290,612.50 | $397,312.50 | $397,313 |
| | **Total** | | | | **$1,333,750.00** | | **$3,632,656.25** | **$4,966,406.25** | **$5,547,631** |


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# APPENDIX C

## Erm Oil Pollution Emergency Plan - (Marine Spill –Bunker "C")

newfoundland labrador hydro
a nalcor energy company

File #: ERM-10
OPEP (Marine Spill – Bunker "C")
Date: April 2003
Rev. #: 1
Rev. Date: Jan 12, 2010
Page 1 of 17

Emergency Response Manual

# ERM-10 Oil Pollution Emergency Plan (OPEP) (Marine Spill – Bunker "C")

## Declaration of the Operators of the Newfoundland and Labrador Hydro Corporation Oil Handling Facility, Holyrood Newfoundland

Pursuant to paragraph 660.2(4)(c) of the **Canada Shipping Act**, as amended by Statutes of Canada 1993, C.36, Newfoundland Labrador Hydro Declares that;

i) to comply with the **Pollution Discharge Reporting Regulations**, and upon the detection of an oil pollution incident that arises out of the unloading of oil to or from a ship where the operator of the Newfoundland and Labrador Hydro Corporation Oil Handling Facility can be identified as the responsible party, the operator of the Newfoundland and Labrador Hydro Corporation Oil Handling Facility will immediately report and, when it is safe to do so, commence containment and cleanup operations in accordance with the oil pollution emergency plan required by paragraph 660.2(4)(d) of the Canada Shipping Act.

ii) In accordance with paragraph 660.2(4)(b) of the Canada Shipping Act, as amended by the Statutes of Canada 1993, C.36, Newfoundland and Labrador Hydro has an arrangement with the certified response organization known as Eastern Canada Response Corporation Ltd. This arrangement is with respect to 10,000 tonnes of oil and in respect of the Newfoundland and Labrador Hydro Oil Handling Facility in Holyrood Newfoundland.

iii) Pursuant to 660.2(4)(c)(iii):

a) the persons listed here are authorized to implement the arrangement described in (ii) above.

| Name | Designation | Work # | After Hours # | Cell # |
|---|---|---|---|---|
| Terry LeDrew | OSC-2 | 229-2110 | 834-3447 | 682-7382 |
| Wayne Rice | OSC-2 | 229-2126 | 738-0197 | 682-7382 |
| Mike Manuel | OSC-2 | 229-2114 | 744-3336 | 682-7382 |
| Bill Kilfoy | OSC-1 | 229-2145 | 744-4605 | 682-7381 |
| Mike Flynn | OSC-1 | 229-2146 | 229-4205 | 682-7381 |

Newfoundland & Labrador Hydro
Manager, Thermal Generation

Terry LeDrew
Printed Name

Jan 13, 2010
Date

Other relevant statutes and standards include:

i) **Oil Handling Facility Standards**, Transport Canada TP 12402, August, 1995: and,

ii) **Response Organizations and Oil Handling Facilities Regulations**, August, 1995.

In no sense is it deemed that the content of this OPEP should supersede the immediate on-scene judgement of the On-Scene Commander (OSC). In all cases, the OSC maintains final authority to take actions and to issue notifications. Rather, this plan is intended to prompt response personnel, in times of emergency, to ensure the completeness and appropriateness of actions taken, to guide the notification and reporting process, and to outline mechanisms ensuring preparedness.

**Scope of Response:**

The principal and only product transferred from ships to the Holyrood Generating Station Oil Handling Facility (OHF) is Bunker C that, under the *Oil Handling Facility Standards*, comes under the category of "Oils". The maximum transfer rate of Bunker C from the ship to shore is 10,000 bph or 1590 $m^3$/h. Therefore, as per the *Oil Handling Facility Standards*, the scenarios presented herein are for a Bunker C spill not exceeding **15 $m^3$ (95 barrels)**, a guideline corresponding to a **Level 3 category oil handling facility** and, the response capability of the Holyrood Thermal Generating Station. Ultimately, the On-Scene Commander, with support from the response structure, will use best judgment to determine if and, to what degree the escalation of the response to RO engagement is required.

The scope of this Action Plan is to detail an Emergency Response to a Bunker C fuel oil spill that occurred while offloading a tanker at the Holyrood Thermal Generating Station hereinafter referred to as the Oil Handling Facility (OHF). Two scenarios are presented:

- the tanker has been surrounded by an oil containment boom prior to the spill event (pre-booming); and,

- the tanker has not been surrounded by an oil containment boom prior to the spill event (no pre-booming).

The general response activities for the two scenarios above, deemed to be areas of high potential through the process of plant wide risk assessment and ranking, are supplemented by a table in this section. Refer to this table for other key response information such as possible collateral hazards, key isolation points, available equipment and, available support resources.

If a ship incurs an actual or probable oil spill, it is the responsibility of the Ship's Master to initiate the shipboard OPEP. In the interest of protecting life, property and the environment, the Shift Supervisor on duty at the OHF should implement appropriate on-shore actions in support of the ship's spill response.

In situations of poor weather, arctic ice, or at any other time deemed to be unsafe, Hydro will not pre-boom tankers unloading at the OHF. Under these circumstances, 366m (1200 feet) of 91 cm (36 inch) boom will be left on site, and 366 m (1200 feet) will be stationed at the Marina in Holyrood, for deployment when conditions can be assessed as being safe. In addition, "Response Activities for No Pre-Booming" will be used in regard to initiating a response to an oil spill when pre-booming has not occurred. In all instances the Marine Terminal Supervisor (MTS) – OSC1 Mechanical Maintenance Supervisor will obtain and assess weather forecasts to determine if pre-booming is to be attempted. This will include using the OHF jetty and the federal wharf in Holyrood to assess the degree of icing, wind speed, and wave height.

If, in the opinion of the MTS or support vessel operator, pre-booming is assessed as "marginal or unsafe", the MTS or support vessel operator shall have the discretion not to deploy boom or pre-boom a vessel. If this is the case, the MTS shall record the pertinent facts and conduct follow-up assessments at varying intervals, including recording the status of icing, wind speed and wave height.



Marine Terminal Supervisors and relevant operating and maintenance personnel shall be familiar with Booming and Transfer Procedures contained in the Holyrood Thermal Generating Station Procedures Database – Ref. #'s MSTD-006,007,008;POP-047;POI-044.

**Appendix B – Maps** details probable spill displacement scenarios/transport times and boom deployment arrangements.

## RESPONSE ACTIVITIES (PRE-BOOMING):

Note: If you did not "Pre-Boom", do not use this scenario; refer instead to the scenario for "No Pre-Booming", page 11 of 17.

Note: if pre-booming results in failure to contain an excessive amount of oil, it may be necessary to escalate the response and adopt the procedures contained within the section "Response Activities (No Pre-Booming)" page 13 of 17, "The OSC Will Now….". Otherwise, continue as follows.

Within the **first hour** of the spill the following response activity will occur:

1. The first person discovering the spill will immediately notify the Tanker Officer of the vessel to discontinue the transfer of Bunker " C " oil from vessel to shore; effect any obvious response within the limits of his/her knowledge or skills; and, notify the Shift Supervisor;

2. The Operator on the jetty will place sorbent boom and pom-poms in all areas on the dock surface contaminated with spilled Bunker C;

3. The Shift Supervisor will contact the OSC-1 and assume the role of OSC until the OSC-1 attends the spill scene;

4. The Shift Supervisor will notify Canadian Coast Guard and initiate a spill report using the standard **Hazardous Material Spill Status**

**Report.** The Shift Supervisor will also initiate an A/I report of the incident; The Shift Supervisor will also call the Plant Manager, the Environment and Performance Manager and the Labour Manager - Operations, after contacting the OSC-1 and Canadian Coast Guard;

5. The on-call OSC-1 upon arrival on-site will be briefed by the Shift Supervisor or the person/operator who first noticed the spill;

6. The Shift Supervisor will attend to his /her normal duties;

7. The OSC-1 assumes responsibility for the response mechanism (e.g. can the spill be contained and cleaned up using plant personnel);

8. Initial emergency response action plans are effected (e.g. the OSC-1 deploys members of the Utility Department in an action of containment and clean-up using the members of the plant Emergency Response Team (ERT) in a support role, if required);

> After the normal day shift or on the weekend when the number of Emergency Response Team members is at a minimum, the Shift Supervisor will upon receiving notification of the emergency direct the on-site trained members of the Emergency Response Team (operators) to the scene of the emergency. The Shift Supervisor or delegate will call off-site members of the Emergency Response Team using the standard home telephone system. These calls will be made to the order of rank as established by the members of the ERT with calls made in a cascading fashion by ERT members once the first person is contacted.

9. If necessary, the OSC-1 in conjunction with the OSC-2 will notify the Response Organization (RO) – Eastern Canada Response Corporation (ECRC) and implement the response arrangement; ECRC can be contacted as per contact name and number contained in Section ERM 04 – Contact Directory.

TRANSPORT CANADA MARINE SAFETY SÉCURITÉ MARITIME CANADA St. John's, NL

**THE OSC 1 WILL NOW:**

10. If required, have the Boom Support Vessel move his vessel from the jetty area and deploy containment booms (**Appendix B - Maps** - Figures #3, #4, and #5);

11. Have the Mechanical Maintenance Supervisor or designate deploy a team to continue monitoring the boom and oiling conditions from the jetty;

12. Have the Mechanical Maintenance Supervisor or designate report back with information relating to the position and flotation status of the Bunker C;

13. Determine if Bunker C is still leaking from the vessel, line, or boom;

14. Consider environmental sensitivities (refer to **Appendix C – Sensitivity Maps)**;

15. Liaise with the Regional Environmental Emergency Team (REET).

**EVENT TIME: 1 - 5 HRS (STAGE 1 RECOVERY OPERATIONS)**

During this period spilled Bunker C will continue to move outwards in a northeasterly direction where it will be contained against the 91 cm (36 inch) solid flotation boom previously deployed. With the oil thus contained, the OHF Spill Response Team (**Utility Department Employees**) can commence Stage 1 recovery operations.

**THE OSC-1 WILL NOW:**

1. Have the Response Personnel, under supervision of the Utility Department Supervisor, or designate use pom-poms to absorb Bunker C deposited on the jetty surface in the vicinity of the spill;

2. After becoming saturated with Bunker C, the pom-poms will be placed in containment drums that have been positioned on the jetty for this purpose.

While the OHF's Response Team's efforts will assist in the overall response, it is not expected to remove all spilled Bunker C unless quantities are extremely small. As such, and from previous experience, it is expected the Bunker C will commence to sink where it will remain submerged within a 5 to 10 metre radius on the bay floor.

If called, and with the expected arrival time for the RO being 6 hours, the OSC - 1 will consider mobilizing response assistance with:

1. A contracted diver assessment of the subsurface oiling conditions; this diving contractor will also provide assistance to the vacuum truck operator by moving the vacuum hose to pockets of oil on the bottom;

2. A contracted vacuum truck operator will be positioned on the jetty for the purpose of removing sinking Bunker C with the assistance of a diving contractor.

Upon arriving on site, all contractors are to report to the OSC-1 for a briefing. This briefing will include a review of Health & Safety, Environmental and other pertinent Company and site information, as outlined in the Holyrood Contractor Orientation manual.

At this stage, and at all points during spill incident, the On-Scene Commander, with support from the response structure, will assess whether or not it is necessary to engage the Response Organization (RO) for immediate escalation of the response up to, if required, the full 10,000 tonne capability of the RO. It is recognized that this decision will be based on factors such as the OHF's resource (equipment and manpower) availability, response effectiveness and environmental conditions. Also, it is acknowledged that the RO may be engaged on a stand-by basis and that, the RO's level of engagement and commitment to resources will be commensurate with the conditions of the spill and under the control of the OHF. **If the RO is not engaged, brief the Canadian Coast Guard hourly.**



**EVENT TIME: 5 - 15 HOURS (STAGE 2 RECOVERY OPERATIONS)**

With the Bunker C contained inside the 91 cm (36 inch) boom, Stage 2 recovery operations will commence after the arrival (between 5 - 6 hours)

of local response contractors. This will be in the form of the vacuum truck and divers.

**COMPLETE THE FOLLOWING:**

1. If safe to do so, the diver will conduct an underwater survey to determine the extent and dispersion of sunken Bunker C. This will be conducted under supervision of the Marine Terminal Supervisor and as many assistants, from the OHF Spill Response Teams, as required. Professional Diving Services are to work to their own pace and are not to be asked to perform any duties other than those for which they have been certified, hired for and believe to be safe;

2. In consultation with Canadian Coast Guard, the RO if required, and other oil spill specialists as required, will determine the size of the recovery operation. This will be accomplished in conjunction with the vacuum truck operator and the contracted diver;

3. If necessary for safety reasons, and after consultation with the First Mate, Vessel Master, and Canadian Coast Guard, the vessel will be moved from the area in which the spill originally occurred;

4. When oiling conditions have been assessed, have the vacuum truck operator deploy the vacuum truck in a position, on the jetty, suitable for recovery operations to commence. This will be accomplished after conducting a briefing to ensure all parties understand the method by which the OSC-1 will be conducting the recovery operation;

5. The **Manager of Environment & Performance** or designate will obtain disposal advice and permits from the Government Services Center or the Newfoundland Department of Environment and ascertain the method by which recovered Bunker C may be disposed of. Empty on-site tanks will be used as a primary storage facility for liquid waste.

**EVENT TIME: 15 - 24 HOURS (STAGE 3 RECOVERY OPERATIONS)**

During this period the vacuum truck and divers will continue removing and transporting recovered Bunker C to the temporary storage containers (rented). The OSC-1 will conduct a strategy briefing with the RO if it has been necessary to call the RO.

**THE OSC-1 WILL THEN:**

1. Commence on-water recovery operations with the 0.61 metre (24 inch) belt skimmer or GT-185 provided and operated by the Response Organization

2. Utilize on-site storage facilities for storage of recovered oil and water.

**SHORELINE CLEANUP:**

The predominant shoreline around the Holyrood Plant is classified as low cliff in the area of the docking facility and cobble/shingle beach in the Indian Pond Beach area. Although the shoreline energy is moderate to high, spilled Bunker C will persist for a considerable amount of time due to its persistence and consistency. As the Bunker C weathers it will also commence to solidify and, as such, become even harder to handle and remove. Shoreline clean-up crews will be assisted by the OHF Spill Response Team (**Utility Department)** in the initial response, subject to the size of the spill**.**

**THE OSC-1 WILL NOW:**

Conduct an assessment of the shoreline oiling conditions with the Response Team or, if required due to the size of the spill, qualified Shoreline Cleanup and Assessment Technologists.

1. Review sensitivities using **Appendix C - Sensitivity Maps**;

2. Segment the shoreline to determine response priorities;

3. Document the segmented shoreline;



4. Photograph and take video of the oiling conditions;

5. Collect sediment and oil samples as required;

6. Characterize the overall health of the shoreline, inter-tidal zone and wildlife communities, and the effects of oil or cleanup operations on those sensitivities;

7. Make an assessment of operational constraints on the recovery potential of the area based upon the condition of the marine environment in unspoiled areas, productivity of the area, and recruitment potential from adjacent or nearby areas. Indicator species are agreed upon prior to the initiation of a shoreline survey;

8. Recommend precautions or constraints that could be followed during cleanup and or treatment to minimize effects on the marine environment;

9. Liaise with the Regional Environmental Emergency Team (REET).

**GENERAL NOTES**

The appropriate mitigative measures to complete the spill response include, but are not limited to, the following:

1. Monitoring, containment, sampling, recovery and disposal of floating oil;

2. Monitoring, containment, sampling, recovery and disposal of sinking oil;

3. Shoreline treatment.

To implement the appropriate mitigative countermeasures the OSC-1 will continue to oversee:

1. Daily situation analysis in consultation with Canadian Coast Guard, REET, and the RO (Response Organization) if called, and other private contractors, as required;

2. Development of an action plan for the following day's field response activities.

This approach will continue on a repetitive daily cycle until the spill response has been completed. When any field group conducting mitigate measures becomes ineffective, that group will be de-mobilized and its resources made available for other response measures deemed more effective.

## RESPONSE ACTIVITIES (NO PRE-BOOMING):

Within the **first hour** of the spill the following response activity occurs:

1. The first person discovering the spill will immediately notify the Tanker Officer of the vessel to discontinue the transfer of Bunker " C " oil from vessel to shore; effect any obvious response within the limits of his/her knowledge or skills; and, notify the Shift Supervisor;

2. The Shift Supervisor will contact the OSC-1and assume the role of OSC until the OSC-1 attends the spill scene;

3. Initial emergency response action plans are effected;

4. The Operator on the jetty will place sorbent boom and pom-poms in all areas on the dock surface contaminated with spilled Bunker C;

5. The Shift Supervisor will notify Canadian Coast Guard and initiate a spill report using the standard **Hazardous Material Spill Status Report.** The Shift Supervisor will also initiate an A / I report of the incident;

6. The on-call OSC-1 upon arrival on-site will be briefed by the Shift Supervisor or the operator who first noticed the spill;

7. The OSC-1 assumes responsibility for the response;

8. If necessary, the OSC-1 has notified the Response Organization (RO) and implemented the response arrangement (see block note page 7 of 17);

9. The Shift Supervisor continues with his normal responsibilities.

**THE OSC-1 WILL NOW:**

1. If required, have the Boom Support Vessel move his vessel from the jetty area and deploy containment booms (refer to **Appendix B – Maps** - Figures #3, #4, and #5);

2. Have the Mechanical Maintenance Supervisor deploy a team to continue monitoring the boom and oiling conditions at the jetty and along the shoreline towards Indian Pond;

3. Have the Mechanical Maintenance Supervisor report back with information relating to the position and flotation status of the Bunker C;

4. Determine if Bunker C is still leaking from the vessel, line, or boom;

5. Consider environmental sensitivities (**Appendix C - Sensitivity Maps**);

6. Liaise with REET.

**EVENT TIME: 1 - 5 HRS (STAGE 1 CONTAINMENT OPERATIONS)**

During this period spilled Bunker C will continue to move in a northeasterly direction where it will impact the shoreline between the jetty and, after approximately 4 hours, the entrance to Indian Pond. From previous experience, it is expected that the Bunker C will also commence to sink while continuing to move in a northeast direction. Under these circumstances the protection of the entrance to Indian Pond will be a priority for the OSC-1 due to the tidal influence in the pond and the

need to protect the plant's water intake. However, if weather, ice, or other safety issue is still present, the on-water response operation is not to commence. If this is the case, the OSC-1 will continue to have the spill response team, via the Mechanical Maintenance Supervisor, monitor the extent of oiling.

Accordingly, from this point, this scenario assumes that weather conditions have improved and that an on-water containment and recovery operation has been deemed to be safe. If this is not the case, continue monitoring the spill and liaise with Coast Guard, REET, the RO if required, and other response contractors as required.

**THE OSC-1 WILL NOW:**

1. Direct the Mechanical Maintenance Supervisor to ready the response trailer and boom reel complete with 366 m (1200 feet) of 91 cm (36 inch) solid flotation boom.

**NOTE: If you have been referred to this scenario from the pre-booming scenario, one 366 m (1200 feet) reel of 91 cm (36 inch) solid flotation boom will be at the federal wharf in Holyrood and on 366 m reel of 91 cm will be located on-scene at the generating station.**

2. Determine, in consultation with the Mechanical Maintenance Supervisor if on-water containment is possible, and if possible, deploy 366 m of 91 cm (36 inch) solid flotation boom to contain the oil in accordance with the diagram in **Appendix B - Maps** Figures #3, #5, and #6.

3. If necessary, have 1 reel positioned ready for deployment between Indian Pond and Holyrood Bay.

4. If necessary, direct the master of the Boom Support Vessel to relocate the vessel to the Generating Station and under direction of the Mechanical Maintenance Supervisor, have him standby approximately 250 m offshore opposite the boom deployment site. Ensure that the vessel does not enter the path of spilled Bunker C.

With the expected arrival time for the RO being 5 hours, the OSC-1 will consider mobilizing response assistance with:

1. A diving contractor who will be used to provide an assessment of the subsurface oiling conditions and will provide assistance to the vacuum truck operator by moving the vacuum hose to pockets of oil on the surface and bottom of the harbor.

2. A vacuum truck operator who will provide a vacuum truck to be positioned, initially, on the jetty for the purpose of removing floating and sinking Bunker C with the assistance of the diving contractor.

On arrival, all contractors are to report to the OSC-1 for a briefing.

**EVENT TIME: 5 – 15 HOURS (STAGE 2 RECOVERY OPERATIONS)**

With the Bunker C contained inside the 91 cm (36 inch) boom, Stage 2 recovery operations will commence after the arrival (between 5 - 6 hours) of local response contractors and, if required, the RO. This will be in the form of the vacuum truck, divers, and the skimmer provided by the RO.

**COMPLETE THE FOLLOWING:**

1. Utilizing the Boom Support Vessel and two members of the spill response team, the 91 cm solid flotation boom containing the Bunker C will be brought to the shoreline.

2. If additional on water containment is required the Boom Support Vessel will deploy the second 366 m reel of 91 cm solid flotation boom with the assistance of the two spill response team members.

3. With the first boom secured at the shoreline, deploy a vacuum truck and skimmer at the shoreline to commence the recovery operations in accordance with the boom deployment locations (**Appendix B Maps**). Temporary storage will be provided, on-scene, by the vacuum truck. As the truck becomes full it will be unloaded into a semi permanent storage tank at the Holyrood Generating Station.

4. If safe to do so, have the divers conduct an underwater oiling survey to determine the extent and dispersion of sunken Bunker C (see **Appendix B – Maps**). This will be conducted under supervision of the

5. Mechanical Maintenance Supervisor and as many assistants, from the OHF Spill Response Teams, as required. Diving Contractors are to work to their own pace and are not to be asked to perform any duties other than those for which they have been certified, hired for and believe to be safe.

6. In consultation with Coast Guard, the RO if required, and other oil spill specialists as required, determine the size of the recovery operation and extent of escalation required.

7. If necessary, due to safety reasons, and after consultation with the First Mate, Vessel Master, and Coast Guard, move the tanker from the area in which the spill originally occurred.

8. The **Manager of Environment and Performance** or designate will obtain disposal advice and permits from the Government Services Center and ascertain the method by which recovered Bunker C may be disposed of. Empty On-Site tanks will be used as a primary storage facility for liquid waste.

**EVENT TIME: 15 – 24 HOURS (STAGE 3 RECOVERY OPERATIONS)**

During this period the vacuum truck, divers, and skimmer (operated by the RO, if required) will continue removing and transporting recovered Bunker C to the on-site storage facilities.

**THE OSC-1 WILL:**

1. If required, commence on-water recovery operations with the belt skimmer provided and operated by the RO.

2. Utilize temporary storage, from the on-site storage facilities for, recovered oil and oily water. Additional equipment available to the OSC is detailed under "Available Equipment" in the table – this section.



**SHORELINE CLEANUP**

The predominant shoreline around the Holyrood Plant is classified as low cliff in the area of the docking facility and cobble/shingle beach in the Indian Pond Beach area. Although the shoreline energy is moderate to high, spilled Bunker C will persist for a considerable amount of time due to its persistence and consistency. As the Bunker C weathers it will also commence to solidify and, as such, become even harder to handle and remove. Shoreline cleanup crews will be assisted, in the initial response, by the OHF Spill Response Team (subject to the size of the spill).

**THE OSC-1 WILL NOW:**

Conduct an assessment of the shoreline oiling conditions with the Spill Response Team or, if required due to the size of the spill, qualified Shoreline Cleanup and Assessment Technologists.

1. Review sensitivities using **Appendix C - Sensitivity Maps**.
2. Segment the shoreline to determine response priorities (see **Appendix B – Maps**);
3. Document the segmented shoreline;
4. Photograph and take video of the oiling conditions;
5. Collect sediment and oil samples as required;
6. Check ecological sensitivities from **Appendix C - Sensitivity Maps**.
7. Characterize the overall health of the shoreline, inter-tidal zone and wildlife communities, and the effects of oil or cleanup operations on those sensitivities;
8. Make assessment of operational constraints on the recovery potential of the area based upon the condition of biota in unoiled areas, productivity of the area, and recruitment potential from

9. adjacent or nearby areas. Indicator species are agreed upon prior to the initiation of a shoreline survey;

10. Recommend precautions or constraints that could be followed during cleanup and or treatment to minimize effects on biota.

**GENERAL NOTES**

The appropriate measures to complete the spill response include, but are not limited to, the following:

1. Monitoring, containment, recovery and disposal of floating oil;

2. Monitoring, containment, recovery and disposal of sinking oil;

3. Shoreline treatment.

To implement the appropriate countermeasures the OSC will continue to oversee:

1. Daily situation analysis in consultation with Canadian Coast Guard, REET, the RO if required, and other private contractors as required;

2. Development of an action plan for the following day's field response activities.

This approach will continue on a repetitive daily cycle until the spill response has been completed. When any field group conducting mitigating measures becomes ineffective, that group will be de-mobilized and its resources made available for other response measures deemed more effective.



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## PLANT WIDE RISK ASSESSMENT
## MARINE SPILL – BUNKER "C"

| ITEM # | SCENARIO | POSSIBLE COLLATERAL HAZARDS | KEY ISOLATION POINTS | AVAILABLE EQUIPMENT | AVAILABLE RESOURCES |
|---|---|---|---|---|---|
| | | | PREBOOMING | | |
| 1 | • Emergency Response to a Bunker C fuel oil spill that occurred while offloading a tanker that has been surrounded by an oil containment boom prior to the spill event. | • Bunker C has a pour point of approximately 6.5°C. From previous experience in a recent spill involving 5 $m^3$ of a Bunker C, and with the predominant winds from a southerly direction, a maximum tidal range of 1.1 m (3.6 ft), surface currents of 0.6 meters per second at the jetty, and maximum wave of 0.91m to 1.5 m (3ft to 5 ft), it is expected that after initially spreading outwards towards the shoreline, the spilled Bunker C will cease to flow, become thick, and eventually commence to sink. The 91 cm (36 inch) boom, deployed prior to commencing transfer operations, will contain the Bunker C in the vicinity of the dock and will limit, if sinking, the area covered by Bunker C;<br>• It is important to note | • Tanker offloading pumps, contact tanker First Mate;<br>• Off-loading pipeline isolation at wharf base and head;<br>• Holyrood Marina entrance (Figure #3, Appendix B);<br>• On water containment (Figure #5, Appendix B);<br>• Shore anchor points for boom deployment (Figure #6, Appendix B). | • Boom Reel 91 cm (36 inch) (Qty 2);<br>• Boom Trailer 91 cm (36 inch) boom reel (Qty 2);<br>• Hydraulic power pack (Qty 2);<br>• Buoys (Qty 6);<br>• Anchors (Qty 6);<br>• Towing device (Qty 2);<br>• Polyethylene rope<br>• 91 cm (36 inch) solid flotation boom (732 m/2400 feet);<br>• 46 cm (18 inch) inshore boom (305 m/1000 feet);<br>• Pom Poms (Qty 3000);<br>• Oceanite (Qty 15 bags);<br>• Oil absorb towelettes (Qty 600);<br>• 1 $m^2$ towelettes (Qty 150);<br>• 5 m (16 foot) aluminum boat c/w 20 HP motor (Qty 1);<br>• 1 portable folding tank (Qty 1). | • ECRC (East Coast Response Corporation);<br>• REET (Regional Environmental Emergency Team);<br>• CCG (Canadian Coast Guard);<br>• Hickey's Ambulance Service;<br>• Medical Support;<br>• RCMP (Holyrood Detachment of Royal Canadian Mounted Police);<br>• RNC (CBS Detachment Royal Newfoundland Constabulary). |

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**PLANT WIDE RISK ASSESSMENT**
**MARINE SPILL – BUNKER "C"**

| ITEM # | SCENARIO | POSSIBLE COLLATERAL HAZARDS | KEY ISOLATION POINTS | AVAILABLE EQUIPMENT | AVAILABLE RESOURCES |
|---|---|---|---|---|---|
| | | that these above environmental conditions would cause Bunker C, not contained by a pre-deployed boom, to move northeasterly towards the shoreline and Kelly's Island at a rate of 0.6 km per hour;<br>• Oiling of the Holyrood Marina (Figure #3, Appendix B);<br>• Oiling of environmentally sensitive areas (Figure #1, Appendix C);<br>• Wave action (Figure #2, Appendix C). | | | |
| | | NO PRE BOOMING | | | |
| 2 | • Emergency Response to a Bunker C fuel oil spill that occurred while offloading a tanker that has not been surrounded by an oil containment boom prior to the spill event. | • Bunker C has a pour point of approximately 6.5°C. From previous experience in a recent spill involving 5 $m^3$ of a Bunker C, and with the predominant winds from a southerly direction, a maximum tidal range of 1.1 m (3.6 ft), surface currents of 0.6 meters per second at the jetty, and maximum wave of 0.91m to 1.5 m | • Tanker offloading pumps, contact tanker First Mate;<br>• Off-loading pipeline isolation at wharf base and head;<br>• Holyrood Marina entrance (Figure #3, Appendix B);<br>• On water containment (Figure #5, Appendix B);<br>• Shore anchor points for boom deployment | • Boom Reel 91 cm (36 inch) (Qty 2);<br>• Boom Trailer 91 cm (36 inch) boom reel (Qty 2);<br>• Hydraulic power pack (Qty 2);<br>• Buoys (Qty 6);<br>• Anchors (Qty 6);<br>• Towing device (Qty 2);<br>• Polyethylene rope<br>• 91 cm (36 inch) solid flotation boom (732 m/2400 feet); | • ECRC (East Coast Response Corporation);<br>• CPPI (Canadian Petroleum Products Institute)<br>• REET (Regional Environmental Emergency Team);<br>• CCG (Canadian Coast Guard);<br>• Hickey's Ambulance Service;<br>• Medical Support;<br>• RCMP (Holyrood |

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## PLANT WIDE RISK ASSESSMENT
## MARINE SPILL – BUNKER "C"

| ITEM # | SCENARIO | POSSIBLE COLLATERAL HAZARDS | KEY ISOLATION POINTS | AVAILABLE EQUIPMENT | AVAILABLE RESOURCES |
|---|---|---|---|---|---|
| | | (3ft to 5 ft), it is expected that after initially spreading outwards towards the shoreline, the spilled Bunker C will cease to flow, become thick, and eventually commence to sink;<br>• It is important to note that these above environmental conditions would cause Bunker C to move northeasterly towards the shoreline and Kelly's Island at a rate of 0.6 km per hour;<br>• Oiling of the Holyrood Marina (Figure #3, Appendix B);<br>• Oiling of environmentally sensitive areas (Figure #1, Appendix C);<br>• Wave action (Fig. #2, Appendix C). | (Figure #6, Appendix B). | • 46 cm (18 inch) inshore boom (305 m/1000 feet);<br>• Pom Poms (Qty 3000);<br>• Oceanite (Qty 15 bags);<br>• Oil absorb towelettes (Qty 600);<br>• 1 $m^2$ towelettes (Qty 150);<br>• 5 m (16 foot) aluminum boat c/w 20 HP motor (Qty 1);<br>• 1 portable folding tank (Qty 1). | Detachment of Royal Canadian Mounted Police);<br>• RNC (CBS Detachment Royal Newfoundland Constabulary). |



# Emergency Response Manual
# Shoreline Protection Plan

## SUMMARY - SEGMENT 1
### REGION: HOLYROOD BAY, CONCEPTION BAY, NF

**RESPONSE PRIORITY:** **HIGH** - Important to protect Indian Pond inlet and therefore exclusion booming is recommended for across the entrance to the inlet.

**PRIMARY RESOURCES AT RISK:** Eco/Bio - primarily waterfowl and fish. This is also the water intake site for the Hydro condensers.

**COMMENTS:**

**BOUNDARIES OF Segment:** North side of Indian Pond trussel (47°27'37"N, 53°05'21"W) to Boom Anchoring Point A (47°27'05"N, 53°06'05"W), north of Floods Point.

**ACCESS ROADS:** Shoreline access is possible via the railway bed which runs parallel to the shore. Presently, the trussel at Indian Pond is unsuitable for any type of access and would require construction work, in the form of a road placed over the existing steel beams, before it can be crossed to\from Seal Cove Road. This area can be accessed, at the south end of the Segment, by the Hydro wharf access road. If necessary, a road can be constructed from the railway bed to the Hydro property at a desired location.

Exclusion booming for the Indian Pond inlet would protect the aquatic life in the inlet and would prevent oil from being stranded in the sheltered area, where finer sediments are present, and keep the oil in a high wave energy zone where natural breakdown is much faster.



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:1**

**Segment LENGTH:** 1.4 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | 90% cobble-boulder, 10% cobble | Permanent Inlet: | Yes - Indian Pond |
| Lower ITZ Type: Beach | | Inlet Width: | Approx 20 meters |
| Shoreline Type: | Boulder Beach | Cyclical Inlet: | Yes |
| Backshore Material: | 90% cobble-boulder, 10% cobble | # Channels: | 1 |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | Yes - exposed. (Except for inside inlet) |
| High or Low Wave Action: | High Wave Energy, except for in Indian Pond - Low Wave Energy. |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (e.g. headland) | No | Sand - Burial Potential | No |
| Man-made Alongshore Barrier (e.g. wharf) | No | Pebble/cobble - Penetration Potential | Yes |
| Bay or Re-Entrant | Yes | Riprap or Boulder - Reservoir Potential | Yes |
| Tidal Inlet or Channel | Yes | Overwash Potential into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No - Holyrood Generating Stn. Water Inlet Site |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | Hydro water intake |
| Crustaceans or Mollusks | Yes | Harbour or Marina | Yes |
| Fish (Nearshore Only) | Yes | Recreation | Yes |
| Flora/Plant Communities | Yes | Residential | Yes - nearby homes in Indian Pond area. |
| Mammals (Marine) | Yes | | |
| Primary Resources: | Protect to Indian Pond area. | | |
| Secondary Resources: | Eco\Bio - Waterfowl and Fish | | |
| Is the Segment Within a PAR? | No | | |

**INFORMATION SOURCES:**

| | | | |
|---|---|---|---|
| Topographic Map(s): | Yes - 9259, 9222, 1 N/6 | Hydrographic Chart(s): | Yes; 4848 |
| Videotape(s): | Yes -"Shoreline Protection Plan" | Aerial Photographs: | 95021-116 |

References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:1**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | No - only Indian Pond area. |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No - except Indian Pond |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | No |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | Yes - Indian Pond |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | Yes - out of Indian Pond |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | | |
|---|---|---|
| P1 Nearshore (on-water) containment and recovery. | | R |
| P2 Nearshore redirection away from shore/recovery. | | R - Only near Indian Pond inlet. |
| P3 Nearshore redirection towards shoreline containment/recovery. | | R |
| P4 Exclusion booming. | | R - Indian Pond inlet |
| P5 Shoreline protection intertidal booming/recovery. | O | |
| P6 Shoreline barrier or berms/recovery. | | O |
| P7 Contact barriers. | | NR |
| P8 Channel boom or barriers/recovery. | | O |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | | |
|---|---|---|
| Nearshore access affected by shoals or reefs/rocks. | | Yes - rocks present |
| Direct backshore or alongshore access. | | Yes - via railway bed |
| Alongshore access affected by boulders, etc. | Yes | |
| Coast exposed to storm and/or winter wave action. | | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No | |
| Winter ice on water and/or on shore. | | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:1**

**SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)**

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | If Possible |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes - except near Indian Pond inlet |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

**SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)**

| | |
|---|---|
| 1. Monitor. | Yes - Indian Pond inlet |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No |
| 3. Remove bulk oil - allow residue to degrade. | No - except for very small amounts of oil |
| 4. Minimize waste generation by in-situ techniques. | No |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

**SHORELINE TREATMENT/CLEANUP - METHODS**

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR, R | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | R |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | NR |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | O |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | O - Indian Pond trussel | S18 Shoreline cleaners | O |
| S9 Manual removal | R | S19 Solidifiers | O - Depending on oil type |
| S10 Vacuums | R | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

**SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS**

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | Yes |
| High tidal range | No | Staging areas available nearby | Yes |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | Yes |
| Winter on-shore ice | Yes | Backshore cliff present | No |

Road access Yes - via railway bed, or most northern part of Segment (Indian Pond) by Seal Cove Road
**Note: Construction is required on the Indian Pond Trussel before is can be crossed.**

**SUMMARY - SEGMENT 2**
**REGION: HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | **LOW** - This area is composed of mainly low cliff and cobble-boulder beach and therefore the main concern for this Segment is possible oil penetration along the cobble-boulder beach areas. |
| **PRIMARY RESOURCES AT RISK:** | Marine life in this area consists mainly of waterfowl and fish, but crustaceans\mollusks and flora\plant communities are common also. |
| **COMMENTS:** | |
| **BOUNDARIES OF Segment:** | From Boom Anchoring Point A (47°27'05"N, 53°06'05"W), just north of Flood's Point, to the north side of the Hydro oil off-loading wharf (47°26'38"N, 53°06'21"W) . |
| **ACCESS ROADS:** | Shoreline access is possible via a steep embankment from the backshore to the railway bed. Existing roads which connect to the railway bed include the Hydro wharf access road, Seal Cove Road (but construction is necessary on the Indian Pond trussel before it can be crossed), and if necessary a road can be constructed from the railway bed to the Hydro property at a desired location. |



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:2**

**Segment LENGTH:** 0.9 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | | |
|---|---|---|---|---|
| Lower ITZ Material: | 20 % boulder, 40% cobble - boulder, 40% bedrock | | | |
| Lower ITZ Type: Beach and low cliff | | Permanent Inlet: | No | |
| Shoreline Type: | 20% boulder beach, 40% cobble - boulder beach and 40% low bedrock cliff | Inlet Width: | | N.A. |
| | | Cyclical Inlet: | No | |
| Backshore Material: | 5% cobble, 40% boulder, 55% bedrock | # Channels: | | N.A. |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | Yes - exposed. |
| High or Low Wave Action: | High Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand - Burial Potential | No |
| Man-made Alongshore Barrier (ex. wharf) | No | Pebble/cobble - Penetration Potential | No |
| Bay or Re - Entrant | No | Riprap/Boulder - Reservoir Potential | Yes |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | No |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |
| Primary Resources: | Eco\Bio - waterfowl and fish | | |
| Secondary Resources: | | | |
| Is the Segment Within a PAR? | No | | |

**INFORMATION SOURCES:**

Topographic Map(s): Yes - 9259, 9222, 1 N/6 Hydrographic Chart(s): Yes - 4848
Videotape(s): Yes - "Shoreline Protection Plan" Aerial Photographs: 95021-116
References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:2**

### PROTECTION - OBJECTIVE(S)

| | | |
|---|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | | No |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No | |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | | Yes - Indian Pond |
| 4. Contain stranded oil at the shoreline. | | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | No | |

### PROTECTION - STRATEGY(IES)

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

### PROTECTION - METHODS:

| | | |
|---|---|---|
| P1 Nearshore (on-water) containment and recovery. | | R |
| P2 Nearshore redirection away from shore/recovery. | | NR |
| P3 Nearshore redirection towards shoreline containment/recovery. | | R |
| P4 Exclusion booming. | | NR |
| P5 Shoreline protection intertidal booming/recovery. | NR | |
| P6 Shoreline barrier or berms/recovery. | | NR |
| P7 Contact barriers. | | NR |
| P8 Channel boom or barriers/recovery. | | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

### PROTECTION - OPERATIONAL CONSIDERATIONS:

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | Yes - via railway bed but construction is necessary in some areas. |
| Alongshore access affected by boulders, etc. Yes | |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). No | |
| Winter ice on water and/or on shore. | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:2**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | | |
|---|---|---|
| 1. Allow oiled shore zone to recover naturally. | | No |
| 2. Restore oiled shore zone to pre-spill condition. | | If Possible |
| 3. Accelerate natural recovery. | | Yes |
| 4. Restore with minimal material removal. | | Yes |
| 5. Minimize remobilization of stranded oil. | Yes | |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | | |
|---|---|---|
| 1. Monitor. | | No |
| 2. Act quickly to remove oil before it is reworked and/or buried. | | No |
| 3. Remove bulk oil - allow residue to degrade. | | No - except for very small amounts of oil |
| 4. Minimize waste generation by in-situ techniques. | No | |
| 5. Manual techniques preferred. | | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | | No |
| 7. Backshore riprap cleanup techniques. | | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR, R | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | R | S13 Passive sorbents | O |
| S4 Low-pressure, warm water wash | R | S14 Tilling/Aeration | NR |
| S5 High-pressure, cold water wash | R | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | R | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No - difficult |
| High tidal range | No | Staging areas available nearby | Yes |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | | |

Backshore cliff present: Yes - in southern portion of Segment. Other Segment areas has steep embankment.
Road access: Yes - via railway bed and access road to the Hydro wharf. Seal Cove Road could also be used if the trussel in Indian Pond is repaired.

## SUMMARY - SEGMENT 3
**REGION: HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | **LOW** - Since the shoreline Segment is composed of bedrock and has high wave energy, the oil should not persist in the environment for long periods of time. |
| **PRIMARY RESOURCES AT RISK:** | Eco/Bio - primarily waterfowl, plant/flora communities, and fish. |

**COMMENTS:**

**BOUNDARIES OF Segment:** From the north side of the Hydro oil off-loading wharf (47°26'38"N, 53°06'21"W), to Boom Anchoring Point No.1 (47°26'10"N, 53°06'33"W).

**ACCESS ROADS:** The railway bed runs parallel to the shoreline and serves as the main access road to this Segment. A steep embankment is present between the backshore and the railway bed and therefore construction would be needed to create an access road or staging area near the shoreline. Existing roads which connect to the railway bed include the Hydro wharf access road and O'Roukes road. Duff's Crescent is an alternative access road, but construction is necessary in the latter portion of the road (near the railway bed) since only a narrow trail presently exists adjacent to private property.

The shoreline impacts and oil persistence in this area are relatively low since bedrock is impermeable, except for fractured areas of bedrock or very small pebble-cobble beach areas, and therefore no oil seepage. An exception would be if the oil should sink to the bottom where it can penetrate the finer sediments and persist for long periods of time.



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:3**

**Segment LENGTH:** 0.7 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | Bedrock and Boulder | Permanent Inlet: | No |
| Lower ITZ Type: Low Cliff | | Inlet Width: | N.A. |
| Shoreline Type: | Low Bedrock Cliff | Cyclical Inlet: | No |
| Backshore Material: | Bedrock | # Channels: | N.A. |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | Yes - exposed. |
| High or Low Wave Action: | High Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand-Burial Potential | No |
| Man-made Alongshore Barrier | Yes-Hydro Wharf | Pebble/cobble - Penetration Potential | No |
| Bay or Re-Entrant | No | Riprap/Boulder - Reservoir Potential | No |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | Yes - Hydro Wharf |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |

| | |
|---|---|
| Primary Resources: | Eco\Bio - waterfowl, fish, and flora/plant communities. |
| Secondary Resources: | |
| Is the Segment Within a PAR? | No |

**INFORMATION SOURCES:**

| | | | |
|---|---|---|---|
| Topographic Map(s): | Yes - 9258, 1 N/6 | Hydrographic Chart(s): | Yes - 4848 |
| Videotape(s): | Yes - "Shoreline Protection Plan" | Aerial Photographs: | 95021-116 |

References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:3**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | No |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | No |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | |
|---|---|
| P1 Nearshore (on-water) containment and recovery. | R |
| P2 Nearshore redirection away from shore/recovery. | NR |
| P3 Nearshore redirection towards shoreline containment/recovery. | R |
| P4 Exclusion booming. | NR |
| P5 Shoreline protection intertidal booming/recovery. | NR |
| P6 Shoreline barrier or berms/recovery. | NR |
| P7 Contact barriers. | NR |
| P8 Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | No - access route can be constructed to rail bed |
| Alongshore access affected by boulders, etc. | Yes |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No |
| Winter ice on water and/or on shore. | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:3**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | If Possible |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | No |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No |
| 3. Remove bulk oil - allow residue to degrade. | No - except for very small amounts of oil |
| 4. Minimize waste generation by in-situ techniques. | No |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | O |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | I |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | O - for wharf area | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O -Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No - difficult |
| High tidal range | No | Staging areas available nearby | Yes |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via Hydro wharf access road or construction of road from backshore to railway bed.

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## SUMMARY - SEGMENT 4

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | **LOW** - No structures or areas present which are considered high priority areas. |
| **PRIMARY RESOURCES AT RISK:** | Eco/Bio - waterfowl, plant/flora communities, and fish. |

**COMMENTS:**

**BOUNDARIES OF Segment:** From Boom Anchoring Point No.1 (47°26'10, 53°06'33"W) to Boom Anchoring Point No.2 (47°25'39"N, 53°06'50"W).

**ACCESS ROADS:** The railway bed runs parallel to the shoreline and serves as the main access road to this Segment. A steep embankment is present between the backshore and the railway bed and therefore construction would be needed to create an access road or staging area near the shoreline. Existing roads which connect to the railway bed include the Hydro wharf access road and O'Roukes road. Duff's Crescent is an alternative access road, but construction is necessary since only a narrow trail presently exists (adjacent to private property) in the latter portion of the road.

The shoreline impacts and oil persistence in this area are relatively low since bedrock is impermeable, except for fractured areas of bedrock or very small cobble beach areas, and therefore no oil seepage. There is high wave energy in most of the Segment and therefore natural breakdown is faster than sheltered areas. An exception would be if the oil should sink to the bottom where it can penetrate the finer sediments and persist for long periods of time.



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:4**

**Segment LENGTH:** 1.2 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | Bedrock and Boulder | Permanent Inlet: | No |
| Lower ITZ Type: Low Cliff | | Inlet Width: | N.A. |
| Shoreline Type: | Low Bedrock Cliff | Cyclical Inlet: | No |
| Backshore Material: | Bedrock | # Channels: | N.A. |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | Northern portion exposed, southern portion is sheltered. |
| High or Low Wave Action: | High and Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (e.g. headland) | No | Sand-Burial Potential | No |
| Man-made Alongshore Barrier (e.g. wharf) | No | Pebble/cobble - Penetration Potential | No |
| Bay or Re - Entrant | No | Riprap/Boulder - Reservoir Potential | No |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |
| Marsh Meadow Oiling Potential During High Water Levels | No | | |

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | No |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |
| Primary Resources: | Eco\Bio - waterfowl, fish, and flora/plant communities. | | |
| Secondary Resources: | | | |
| Is the Segment Within a PAR? | No | | |

**INFORMATION SOURCES:**

| | | | |
|---|---|---|---|
| Topographic Map(s): | Yes - 9258, 1 N/6 | Hydrographic Chart(s): | Yes, 4848 |
| Videotape(s): | Yes - "Shoreline Protection Plan" | Aerial Photographs: | 95021-175 |

References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:4**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore resource(s) at risk within the Segment. | No |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | No |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | | |
|---|---|---|
| P1 | Nearshore (on-water) containment and recovery. | R |
| P2 | Nearshore redirection away from shore/recovery. | NR |
| P3 | Nearshore redirection towards shoreline containment/recovery. | R |
| P4 | Exclusion booming. | NR |
| P5 | Shoreline protection intertidal booming/recovery. NR | |
| P6 | Shoreline barrier or berms/recovery. | NR |
| P7 | Contact barriers. | NR |
| P8 | Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | | |
|---|---|---|
| Nearshore access affected by shoals or reefs/rocks. | | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | | No - access route can be constructed to rail bed |
| Alongshore access affected by boulders, etc. | Yes | |
| Coast exposed to storm and/or winter wave action. | | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No | |
| Winter ice on water and/or on shore. | | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:4**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | If Possible |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | No |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No |
| 3. Remove bulk oil - allow residue to degrade. | No - except for very small amounts of oil |
| 4. Minimize waste generation by in-situ techniques. | Optional |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | O |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | I |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | O | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via Hydro wharf access road or construction of road from backshore to railway bed.

## SUMMARY - SEGMENT 5
**REGION: HOLYROOD BAY, CONCEPTION BAY, NF**

**RESPONSE PRIORITY:** **LOW** - No structures or important environmental concerns presents.

**PRIMARY RESOURCES AT RISK:** Eco/Bio - waterfowl, plant/flora communities, and fish.

**COMMENTS:**

**BOUNDARIES OF Segment:** From Boom Anchoring Point No.2 (47°25'39"N, 53°06'50"W) to Boom Anchoring Point No.3 (47°25'02"N, 53°07'11"W).

**ACCESS ROADS:** The railway bed runs parallel to the shoreline and serves as the main access road to this Segment. A steep embankment is present between the backshore and the railway bed and therefore construction would be needed to create an access road or staging area near the shoreline. Existing roads which connect to the railway bed include the Hydro wharf access road and O'Roukes road. Duff's Crescent is an alternative access road, but construction is necessary since only a narrow trail presently exists (adjacent to private property) in the latter portion of the road.

Since the shoreline Segment is composed of bedrock, the shore impact and persistence of oiling is not as extreme as other locations which contain smaller sediment types. The situation becomes more serious if the oil sinks to the bottom in the nearshore area where smaller sediments are present. This can cause the oil to be buried and/or plants/animals to smother.



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:5**

**Segment LENGTH:** 1.3 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | Bedrock and Boulder | Permanent Inlet: | No |
| Lower ITZ Type: Low Cliff | | Inlet Width: | N.A. |
| Shoreline Type: | Low Bedrock Cliff | Cyclical Inlet: | No |
| Backshore Material: | Bedrock | # Channels: | N.A. |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | No - sheltered. |
| High or Low Wave Action: | Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand-Burial Potential | No |
| Man-made Alongshore Barrier (ex. wharf) | No | Pebble/cobble - Penetration Potential | No |
| Bay or Re - Entrant | No | Riprap/Boulder - Reservoir Potential | No |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |
| Marsh Meadow Oiling Potential During High Water Levels | No | | |

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | No |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |
| Primary Resources: | Eco\Bio - waterfowl, fish, and flora/plant communities. | | |
| Secondary Resources: | | | |
| Is the Segment Within a PAR? | No | | |

**INFORMATION SOURCES:**

| | | | |
|---|---|---|---|
| Topographic Map(s): | Yes - 9258, 1 N/6 | Hydrographic Chart(s): | Yes, 4848 |
| Videotape(s): | Yes - "Shoreline Protection Plan" | Aerial Photographs: | 95021-175 |

References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:5**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | No |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | No - except residential and cobble beach areas in Segment 6. |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | |
|---|---|
| P1 Nearshore (on-water) containment and recovery. | R |
| P2 Nearshore redirection away from shore/recovery. | NR |
| P3 Nearshore redirection towards shoreline containment/recovery. | R |
| P4 Exclusion booming. | NR |
| P5 Shoreline protection intertidal booming/recovery. | NR |
| P6 Shoreline barrier or berms/recovery. | NR |
| P7 Contact barriers. | NR |
| P8 Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | No - access route can be constructed to rail bed |
| Alongshore access affected by boulders, etc. | Yes |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No |
| Winter ice on water and/or on shore. | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:5**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | If Possible |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | No |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No |
| 3. Remove bulk oil - allow residue to degrade. | No - except for very small amounts of oil |
| 4. Minimize waste generation by in-situ techniques. | Optional |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | O |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | I |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - but access can be created from backshore to railway bed with only minor construction.

| SUMMARY - SEGMENT 6<br>REGION: HOLYROOD BAY, CONCEPTION BAY, NF | |
|---|---|
| **RESPONSE PRIORITY:** | **LOW** - Only concerns are for the beach house shoreline zone and some very small areas of pebble-cobble beach. |
| **PRIMARY RESOURCES AT RISK:** | Eco/Bio - waterfowl, plant/flora communities, and fish. |
| **COMMENTS:** | |
| **BOUNDARIES OF SEGMENT:** | From Boom Anchoring Point No.3 (47°25'02"N, 53°07'11"W) to the north side of the Ultramar wharf (47°23'48"N, 53°07'28"W). |
| **ACCESS ROADS:** | Shoreline access is possible via the railway bed which runs parallel to the shore. If necessary, a road directly to the backshore and/or a staging area near the shoreline can be created with only minor construction. Roads which connect to the railway bed include O'Roukes Road and Brien's Road. Access to the south end of the Segment is possible through the Ultramar property (via Refinery Road). |



## SHORE ZONE CHARACTER

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:6**

**Segment LENGTH:** 2.28 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | 5% cobble, 15% boulder, 80% bedrock | Permanent Inlet: | No |
| Lower ITZ Type: | 20% beach, 80% low cliff | Inlet Width: | N.A. |
| Shoreline Type: | 5% cobble beach, 15% boulder beach and 80% low bedrock cliff | Cyclical Inlet: | No |
| | | # Channels: | N.A. |
| Backshore Material: | 5% cobble, 15% boulder, 80 % bedrock | | |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | No, sheltered. |
| High or Low Wave Action: | Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand - Burial Potential | Yes - cobble beach |
| Man-made Alongshore Barrier (ex. wharf) | No | Pebble/cobble - Penetration Potential | Yes |
| Bay or Re-Entrant | No | Riprap/Boulder - Reservoir Potential | Yes |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | Yes - Ultramar Property |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | Yes |
| Mammals (Marine) | Yes | | |

| | |
|---|---|
| Primary Resources: | Eco\Bio - waterfowl, fish, and flora/plant communities. |
| Secondary Resources: | Residential area at about halfway point of Segment. |
| Is the Segment Within a PAR? | No |

**INFORMATION SOURCES:**

Topographic Map(s): Yes - 9258, 1 N/6 Hydrographic Chart(s): Yes - 4848
Videotape(s): Yes - "Shoreline Protection Plan" Aerial Photographs: 95021-175
References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:6**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore resource(s) at risk within the Segment. | Yes - residential and pebble-cobble beach areas. |
| 2. Minimize degree of contact with shore or resource (s) at risk. | No |
| 3. Prevent contact with shore or resource (s) at risk in adjacent Segment(s). | No - except the pebble cobble beach in Segment 7 where waterfowl gather. |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | | |
|---|---|---|
| P1 | Nearshore (on-water) containment and recovery. | R |
| P2 | Nearshore redirection away from shore/recovery. | NR |
| P3 | Nearshore redirection towards shoreline containment/recovery. | R |
| P4 | Exclusion booming. | NR |
| P5 | Shoreline protection intertidal booming/recovery. NR | |
| P6 | Shoreline barrier or berms/recovery. | NR |
| P7 | Contact barriers. | NR |
| P8 | Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | No - except for access roads to beach - house or Ultramar property |
| Alongshore access affected by boulders, etc. Yes | |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). No | |
| Winter ice on water and/or on shore. | Yes |



## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:6**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | If Possible |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | No |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No - except for cobble areas |
| 3. Remove bulk oil - allow residue to degrade. | No |
| 4. Minimize waste generation by in-situ techniques. | Optional |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | R |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | I |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O - Bedrock\Boulder areas | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O -Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via steep embankment (construction required) to Ultramar property and railway bed or by beach house access road.

## SUMMARY - SEGMENT 7
**REGION: HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | **LOW** - Most of this Segment is composed of boulder beach with only two small sections of pebble-cobble beach in which oil penetration may occur. |
| **PRIMARY RESOURCES AT RISK:** | Eco/Bio - waterfowl (particular around the small stream which flows into the bay), plant/flora communities, and fish. |
| **COMMENTS:** | |
| **BOUNDARIES OF SEGMENT:** | North side of the Ultramar wharf (47°23'48"N, 53°07'28"W) to the north side of the Holyrood Marina (47°23'21"N, 53°07'35"W). |
| **ACCESS ROADS:** | Backshore access to this Segment is possible via Refinery Road and the Ultramar oil handing facility property (land and wharf). Backshore access is inhibited by a steep embankment, 5-10 meters high, and therefore boom trucks may be necessary for manoeuvring heavy equipment. Alongshore access is difficult due to the boulder beach areas. |



## SHORE ZONE CHARACTER

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:7**

**Segment LENGTH:** 0.85 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | 15% cobble, 85% boulder | Permanent Inlet: | No |
| Lower ITZ Type: | Beach | Inlet Width: | N.A. |
| Shoreline Type: | 15% cobble beach, 85% boulder beach | Cyclical Inlet: | No |
| Backshore Material: | 10% cobble, 90% boulder | # Channels: | N.A. |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | No - sheltered. |
| High or Low Wave Action: | Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Northeast

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (e.g. headland) | No | Sand-Burial Potential | Yes - cobble beach |
| Man-made Alongshore Barrier (e.g. wharf) | Yes | Pebble/cobble - Penetration Potential | Yes |
| Bay or Re-Entrant | No | Riprap/Boulder - Reservoir Potential | Yes |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | Yes - Ultramar wharf and Property |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | No |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |

| | |
|---|---|
| Primary Resources: | Eco\Bio - waterfowl, fish, and flora/plant communities. |
| Secondary Resources: | Ultramar oil handling facility wharf |
| Is the Segment Within a PAR? | No |

**INFORMATION SOURCES:**

Topographic Map(s): Yes - 9222, 9258, 1 N/6 Hydrographic Chart(s): Yes -4848
Videotape(s): Yes - "Shoreline Protection Plan" Aerial Photographs: 95023-128
References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:7**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | No - except for the pebble-cobble beach areas. |
| 2. Minimize degree of contact with shore or resource(s) at risk. | Yes - small stream area |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | Yes - Holyrood Marina, pebble cobble beach, and fish plants in Segment 8 |
| 4. Contain stranded oil at the shoreline. | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | |
|---|---|
| P1 Nearshore (on-water) containment and recovery. | R |
| P2 Nearshore redirection away from shore/recovery. | NR |
| P3 Nearshore redirection towards shoreline containment/recovery. | R |
| P4 Exclusion booming. | NR |
| P5 Shoreline protection intertidal booming/recovery. | NR |
| P6 Shoreline barrier or berms/recovery. | O - in pebble-beach areas |
| P7 Contact barriers. | NR |
| P8 Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**




**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | | |
|---|---|---|
| Nearshore access affected by shoals or reefs/rocks. | | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | | Yes - bachshore access via steep embankment to Refinery road or Ultramar property |
| Alongshore access affected by boulders, etc. | Yes | |
| Coast exposed to storm and/or winter wave action. | | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No | |
| Winter ice on water and/or on shore. | | Yes |

## SHORELINE TREATMENT

**REGION: HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:7**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | Yes |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | Yes |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No - except for the pebble-cobble beach areas. |
| 3. Remove bulk oil - allow residue to degrade. | No |
| 4. Minimize waste generation by in-situ techniques. | No |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | NR | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | R |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | NR |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via steep embankment to Refinery Road or Ultramar property and by the Ultramar wharf access road.

## SUMMARY - SEGMENT 8

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | **HIGH** - The Holyrood Marina, long stretch of pebble-cobble beach, and two fish plants should be protected from oiling by exclusion booming. |
| **PRIMARY RESOURCES AT RISK:** | Valuable boats in Holyrood Marina, and fish processing plants should be protected from being oiled. Eco\Bio - waterfowl, flora\plant communities, and fish. |
| **COMMENTS:** | |
| **BOUNDARIES OF SEGMENT:** | North side of the Holyrood Marina (47°23'21"N, 53°07'35"W) and around the base of the bay to the north side of Holyrood Fish Processors Ltd. (47°23'28"N, 53°08'15"W). |
| **ACCESS ROADS:** | Access to the Holyrood marina is possible via Refinery Road and Byrne's Road from Conception Bay Highway. Alongshore access is possible by the long pebble-cobble beach, located west of the Holyrood marina, and adjacent to Conception Bay Highway. Backshore access to the shoreline, on the west side of South Arm, is inhibited by a steep embankment (about 5-10 meters high). The railway bed runs parallel between both Conception Bay Highway and North Side Road and the shoreline. The rail bed could be used as a road or staging area. "The Back Road", which joins into North Side Road, is located closer to the shoreline and would also serve as an access road or staging area for equipment for this Segment.<br><br>The main priorities in this Segment are to protect the Holyrood Marina and two fish plants. Exclusion booming is recommended for these areas. The marina often has numerous boats, primarily during the months of April-October, which are valuable and therefore should be protected from being oiled. The wharf, constructed mainly of wood and rocks, may allow oil seepage and therefore exclusion booming around the entire wharf areas is preferred. Another concern in the area is the long stretch of pebble-cobble beach, adjacent to the Holyrood Marina, in the south end of the bay. |



## SHORE ZONE CHARACTER

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:8**

**Segment LENGTH:** 1.16 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | 55% boulder, 40% pebble - cobble, 5% bedrock | Permanent Inlet: | No |
| Lower ITZ Type: Beach | | Inlet Width: | N.A. |
| Shoreline Type: | 55% boulder beach, 40% pebble cobble beach, and 5% bedrock | Cyclical Inlet: | No |
| | | # Channels: | N.A. |
| Backshore Material: | 60% boulder, 35% pebble-cobble, 5% bedrock. | | |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | No, sheltered. |
| High or Low Wave Action: | Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:**

Southwest along South Arm, Westward along the south beach, and Northeast near Marina.

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand-Burial Potential | Yes - pebble-cobble area |
| Man-made Alongshore Barrier (ex. wharf | Yes | Pebble/cobble - Penetration Potential | Yes |
| Bay or Re-Entrant | No | Riprap or Boulder - Reservoir Potential | No |
| Tidal Inlet or Channel | No | Overwash Potential into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |

Marsh Meadow Oiling Potential During High Water Levels No

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | Yes - 2 fish plants |
| Crustaceans or Mollusks | Yes | Harbour or Marina | Yes - Holyrood Marina |
| Fish (Nearshore Only) | Yes | Recreation | Yes |
| Flora/Plant Communities | Yes | Residential | Yes - Nearly homes. |
| Mammals (Marine) | Yes | | |

| | |
|---|---|
| Primary Resources: | Protect Holyrood Marina and fish plant areas. |
| Secondary Resources: | Long stretch of cobble beach at base (south end) of Holyrood Bay is a recreation and tourist area. Eco/Bio - waterfowl and fish. |
| Is the Segment Within a PAR? | No |

**INFORMATION SOURCES:**

| | | | |
|---|---|---|---|
| Topographic Map(s): | Yes - 9222, 9258, 1 N/6 | Hydrographic Chart(s): | Yes - 4848 |
| Videotape(s): | Yes - "Shoreline Protection Plan" | Aerial Photographs: | 95032-128 |

References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT: 8**

**PROTECTION - OBJECTIVE(S)**

| | |
|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | Yes |
| 2. Minimize degree of contact with shore or resource(s) at risk. | Yes |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | No |
| 4. Contain stranded oil at the shoreline. | No |
| 5. Prevent oil transport into inlet, estuary, or channel. | No - but not into Marina area |

**PROTECTION - STRATEGY(IES)**

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - away from shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | Yes - Marina area |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

**PROTECTION - METHODS:**

| | |
|---|---|
| P1 Nearshore (on-water) containment and recovery. | O -near pebble-cobble beach area |
| P2 Nearshore redirection away from shore/recovery. | R - near fish plant and Marina areas |
| P3 Nearshore redirection towards shoreline containment/recovery. | O - away from Marina and fish plants |
| P4 Exclusion booming. | R - near fish plants and Marina areas |
| P5 Shoreline protection intertidal booming/recovery. | O |
| P6 Shoreline barrier or berms/recovery. | O - pebble-cobble beach |
| P7 Contact barriers. | O |
| P8 Channel boom or barriers/recovery. | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**

**PROTECTION - OPERATIONAL CONSIDERATIONS:**

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | Yes - via Refinery Road, Conception Bay Highway, North side Road, and The Back Road. |
| Alongshore access affected by boulders, etc. | Yes |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). | No |
| Winter ice on water and/or on shore. | Yes |



## SHORELINE TREATMENT

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT: 8**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | Yes |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes - except near Marina and fish plants. |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | Yes |
| 2. Act quickly to remove oil before it is reworked and/or buried. | Yes - in nearshore and pebble-cobble beach areas. |
| 3. Remove bulk oil - allow residue to degrade. | No |
| 4. Minimize waste generation by in-situ techniques. No | |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | R |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | O |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | O |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via Refinery Road, Conception Bay Highway, North Side Road, and The Back Road.

## SUMMARY - SEGMENT 9

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF**

| | |
|---|---|
| **RESPONSE PRIORITY:** | LOW - Main concern is to prevent oiling of Segment 8 (Marina, pebble-cobble beach, and 2 fish plants) and to prohibit flow into North Arm. |
| **PRIMARY RESOURCES AT RISK:** | Eco\Bio - waterfowl, flora\plant communities, and fish. |
| **COMMENTS:** | |
| **BOUNDARIES OF SEGMENT:** | From the north side of Holyrood Fish Processors Ltd. (47°23'28"N, 53°08'15"W) and extends northward to Joy's Point (47°23'58"N, 53°08'25"W), the tip of South Arm |
| **ACCESS ROADS:** | Shoreline access is possible via a steep embankment (5 meters) to North Side Road. The railway bed runs between North Side Road and the shoreline which can serve as an alternative road or equipment staging area. Alongshore access is difficult due to boulder and bedrock areas. |



## SHORE ZONE CHARACTER

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:9**

**Segment LENGTH:** 1.0 kilometers

**SHORELINE MATERIAL/TYPE**

| | | | |
|---|---|---|---|
| Lower ITZ Material: | 15% bedrock - boulder, 60% boulder, 20% bedrock, 5% pebble-cobble | Depth of Water: Permanent Inlet: | No |
| Lower ITZ Type: Beach | | Inlet Width: | N.A. |
| Shoreline Type: | 15% bedrock - boulder beach, 60% boulder beach, 20% bedrock beach, 5% pebble-cobble beach. | Cyclical Inlet: # Channels: | No N.A. |
| Backshore Material: | 25% bedrock - boulder, 60% boulder, 10 % bedrock 5% pebble - cobble. | | |

**NEARSHORE ENVIRONMENT:**

| | |
|---|---|
| Tidal Range: | 0.5 meters |
| Open, Exposed Coast? | No, sheltered. |
| High or Low Wave Action: | Moderate Wave Energy |

**PREDOMINANT LONGSHORE CURRENT/DRIFT DIRECTION:** Southwest

**OIL TRAPS AND POTENTIAL BEHAVIOUR:**

| | | | |
|---|---|---|---|
| Natural Alongshore Barrier (ex. headland) | No | Sand - Burial Potential | No |
| Man-made Alongshore Barrier (ex. wharf) | Yes | Pebble/cobble - Penetration Potential | Yes |
| Bay or Re-Entrant | No | Riprap/Boulder - Reservoir Potential | No |
| Tidal Inlet or Channel | No | Overwash into Lagoon/Marsh | No |
| Tidal Lagoon or Estuary | No | | |
| Marsh Meadow Oiling Potential During High Water Levels | N.A. | | |

**RESOURCES AT RISK:**

| | | | |
|---|---|---|---|
| Amphibians | No | Agricultural | No |
| Birds (Shore Birds, Ducks) | Yes | Commercial/Industrial | No |
| Crustaceans or Mollusks | Yes | Harbour or Marina | No |
| Fish (Nearshore Only) | Yes | Recreation | Yes |
| Flora/Plant Communities | Yes | Residential | No |
| Mammals (Marine) | Yes | | |
| Primary Resources: | Eco\Bio - waterfowl, flora\plant communities, and fish. | | |
| Secondary Resources: | | | |
| Is the Segment Within a PAR? | No | | |

**INFORMATION SOURCES:**

Topographic Map(s): Yes - 9258, 1 N/6 Hydrographic Chart(s): Yes - 4848
Videotape(s): Yes - "Shoreline Protection Plan" Aerial Photographs: 95023-128
References: Atlantic Canada Shoreline and Spill Response, Shoreline Clean-Up and Technology, Protection and Clean-Up of Oiled Shorelines, Oil Spill Response Field Guide, and the Field Guide to the Documentation and Description of Oiled Shorelines.

## SHORELINE PROTECTION

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF** **SEGMENT:9**

### PROTECTION - OBJECTIVE(S)

| | | |
|---|---|---|
| 1. Prevent contact with shore\resource(s) at risk within the Segment. | | No |
| 2. Minimize degree of contact with shore or resource(s) at risk. | No | |
| 3. Prevent contact with shore or resource(s) at risk in adjacent Segment(s). | | Yes |
| 4. Contain stranded oil at the shoreline. | | Yes |
| 5. Prevent oil transport into inlet, estuary, or channel. | N.A. | |

### PROTECTION - STRATEGY(IES)

| | |
|---|---|
| 1. Alter direction of transport or movement of oil on water. | Yes - toward shoreline |
| 2. Prevent oil movement in channel(s) on flooding tides. | N.A. |
| 3. Prevent overwash into backshore or lagoon. | No |
| 4. Pre-impact shoreline debris removal. | No |

### PROTECTION - METHODS:

| | | | |
|---|---|---|---|
| P1 | Nearshore (on-water) containment and recovery. | R | |
| P2 | Nearshore redirection away from shore/recovery. | | NR |
| P3 | Nearshore redirection towards shoreline containment/recovery. | | R |
| P4 | Exclusion booming. | | NR |
| P5 | Shoreline protection intertidal booming/recovery. | NR | |
| P6 | Shoreline barrier or berms/recovery. | | NR |
| P7 | Contact barriers. | | NR |
| P8 | Channel boom or barriers/recovery. | | NR |

**R-Recommended** **O-Optional or Possible** **I-Impractical** **NR-Not Recommended**




### PROTECTION - OPERATIONAL CONSIDERATIONS:

| | |
|---|---|
| Nearshore access affected by shoals or reefs/rocks. | Yes - rocks present in nearshore |
| Direct backshore or alongshore access. | Yes - via North side Road, The Back Road and the railway bed. |
| Alongshore access affected by boulders, etc. Yes | |
| Coast exposed to storm and/or winter wave action. | Yes |
| Strong currents (> 1 knot: 0.5 m/s). No | |
| Winter ice on water and/or on shore. | Yes |

## SHORELINE TREATMENT

**REGION: SOUTH ARM, HOLYROOD BAY, CONCEPTION BAY, NF.** **SEGMENT:9**

### SHORELINE TREATMENT/CLEANUP - OBJECTIVE(S)

| | |
|---|---|
| 1. Allow oiled shore zone to recover naturally. | No |
| 2. Restore oiled shore zone to pre-spill condition. | Yes |
| 3. Accelerate natural recovery. | Yes |
| 4. Restore with minimal material removal. | Yes |
| 5. Minimize remobilization of stranded oil. | Yes |
| 6. Minimize operational damage to dune, marsh, or peat bog system. | N.A. |

### SHORELINE TREATMENT/CLEANUP - STRATEGY(IES)

| | |
|---|---|
| 1. Monitor. | Yes - to prevent Segment 8 and North Arm from becoming oiled. |
| 2. Act quickly to remove oil before it is reworked and/or buried. | No - except for pebble-cobble beach areas. |
| 3. Remove bulk oil - allow residue to degrade. | No |
| 4. Minimize waste generation by in-situ techniques. | No |
| 5. Manual techniques preferred. | Yes |
| 6. Salt-marsh fringe or backshore cleanup strategy | No |
| 7. Backshore riprap cleanup techniques. | No |

### SHORELINE TREATMENT/CLEANUP - METHODS

| | | | |
|---|---|---|---|
| S1 Natural recovery | NR | S11 Mechanical recovery | R |
| S2 Flooding | O (pebble-cobble beach area) | S12 Vegetation removal/Cropping | NR |
| S3 Low-pressure, cold water wash | O | S13 Passive sorbents | O |
| S4 Low-pressure, warm water wash | O | S14 Tilling/Aeration | NR |
| S5 High-pressure, cold water wash | O | S15 Surf washing/Sed. reworking | NR |
| S6 High-pressure, warm water wash | O | S16 Burning | I |
| S7 Steam cleaning | O | S17 Dispersants | R |
| S8 Sandblasting | NR | S18 Shoreline cleaners | R |
| S9 Manual removal | R | S19 Solidifers | O - Depending on oil type |
| S10 Vacuums | O | S20 Bioremediation | R |

**R-Recommended** **O-Optional/Possible** **I-Impartial** **NR-Not Recommended**
**(*for small amounts of oil)**

### SHORELINE TREATMENT/CLEANUP - OPERATIONAL CONSIDERATIONS

| | | | |
|---|---|---|---|
| Nearshore shoals, shallow water | No | Alongshore access possible | No |
| High tidal range | No | Staging areas available nearby | No - need construction |
| Narrow intertidal width | Yes | Shore zone suitable for machinery | No |
| Winter on-shore ice | Yes | Backshore cliff present | Yes - low cliff |

Road access Yes - via steep embankment to North Side Road, The Back Road, and railway bed.

## Shoreline Protection Plan For Holyrood Bay

This section of the Oil Pollution Emergency Plan is intended to describe a shoreline protection plan for the areas of Holyrood Bay which would likely be affected in the event of an oil spill from the Newfoundland and Labrador Hydro oil handling facility. The area described is from the Indian Pond inlet, along the east side and base of Holyrood Bay, to Joy's Point, the tip of South Arm. Following is some information on the priority areas for oil spill response.

To adequately describe the area of concern it has been divided into nine Segments. A map of Holyrood Bay and each individual segment is on page 42. These Segments were divided by permanent sites such as the Hydro and Ultramar wharfs, and points which are distinguishable when on water. Road access routes to these areas are important for quick response. These roads are therefore indicated on map No.2, titled "Road Access Routes to the Holyrood Bay Area", on page 43. A description of each of the nine segments, including access roads and boundaries, and an environmental description consisting of an overall segment summary and three description sheets, is included.

## Summary of High Priority Areas

The main areas of concern for Holyrood Bay are the Indian Pond area, Holyrood Marina, and two fish plants located on the west side of South Arm. These areas are considered "High Priority Areas" due to the environmental and economic impacts that oiling would cause. It is recommended that exclusion booming be used in these areas to prevent them from being oiled. Each high priority area is further discussed in the Segment descriptions which follow.




## Common Environmental Concerns for the Holyrood Bay Area

Environmental concerns for many of the nine Segments are essentially the same. For instance, the waterfowl for Holyrood Bay consist primarily of the herring gull, black guillemot, great black backed gull, ducks (black ducks, mallards, scoters, etc.), turrs, murrs, dovekies, puffins, razorbills, gannets, tetrels, and terns. Mammals in the area are mainly whales, seals, and porpoises. There is little threat to mammals since Holyrood Bay is not a breeding ground for the mammals mentioned, and they are not typically seen for most of the year. Plant/flora communities are found mainly near shore in bedrock/boulder areas in the upper intertidal zone. These flora/plant communities are usually kelps (cabbage kelp, finger kelp, ribbon kelp, and colander kelp), rockweeds (knotted rockweed), and red seaweeds (irish moss, dulse, laver, corraline algae, and redweed). Crustaceans/mollusks are also found along the rocky shorelines such as the boulder beaches and bedrock cliffs and consist mainly of mussels, clams, snails, and sea urchins. Many species of fish can be found at different locations along the shoreline in Holyrood Bay. The species of fish include lobster, capelin, squid, cod, herring, and salmon.

All the species mentioned, and those that are present but not mentioned, are environmental concerns for the Holyrood Bay area. Only the species most at risk will be mentioned in the following Segment descriptions.

**Segment 1 - Indian Pond Inlet to Boom Anchoring Point A**

The borders of Segment 1 are the north side of Indian Pond inlet (47°27'37"N, 53°05'21"W) and extends southward to the Boom Anchoring Point A located in front of the Hydro oil-tank farm at 47°27'05"N, 53°06'05"W. This Segment is approximately 1.4 kilometres in length and is classified as cobble-boulder beach, except for 1 small area of cobble beach. The backshore material consists of boulders, cobble, and gravel.

This area is considered a high priority area due to the Indian Pond inlet. Oil should be prevented from passing under the trussel and entering into Indian Pond, which contains fish and is a gathering site for waterfowl. The Indian Pond area is composed of about 80% pebble-cobble beach and 20% boulder beach. Some small boats are anchored in this area, during the summer months, and two small wooden wharfs are also present. Quarry Brook enters the inlet on the east side of the pond. Indian Pond is also the water intake site for condensers for the Hydro Thermal Generating Station. Other environmental concerns are for flora/plant and crustacean/mollusk communities. The most common fish species are lobster and cod.

The railway bed runs parallel, at about 10-20 meters, to the shoreline and serves as the main access road. The trussel at Indian Pond must be repaired, a road placed over the existing steel beams, before access from the north portion of the Segment is possible. The railway bed can be accessed at the north end of the Segment via Seal Cove Road, by the Hydro wharf access road at the south end, or if necessary a road could be constructed through the Hydro property to the middle of the Segment.

**Segment 2 - Boom Anchoring Point to Hydro Wharf**

The borders of Segment 2 are from Boom Anchoring Point A (47°27'05"N, 53°06'05"W), located in front of the Hydro oil tank farm, southward to the north side of the Hydro oil off-loading wharf (47°26'38"N, 53°06'21"W). This Segment is about 0.9 kilometres in length and consists of approximately 40% low bedrock cliff, 40% cobble-boulder beach, and 20% boulder beach. Backshore material is 5% cobble, 40% boulder, and 55% bedrock.

This area can be classified as a low priority area since there is no structure or area present which requires immediate attention. Environmental concerns for this area is mainly waterfowl and fish (lobster). Flora/plant communities, along with mussels, are also concerns in rocky areas.

The railway bed runs parallel, at about 15-30 meters, to the shoreline and serves as the main access road. Again, the trussel at Indian Pond inlet must undergo construction before it can be crossed

to/from Seal Cove Road. Another access to the railway bed is the Hydro wharf access road, and if necessary a road can be constructed from the railway bed to the Hydro property at a desired location.

**Segment 3 - Hydro Wharf to Boom Anchoring Point #1**
**Segment 4 - Boom Anchoring Point #1 to Boom Anchoring Point #2**
**Segment 5 - Boom Anchoring Point #2 to Boom Anchoring Point #3**

The boundaries for Segment 3 are the north side of the Hydro oil off-loading wharf (47°26'38"N, 53°6'21"W) to Boom Anchoring Point No.1 (47°26'10°N, 53°06'33"W). The borders of Segment 4 are the Boom Anchoring Point No.1 (47°26'10"N, 53°06'33"W) southward to Boom Anchoring Point No.2 (47°25'39"N, 53°06'50"W), while Segment 5 is from Boom Anchoring Point No.2 (47°25'39"N, 53°06'50"W) southward to Boom Anchoring Point No.3 (47°25'02"N, 53°07'11"W). The shoreline lengths of Segments 3,4, and 5 are 0.9, 1.2, and 1.3 kilometres respectively. The shoreline type for these areas is low bedrock cliff with the backshore being composed of bedrock and boulder.

These areas can be classified as low priority areas since there are no structures or areas which require immediate attention. Environmental concerns for this area are mainly waterfowl and fish (capelin and lobster). Flora/plant communities, along with mussels, are also concerns in rocky areas.

The railway bed runs parallel, at about 15-40 meters, to the shoreline and serves as the main access road for these Segments. Easy access to the railway bed is possible via the Hydro oil off-loading wharf access road. Other possible roads to the railway bed from Conception Bay Highway include Duff's Crescent and O'Roukes Road. However, some construction would be needed to improve the latter portion of Duff's Crescent since only a trail presently exists adjacent to private property.

Direct backshore access to all these Segments is currently inhibited by a thick forested area and steep embankment between the shoreline and the railway bed. Construction, in the form of tree-cutting, landfill, and heavy equipment operation, would be required to provide an access road or staging area.

**Segment 6 - Boom Anchoring Point #3 to the Ultramar Wharf**

The borders of Segment 6 is from Hydro's most southerly Boom Anchoring Point (47°25'02"N, 53°07'11"W) and extends southward to the north side of the Ultramar oil off-loading wharf (47°23'48"N, 53°07'28"W). The shoreline length is about 2.23 kilometres. This area is composed of approximately 80% low bedrock cliff, 15% boulder beach, and 5% cobble beach. Backshore material has a similar ratio.

TRANSPORT CANADA TRANSPORTS CANADA MARINE SAFETY SÉCURITÉ MARITIME CANADA St. John's, NL

This area is considered a low priority area since the only structure present is a beach home located near in the northern portion of the Segment (47°24'46"N, 53°07'13"W). Due to the rocky shoreline, composed of bedrock and boulders, and narrow intertidal zone, there is essentially no threat to the residential area. Environmental concerns for this area are mainly waterfowl and fish (capelin and lobster). Flora/plant communities, along with mussels, are also concerns in rocky areas.

The railway bed runs parallel to this Segment, at about 15-50 meters away from the shoreline, and access to the railway bed is possible via O'Roukes Road, Brien's Road, and the Ultramar property (by Refinery Road). Direct backshore access is difficult, except at the residential area, in the northern portion of the Segment, since a thick forested area and steep embankment are present. Backshore access to the southern portion of the Segment is possible through the Ultramar property but a steep embankment, from 5-15 meters, exists in this area.

**Segment 7 - Ultramar Wharf to North Side of Holyrood Marina**

Segment 7 is from the north side of the Ultramar oil off-loading wharf (47°23'48"N,53°07'28"W) and extends southward to the north side of the Holyrood Marina (47°23'21"N,53°07'35"W). The shoreline is 0.85 kilometres in length and is composed of 85% boulder beach and 15% cobble beach. The backshore material consists of about 90% boulder and 10% cobble.

This Segment is considered a low priority area since there are no structures that require prompt attention. The Ultramar oil off-loading wharf is constructed of wooden logs and rock which oil can penetrate and exist for long periods of time. Therefore this area may require extra attention. The main environmental concern is for waterfowl, which gather near the small stream which runs into Holyrood Bay.

Access to this area is possible via Refinery Road and the Ultramar property and wharf access road. A steep embankment exists between the access roads and the shoreline and therefore boom trucks or cranes would be necessary if heavy equipment is to be mobilized. The access roads range from 8-15 meters from the shoreline.

**Segment 8 - Holyrood Marina to North Side of Fish Plant (Holyrood Fish Processors Ltd.)**

Segment 8 is from the north side of the Holyrood Marina (47°23'21"N,53°07'35"W) and extends to the north side of the Holyrood Fish Processor's Fish Plant (47°23'28"N, 53°08'15"W) on the west side of South Arm. The length of this Segment is about 1.61 kilometres with the shoreline consisting of approximately 55% boulder beach, 40% pebble-cobble beach, and 5% bedrock beach. The backshore material is made up of 60% boulder, 35% pebble-cobble, and 5% bedrock.

This area is classified as a high priority area due to the Holyrood Marina, two fish plants, and a long stretch of pebble-cobble beach at the south end of Holyrood Bay. The pebble-cobble beach is used

for recreation and can be considered a tourist area. Maher's River runs into the Holyrood Marina and therefore an environmental concern is present for fresh water species (especially fish) in this area. The Marina often contains many valuable boats and the fish plants process food. Therefore these areas should be protected from oil contamination, preferably by exclusion booming. Environmental concerns are primarily to protect the waterfowl and harvesting areas of capelin and squid.

The wharfs for the Holyrood Marina and fish plants are wooden and filled with rocks. Oil can therefore penetrate the wharfs and exist for long periods of time. To prevent this potential problem, exclusion booming around the entire wharf areas is recommended.

Access to the Holyrood Marina is possible via Refinery Road and Brien's Road, the pebble-cobble beach at the base of South Arm by Conception Bay Highway, and the west side of South Arm by North Side Road. "The Back Road" branches from North Side Road and runs closer to the shoreline for a portion of this Segment. The railway bed also runs parallel to the shoreline and may be used as an equipment staging area or a possible access road.

**Segment 9 - North Side of Fish Plant to Joy's Point**

This Segment begins on the north side of the Holyrood Fish Processors Ltd. - Fish Plant (47°23'28"N, 53°08'15"W) and extends northward to include Joy's Point (47°23'58"N, 53°08'25"W), the tip of South Arm. This Segment is approximately 1 kilometer in length with the shoreline type consisting of 60% boulder beach, 20% bedrock beach, 15% bedrock-boulder beach, and 5% pebble-cobble beach. The backshore material is composed of 25% bedrock-boulder, 60% boulder, 10% bedrock and 5% pebble-cobble.

This is a low priority area since there are no areas or structures within this Segment which require prompt attention. The environmental concerns in this Segment are waterfowl and fish (cod and capelin). An effort should be made to contain oil on the south side of Joy's Point to prevent oil from flowing into North Arm.

The main access road to this Segment is North Side Road. The railway bed, which runs between 10-20 meters of the shoreline, can also be used as an access road or staging area.



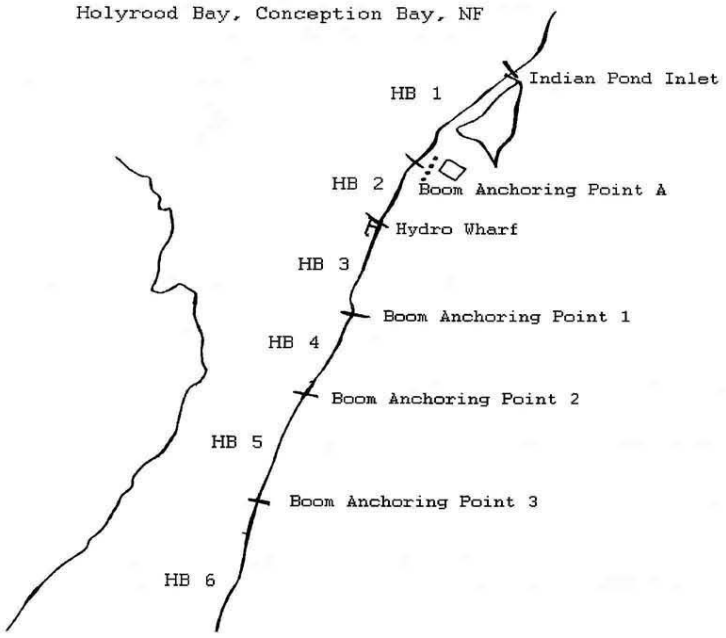


**Figure 1 - Segment Boundaries**

The figure above outlines how the area of concern, the most probable area of Holyrood Bay which would be affected in the event of an oil spill from the Hydro and Ultramar oil storage facilities, was divided into segments. Permanent sites (including latitudes and longitudes), such as the Hydro and Ultramar wharf, were chosen to be segment boundaries.

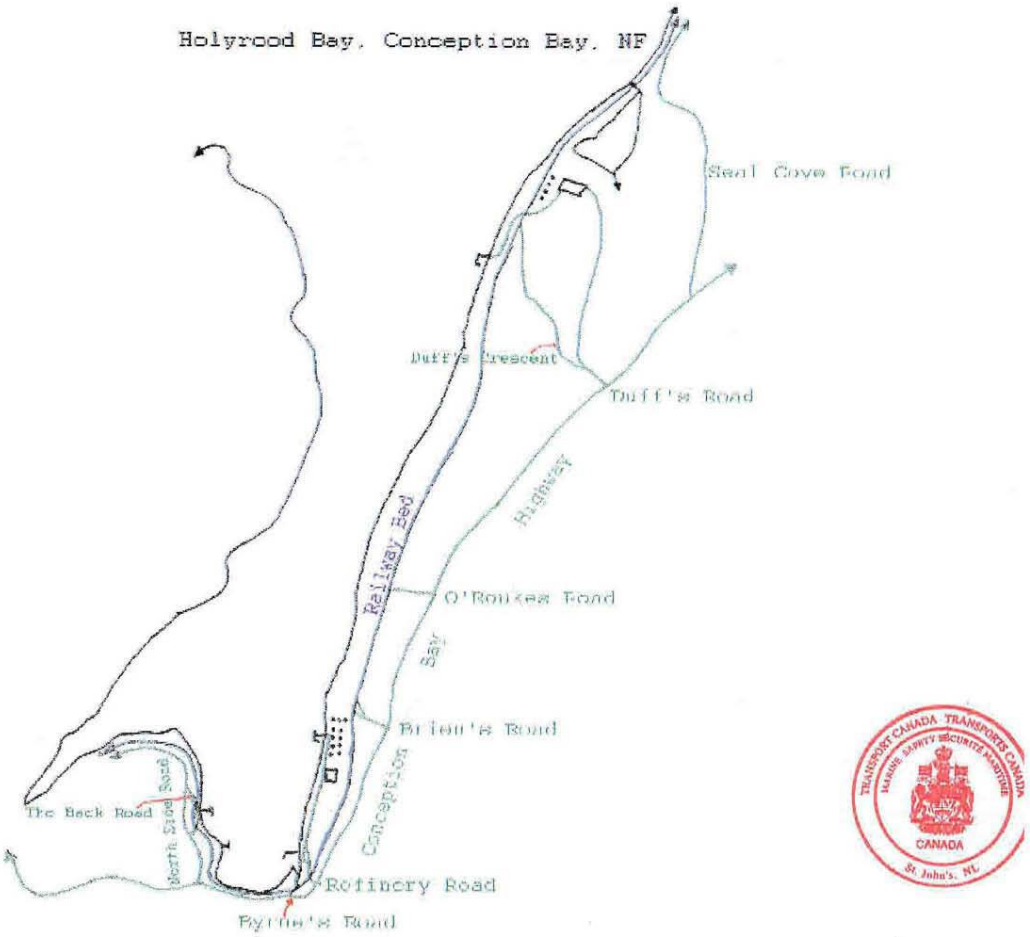


**Figure 2 - Road Access Routes to the Holyrood Bay Area**

The figure above outlines the possible access roads for the various segments which were shown on the previous page.

newfoundland labrador hydro
a nalcor energy company

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Rev. #: 1
Rev. Date: Jan 12, 2010
Page 1 of 5

Emergency Response Manual

# ERM - Appendix B
# Maps

Figure:

1. PROBABLE SPILL DISPLACEMENT (NORTHEASTERLY WIND)
2. PROBABLE SPILL DISPLACEMENT (SOUTHWESTERLY WIND)
3. BOOM DEPLOYMENT HOLYROOD (PROTECTION STRATEGY)
4. BOOM DEPLOYMENT SITE HOLYROOD (INITIAL DEPLOYMENT – PRE-BOOMING)
5. BOOM DEPLOYMENT HOLYROOD (VESSEL PRE-BOOMING STRATEGY AND POTENTIAL ON-WATER CONTAINMENT)
6. BOOM DEPLOYMENT HOLYROOD (SHORELINE CONTAINMENT AND INDIAN POND PROTECTION)



**Probable Spill Displacement**

The two significant factors which affect the transport of spilled oil on the water surface are wind and surface current. The wind generates a current component directed 10° to the right of the wind in the northern hemisphere and having a magnitude of approximately 3.5% of the wind speed. In addition, the presence of a surface current displaces any point on the surface in the direction of the current at 100% of the current speed. The surface current itself is typically a super positioning of tidal, density driven, and long term periodic motions. The net transport is due to the sum of the surface current and wind-driven current components.

Winds at St. John's airport can be considered generally representative of winds over Conception Bay, although speeds over water can typically be 20% or more greater than those over land. Winds over Conception Bay are predominantly from the southwest in summer and from the west the remainder of the year. Northeasterly and easterly winds in the area occur most frequently in the fall and winter and are generally associated with storms. Monthly mean winds (at St. John's airport) range from 11 to 15 knots, with monthly maximum hourly speeds ranging from 36 to 74 knots. Winds - particularly southwest winds - near the Newfoundland Hydro Holyrood Generating Station are increased in speed due to funnelling which occurs in Holyrood Bay. Funnelling also occurs further down the bay, along the Bell Island Tickle, where winds can be 15 to 25 knots stronger than in other parts of the Bay.

Although work has been carried out to investigate the circulation in Conception Bay (e.g. deYoung and Sanderson, 1995) information for Holyrood Bay and nearshore in the immediate vicinity of the Newfoundland Hydro Holyrood Generating Station is minimal. A review of the work of deYoung and Sanderson (1995), which included data from 1988 to 1991, indicates that there is a relatively weak mean circulation pattern, and that there is much temporal and spatial variability within Conception Bay. Mean current velocities are less than 2 cm/s (0.04 knots) and the mean is less than the standard deviation of the surface currents, 2 - 11 cm/s (0.04 - 0.2 knots). Persistent outflowing currents on the eastern side of the Bay are as high as 20-30 cm/s (0.4 - 0.6 knots). Current direction data obtained from a current meter moored approximately 5 km offshore from

Seal Cove indicates a mean flow directed shorewards. Observations at other nearshore moorings indicated that flow is guided by the coastal topography and bathymetry in the bay and so runs parallel with the shore in a southwesterly direction in the area of the Holyrood Generating Station. These motions are consistent with other findings in the study that suggest an anticyclonic (clockwise) circulation at the head of Conception Bay. Tidal currents are weak in the bay.

As a further indicator of displacement of oil pollution on the surface of the water, residence times can be used. As defined by deYoung and Sanderson (1995), the residence time is the point at which 50% of an initial mass has left Conception Bay. deYoung has suggested (1995) that residence times estimated at approximately 30 days in their original work (deYoung and Sanderson, 1995) should, in fact, be in the range of 10 to 15 days. Residence times nearer the mouth of the bay will certainly be less than this.

The movement of any marine oil spill at the Newfoundland Hydro Holyrood Generating Station can, therefore, be expected to be driven predominantly by local winds and, to a lesser extent, by surface currents. The most likely scenario is that at the time of a spill, the wind will be blowing from the west or southwest and will be moderate to strong. This wind will transport the oil northward along the eastern shore of Conception Bay towards the community of Conception Bay South and will keep the oil near shore. The weak surface currents acting in the opposite direction will tend to slow the wind driven motion and will also tend to keep the oil near shore. If the wind speed is very light (<15 knots), the surface current may be sufficient to move the oil slowly in the opposite direction toward the head of Holyrood Bay. If the wind is from the north or northeast, the oil can be expected to move quickly to the head of Holyrood Bay driven by both the wind and the surface current and to spread out into the Bay from the eastern shore.




A slick originating from a spill of Bunker C oil can also be expected to increase in density due to evaporation of light components and cooling over a period of hours to days which may result in its submerging below the surface of the water or even sinking to the ocean bottom. The rate at which this occurs depends heavily on the environmental conditions, particularly water and air temperature together with wind and wave action.

In general, this will occur more rapidly in cold, stormy winter conditions than in mild, calm summer conditions.

The following table estimates theoretical transport times for oil originating from a marine spill at the Holyrood Generating Station to reach landmarks or communities in the area under frequently occurring wind conditions. The values calculated in this table are based on the premise that the wind blows constantly from the same direction and at the same speed over the period and that the slick remains on the surface of the water. In reality, these conditions are not typical. Wind direction will normally vary to some degree under the same speed conditions with the result that the slick will take actually take longer to reach the destinations than the times calculated above. Furthermore, ocean currents will also affect oil slick transport. Appropriate judgment should be applied in using this information.

**Transport Time for an Oil Slick Originating at Holyrood Generating Station Dock**

| Wind (from) | NE | E | SE | SW | | | |
|---|---|---|---|---|---|---|---|
| **Extent** | Holyrood | Salmon Cove Pt. | Colliers Point | Seal Cove | Kelligrews | Long Pond | Topsail Cove |
| **Distance** | 7.8 km | 3.9 km | 8.2 km | 2.2 km | 8.0 km | 11.9 km | 16.9 km |
| **Wind Speed (knots)** | **Transport Time (hours)** | | | | | | |
| 5 | 28.3 | 14.1 | 29.7 | 8.0 | 29.0 | 43.1 | 61.2 |
| 10 | 14.1 | 7.1 | 14.9 | 4.0 | 14.5 | 21.6 | 30.6 |
| 15 | 9.4 | 4.7 | 9.9 | 2.7 | 9.7 | 14.4 | 20.4 |
| 20 | 7.1 | 3.5 | 7.4 | 2.0 | 7.2 | 10.8 | 15.3 |
| 25 | 5.7 | 2.8 | 5.9 | 1.6 | 5.8 | 8.6 | 12.2 |
| 30 | 4.7 | 2.4 | 5.0 | 1.3 | 4.8 | 7.2 | 10.2 |
| 35 | 4.0 | 2.0 | 4.2 | 1.1 | 4.1 | 6.2 | 8.7 |
| 40 | 3.5 | 1.8 | 3.7 | 1.0 | 3.6 | 5.4 | 7.7 |
| 45 | 3.1 | 1.6 | 3.3 | 0.9 | 3.2 | 4.8 | 6.8 |
| 50 | 2.8 | 1.4 | 3.0 | 0.8 | 2.9 | 4.3 | 6.1 |
| 55 | 2.6 | 1.3 | 2.7 | 0.7 | 2.6 | 3.9 | 5.6 |
| 60 | 2.4 | 1.2 | 2.5 | 0.6 | 2.4 | 3.6 | 5.1 |

Example - Under a constant 25 knot wind from the southwest, an uncontained spill originating at the Holyrood Generating Station dock could be expected to reach Seal Cove, a community 2.2 km northeast of the plant, in approximately 1.6 hours.




References

deYoung, B. and B. Sanderson, 1995. "The Circulation and Hydrography of Conception Bay, Newfoundland." Atmosphere-Ocean, 33(1), 135-162.

deYoung, B., August 1995. "Circulation in Conception Bay, Newfoundland." Personal Communication.

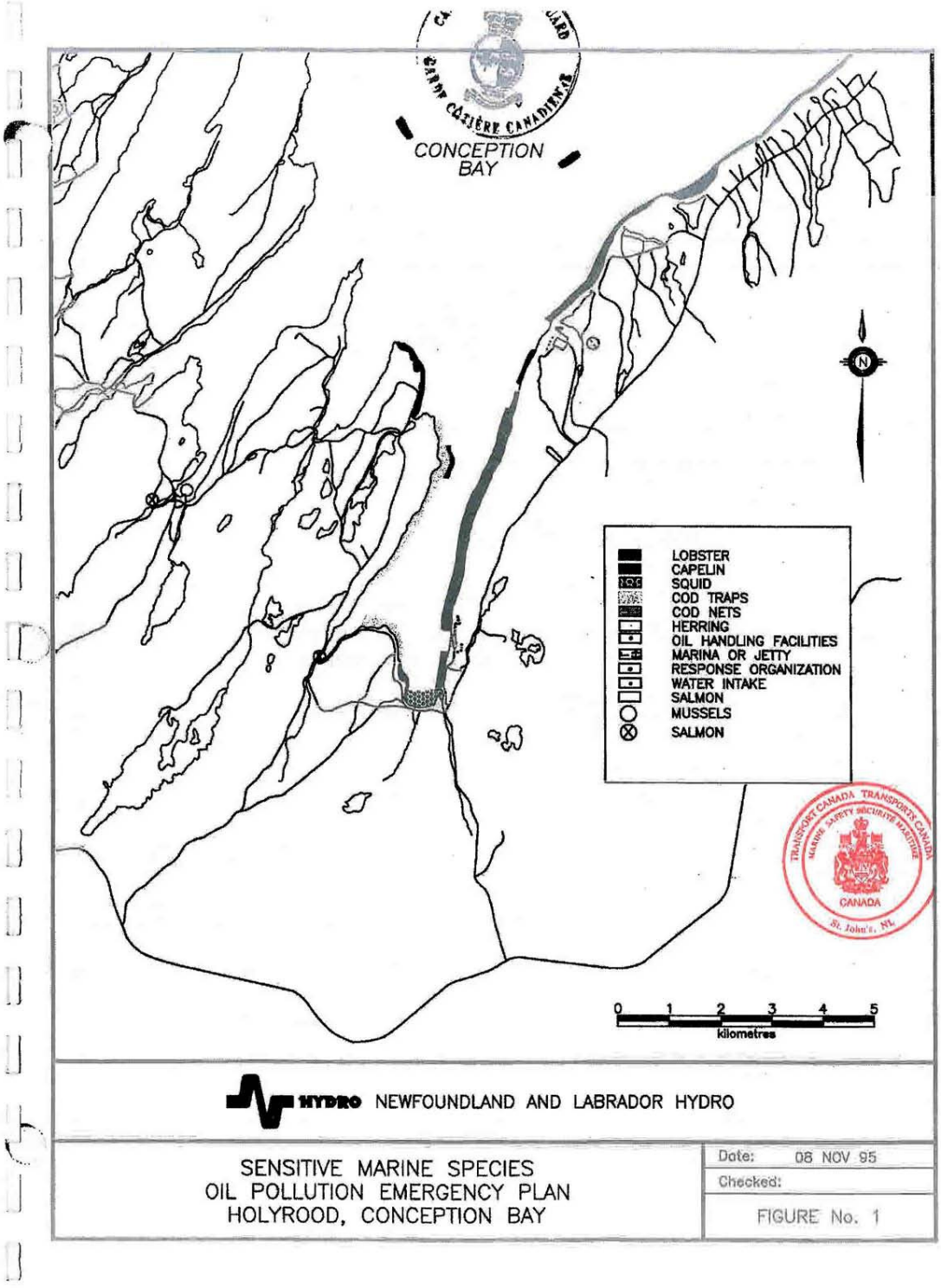
CONCEPTION BAY
N
LOBSTER
CAPELIN
SQUID
COD TRAPS
COD NETS
HERRING
OIL HANDLING FACILITIES
MARINA OR JETTY
RESPONSE ORGANIZATION
WATER INTAKE
SALMON
MUSSELS
SALMON
TRANSPORT CANADA TRANSPORTS CANADA
MARINE SAFETY SÉCURITÉ MARITIME
CANADA
St. John's, NL
0 1 2 3 4 5
kilometres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
SENSITIVE MARINE SPECIES
OIL POLLUTION EMERGENCY PLAN
HOLYROOD, CONCEPTION BAY
Date: 08 NOV 95
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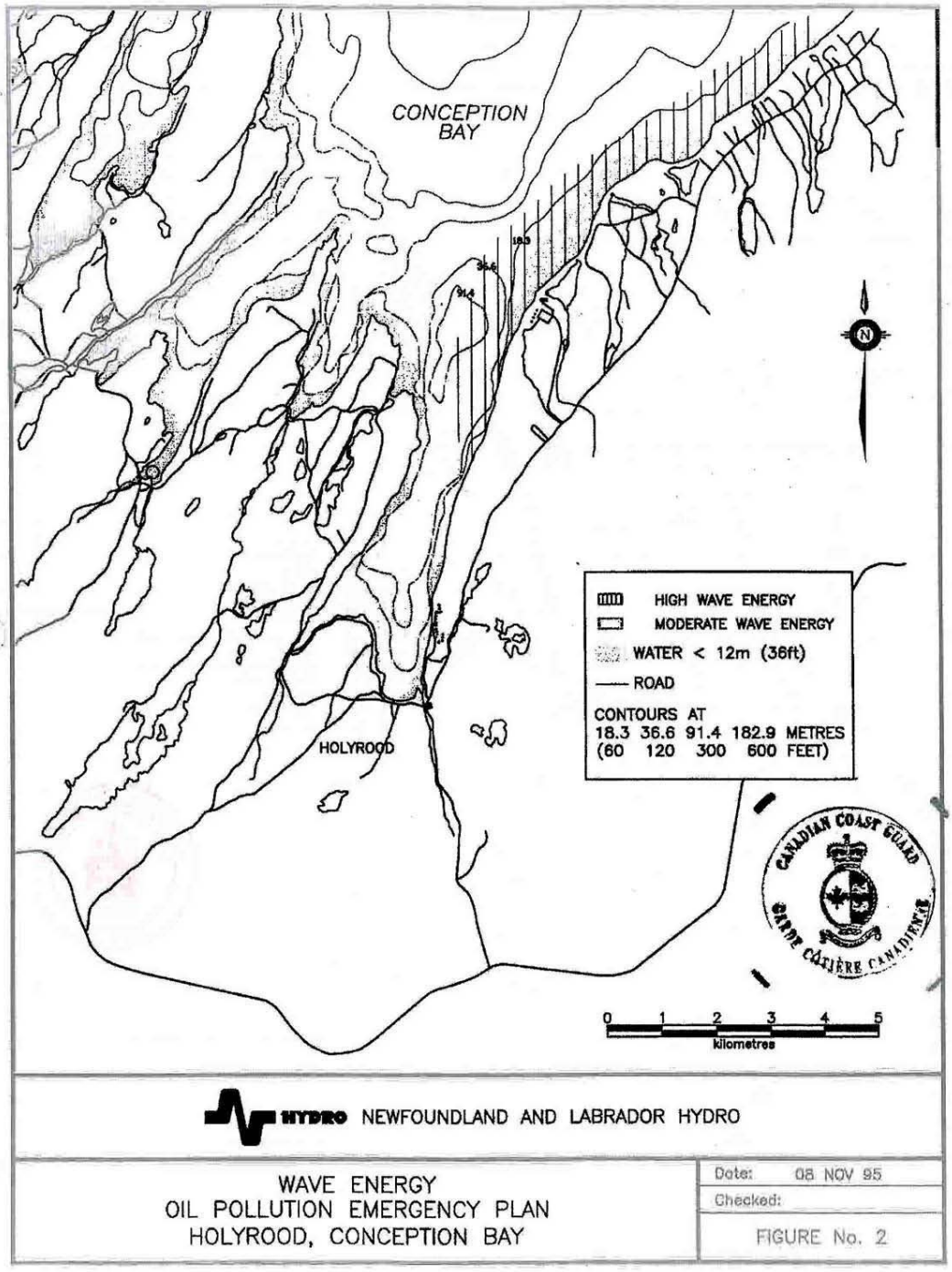
FIGURE No. 1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HOLYROOD
HIGH WAVE ENERGY
MODERATE WAVE ENERGY
WATER < 12m (36ft)
ROAD
CONTOURS AT
18.3 36.6 91.4 182.9 METRES
(60 120 300 600 FEET)
CANADIAN COAST GUARD
GARDE CÔTIÈRE CANADIENNE
0 1 2 3 4 5
kilometres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
WAVE ENERGY
OIL POLLUTION EMERGENCY PLAN
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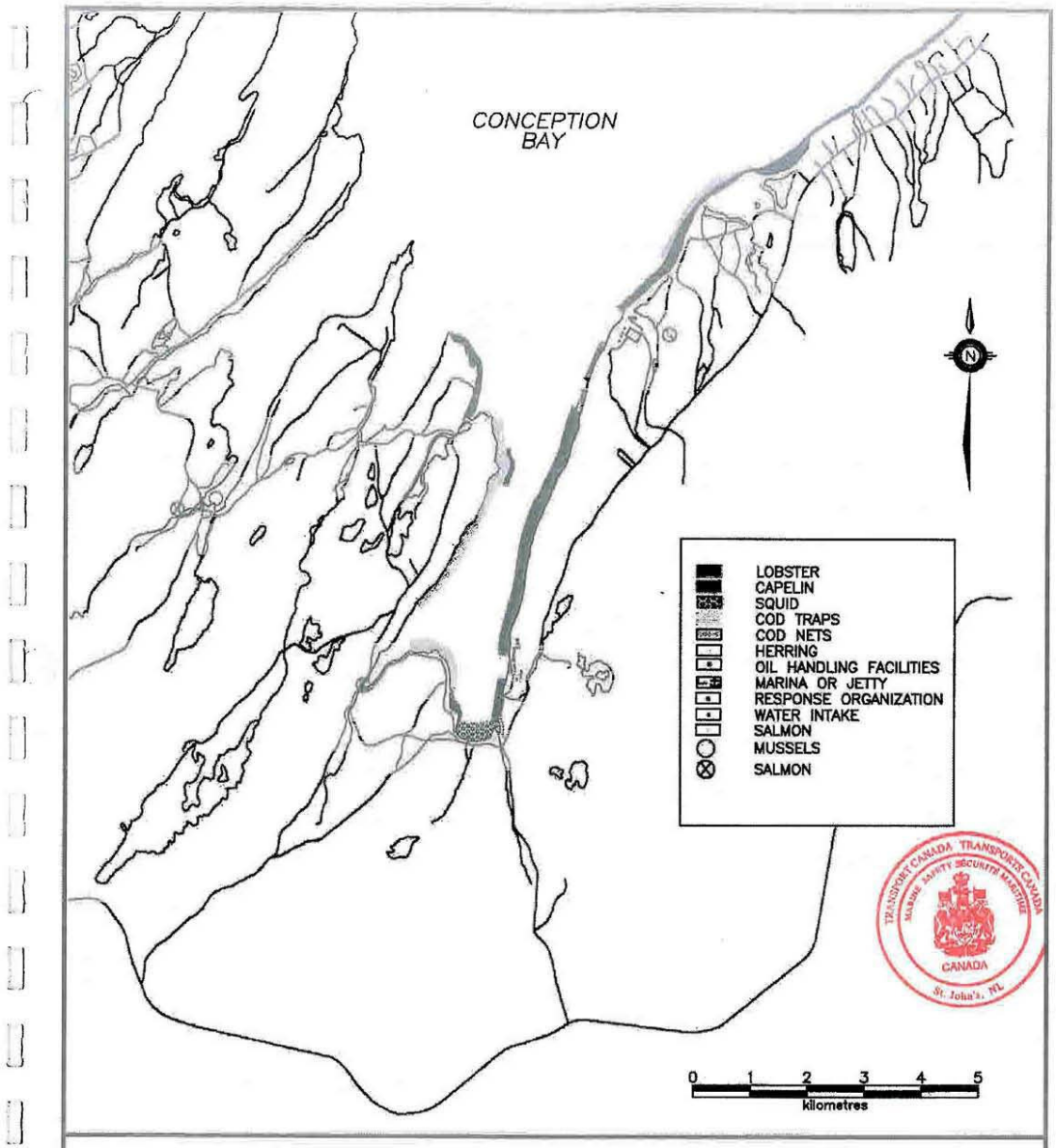
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LOBSTER
CAPELIN
SQUID
COD TRAPS
COD NETS
HERRING
OIL HANDLING FACILITIES
MARINA OR JETTY
RESPONSE ORGANIZATION
WATER INTAKE
SALMON
MUSSELS
SALMON
TRANSPORT CANADA TRANSPORTS CANADA
MARINE SAFETY SÉCURITÉ MARITIME
CANADA
St. John's, NL
0 1 2 3 4 5
kilometres
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SENSITIVE MARINE SPECIES
OIL POLLUTION EMERGENCY PLAN
HOLYROOD, CONCEPTION BAY
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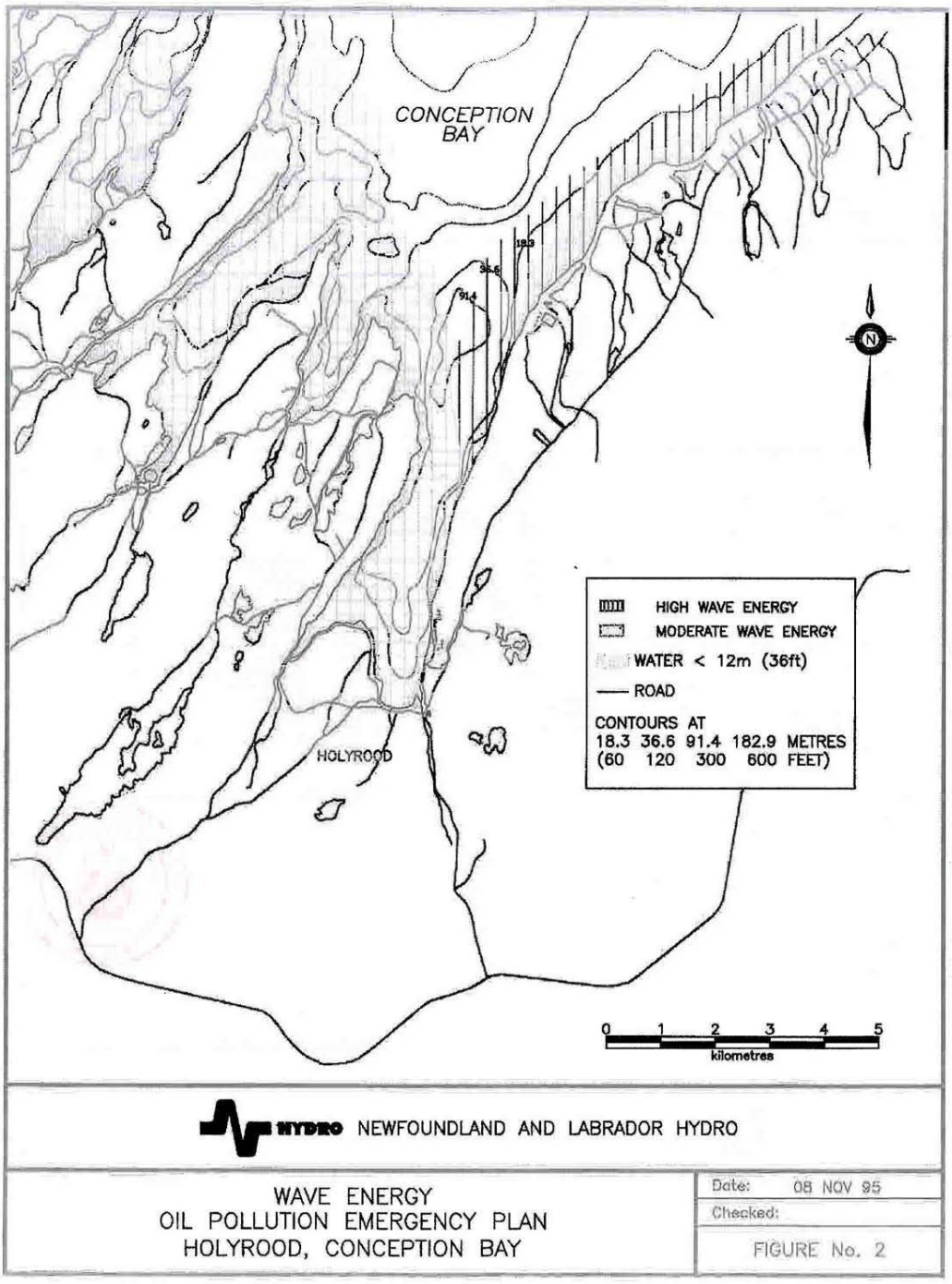
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HOLYROOD
HIGH WAVE ENERGY
MODERATE WAVE ENERGY
WATER < 12m (36ft)
ROAD
CONTOURS AT
18.3 36.6 91.4 182.9 METRES
(60 120 300 600 FEET)
0 1 2 3 4 5
kilometres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
WAVE ENERGY
OIL POLLUTION EMERGENCY PLAN
HOLYROOD, CONCEPTION BAY
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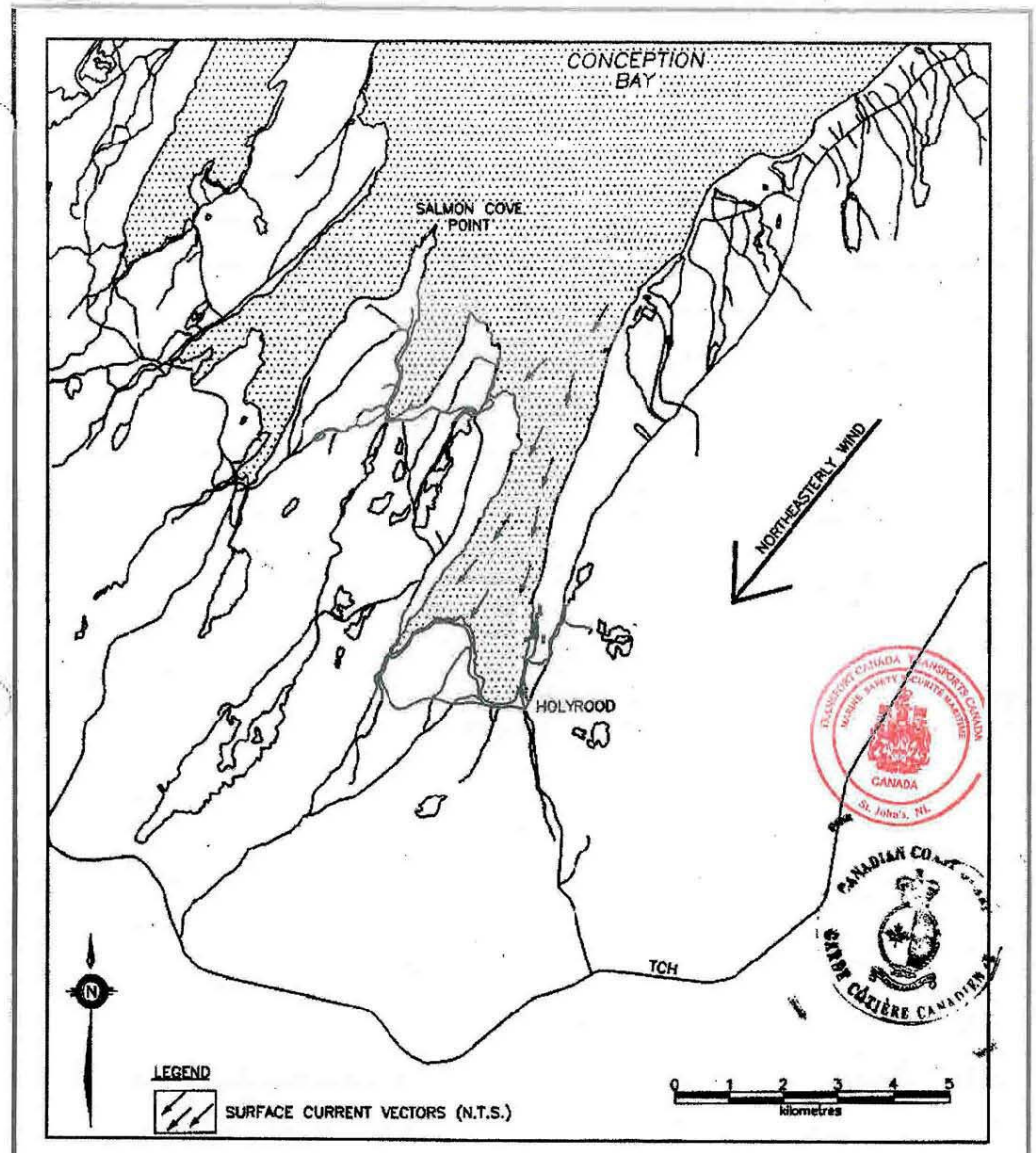
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SALMON COVE POINT
NORTHEASTERLY WIND
HOLYROOD
TCH
N
LEGEND
SURFACE CURRENT VECTORS (N.T.S.)
0 1 2 3 4 5
kilometres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
PROBABLE SPILL DISPLACEMENT
UNDER NORTHEASTERLY WIND
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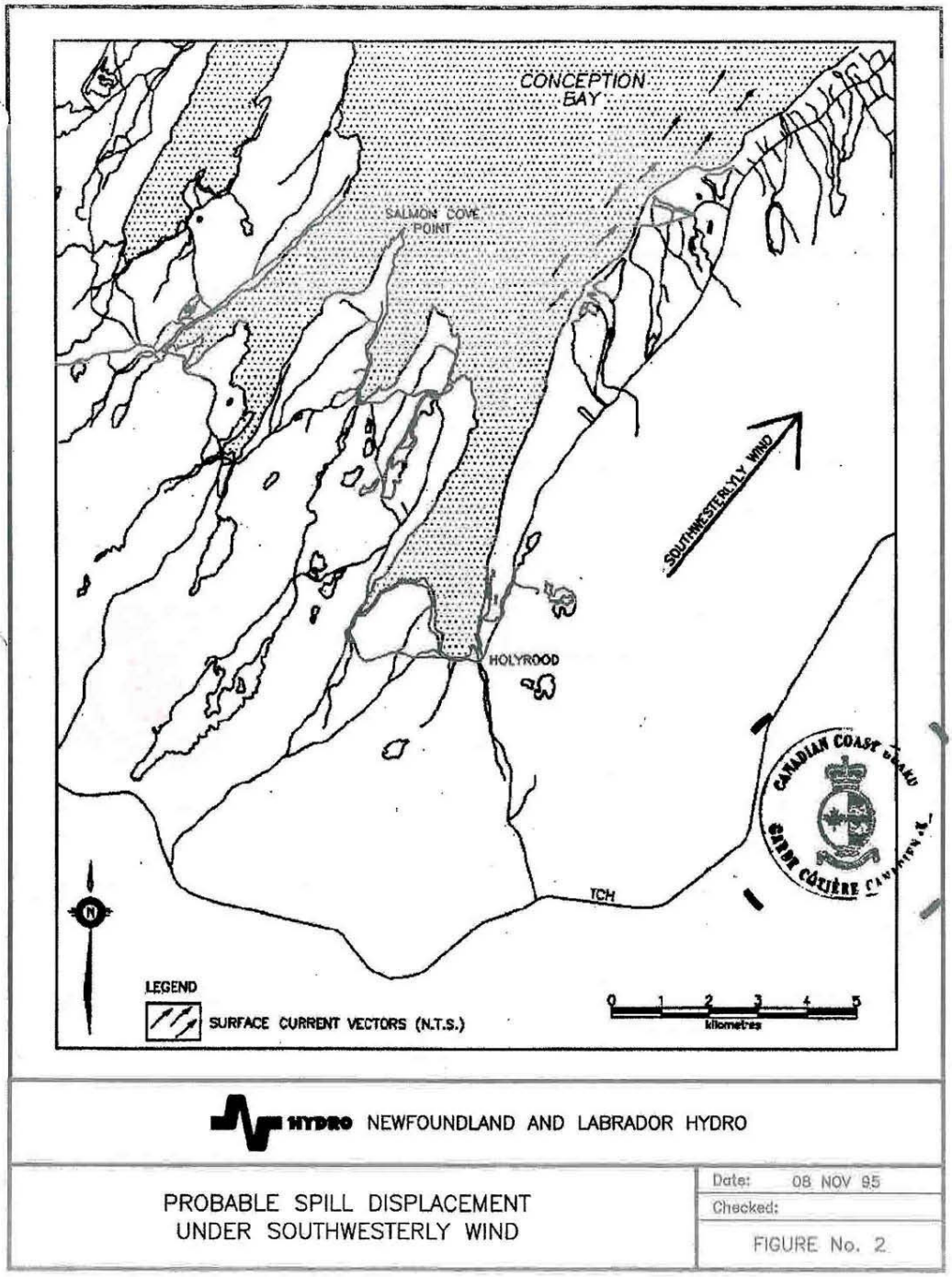
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SALMON COVE POINT
HOLYROOD
SOUTHWESTERLY WIND
TCH
N
LEGEND
SURFACE CURRENT VECTORS (N.T.S.)
0 1 2 3 4 5
kilometres
CANADIAN COAST GUARD
GARDE CÔTIÈRE CANADIENNE
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
PROBABLE SPILL DISPLACEMENT
UNDER SOUTHWESTERLY WIND
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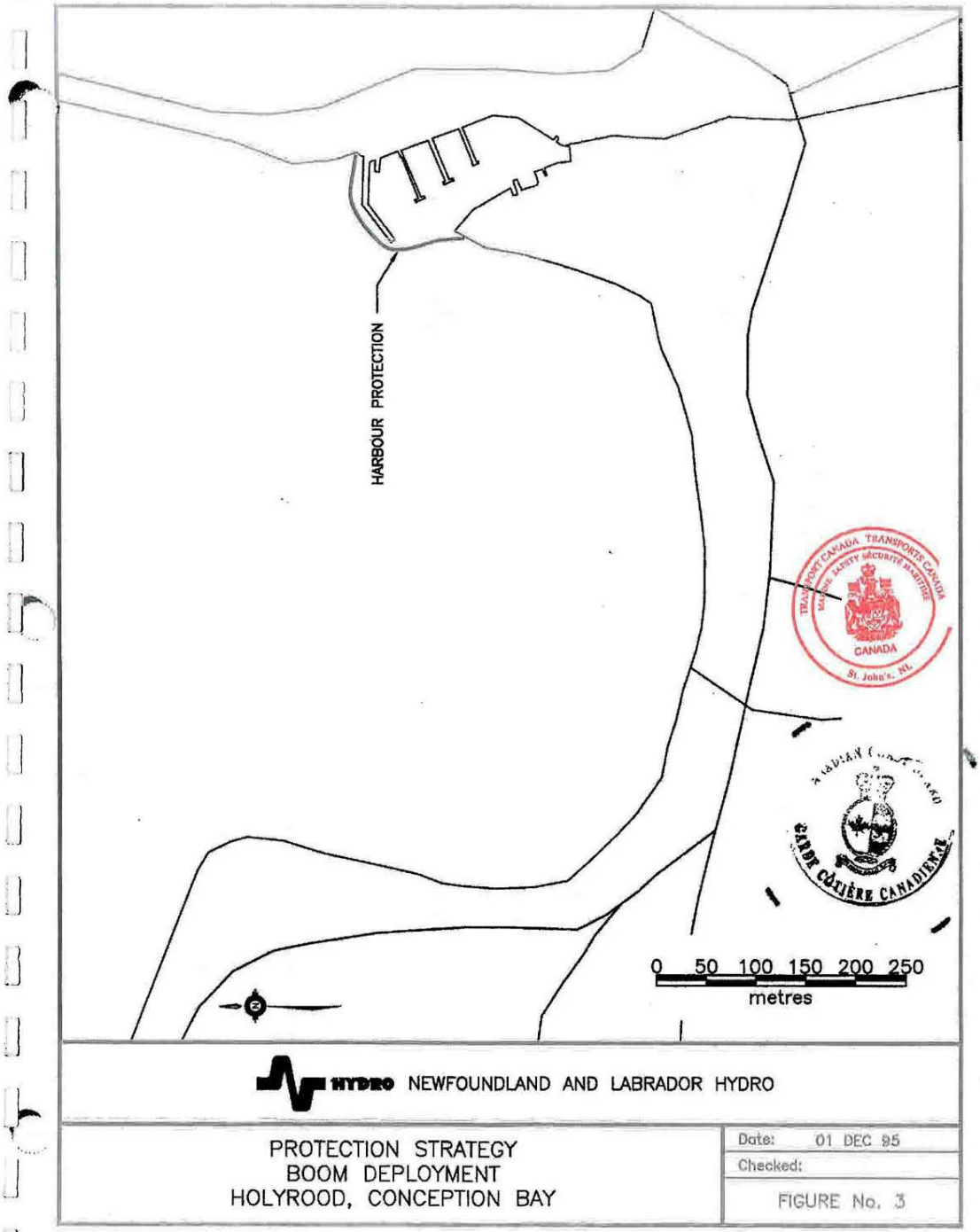
HARBOUR PROTECTION
TRANSPORT CANADA TRANSPORTS CANADA
MARINE SAFETY SÉCURITÉ MARITIME
CANADA
St. John's, NL
CANADIAN COAST GUARD
GARDE CÔTIÈRE CANADIENNE
0 50 100 150 200 250
metres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
PROTECTION STRATEGY
BOOM DEPLOYMENT
HOLYROOD, CONCEPTION BAY
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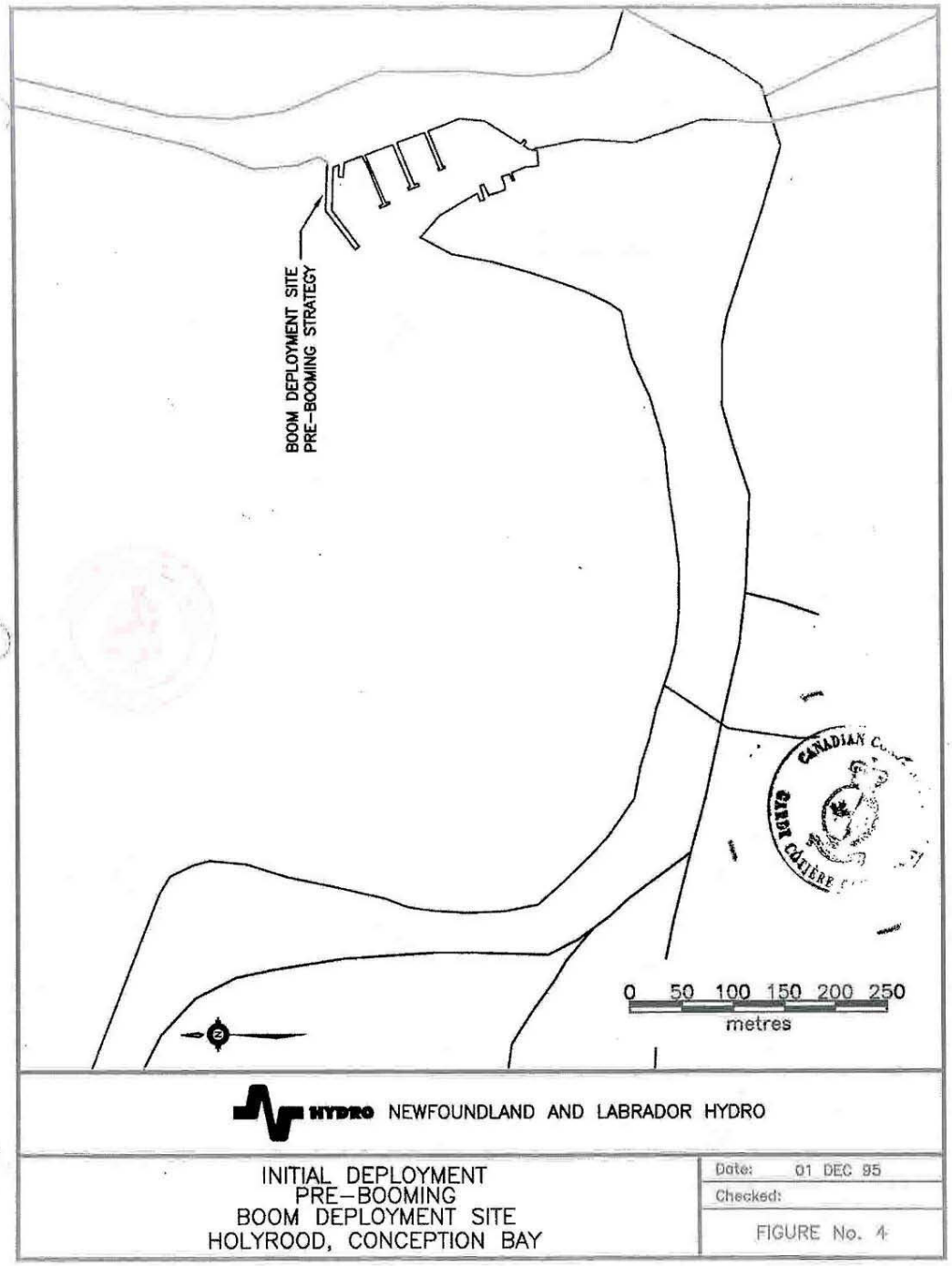
BOOM DEPLOYMENT SITE
PRE-BOOMING STRATEGY
0 50 100 150 200 250
metres
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INITIAL DEPLOYMENT
PRE-BOOMING
BOOM DEPLOYMENT SITE
HOLYROOD, CONCEPTION BAY
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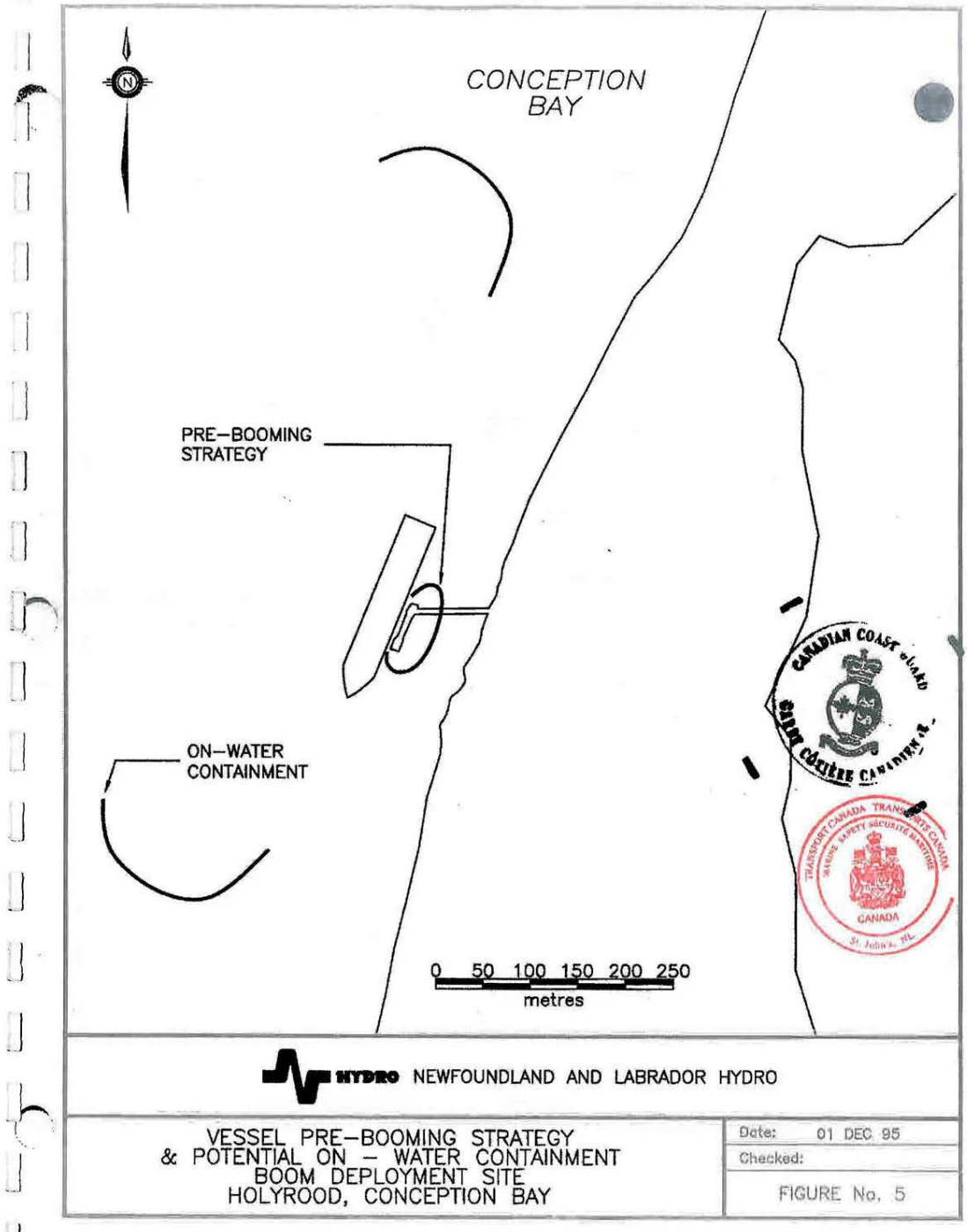
CONCEPTION BAY
PRE–BOOMING STRATEGY
ON–WATER CONTAINMENT
0 50 100 150 200 250
metres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
VESSEL PRE–BOOMING STRATEGY
& POTENTIAL ON – WATER CONTAINMENT
BOOM DEPLOYMENT SITE
HOLYROOD, CONCEPTION BAY
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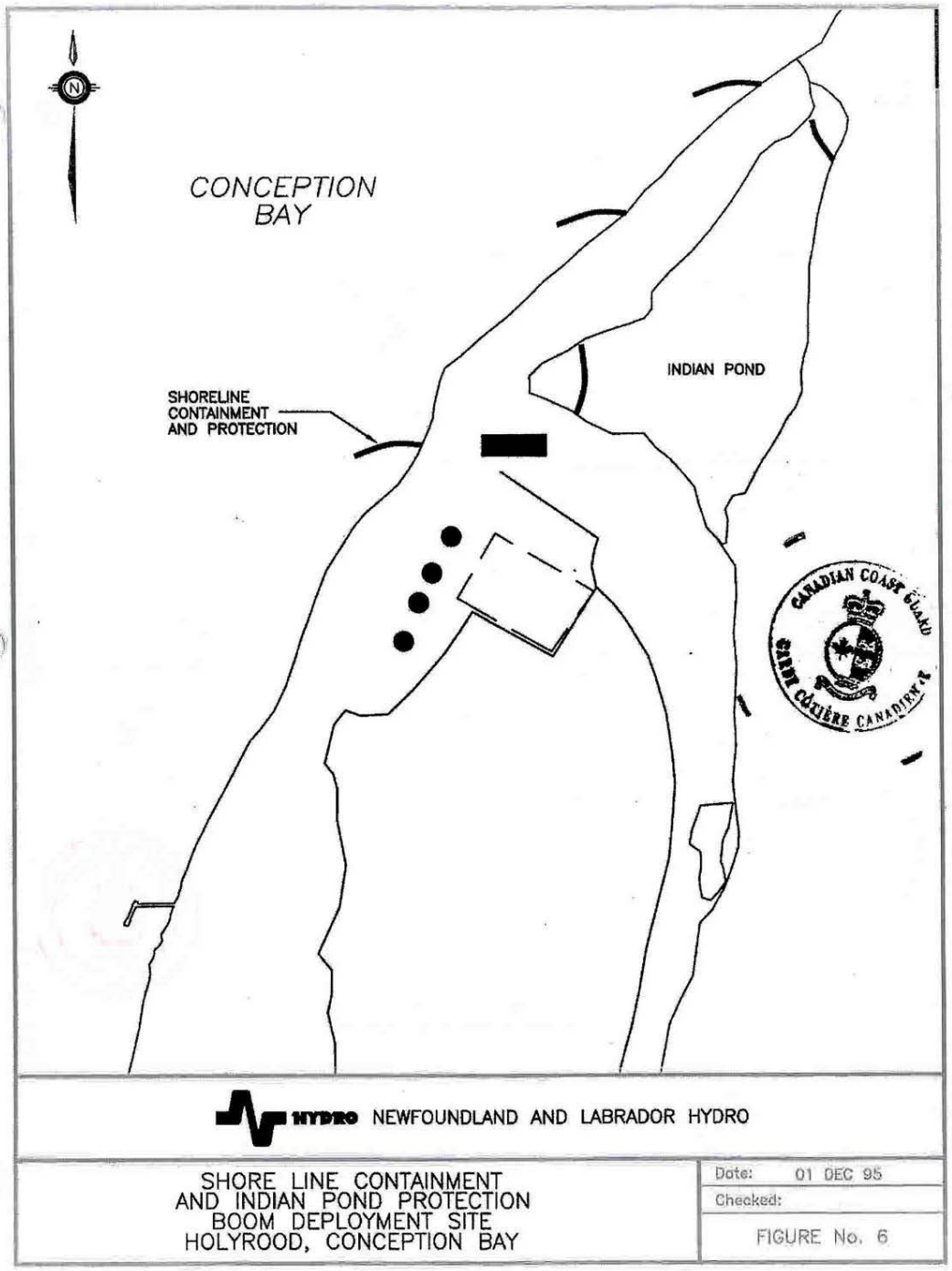
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SHORELINE CONTAINMENT AND PROTECTION
CANADIAN COAST GUARD
GARDE CÔTIÈRE CANADIENNE
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
SHORE LINE CONTAINMENT AND INDIAN POND PROTECTION BOOM DEPLOYMENT SITE HOLYROOD, CONCEPTION BAY
Date: 01 DEC 95
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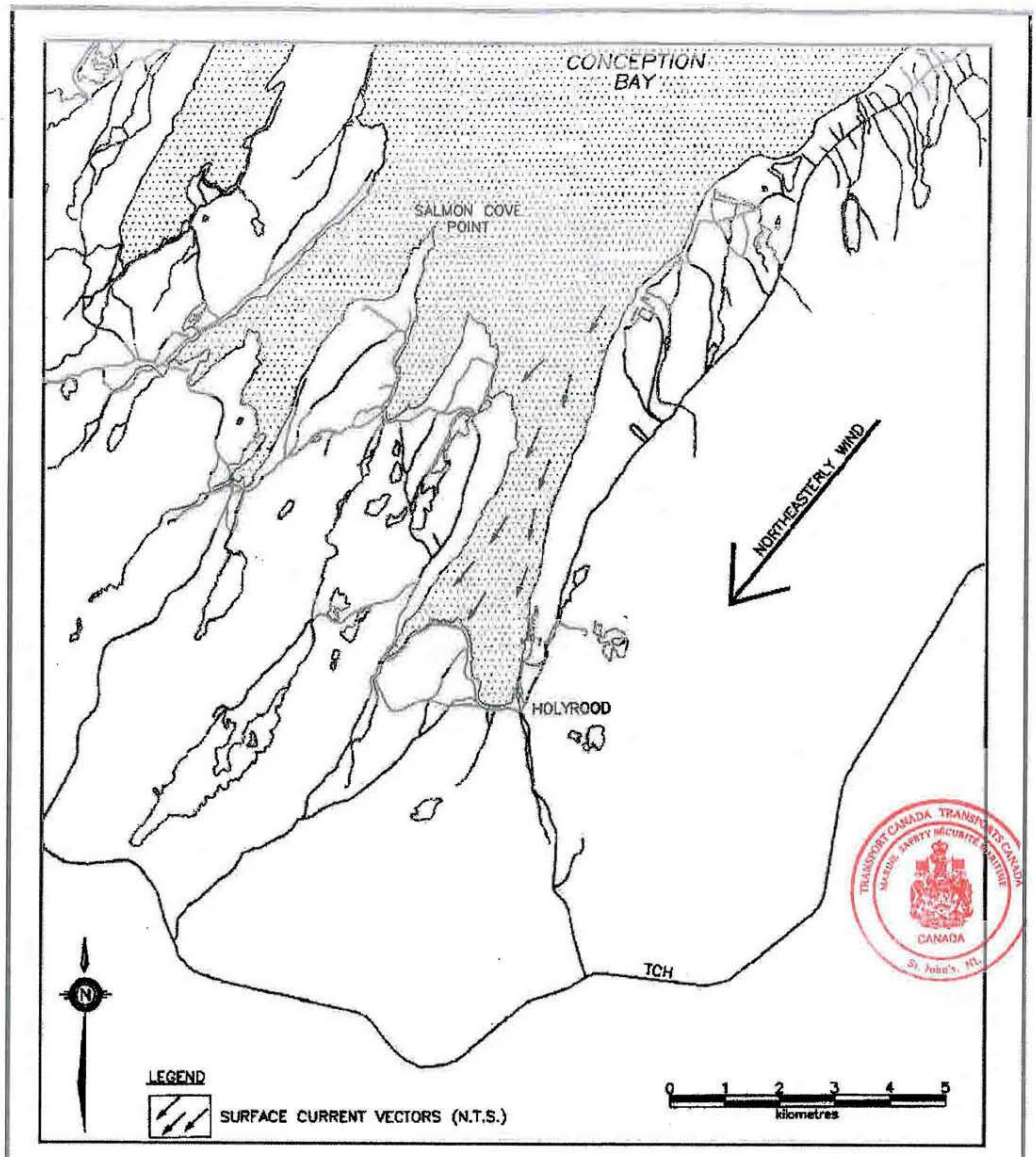
FIGURE No. 6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SALMON COVE POINT
NORTHEASTERLY WIND
HOLYROOD
TCH
N
LEGEND
SURFACE CURRENT VECTORS (N.T.S.)
0 1 2 3 4 5
kilometres
TRANSPORT CANADA TRANSPORTS CANADA
MARINE SAFETY SÉCURITÉ MARITIME
CANADA
St. John's, NL
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
PROBABLE SPILL DISPLACEMENT
UNDER NORTHEASTERLY WIND
Date: 08 NOV 95
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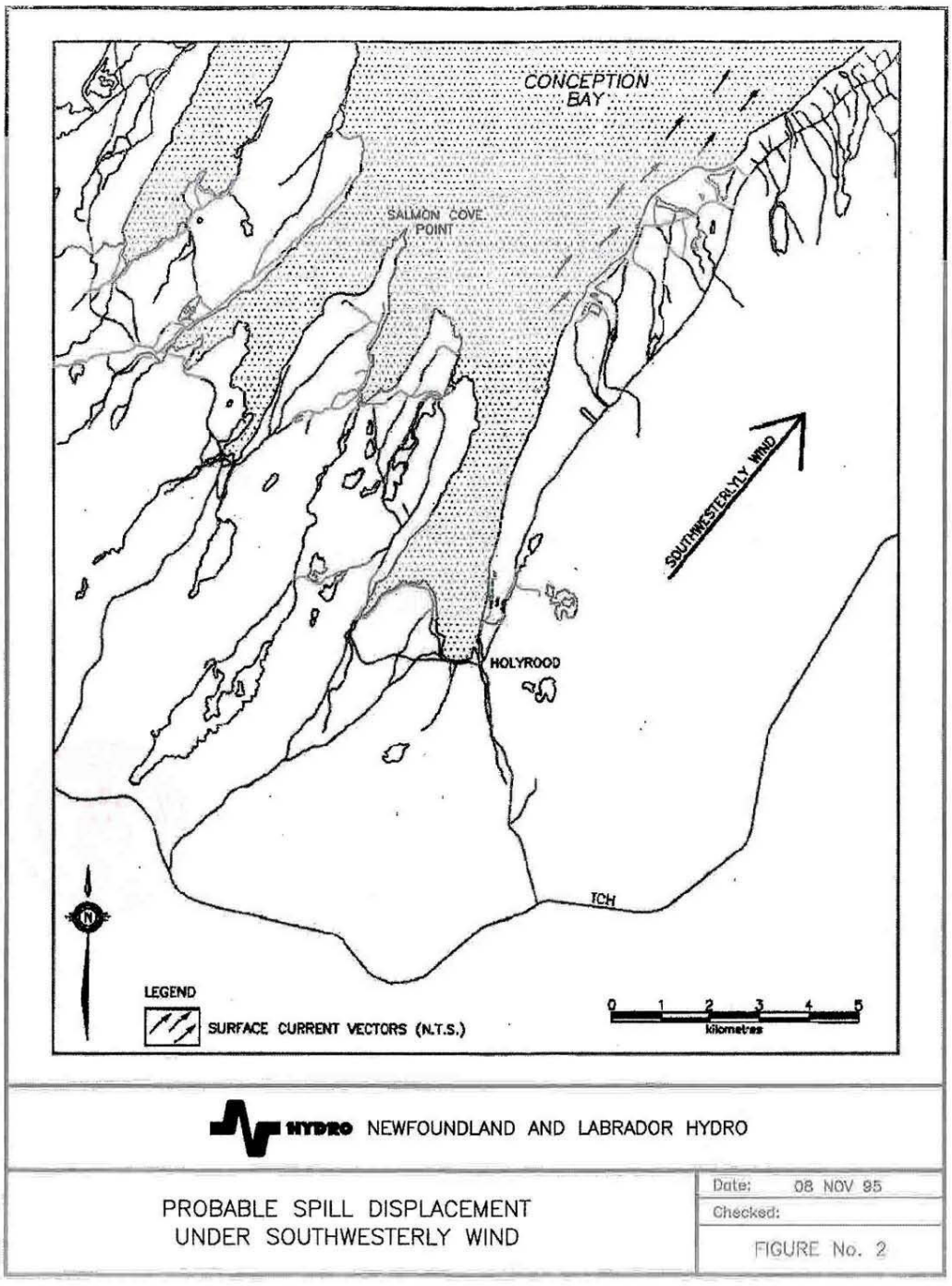
FIGURE No. 1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SOUTHWESTERLY WIND
HOLYROOD
TCH
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LEGEND
SURFACE CURRENT VECTORS (N.T.S.)
0 1 2 3 4 5
kilometres
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PROBABLE SPILL DISPLACEMENT
UNDER SOUTHWESTERLY WIND
Date: 08 NOV 95
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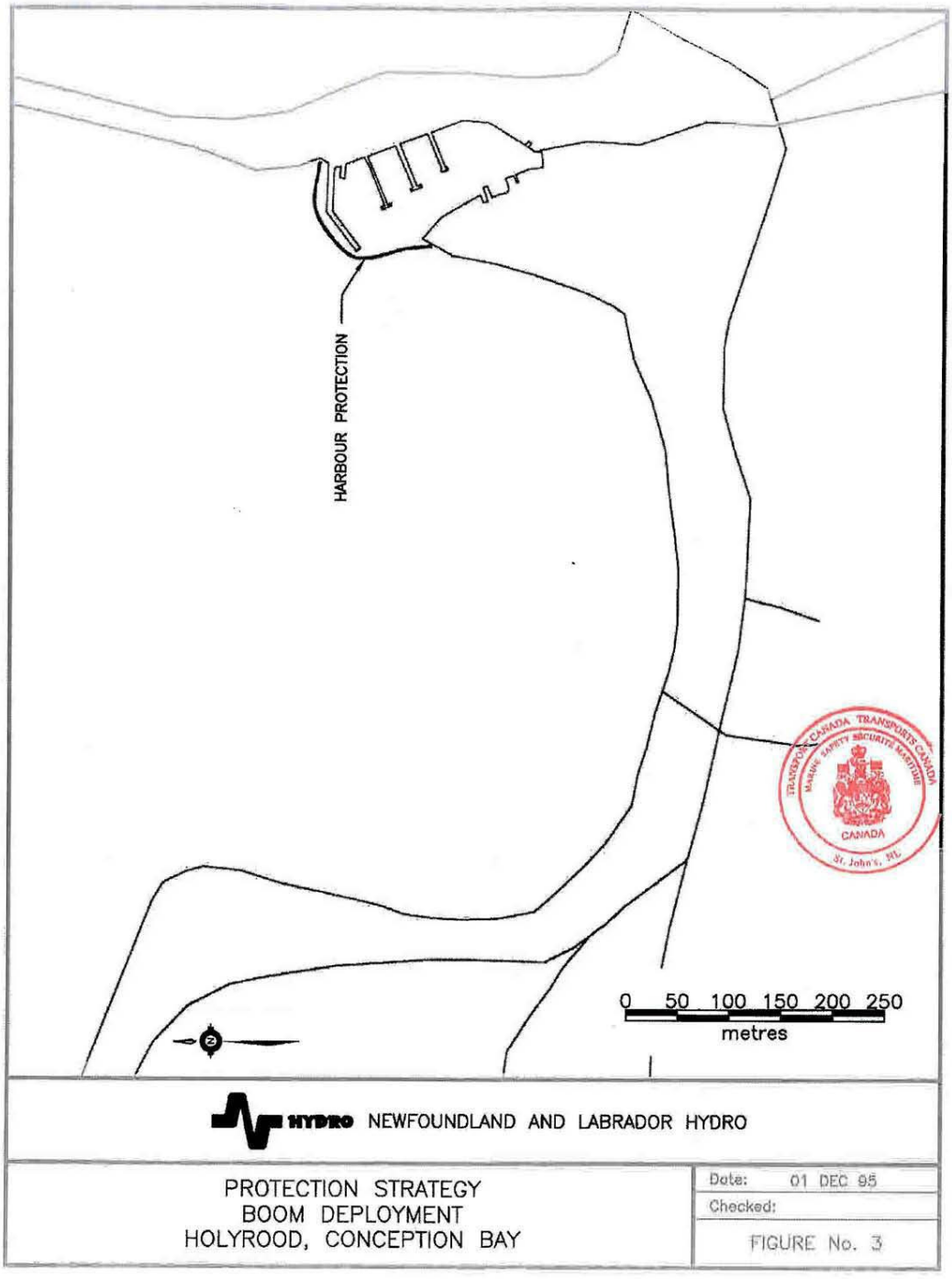
FIGURE No. 2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MARINE SAFETY SÉCURITÉ MARITIME
CANADA
St. John's, NL
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metres
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BOOM DEPLOYMENT
HOLYROOD, CONCEPTION BAY
Date: 01 DEC 95
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FIGURE No. 3

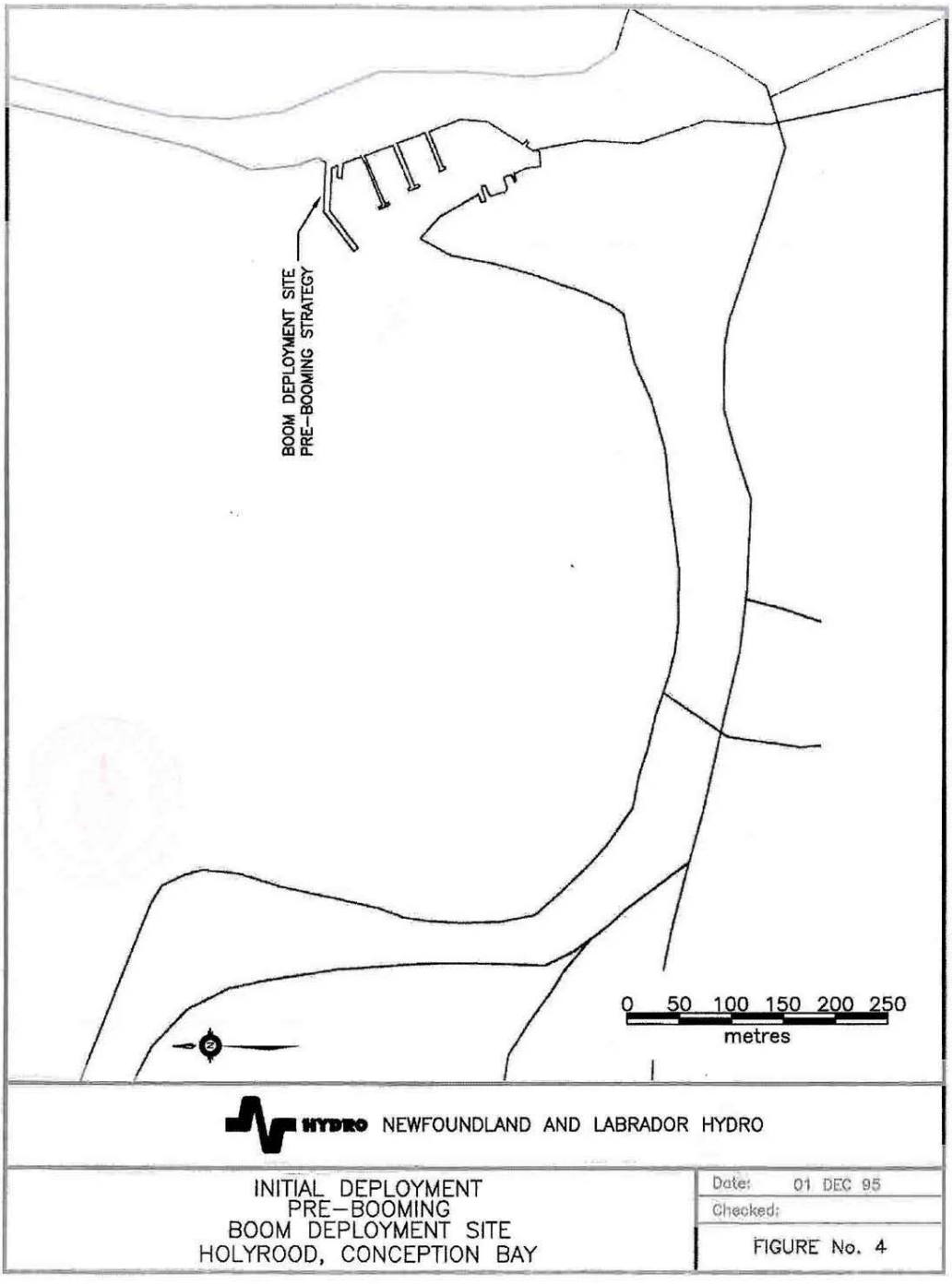
BOOM DEPLOYMENT SITE
PRE-BOOMING STRATEGY
0 50 100 150 200 250
metres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
INITIAL DEPLOYMENT
PRE-BOOMING
BOOM DEPLOYMENT SITE
HOLYROOD, CONCEPTION BAY
Date: 01 DEC 95
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FIGURE No. 4

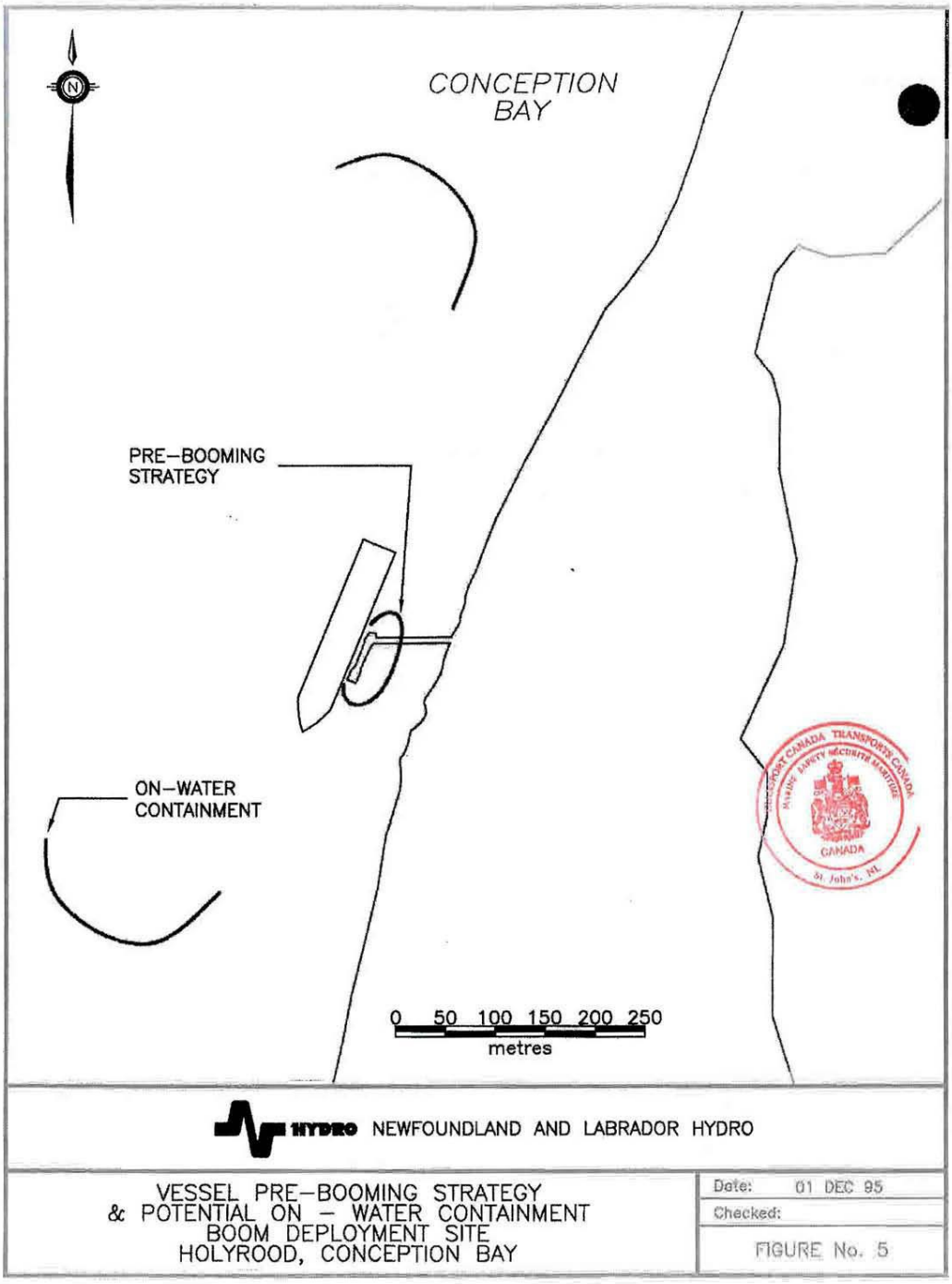
CONCEPTION BAY
PRE–BOOMING STRATEGY
ON–WATER CONTAINMENT
0 50 100 150 200 250
metres
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
VESSEL PRE–BOOMING STRATEGY
& POTENTIAL ON – WATER CONTAINMENT
BOOM DEPLOYMENT SITE
HOLYROOD, CONCEPTION BAY
Date: 01 DEC 95
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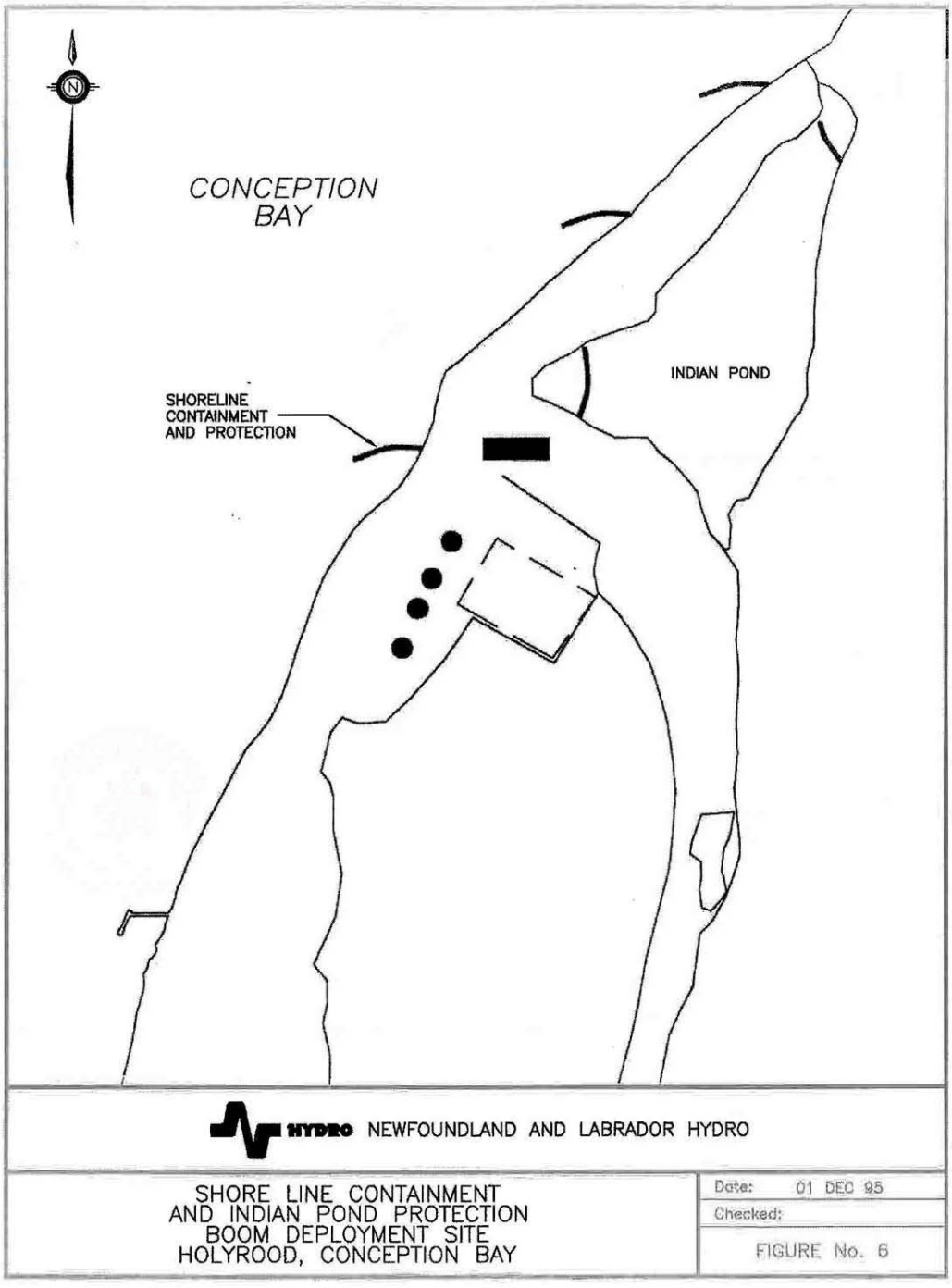
FIGURE No. 5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INDIAN POND
SHORELINE CONTAINMENT AND PROTECTION
HYDRO NEWFOUNDLAND AND LABRADOR HYDRO
SHORE LINE CONTAINMENT AND INDIAN POND PROTECTION BOOM DEPLOYMENT SITE HOLYROOD, CONCEPTION BAY
Date: 01 DEC 95
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FIGURE No. 6

# ERM - Appendix C
# Sensitivity Maps

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## Climatology

A general overview of the climatology for the Holyrood region has been based on the climate normals for St. John's and Holyrood and the climatology surface station nearest to the OHF. The climate normals are estimates of the true mean, obtained in a 30 year sample record, 1951-1980 (Environment Canada, undated). Winters in the Holyrood area are long and mild, while spring tends to be late and cool, followed by a short cool summer. Average monthly temperatures are presented in the Table H-1 below:

### Temperature

**Table H-1**
**Mean Temperature °C**

| | Winter | Spring | Summer | Autumn | Extreme Maximum | Extreme Minimum |
|---|---|---|---|---|---|---|
| **Holyrood** | - 3.2 | 5.5 | 13.7 | 3.1 | 30.6 | - 8.9 |
| **St. John's** | - 3.6 | 5.8 | 14.1 | 2.9 | 30.6 | - 23.3 |

(Source: AES Climate Normals 1951-1980, Vol. 2)

### Precipitation

Total precipitation is relatively evenly distributed throughout the year. Total annual accumulations are:

**Table H-2**
**Monthly Average Precipitation**

| | Winter | Spring | Summer | Autumn | Year |
|---|---|---|---|---|---|
| **Holyrood Snow (cm)** | 140.2 | 15 | 0 | 31.9 | 187.1 |
| **Total Precipitation (mm)** | 316.5 | 183.3 | 212.4 | 316.7 | 1028.9 |

(Source: AES Climate Normals 1951-1980, Vol. 5)

**Winds**

Prevailing winds in the summer are west to west/southwest. Winds in January and February tend to be from west, while winds in March are an equal mix of west and east to east northeast. The following table provides information on seasonal wind direction for the Holyrood region.

**Table H-3**
**Seasonal Winds**

| | Winter | Spring | Summer | Autumn | Year |
|---|---|---|---|---|---|
| **St. John's (km/hr)** | 10.4 | 8.8 | 12.0 | 10.9 | 10.3 |

(Source: AES Climate Normals 1951-1980, Vol. 5)

**Wave Energy**

Classified as high, medium, or low, wave energy can be expressed as the force exerted by a wave impacting upon a section of shoreline. The importance of wave energy, in relation to an oiled shoreline, is that cleanup operations can be assisted due to action of the wave energy agitating oil on a shoreline and assisting in its breakup and removal. Based upon this occurrence, a responder could expect shorelines in regions of high wave energy to be cleaned quicker than those subject to low wave energy. A diagram demonstrating the wave energy in the Holyrood region has been included in this appendix.




Also taken in to account is the coastal geomorphology of the region. In particular, shorelines that permit penetration of oil (permeable) to the subsurface layers will take longer and require substantially different response techniques than those portions of shoreline that are non permeable. Therefore, shorelines exposed to high wave energy and consisting of non-permeable surfaces would, in theory, clean quicker than those exposed to low energy permeable surfaces.

A search for maps and documentation on the coastal geomorphology of Conception Bay failed to produce text or maps suitable for inclusion in this OPEP (Section ERM-10).

**Biological Coastal Character**

The biological character of the shoreline in the Holyrood region is limited to the species that are dependant upon the actual shore or the immediate near shore waters (i.e., within approximately 100 m offshore). In all cases deflection and exclusion booms should be considered as a means of reducing, and hopefully eliminating, the impact upon present species. Maps indicating known habitats have been included in this section of the OPEP (Section ERM-10) and should be referred to by the OSC in all instances when making decisions in relation to planning, operations, and in the development of strategies for boom deployment. Based upon this assessment, the primary biological concerns for the Holyrood region are:

**Capelin Spawning Grounds**

Capelin in Newfoundland spawn on sand or gravel beaches in the intertidal zone or, if surface water temperatures become too high (above about 8.5°C), in deeper water. Spawning takes place in spring and early summer and lasts six to eight weeks, with an incubation time of a further two or three weeks. Eggs stay on the bottom where they stick to the sand and gravel until hatching. The lower inter-tidal zone of many sand, mixed or coarse sediment beaches in the Holyrood region provides such conditions and presents an acceptable spawning habitat for Capelin.

Capelin are highly specific as to which beaches are used once spawning commences, however, whether this is a follow the leader phenomenon or keyed to some crucial characteristic of the beach itself has not been determined.

Whilst capelin are of growing commercial importance, their true significance is as prey for most of the commercially harvested groundfish, especially cod. Capelin is also utilized by Atlantic Salmon and is the primary food source for many seabirds, especially common and thick billed murres and Atlantic Puffins.

**Herring**

Herring spawn in shallow (<2 m) near shore waters during spring. Their eggs settle on seaweed and would be vulnerable to oil damage during incubation and hatching, but only if the oil contained a significant portion of the lighter, more toxic fractions, and these had become dissolved in the water column.

**Atlantic Salmon**

Atlantic Salmon utilize (i.e. shelter and feed) in the estuarine environment during two periods in their life cycles. The young fish migrate downstream from the spawning grounds to the sea during early summer, feeding in the river mouths for a short period before moving offshore, while the adults move upstream in the summer and fall.

**Lobster**

Lobster are prevalent throughout most of the Holyrood region where they move inshore during the warmer months. Accordingly, lobster would be vulnerable to sinking oils in near shore regions whereas lobster pots, lines, and fishing boats would be vulnerable to oil due to there positioning and necessity of inshore fishermen to traverse near shore waters.




**Other Fisheries (Fish Trapping and Surface Gillnetting)**

The trapping (cod and capelin) and Gillnetting (salmon, herring, and mackerel) industries could be substantially affected by oil in near shore waters. Fish traps set for cod and capelin are complex net structures set in specific locations for the duration of a season and are not easily moved during a spill. Surface gillnets set perpendicular to the coast, reaching from the shore to 30-50 m offshore would also be impacted during a spill and like the trapping fishery would have to be completely curtailed for the time oil was present in the near shore zone.

**Marine Mammals**

There is little danger of serious disruption to any major marine mammal populations through oil reaching the coast as there are no known important breeding areas for marine mammals along this section of coast in the Holyrood region.

**Seabird Colonies**

Although seabirds spend most of their lives at sea, they breed on land in colonies. However, because their breeding sites (islands and cliffs) normally confer protection from predators and environmental hazards, seabirds are ill-adapted to intrusion and disturbance, and are vulnerable to physical and environmental disturbances.

Such populations are vulnerable to damage that can result from oil slicks in near shore waters, with the greatest mortality resulting from birds fouled by oil slicks during foraging activities. The most significant bird colonies within Conception Bay is located on Kelly's Island and Little Bell Island. Whilst both fall outside the immediate vicinity of the generating station, both warrant mention should there be a requirement to escalate the response. Breeding birds include:

| **Breeding Birds** | |
|---|---|
| **Kelly's Island** | **Little Bell Island** |
| Herring Gull | Herring Gull |
| Black Guillemot | Black Guillemot |
| | Great Black Backed Gull |

It is important to note that oil destroys the insulative and waterproof qualities of feathers, causing a heat drain and increasing the effective weight of the bird. The bird dies of hypothermia within hours or days after oiling.

**Community Characteristics**

Within the Holyrood region there are fixed jetties at the generating station, Ultramar and in Holyrood Harbour, Holyrood. These fixed structures are constructed of wood, metal, rubble or other concrete materials, even within the same harbour area. Larger vessels are normally tied up at jetties (Holyrood Generating Station) and docks (Ultramar) whilst smaller craft are anchored in marinas in the near shore area (Holyrood Harbour).

The impact of oil on these fixtures can be determined from the material used for construction:

| **Cleanup Impact Assessment - Wharfs - Jetty - Docks - Marinas** | | |
|---|---|---|
| **Hydro Jetty** | Low | Steel and Concrete |
| **Ultramar Dock** | Medium | Concrete |
| **Holyrood Harbour** | High | Wood, Rubble, Steel and Concrete |



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**CONTACT NUMBERS FOR TANKER OFF-LOADING**
**HOLYROOD THERMAL GENERATING STATION (MARINE TERMINAL)**

| Title | Name | Work# | Home# | Cell# |
|---|---|---|---|---|
| OSC-1 Mech. Maint. Supervisor | Mike Flynn | 229-2146 | 229-4205 | 682-7381 |
| OSC-1 Mech. Maint. Supervisor | Bill Kilfoy | 229-2145 | 744-4605 | 682-7381 |
| OSC-2 Thermal Plant Manager | Terry LeDrew | 229-2110 | 834-3447 | 682-7382<br>682-5518 |
| OSC-2 Asset Manager Thermal | Mike Manuel | 229-2114 | 744-3336 | 682-7382 |
| OSC-2 Labour Manager Thermal | Wayne Rice | 229-2126 | | 682-7382 |
| Control Room | Shift Supervisor | 229-2132/2158/2159 | | |
| Dock | Operator | | | 682-5472 |
| Support Services Vessel (Captain) | Barry Tippet | | 229-1958 | 682-7827 |
| Support Services Vessel | Rick Tippet | | 744-2075 | 682-7827 |
| Emergency Response Coordinator (HTGS) | Ron LeDrew | 229-2739 | 579-1026 | 699-2171 |
| Safety Coordinator (HTGS) | Wade Kelloway | 229-2124 | 782-4061 | 728-6146 |
| Eastern Canada Response Corp. (ECRC) | | 1-613-930-9690<br>(OSC-2 only) | | |
| Canadian Coast Guard | | 722-2083 / 1-800-563-9089 | | |
| Security (Main Gate)<br>Security (Dock) | | 229-2180<br>229-2720 | | |
| Jetty Shack | | 229-2721 | | |
| Hickey's Ambulance (Medical Emergency) | | 229-1111 | | |
| RCMP Holyrood Detachment | | 229-3892 | | |

Revised 10 Nov 09
R. LeDrew

A REPORT TO

THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

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# REPLACE FUEL OIL HEAT TRACING

## Holyrood Thermal Generating Station

July 2011

newfoundland labrador hydro
a nalcor energy company

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# 1 INTRODUCTION

The Holyrood Thermal Generating Station (Holyrood) is an essential part of Newfoundland and Labrador's generating system, delivering electrical energy to retail, industrial, and residential customers. This plant has three generating units producing a total capacity of 490 MW. The plant was constructed in two stages. Stage 1 was commissioned in 1971 bringing on line generating Units 1 and 2, each rated at 150 MW. Stage 2 was commissioned in 1979 bringing on line generating Unit 3 also rated at 150 MW. In 1988 and 1989, the generation capacity of Units 1 and 2 was increased to 175 MW each. Holyrood has the capacity of generating over 3,000,000 MWh of energy annually which is approximately 40 percent of the Island Interconnected System's energy requirement.



**Figure 1: Holyrood Thermal Generating Station**

At this plant, Bunker C fuel oil is burned in large oil burning furnaces, converting water to steam which is then used to propel turbine generators. A 455 mm diameter insulated pipe, equipped with electric heat tracing was installed as part of the original construction and is used to transport Bunker C Fuel Oil from the marine terminal to the facility's fuel storage

tanks approximately 1200 m away. The 455 mm diameter pipeline is divided into two subsections at approximately the midpoint of the pipeline. Each subsection of pipeline consists of separate heat tracing circuits, designated as North Section and South Section. In addition, there is a section of 100 mm diameter pipeline, approximately 100 m in length, which also requires replacement of heat tracing cable.

During the period from September to April, shuttle tankers arrive at the marine terminal and Bunker C fuel oil is pumped through the 455 mm diameter insulated pipeline to the tank farm. Before the shuttle tanker attempts to pump oil into the pipeline, the oil is heated to approximately $60^{O}$C onboard the tanker. Because of the thick nature of this oil, to successfully transport oil through the pipe the oil temperature must be maintained at a minimum of $30^{O}$C throughout its path of flow. To maintain an oil temperature of $30^{O}$C throughout the pipe, an oil heating system known as electric heat tracing (EHT) is installed along the full length of the pipe. The main component of EHT is the copper conductor which is heated by the flow of electric current produced by three phase 600 volt power supply. Figure 2 shows a picture of the existing 455 mm fuel oil pipeline equipped with electric heat tracing in Holyrood.




**Figure 2: Electric Heat Tracing**

# 2 PROJECT DESCRIPTION

This project is required to replace the electric heat tracing (EHT) on the fuel oil pipeline at the Holyrood Thermal Generating Station. The existing heat tracing cables have deteriorated and have resulted in various problems with the performance of the existing application, including failed sections of heat tracing due to open circuits and ground faults. This two year project also includes the replacement of fiberglass insulation and metal cladding for the entire pipeline. The scope of work includes:

- Erection of scaffolding for the shore arm and three expansion joints on the 455 mm diameter line
- Removal of existing insulation, metal cladding and mineral insulated heating cables
- Testing of 455 mm diameter pipe thickness at prescribed intervals
- Coating of 455 mm diameter pipe for corrosion protection
- Installation of the new electric heat tracing system
- Installation of new insulation and cladding
- Installation of programmable controller with self diagnostics
- Construction Management
- Commissioning of the new system
- Disposal of existing metal cladding, insulation, and heat tracing cable

An external contractor will be required to install the new system. Based on discussions with the original equipment manufacturer (OEM), Tyco Thermals Controls, of the existing heat tracing system, it is anticipated that the existing copper heat tracing cable will need to be replaced with a stainless steel heat tracing cable. Stainless steel heat tracing cables offer better corrosion resistance than copper heat tracing, making it more suitable for this application.

It will take approximately four to six months to complete replacement of the entire heat tracing system. Hydro proposes to complete the work in two sections – the South Section and 100 mm diameter pipeline to be completed in the summer of 2012 and the North Section to be completed in the summer of 2013. Each section takes approximately two to three months to complete.

# 3 EXISTING SYSTEM

The electric heat tracing equipped on the fuel oil pipeline consists of a High Density Polyethylene (HDPE), copper sheathed, mineral insulated (MI) electric heat tracing cable. These cables are strapped to the fuel oil pipe line every three to five linear feet intervals. They are then insulated with two inches of fiberglass insulation and then wrapped with metal cladding as shown in Figure 3.

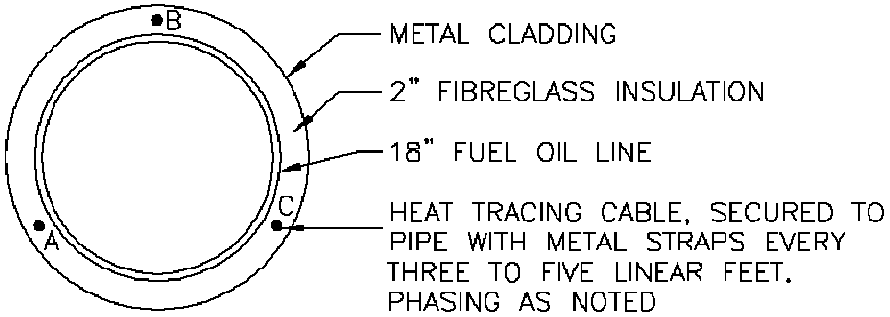



**Figure 3: Cross Section of 18" (455 mm) Pipeline**

The 455 mm diameter fuel oil pipeline heat tracing consists of two main electric circuits, North Section and South Section, both of which are approximately 600 meters in length. Each section of pipeline is then subdivided by heat tracing cable lengths of approximately 50 meters. The North Section runs from the facility tank farm to the midpoint of the pipeline, and the South Section runs from the marine terminal to the midpoint of the pipeline.

The 100 mm diameter pipeline runs from the marine terminal to approximately three meters past the control valve located near the base of the shore arm. The shore arm is a cement structure extending approximately 100 m from the shoreline into the ocean to support a marine terminal at water depths which allow shuttle tankers to dock and un-load fuel oil. The purpose of this pipeline is to drain a section of 455 mm diameter pipeline from the marine terminal to the control valve. This is done so that if ice were to damage the 455 mm diameter pipeline on the shore arm, the pipeline would be empty of fuel and no oil

would be released into the environment. The shore arm is shown in Figure 4.




**Figure 4: Shore Arm**

Please refer to Appendix A for a layout drawing of the existing fuel oil pipeline.

From 2004 to 2011, repetitive failures of the existing heat tracing cables have occurred due to ground faults and open circuits. As a result, attempts to pump oil through the pipeline have failed because the oil could not be maintained at the required temperature for oil flow.

The existing heat tracing system was newly installed in 2002 to replace the original bare copper mineral insulated electric heat tracing. Since 2002, the high density polyethylene jacket has melted off and the cable is failing prematurely.

Over time, moisture has accumulated within the insulation, and has caused corrosion of the copper sheath of the cable. The moisture seeps through the outer copper sheath and causes system failure by creating open electric circuits and ground faults. As a result, in 2009, the original three phase system was modified into a two phase system in order for the system to remain operational. This system operates on a continuous basis due to the lack of confidence that the system will re-energize once turned off.

Figures 5 and 6 show pictures of the deteriorated heat tracing cables.



**Figure 5: Deteriorated Heat Tracing Cable**



**Figure 6: Deteriorated Heat Tracing Cable**

Also, the existing heat tracing application on the 100 mm diameter pipeline has experienced similar problems as the main pipeline. It consists of bare copper mineral insulated heat tracing cables which were installed during original construction and has exceeded its useful service life. Over the years moisture has accumulated within the insulation and corroded the copper sheath, resulting in open electric circuits and ground faults and thus, failure to heat the oil.

Figure 7 shows a picture of the existing electric heat tracing cable on the 100 mm diameter fuel oil pipeline.



**Figure 7: Deteriorated Heat Tracing Cable**

The condition of the existing heat tracing cables on the 455 mm diameter and 100 mm diameter pipes place the environment, worker safety and system reliability at risk.

## 3.1 Age of Equipment or System

The heat tracing system on both the North and South section of the 455 mm diameter pipeline replaced the original in 2002. It has been in operation for nine years. The 100 mm diameter pipeline was installed during original construction and has been in operation for 40 years.

## 3.2 Major Work and/or Upgrades

In 2002, the original bare copper electric heat tracing cable on the South Section and North Section was replaced with a new copper sheathed mineral insulated electric heat tracing cable, equipped with a high density polyethylene jacket.

Tyco Thermal Controls (TTC) is the Original Equipment Manufacturer (OEM) for the electric heat tracing installed during original construction, and for the new replacement cable installed in 2002.

From 2004 to 2011, repetitive failures have been experienced with the cables on both the North and South Sections of EHT cable which was installed new in 2002. As a result, Hydro operations personnel modified the three phase electric heating system into a two phase system to mitigate sections of deteriorated heat tracing cable. This modification was required for the electric heating system to remain operational, and is a temporary measure until replacement of the entire electric heat tracing system occurs. The procedure of eliminating an electrical phase, or "making two phases into one" allowed reenergization of the heat trace during critical operational periods in the winter months. The trade off for this is essentially double the rated electrical current flowing through sections of the heat trace system. This shortens the life of the remaining sections of heat trace. Given the total length of the fuel oil piping a proper design requires three individual electrical phases, each equally sharing a component of the total heat trace system.

In September 2009, Hydro contracted the OEM of the existing heat tracing cables to provide an analysis and opinion to determine the cause of the premature failure of the electric heat tracing cable installed in 2002. TTC discovered that the HDPE jacketed copper MI cables had been installed in place of bare copper MI cables. The following is a quote from Page 2 from the TTC Report dated March 31, 2011: “There are two problems associated with using the jacketed cable for this installation. The first is that the 26.7 watts/ft output of the heater exceeds our maximum recommendation of 8-9 watts/ft for jacketed copper MI cables on metal pipes. The second is that the sheath temperature for these heaters would be in excess of 405$^{o}$F and this exceeds the recommended maximum continuous operating temperature for HDPE of 248$^{o}$F”. Please refer to Appendix B for more information.

Also, early in 2011, an internal root cause failure analysis was completed to determine the

reasoning behind the decision to choose the electric heat tracing cable currently installed on the North and South section of the fuel oil pipeline. Please refer to Appendix C.

## 3.3 Anticipated Useful life

The anticipated useful life of copper heat tracing cable is 20 years. However, this may vary depending on environmental and service conditions.

## 3.4 Maintenance History

The five year maintenance history for the Holyrood Thermal Generating Station electric heat tracing system is shown in Table 1.

**Table 1: Five Year Maintenance History**

| Year | Corrective Maintenance ($000) | Corrective Maintenance (CM) |
|---|---|---|
| 2011 | 9.0 | Three CM work orders on malfunctioning of EHT |
| 2010 | 0.5 | One CM work order on malfunctioning of EHT |
| 2009 | 32.3 | Four CM work orders on malfunctioning of EHT. 3 phase system modified to a 2 phase system |
| 2008 | 7.9 | Five CM work orders on malfunctioning of EHT |
| 2007 | 0.5 | One CM work order on malfunctioning of EHT |

Preventive maintenance of the heat tracing system is a component of the annual maintenance strategy of the fuel oil delivery system. Hydro does not track heat tracing preventive maintenance costs separately from the total unit maintenance cost. As a result, specific preventive maintenance costs for the heat tracing system are not available.

## 3.5 Outage Statistics

No outages have been attributed to failed electric heat tracing at Holyrood.

## 3.6 Industry Experience

Curtiss Wright, Scientech, is experiencing similar problems such as ground faults and circuit failures with bare copper electric heat tracing. The outer copper sheath of the heat tracing cable reacts to the original pipe insulating material, attacking the outer sheath. Over time, moisture seeps through the outer sheath and causes electrical ground faults resulting in failure of the electric heat tracing. Please refer to Appendix D.

## 3.7 Maintenance or Support Arrangements

All maintenance work is performed by Hydro operations personnel.

## 3.8 Vendor Recommendations

TTC recommends replacement of the entire existing copper heat tracing system with stainless steel heat tracing. Copper heat tracing is not suitable for this application because of the moisture levels and sea salt spray experienced in Holyrood. Please refer to Appendix E.

## 3.9 Availability of Replacement Parts

Replacement heat tracing cables are readily available within three to four weeks of an order.

## 3.10 Safety Performance

The existing heat tracing cables have deteriorated resulting in safety hazards from potentially failing equipment. Improper functioning of the heat tracing is a serious concern to the safety of operations personnel when shuttle tankers attempt to pump Bunker C fuel oil from the marine terminal to Holyrood's facility tank farm. For successful pumping of oil through the pipe to the tank farm, the oil must be maintained at a temperature of $30^{O}$C. Improper functioning heat tracing cannot achieve this temperature. As a result, as the tanker attempts to pump cooled oil ($<30^{O}$C) through the pipe, there is the possibility for build-up of excessive back pressure in the pipeline at the marine terminal. Excessive pressure can result in damaging the pipeline, leading to spillage of hot Bunker C fuel oil, potentially causing severe burns or a fatality.

## 3.11 Environmental Performance

The environmental concern present with the condition of the existing heat tracing system is the potential release of a large volume of bunker C fuel oil into the environment. As mentioned earlier, a shuttle tanker attempting to pump oil through the pipeline at a maintained temperature lower than $30^{O}$C, can potentially result in excessive back pressure in the line, bursting the pipe, leading to spillage of Bunker C fuel oil into the Atlantic Ocean.



**Figure 8: 455 mm Pipeline**

Spillage of Bunker C oil presents serious concern. The release of oil would result in contamination of the Atlantic Ocean, detrimentally impacting highly populated plant and marine life. It should also be noted that a nearby public beach would be negatively impacted as well.

Bunker C oil is very thick and sticky, and has been found to float, sink, or do both in water[1]. Bunker C oil properties make it very difficult to treat and clean up when it comes in contact with the environment.

Clean up of an oil spill of approximately 15,000 barrels would not only require great effort, but will be very costly as an extensive amount of resources will be required to clean up oil from the ocean and shoreline. It was estimated that a minimum cost to clean up an oil spill into the Atlantic Ocean is approximately $1,000,000.

[1] - www.buzzardsbay.org/number6oil.htm

Figure 9 shows a picture of the beach and surrounding area near the Holyrood Thermal Plant.




**Figure 9: Holyrood**

Image taken from http://sonyald.blogspot.com/2011/02/my-hometown-holyrood-nl.html

Figure 10 below is a picture of a bunker oil spill in San Francisco.



**Figure 10: Bunker Oil Spill in San Francisco**

Image taken from http://thegreenists.com/date/2007/11/page/4

## 3.12 Operating Regime

Currently, the remaining two phases of heat tracing is in continuous operation because of the lack of confidence the system will work again if turned off. Operations personnel believe the existing system has deteriorated to the point that if they de-energize the cables for any period of time, they will not re-energize when turned back on. The new proposed installation will allow for the heat tracing system to be switched off during summer months through the installation of a programmable controller. Seasonal operation will reduce the total power consumed by approximately 50% of the total power consumed by the existing system.

# 4 JUSTIFICATION

This project is justified on the requirement to replace the deteriorated electric heat tracing system based on safety, operational reliability, and the environment. Due to the highly corrosive environment that this heat tracing system is exposed to, an anti-corrosive material is required. The previous installation used a copper sheathed material with a HDPE jacket. This jacket did not withstand the temperatures it was exposed to and melted. Stainless steel is the most economic material that will withstand both corrosion and the required temperatures.

The project is required based on the following reasons:

1. Failure to Receive Oil

The storage of Bunker C fuel oil has to be maintained at sufficient levels in the tank farm to ensure continuous operation of the Holyrood Generating Station. Electric heat tracing of the entire length of piping heats the highly viscous oil to enable pumping from shuttle tankers to the facility tank farm. The existing electric heat tracing system has deteriorated and is now temporarily repaired for unloading oil from the tankers. On February 22, 2011, a tanker could not deliver fuel for three days due to failed electric heat tracing, resulting in three days of demurrage payments of $18,000 to $25,000 per day.

2. Consultant Recommendations

A consultant, AMEC completed a condition assessment and advised Hydro that the system should be replaced as indicated in the following quote from Page 1 of their condition assessment report: “The heavy oil electrical trace heating system on the pipeline from the dock to the receiving point at the south end of the tank farm was replaced but has recently experienced failures. The plant has managed to get two phases back in working order, but the failure of these phases is very likely. This issue needs to be resolved and the system replaced”. See Appendix F.

3. OEM Recommendations

The OEM, Tyco Thermal Controls, has recommended that the existing copper heat tracing system be replaced with new stainless steel electric heat tracing.

4. Personnel Safety

The insulation of the cables of the existing heat trace system has become brittle. This reduces the ability of the insulation to protect from electric ground faults and the insulation resistance has become lower than the acceptable minimum value. The deterioration of the insulation indicates that there are places where there are leakage currents which endanger the safety of personnel.

5. Environmental Performance

Release of Bunker C oil into the Atlantic Ocean is a serious environmental concern, and presents a high risk of severely impacting an environment which is highly populated with plant and marine life. The pipeline has the capacity to contain approximately 15,000 barrels of oil. This risk is significantly reduced with the installation of a new heat tracing cable suitable for this application.

Failure to replace the existing heat tracing cables increases the likelihood of failure to receive fuel oil and could lead to extensive equipment damage, and poses serious risk to personnel safety, the environment and operational reliability.

## 4.1 Net Present Value

A net present value calculation was not performed in this instance as only one viable alternative exists.

## 4.2 Levelized Cost of Energy

This project will not affect the levelized cost of energy for the system.

## 4.3 Cost Benefit Analysis

A cost benefit analysis is not required for this project proposal as there are no quantifiable benefits.

## 4.4 Legislative or Regulatory Requirements

There are no legislative or regulatory requirements associated with this project.

## 4.5 Historical Information

In 2002, the original copper MI heat tracing cables on the fuel oil delivery pipeline was replaced with new jacketed copper MI heat tracing cables. Please refer to Appendices B and C.

## 4.6 Forecast Customer Growth

This project has no effect on forecasted customer growth. Figures 11 and 12 below show the fuel quantity forecast required to meet the load forecast.

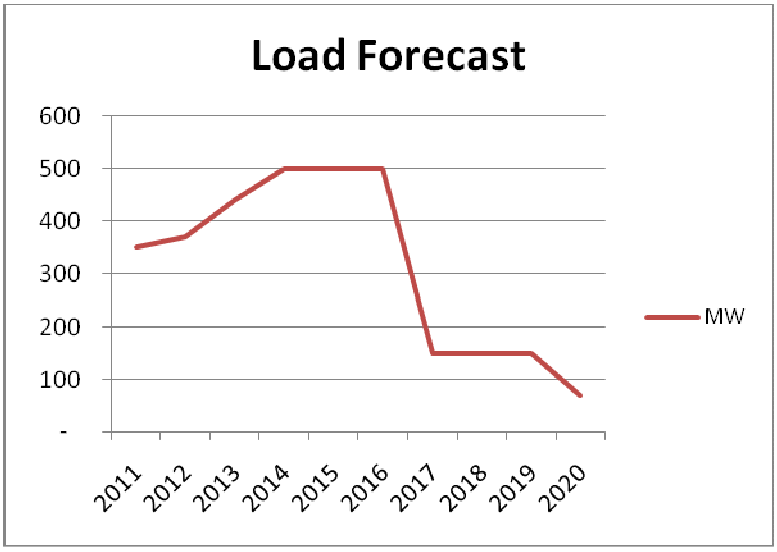



**Figure 11: Island Interconnected Peak Demand to be supplied to Holyrood**

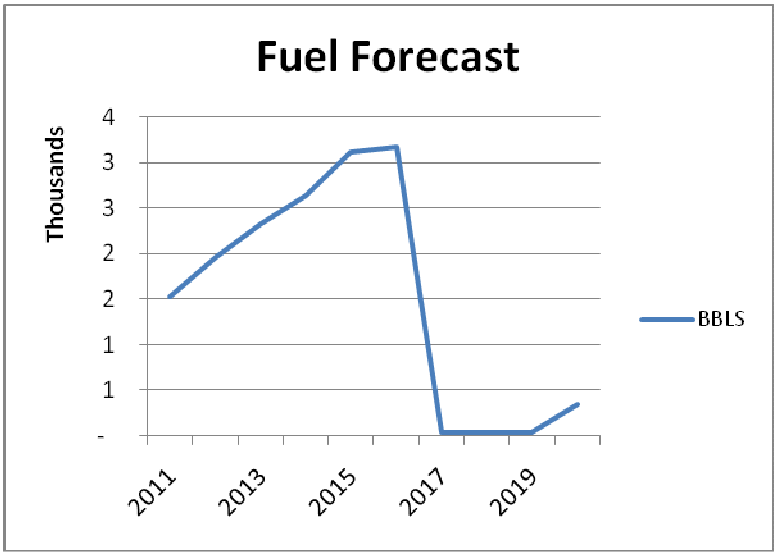



**Figure 12: Holyrood Plant Fuel Forecast**

## 4.7 Energy Efficiency Benefits

There are no energy efficiency benefits associated with replacement of the existing copper electrical heat tracing system with stainless steel heat tracing.

## 4.8 Losses during Construction

There are no losses anticipated to occur during construction of this project as the replacement will be performed during the period from May 1 to August 31 when no oil is delivered to Holyrood.

## 4.9 Status Quo

The status quo is not an acceptable alternative because the deteriorated and obsolete equipment poses safety hazards to Hydro operations personnel and poses risk to the environment and reliable delivery of service to customers.

## 4.10 Alternatives

Electric heat tracing is the only viable option to the problems described.

# 5 CONCLUSION

The replacement of the fuel oil heat tracing system is justified on the basis of the safety and environmental concerns and the unreliability of the existing equipment to operate properly. Without the replacement, operating staff, the environment, and system reliability are exposed to unacceptable risks associated with failure of the heat tracing cable. To eliminate known safety, reliability and environmental risks, the entire heat tracing system on the fuel oil pipeline requires replacement.

## 5.1 Budget Estimate

The budget estimate for this project is shown in Table 2.

**Table 2: Budget Estimate**

| **Project Cost:***($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 5.0 | 5.0 | 0.0 | 10.0 |
| **Labour** | 234.1 | 191.0 | 0.0 | 425.1 |
| **Consultant** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Contract Work** | 1,027.0 | 917.0 | 0.0 | 1,944.0 |
| **Other Direct Costs** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Interest and Escalation** | 86.9 | 213.1 | 0.0 | 300.0 |
| **Contingency** | 121.3 | 87.8 | 0.0 | 209.1 |
| **TOTAL** | **1,474.3** | **1,413.9** | **0.0** | **2,888.2** |

## 5.2 Project Schedule

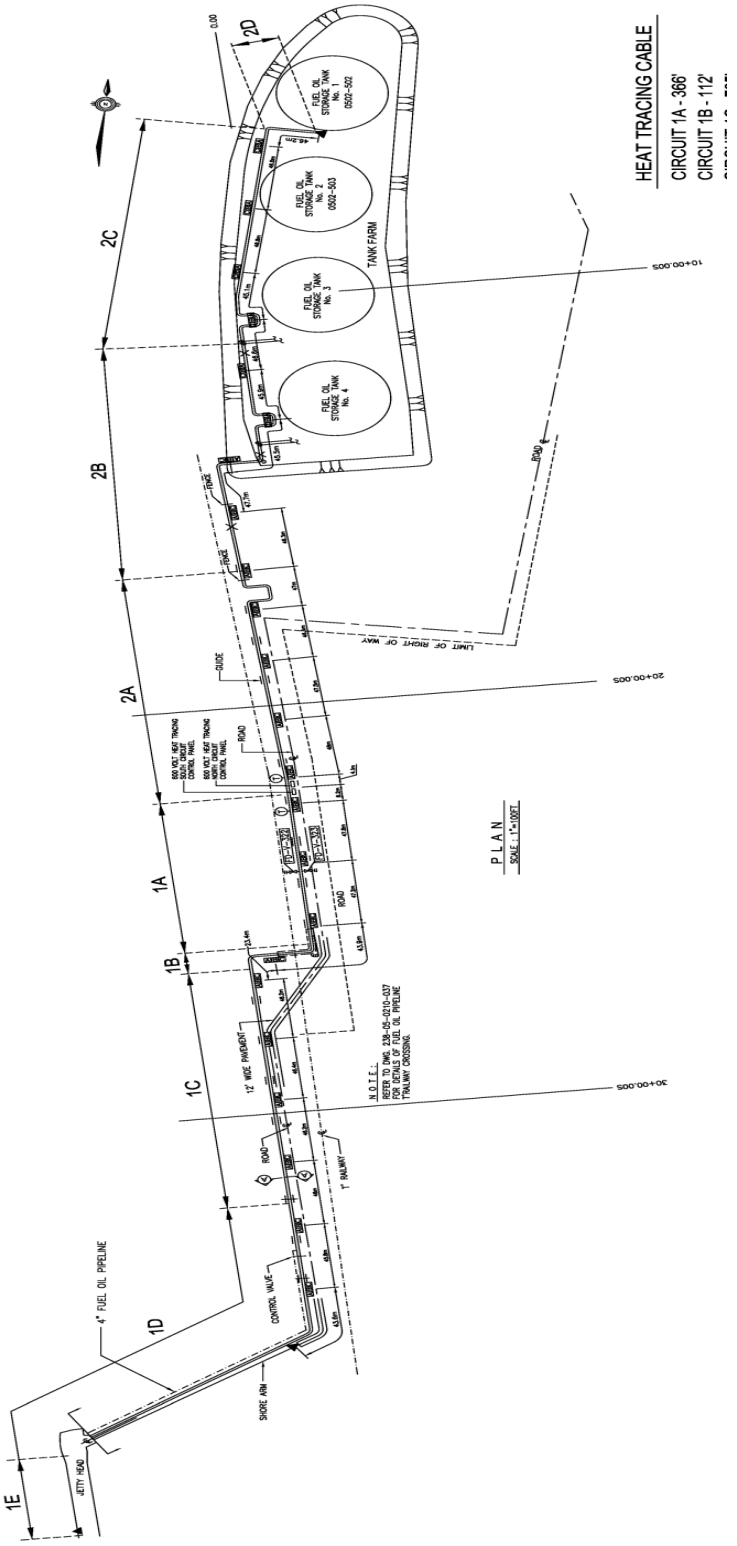
The work is scheduled over a two year period and will be completed during the period from May through August when no fuel oil is deliv**e**red to site. The anticipated project schedule is shown in Table 3.

**Table 3: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Planning | Initial Project Planning<br>Design Transmittal Development | Jan 2012 | Mar 2012 |
| Design | Equipment Tenders<br>Placement of Orders<br>Detailed Design Engineering | Mar 2012 | Apr 2012 |
| Procurement | Equipment Delivery | Apr 2012 | May 2012 |
| Construction | Equipment Installations – South Section<br>Equipment Installations – North Section<br>Equipment Retirement | May 2012<br>May 2013 | Aug 2012<br>Aug 2013 |
| Commissioning | Equipment in Service – South Section<br>Equipment in Service – North Section | Sep 2012<br>Sep 2013 | Sep 2012<br>Sep 2013 |
| Closeout | Project Completion and Closeout | Dec 2013 | Dec 2013 |

# APPENDIX A

## Fuel Oil Delivery Line Heat Trace


HEAT TRACING CABLE
CIRCUIT 1A - 366'
CIRCUIT 1B - 112'
PLAN
SCALE : 1"=100'
TANK FARM
FUEL OIL STORAGE TANK No. 1 0502-S02
FUEL OIL STORAGE TANK No. 2 0502-S03
FUEL OIL STORAGE TANK No. 3
FUEL OIL STORAGE TANK No. 4
ROAD
LIMIT OF RIGHT OF WAY
10+00.00S
20+00.00S
30+00.00S
660 VOLT HEAT TRACING CONTROL PANEL
600 VOLT HEAT TRACING CONTROL PANEL
12' WIDE PAVEMENT
1" RAILWAY
4" FUEL OIL PIPELINE
CONTROL VALVE
SHORE ARM
JETTY HEAD
2A
2B
2C
2D
1A
1B
1C
1D
1E

# Appendix B

## Tyco Thermal Controls – Holyrood Heat Tracing Background Information

tyco
Thermal Controls

March 31, 2011

Newfoundland Labrador Hydro
Holyrood, NL
A0A 2R0

Attention: Christian Thangasamy, M.Eng., P. Eng.

Reference: EHT system on the 18 inch Fuel Oil Line
Background Information

Christian,

The following represents a summary of the Tyco Thermal Controls (TTC) electric heat tracing (EHT) system installed on the 18 inch fuel oil line at the Holyrood Generating Facility.

The original installation was done in February 1970. The construction drawings show that the 4000 foot line was divided into two circuits at approximately the mid-point of the pipeline. The circuits were designated as North (ccts 1A to 1E) and South (ccts 2A-2D). The mineral insulated heating cable was Pyrotenax reference R12C: single conductor, 600 volt, bare copper, 14 watts/linear foot. The system operated as designed for approximately 30 years until 2000 when repair work began.

TTC provided a budget to replace the heat tracing in December 2000 offering 3 options: self-regulating heating cables, mineral insulated heating cables or STS (skin effect). It was suggested at this time to change the mineral insulated cables to stainless steel. Alloy 825 heating cables have a higher operating temperature range and offer better corrosion resistance than copper jacketed cables.

In May 2002 another proposal was submitted offering 2 options: replace all or a part of the MI heating cable with new MI cables or install a complete new system with self-regulating heaters. It is our understanding that, for budget considerations, only a few of the heating cables were replaced on the North circuit. TTC introduced new cable reference numbers

effective March 17, 1997 and the original R12C cable reference was changed to the new reference 61CC5162. This reference is a copper MI cable.

On May 23, 2002 Tyco sent a letter to Newfoundland Hydro summarizing the existing EHT system. Over the past number of years many significant changes had been made to the system.

- Existing circuits 1B, 1D and 1E were not operating.
- Circuit 1B was taken out of service and teck cable was installed as a jumper. This would reduce the overall resistance in the circuit and increase the power output and sheath temperature of the remaining cables.
- NL Hydro request made to provide a new design to install 6 each 150 foot MI cables series connected to the 3 each 366 foot cables of circuit 1A.
- At some time in 2003 Newfoundland Hydro would reconnect ½ of circuit 1D and all of circuit 1E.
- By connecting the MI cables as detailed above, the copper heating cables would be operating at 41 volts, producing 26.7 watts/ft and having a sheath temperature of approximately 407 deg. F. It was noted that TTC normally limits the sheath temperature of copper cables to 392 deg. F.

TTC was not made aware of whether or not circuit 1D and 1E were ever reconnected. Also, it is not clear if or when the teck cable was replaced by heating cable.

In September 2009 TTC reviewed this installation again. Insulation was removed to check the condition of the heater in different sections of the pipe. At this time it was discovered that HDPE jacketed copper MI (B61CH5162/…) had been installed in place of bare copper (B61CC5162/…) during the retrofits.There are two problems associated with using the jacketed cable for this installation. The first is that the 26.7 watts/ft output of the heater exceeds our maximum recommendation of 8-9 watts/ft for jacketed copper MI cables on metal pipes. The second is that the sheath temperature for these heaters would be in excess of 405 deg. F and this exceeds the recommended maximum continuous operating temperature for HDPE of 248 deg. F. During the visual inspection of the heater it was found that the jacket had melted off of the copper heating cable which would be expected based on the calculated sheath temperature. It appears that an incorrect purchase requisition may have been issued for jacketed copper heating cable. While the HDPE jacket would be damaged due to temperature, the copper MI cable would still operate. The copper cable, without the HDPE jacket, may have been subject to increased corrosion.

Later in September TTC sent their field service representative to site to inspect the system and fault locate many of the cables. Many of the circuits were found to be open or grounded. A report was submitted outlining the necessary steps to repair some of the

cables. The field service rep returned in October to carry out some of the repairs to the cables. The system today operates with only 2 of the phases working.

In general, TTC electric heat tracing systems have a 10-year warranty and an expected life in excess of 20 years. This assumes that the EHT system, which includes not only the heat tracing cables and controls but also the insulation, cladding and distribution wiring, is properly maintained.

The existing system appears to have worked for almost 30 years. When repairs were undertaken it seems that, to meet budget constraints, compromises were made to the system. As this is a resistance heating system, changes made to some sections of the circuit design (1A to 1E) caused other heating cables in the circuit to operate at wattages, currents or temperatures exceeding their recommended design limits.

Please call me if you have any questions concerning this information.

Regards,

Pete Inglis
Regional Manager
Tyco Thermal Controls
3 Kingslea Gardens
Toronto, ON
M8Y 2A7

Phone: 416-234-0886

# Appendix C

## Root Cause Failure Analysis of Electric Heat Tracing

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| Appendix 5 | Canadian Maritime Agency Statements of Facts |
| Appendix 6 | Tyco's Inspection Report |
| Appendix 7 | Copy of Cable Tag |
| Appendix 8 | Copy Tyco Specification Sheet for Copper MI Cables |
| Appendix 9 | Copy of Purchase Order Requisition for Copper Sheathed Cable |
| Appendix 10 | Copy of the Quote for 12w/ft copper sheathed cables from vendor with the words PVC jacket |
| Appendix 11 | Copy of P.O. #40043 OP dated 03/02/17 for R12C |
| Appendix 12 | Copy of the Vendor's fax dated May 23, 2002 informing delivery time and price for copper sheathed cables |

**HOLYROOD THERMAL GENERATING STATION**

**INCIDENT REPORT**

**Root Cause Failure Analysis of Electric Heat Tracing**

Marine Terminal to Tank Farm 18 inch Bunker C oil Piping

**Date of incident:** 19 February 2011

**Date of start of investigation:** 14 March 2011

**Date of final report:** 31 March 2011

**Incident Cost:** $ 100,000

**Incident Summary:**

The Holyrood Thermal Generating Station burns Bunker C oil as fuel in the burners. Bunker C oil is stored in four tanks on site for its daily use. These tanks are filled by Bunker C oil brought by ocean going tankers. These tankers berth at the plant's marine terminal which is at a distance of 4000 feet from tank # 1 which is the farthest tank. The oil from the tankers is pumped through 18 inch piping. Bunker C oil being very viscous needs to be maintained at approximately $30^0$ C by means of either electrical or steam tracing the piping for pumping. At Holyrood the 18 inch pipe is provided with electrical heat tracing.

Every year the plant receives between five and ten oil tankers. On 14th February a tanker arrived at St John's pilot station and it was ready to discharge oil on 19th February. The oil could not be pumped for three days due the failure of the electric heat tracing on the 18 inch 4000 feet long pipe. This resulted in a demurrage payment for three days.

**Initial Conditions:**

The electric heat tracing was on. It had not tripped.

**Initiating Event:**

When commencing to pump from the tanker the pressure was increasing indicating a block in the discharge piping. The flow meter in the ship did not show any indication of oil flow.

**Incident Description:**

On 19th February, mechanics went to the dock to discharge oil from the tank. The loading arms were connected at 1410 hrs. Mechanics commenced pumping at 1530 hrs. The pump discharge pressure remained at 400 kpa until 1800 hrs. The flow meter at the tanker did not show any flow

except for the 137 barrels which is the volume of the empty 18 inch piping from the dock to the block valve at dock gate. This portion of the piping is drained after discharging the oil from tankers by means of 4 inch drain piping. It was found that the electric heat tracing had malfunctioned.

The Shift Supervisor raised an emergency work order on 20th February for electricians to attend to the defective electric heat tracing.

The present electric heat tracing was commissioned in 2004. In 2000, Tyco, the manufacturer of the electric heat tracing submitted a proposal to Hydro for replacement the 30 year old electric heat tracing system. The original heat tracing cables were copper sheathed with part number R12C150. The letter 'C' is for copper sheathed, the number 150 is for the length of the heating cable in feet and the number 12 is the size of the cable in wire gauge.

Tyco's options in 2000 were:

| | | |
|---|---|---|
| 1. | Self Regulating Heating Cables | $1,122,498.00 |
| 2. | Mineral Insulated Inconel Sheathed Heating Cables | $879,341.00 |
| 3. | Skin Effect Heat Tracing System | $710,388.00 |

Tyco included the option of stainless steel sheathed cable heaters. However, in 2002, Hydro did not opt for any of the above when the project for replacement of the Heat Tracing started. Hydro did not have a budget to afford any of the above options. Hence Hydro planned to replace the defective copper sheathed heater cables, by the plant forces over a two/four year period to preserve budget. Tyco carried out the design calculations for copper sheathed heater cables. The sheath temperature was calculated to be $138^0$ C. The watts/ft was 12. Hydro contemplated replacing the copper sheathed mineral insulated heater cables with self regulating cables. Tyco informed Hydro that the cost of self regulated cables would be $84,000 and that of copper sheathed mineral filled heater cables as $18,000. Hydro opted for the copper sheathed mineral filled heater cables in view of the lower cost as well as costs associated with new 208 V step down transformers required for the self regulating heater cables.

The plant decided to have the copper sheathed heater cables to be jacketed with High Density Polyethylene to protect the copper sheath from corrosion. Plant electricians began installing High Density Polyethylene jacketed copper sheathed mineral cables during Oct 2002. The allowable maximum temperature for High Density Polyethylene is $110^0$C. The maximum allowable wattage for High Density Polyethylene jacketed heater cable is 8 watts per foot. Hydro did not change the heater cable length to suit the lowered wattage loading.

The electric heat tracing project was completed on 12th November 2004 at a cost of $231,698. The heat tracing began to fail from 2005. It was observed that the HDPE was cracking and melting. The heater cable was getting overheated and grounding out due to loss of insulation. In Nov 2009, the heat tracing system had to be modified to a two phase system from 3 phases due to excessive

grounding in one phase. There were 19 corrective maintenance work orders between Nov 2004 and 19th Feb 2011.

**Immediate Corrective Action:**

The electricians found that the electric heat tracing was 'ON' with a section halfway between the railway crossing and the dock gate, 'open' circuited. The terminations of the cold leads to the defective section had to be drilled as they had fused to their brass terminals at the terminal box. The defective section was by-passed by energizing an unused section of a phase which had been taken out of service in 2009.

**Causes & Corrective Actions:**

The decision by the Plant to go for High Density Polyethylene jacketed heater cables contributed to the failure of the heat tracing system. As per Tyco, the HDPE jacketed cables are designed and used as snow melting cables. These cables are used for corrosive embedded applications such as asphalt or snow melting where the HDPE can dissipate heat over a large area. When the HDPE jacketed heater cable is wrapped on a pipe, it has only a finite area of contact thus limiting the area for heat transfer. The wattage loading is 8 watts per foot for the high density polyethylene jacketed cables. The plant purchased HDPE jacketed heaters for a system which was designed for copper sheathed cables with a load of 12 watts per foot. The tags on the cables on the 18 inch fuel oil piping show 150 feet and 1800 watts. Thus High Density Polyethylene cable heaters which were designed for a maximum load of 8 watts/foot were subjected to a load of 12 watt/foot.

The HDPE jacketed cables have therefore been subjected to excessive overheating and broke down. The copper core burnt out due to higher than design wattage causing the break down of the copper sheath resulting in cable failure. The resistance measured on the system has repetitively been lower than the allowable value of 1.6 meg ohm.

The following accelerated the breakdown of the heat tracing system.

1. The moisture ingress through defective sealing in the cladding which provided a source for grounding.
2. Tech cables which were installed to by pass defective circuits decreased the resistance in the heater cables and thereby increased the power in the cables resulting in overheating.

Weekly measuring of the resistance in the circuits has been initiated as a condition monitoring strategy.

**Lessons Learned:**

1. When changing the material composition of a component, thorough research has to be done on the applicability of the new material.

2. When replacing a component in an existing system, the new component must be checked whether it conforms to the specifications of the existing system.

3. Prior to commissioning a project, the function of the system and components in the system should be thoroughly understood by calling for meetings and discussions with end users/vendors.

4. When budget is not available, more Preventive Maintenance needs to be carried out to keep the system in operation and efforts to expedite the budget approval process should be made rather than trying to fit the project to the available budget.

Appendix 1

newfoundland labrador hydro
a nalcor energy company

File 102.81.54/5

**TO:** **Terry LeDrew**
**Manager – Thermal Generation**

**FROM:** **Bill Kilfoy**
**Mechanical Maintenance Supervisor**

**DATE:** **February 24, 2011**

**SUBJECT:** **M T Aris**

---

The marine tanker **MT Aris** arrived at the St. John's pilot station at 1600hrs February 14, 2011. Pilot on board 1625hrs. 2015hrs notice of readiness tendered, vessel anchored awaiting daylight hours for berthing.

Feb 15, 2011
0700hrs pilot boarding cancelled, vessel remained at anchor due to high winds.

Feb 16-18, 2011
Vessel remained at anchor due to high winds.

Feb 19, 2011
0700hrs pilot onboard. 0850hrs first line ashore, all fast at 1200hrs and gangway secured at 1230hrs. Loading arms connected at 1410hrs. Sampling complete at 1448hrs. Commenced discharging cargo at 1530hrs. Discharging shut down at 1800hrs due to malfunction in heat tracing on fuel oil lines to shore tanks.

Feb 20, 2011
Maintenance Department found and made repairs to problem with heat tracing on fuel oil line. Cargo discharge delayed until fuel oil line temperature increases.

Feb 21, 2011
Cargo discharge delayed until Feb 22, 2011 am to let temperature of fuel oil line reach acceptable temperatures for discharging.

Feb 22, 2011
Commenced discharging cargo at 1010hrs.

newfoundland labrador hydro
a nalcor energy company

File 102.81.54/5

Feb 23, 2011
Cargo discharge completed at 1530hrs and tank inspection started. Tank inspection completed 1612hrs, calculations completed 1630hrs. All cargo documents completed 1740hrs. Cargo arms disconnected at 1810hrs. 1740hrs pilot advised vessel will not be sailing today due to high winds.

Feb 24, 2011
Pilot on board 1000hrs. Last line off 1100hrs. Vessel sailed 1102hrs.

Bill Kilfoy
Mechanical Maintenance Supervisor
/dbb
attach.
cc: Central File

Appendix
2

HYDRO

# NEWFOUNDLAND AND LABRADOR HYDRO

## ACCEPTANCE FORM FOR OFFLOADING FUEL OIL TANKERS

1. The shore facilities at this terminal are not equipped with check valves. If cargo pumps are shut down during discharge of cargo, the ship's manifold valves are to be closed.

2. Every effort must be made to ensure that both cargo arms contain hot cargo at the completion of cargo discharge.

3. Maximum discharge pressure not to exceed 125 psi. (860 Kpa ) at any time. Discharge pressure at the shore terminal to be maintained between 90 and 100 psi (630 and 700 Kpa) throughout the discharge… noting that while stripping tanks, these pressures may not be achieved.

4. Ship's representative is required to give 4 (four) hours notice of completion of discharge to the Marine Terminal Supervisor

**Name of Ship:** M.T. ARIS

**Chief Officer:** /A. GUSHOV/

**Hydro's Representative:** [signature]

**Date:** 19.02.2011

H:\Holyrood\Forms\acceptance for offloading fuel.doc

Appendix 3

NEWFOUNDLAND & LABRADOR HYDRO

DISCHARGE PUMPING PRESSURE

NAME OF TANKER MT ARIS

DATE 2011-02-19

| TIME | PRESSURE |
|---|---|
| 0001 | |
| 0100 | |
| 0200 | |
| 0300 | |
| 0400 | |
| 0500 | |
| 0600 | |
| 0700 | |
| 0800 | |
| 0900 | |
| 1000 | |
| 1100 | |
| 1200 | |
| 1300 | |
| 1400 | |
| 1500 | STARTED PUMPING 15:30 |
| 1600 | 400 Kpa |
| 1700 | 400 Kpa |
| 1800 | SHUT DOWN |
| 1900 | |
| 2000 | |
| 2100 | |
| 2200 | |
| 2300 | |
| 2400 | |

DATE

| TIME | PRESSURE |
|---|---|
| 0100 | |
| 0200 | |
| 0300 | |
| 0400 | |
| 0500 | |
| 0600 | |
| 0700 | |
| 0800 | |
| 0900 | |
| 1000 | |
| 1100 | |
| 1200 | |
| 1300 | |
| 1400 | |
| 1500 | |
| 1600 | |
| 1700 | |
| 1800 | |
| 1900 | |
| 2000 | |
| 2100 | |
| 2200 | |
| 2300 | |
| 2400 | |

NEWFOUNDLAND & LABRADOR HYDRO

DISCHARGE PUMPING PRESSURE

NAME OF TANKER MT ARIS
DATE 2011 10 2 / 22

| TIME | PRESSURE |
|---|---|
| 0001 | |
| 0100 | |
| 0200 | |
| 0300 | |
| 0400 | |
| 0500 | |
| 0600 | |
| 0700 | |
| 0800 | |
| 0900 | |
| 1000 | START PUMPING 10:10 |
| 1100 | 600 KPa |
| 1200 | 500 KPa |
| 1300 | 650 KPa |
| 1400 | 650 KPa |
| 1500 | 650 KPa |
| 1600 | 650 KPa |
| 1700 | 625 KPa |
| 1800 | 650 KPa |
| 1900 | 660 KPa |
| 2000 | 660 KPa |
| 2100 | 320 KPa |
| 2200 | 550 KPa |
| 2300 | 370 KPa |
| 2400 | 525 KPa |

DATE

| TIME | PRESSURE |
|---|---|
| 0100 | 700 KPa |
| 0200 | 350 KPa |
| 0300 | 670 KPa |
| 0400 | 550 KPa |
| 0500 | 550 KPa |
| 0600 | 670 KPa |
| 0700 | 410 KPa |
| 0800 | 350 KPa |
| 0900 | 540 KPa |
| 1000 | 550 KPa |
| 1100 | 200 KPa |
| 1200 | 370 KPa |
| 1300 | 370 KPa |
| 1400 | 370 KPa |
| 1500 | 370 KPa |
| 1600 | SHUT DOWN 15:30 HRS |
| 1700 | |
| 1800 | |
| 1900 | |
| 2000 | |
| 2100 | |
| 2200 | |
| 2300 | |
| 2400 | |

Appendix 4

HEIDMAR
A subsidiary of Morgan Stanley

**PUMPING LOG**

| | |
|---|---|
| VESSEL | ARIS |
| PORT | HOLYROOD |
| BERTH | NL HYDRO |
| DATE/TIME COMMENCED PUMPING | 19.02.2011 15:30 LT |
| DATE/TIME COMPLETED PUMPING | 23.02.2011 15:30 LT |
| DATE/TIME DISCONNECTED | |
| MAX DISCHARGE RATE PERMITTED BY SHORE | MAX PRESSURE 125 PSI |
| OTHER SHORE RESTRICTIONS | MAX PRESSURE 125 PSI |
| NUMBER OF HOSES/CHICKSANS | 2 |
| DIAMETER OF HOSES/CHICKSANS | 12" |
| DIAMETER OF SHORE LINE | 18" |
| APPROX DISTANCE TO SHORE TANKS | 836 METRES |

| DATE 19.02.2011 | PRESSURE @ SHIPS RAIL IN (PSI OR BARS) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | MANIFOLD NUMBER | | | | | | | |
| TIME | 3 | 4 | 5 | 6 | AIR TEMP | CARGO TEMP | REMARKS/ SHORE STOPPAGE | C/M INITIALS |
| 19/02/11 15:30 | | | | | 3 | 125.1 | Commenced pumping | AG |
| 16:00 | 6.2 | 6.2 | | | 3 | 125.0 | | AG |
| 17:00 | 7.1 | 7.1 | | | 3 | 125.0 | | AG |
| 18:00 | | | | | 3 | 125.0 | Stopped pumping | AG |
| 22/02/11 10:10 | 6.2 | 6.3 | | | 1 | 125.2 | Resumed discharging | AG |
| 11:00 | 6.2 | 6.3 | | | 1 | 125.1 | | AG |
| 12:00 | 7.0 | 7.1 | | | 1 | 125.1 | | AG |
| 13:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 14:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 15:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 16:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 17:00 | 7.0 | 7.0 | | | 1 | 125.0 | | AG |
| 18:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 19:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 20:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 21:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 22:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 23:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 0:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 1:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 2:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 3:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 4:00 | 7.0 | 7.1 | | | 1 | 125.0 | | AG |
| 5:00 | 7.0 | 7.0 | | | 1 | 124.9 | | AG |
| 6:00 | 7.0 | 7.1 | | | 1 | 124.9 | | AG |
| 7:00 | 7.0 | 7.1 | | | 1 | 124.8 | | AG |
| 8:00 | 7.0 | 7.0 | | | 1 | 124.8 | | AG |
| 9:00 | 7.0 | 7.0 | | | 1 | 124.8 | | AG |
| 10:00 | 7.0 | 7.0 | | | 1 | 124.8 | | AG |
| 11:00 | 7.0 | 7.0 | | | 1 | 124.8 | | AG |
| 12:00 | 6.7 | 6.5 | | | 1 | 124.7 | | AG |
| 13:00 | 6.5 | 6.5 | | | 1 | 124.6 | | AG |
| 14:00 | 6.5 | 6.5 | | | 1 | 124.6 | | AG |
| 15:00 | 5.0 | 5.0 | | | 1 | 124.4 | | AG |
| 15:30 | - | - | | | 1 | 124.4 | Completed Bulk discharging.Stripping | AG |
| | | | | | | | Completed discharging. | AG |

TERMINAL REP

SURVEYOR
For receipt only

CHIEF MATE

MASTER

Appendix 5

CANADIAN MARITIME AGENCY LIMITED
P. O. Box 119
Come By Chance
Newfoundland & Labrador A0B 1N0
(709) 463-8735 · Fax: (709) 463-8737 · www.canadianmaritime.com

**STATEMENT OF FACTS**

PORT: Holyrood, Newfoundland

VESSEL: M.T. Aris VOY NO: 160025

MASTER: Captains Alexander Shirokov & Yuriy Oskin Berth: Hydro Dock

CARGO: Fuel Oil

---

**February 14, 2011**

1600- End of sea passage.
1625- Pilot onboard. (Captain Lou Power)
2015- Notice of readiness tendered. Vessel anchored. Awaiting daylight hours for berthing.
2020- Pilot disembarked.

**February 15, 2011**

0700- Pilot boarding cancelled. Vessel remained at anchor due to high winds.

**February 16-18, 2011**

Vessel remained at anchor due to high winds.

**February 19, 2011**

0700- Pilot onboard. (Captain Lou Power)
0720- Anchor aweigh.
0745- Tug all fast for berthing.
0850- First line ashore.
1200- All fast.
1230- Gangway secured. Pilot disembarked. Agent and surveyor on board.
1315- Commenced cargo survey.
1330- Notice of readiness received.
1410- Cargo arm connected. (2X12)
1418- Completed cargo survey. Commenced calculations.
1448- Completed calculations. Awaiting shore readiness.
1500- Completed sampling.
1530- Commenced discharging.
1800- Shutdown discharging. Awaiting terminal readiness due to plugged shore line.

**February 20-21, 2011**

Awaiting terminal readiness due to plugged shore line.

Canadian Maritime Agency- Statement of facts

Page 2 of 2
(Aris / Voy 160025 / Holyrood)

**February 22, 2011**

1010- Resumed discharging fuel oil.

**February 23, 2011**

1530 - Completed discharging fuel oil.
1530 - Commenced ROB survey.
- Cargo arms disconnected.
1612 - Completed ROB survey. Commenced calculations.
1630 - Completed calculations.
1530 - Documents onboard. (SOF only)
1740 - Documents completed.
- Pilot onboard. (Captain )
- Last line.
- Vessel sailed.

**ARRIVAL / DEPARTURE CONDITIONS**

| | | |
|---|---|---|
| Draft In: | Fwd/ 10.55 M | Aft/ 10.55 M |
| Draft Out: | Fwd/ 6.10 M | Aft/ 7.6 M |

| | | |
|---|---|---|
| Bunkers on Arrival: | Fuel/ 730.41 MT | Diesel/ 68.78 MT |
| Bunkers Taken | Fuel/ NIL MT | Diesel/ Nil MT |
| Bunkers on Departure: | Fuel/ 687.75 MT | Diesel/ 55.92 MT |

Freshwater: Arrival/ 88 MT Loaded: Nil MT Departure/ 48 MT

No. of Tugs: Arrival/ 2 Departure/ 2

Destination: High seas for orders ETA: February , 2011 @ hrs LT

Shawn Vardy
per CANADIAN MARITIME AGENCY LTD
As Agents Only

TERMINAL
Sign as Arrival only

MASTER

MIT ARIS
NASSAU

Appendix 6

**Date:** October 8, 2009

**To:** Rory MacNeill

**From:** Gus MacDougall

**Re:** Report into the heat tracing installed on the bunker sea oil line at the Holyrood Thermal Generation Plant

Rory, here is a report into the fault locating on some of the cables on the bunker sea oil line. I have attached the original field report from the electrical department to help understand what future work is required.

**Project Overview:**

The MI pipe tracing installed on the line is prematurely failing and my visit was to try to establish where and later why this may be happening. The area of tracing in question is the upper section of the line, approximately 1500 feet. This section is sub divided into cable lengths of 150 feet with the cables in a 3 phase configuration along the pipe and wye connected at the end. The complete cable reference from the field tags supplied earlier is B/[illegible]5162/150/1800/24/7/6V/Y and from the drawing B/61CC5162/150/4007/41/7/6/Y

**Progress Overview:**

There was some initial difficulty getting started because the electrical department was very busy. Once we did get started we established where the first cable on the black phase was open circuited. The open circuit was measured to be at 95 feet from the first JB. A second reading was taken from the second JB back to the 1st and the open circuit was measured to be 71 feet. Considering the overall length of the heater and the cold leads, these measurements appear to be correct. Unfortunately we were unable to open and expose the cables because we had no insulators working with us. The other cables were tested up to and including JB # 4. The readings obtained show the cable is open circuited at or near the hot cold (h/c) splice on the cable. So going forward we can almost surmise that all the open circuits shown on the electrical department's reports will be in the h/c splice area. We were unable to get any further than the first four boxes. The good news is that I believe all the cables can be fault located and repaired without removing too much insulation.

However, it is almost impossible to say why this has happened without seeing the heat tracing but it may be a voltage surge. The cables may have been powered up before the circuit was completed.

The high density polyethylene (HDPE) jacket has melted off the cables because the wattage is too high for the HDPE jacket. The maximum wattage for a HDPE cable on a pipe is 8 watts a foot. This however will have no adverse effect on how the cable will heat the pipe.

**Objective:**

In order to get the bunker sea line back up to its operating temperature, the cables in question need to be fault located and repaired. In order to carry out these repairs, a team needs to be put together to make this a priority.

1/ Junction boxes opened and the cables fault located

2/ Insulators remove the insulation from the located area

3/ Cable repaired with silver brazed brass splices

4/ Cable tested, powered up and current tested.

5/ Insulation reapplied over the repaired area

**Extra notes:**

The Report on the Heat Tracing from the Electrical Department

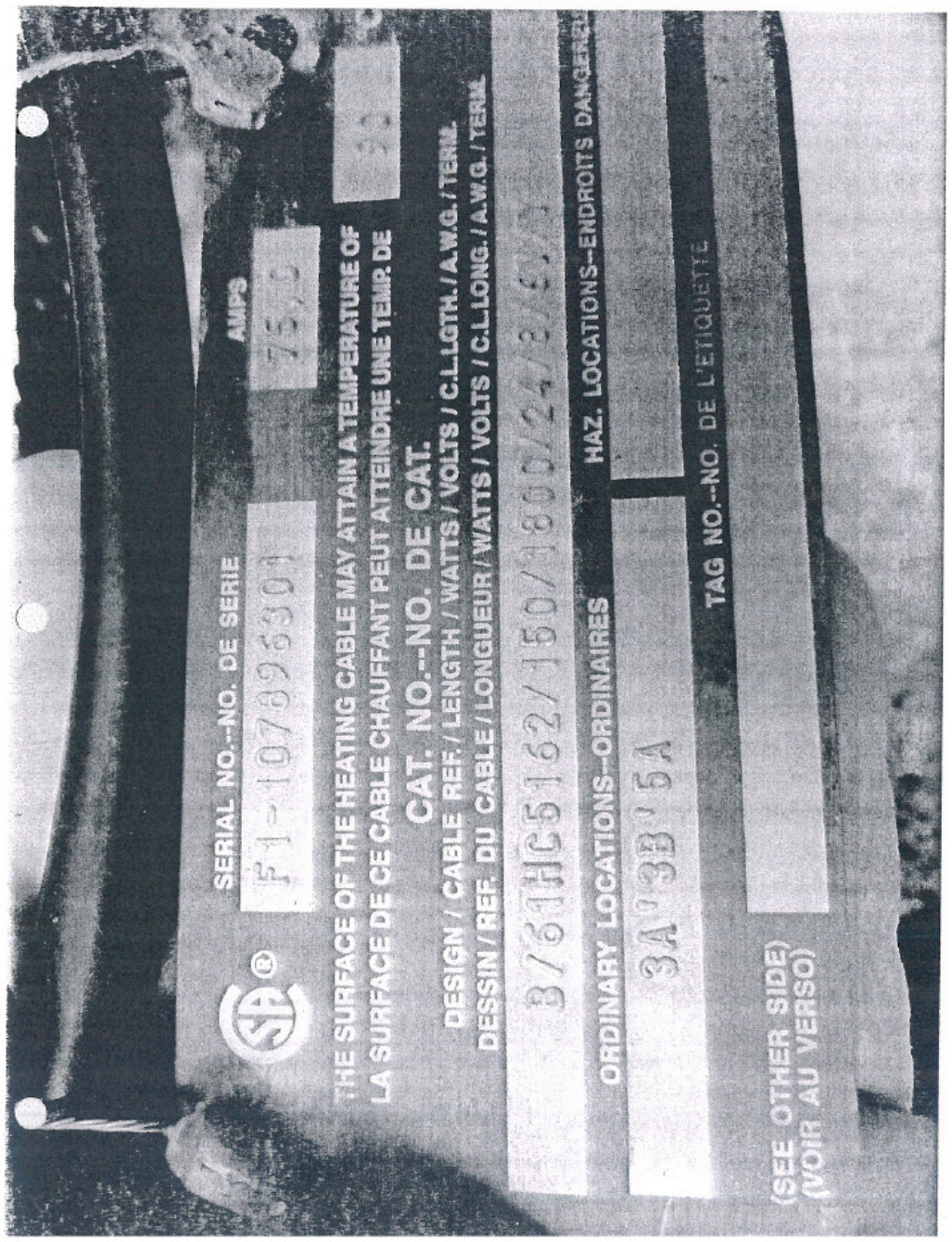
1/ Good, means exactly that this cable is working

2/ Grounded, means the cable is open circuited and grounded

3/ Open, means the cable has a high Meg ohm reading but is open circuited.

4/ At the time of the report, the Blue circuit was working ok from start to finish and was not included in the report. Since that time however there is now an open circuit on the Blue phase.

Appendix 7


SERIAL NO.--NO. DE SERIE
AMPS
THE SURFACE OF THE HEATING CABLE MAY ATTAIN A TEMPERATURE OF
LA SURFACE DE CE CABLE CHAUFFANT PEUT ATTEINDRE UNE TEMP. DE
CAT. NO.--NO. DE CAT.
DESIGN / CABLE REF. / LENGTH / WATTS / VOLTS / C.L.LGTH. / A.W.G. / TERM.
DESSIN / REF. DU CABLE / LONGUEUR / WATTS / VOLTS / C.L.LONG. / A.W.G. / TERM.
HAZ. LOCATIONS--ENDROITS DANGER
ORDINARY LOCATIONS--ORDINAIRES
TAG NO.--NO. DE L'ETIQUETTE
(SEE OTHER SIDE)
(VOIR AU VERSO)

Appendix 8

# MI Cable — Copper

D100
0AT0
011A

## Copper Sheathed Mineral Insulated Heating Cable

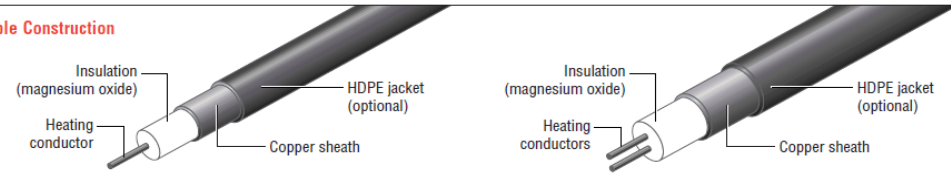
**Pyrotenax brand copper mineral insulated heating cables are designed for a wide range of commercial and industrial applications.**

The copper sheath allows for a rugged yet flexible heating cable, which is easy to install. The low resistance of the copper provides an ideal ground path.

For corrosive applications or for embedded installations, a version with a high-density polyethylene (HDPE) jacket is recommended. Refer to the chart below for a list of possible applications.

Pyrotenax brand MI heating cables by Tyco Thermal Controls meet the requirements of the U.S. National Electrical Code and the Canadian Electrical Code. For additional information, contact your Tyco Thermal Controls representative or call (800) 545-6258.

### Cable Construction




### Application and Power Output

| Bare copper sheathed cable: | FM | CSA | UL | Max. recomm. power output [1] W/ft (W/m) |
|---|---|---|---|---|
| Freeze protection of metal pipes | X | X | X | 18 (59) |
| Process temperature maintenance | X | X | X | 18 (59) |
| De-icing of metal gutters and downspouts | – | NH | – | 15 (49) |
| De-icing of plastic gutters and downspouts | – | NH | – | 5 (16) |
| Snow melting on metal roofs | – | NH | – | 15 (49) |
| Floor warming attached to concrete slab | – | NH[2] | – | 15 (49) |

| HDPE jacketed heating cable: | FM | CSA | UL | Max. recomm. power output [1] W/ft (W/m) |
|---|---|---|---|---|
| Snow melting in concrete and mastic asphalt slab | – | NH[2] | NH[2] | 30 (99) |
| Snow melting in road-grade asphalt slab | – | NH[2] | NH[2] | 25 (82) |
| Snow melting in limestone screenings under pavers | – | NH[2] | NH[2] | 20 (66) |
| Snow melting on non-metal roof | – | NH | – | 8 (26) |
| De-icing of metal gutters and downspouts | – | NH | – | 8 (26) |
| De-icing of plastic gutters and downspouts | – | NH | – | 5 (16) |
| Floor warming in concrete slab | – | NH[2] | – | 10 (33) |
| Frost heave prevention in sand under freezer or arena floor | – | NH[2] | NH[2] | 7 (23) |
| Freeze protection of metal pipes - internal | – | NH | – | 9 (29) |
| Freeze protection of metal pipes - external | – | NH | NH | 9 (29) |
| Freeze protection of plastic pipes - internal | – | NH | NH | 4 (13) |
| Freeze protection of plastic pipes - external | – | NH | – | 4 (13) |

**Legend**
X Approval specifics listed below are applicable
– Approval specifics listed below are NOT applicable
NH Approval specifics listed below apply for nonhazardous areas only

[1] Actual values are application specific and may be lower. In hazardous locations, the values may also be lower to ensure that the maximum sheath temperature does not exceed the autoignition temperature of the area. Use our design software or contact Tyco Thermal Controls for assistance.

[2] Hazardous area approvals not required if heating cable is fully embedded. Cold lead cable is approved for hazardous locations (CSA: CID1 and D2 Groups A, B, C, D; UL: CID1 and D2 Groups B, C, D)

### Temperature Rating

| | |
|---|---|
| Maximum exposure temperature | 392°F (200°C) Bare copper sheathed heating cable<br>194°F (90°C) HDPE jacketed heating cable* |

*HDPE sheathed cables may be exposed to higher temperatures during installation in asphalt.

### Temperature ID Number (T-rating)

To be established by calculating the maximum sheath temperature. Use our design software or contact Tyco Thermal Controls for assistance.

### Approvals

Also refer to application tables above.

FM approved for use in nonhazardous and Class I, Div. 1 and 2, Groups B, C, D hazardous locations

CSA approved for use in nonhazardous and Class I, Div. 1 and 2, Groups A, B, C, D hazardous locations

UL listed for use in nonhazardous locations and Class I, Div. 2, Groups A, B, C, D hazardous locations

Appendix 9

# REQUISITION/RELEASE

| | |
|---|---|
| PURCHASE ORDER # | |
| COMMODITY BUYER | TB |
| PLANT | |

☐ RELEASE ☒ PURCHASING ☐ INVENTORY

| SUGGESTED VENDORS | SHIP TO: | SPECIAL SHIPPING INSTRUCTIONS |
|---|---|---|
| Harris and Roome<br>24249 OQ | Newfoundland and Labrador Hydro<br>Holyrood Generating Station<br>Holyrood<br>Newfoundland<br>A0A 2R0<br>COPY | Attn. Jim Wiseman<br>KEYED<br>03.02.10 29826-OR<br>INITIALS |

| BLANKET NUMBER | | FINAL DESTINATION | Holyrood G.S. | DATE APPROVED | 2003 YY 2 MM 10 DD | DATE REQUIRED | 2003 YY 05 MM 30 DD |
|---|---|---|---|---|---|---|---|
| REQUESTOR NAME & EMPLOYEE # (PRINT) | Glenn Winsor 11140 | | | APPROVER NAME (PRINT) | John Mallam | | |

| ITEM | PART NO. | DESCRIPTION | UOM | QUANTITY | EST UNIT PRICE | EST. AMOUNT |
|---|---|---|---|---|---|---|
| 1 | 03900003 | Cable, Heating Pyrotx R12C150<br>Cat. No. B/61CC5162/150/4007/41/7/6/Y | ea | 33 | 625.00 | 20,625.00 |
| 2 | 742 | Straps, Raychem Cat. No. PB2400 | ea | 750 | 3.15 | 2,362.50 |
| 3 | 741 | Junction Box, Raychem Cat. No. D1297 | ea | 33 | 150.00 | 4,950.00 |
| | | RETURN FOR TECHNICAL EVALUATION<br>Purchasing Exception Report to Follow | | | | |
| | | ACCOUNTING CODE | | | ESTIMATED TOTAL | 27,937.50 |

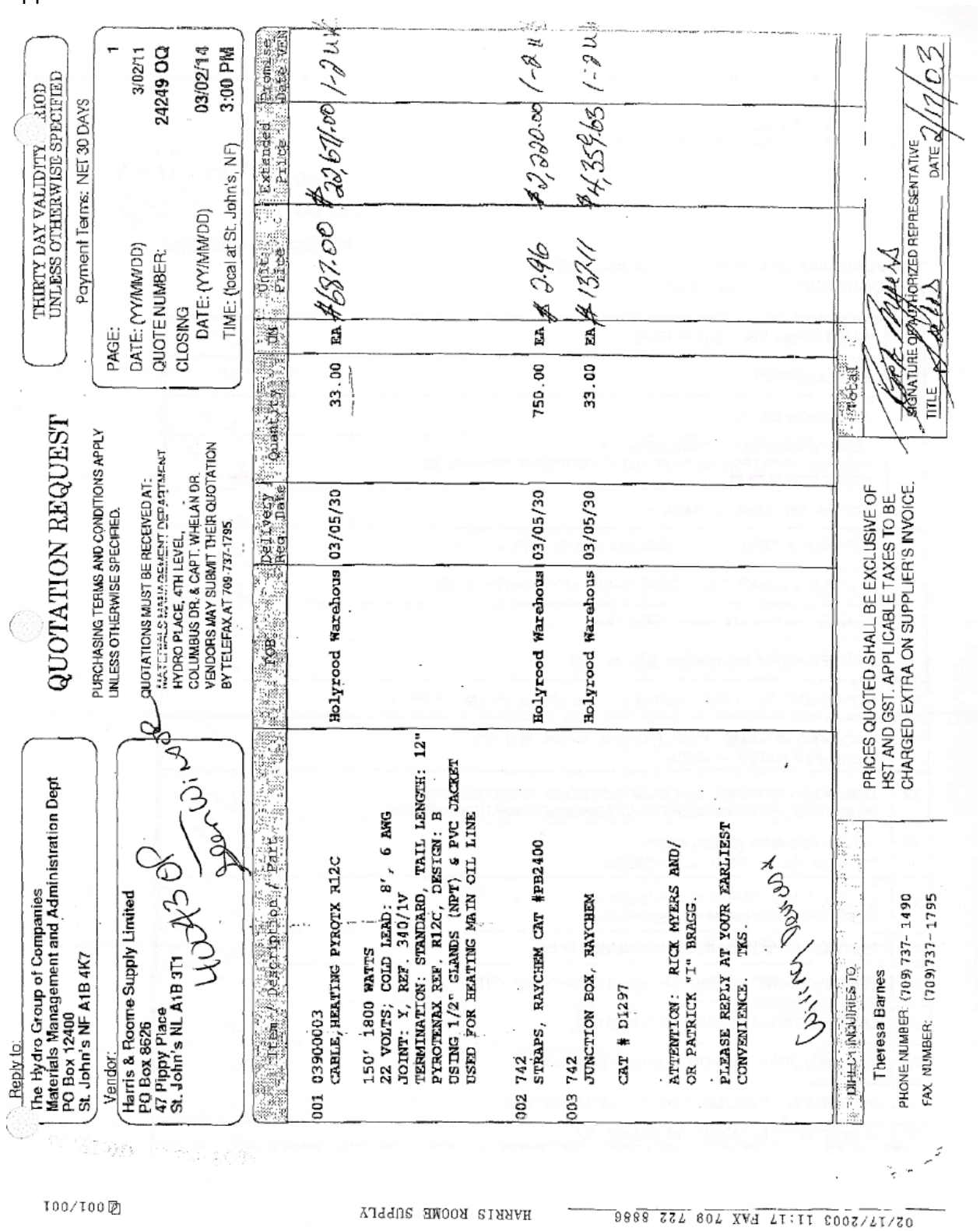
| ITEM | Company | Business Unit (Cap. Job No.) | Object (Type) | Subsidiary (Cap. Cost Code) | Subledger (Work Order) |
|---|---|---|---|---|---|
| 1 | 10 | 1267 | 6105 | 4 | 324204 |

APPROVED BY: [signature]

APPROVED BY:

FORM NO. 60-2320 R98/0

Appendix 10



Reply to:
The Hydro Group of Companies
Materials Management and Administration Dept
PO Box 12400
St. John's NF A1B 4K7

Vendor:
Harris & Roome Supply Limited
PO Box 8626
47 Pippy Place
St. John's NL A1B 3T1

QUOTATION REQUEST

PURCHASING TERMS AND CONDITIONS APPLY UNLESS OTHERWISE SPECIFIED.

QUOTATIONS MUST BE RECEIVED AT:
MATERIALS MANAGEMENT DEPARTMENT
HYDRO PLACE, 4TH LEVEL,
COLUMBUS DR. & CAPT. WHELAN DR.
VENDORS MAY SUBMIT THEIR QUOTATION
BY TELEFAX AT 709-737-1795.

THIRTY DAY VALIDITY PERIOD
UNLESS OTHERWISE SPECIFIED

Payment Terms: NET 30 DAYS

PAGE: 1
DATE: (YY/MM/DD) 3/02/11
QUOTE NUMBER: 24249 OQ
CLOSING
DATE: (YY/MM/DD) 03/02/14
TIME: (local at St. John's, NF) 3:00 PM

| Item / Description / Part | FOB | Delivery Req. Date | Quantity | UM | Unit Price | Extended Price | Promised Date/Min |
|---|---|---|---|---|---|---|---|
| 001 03900003<br>CABLE, HEATING PYROTX R12C<br>150' 1800 WATTS<br>22 VOLTS; COLD LEAD: 8', 6 AWG<br>JOINT: Y, REF. 340/1V<br>TERMINATION: STANDARD, TAIL LENGTH: 12"<br>PYROTENAX REF. R12C, DESIGN: B<br>USING 1/2" GLANDS (NPT) & PVC JACKET<br>USED FOR HEATING MAIN OIL LINE | Holyrood Warehous | 03/05/30 | 33.00 | EA | $687.00 | $22,671.00 | 1-2 wk |
| 002 742<br>STRAPS, RAYCHEM CAT #PB2400 | Holyrood Warehous | 03/05/30 | 750.00 | EA | $ 2.96 | $2,220.00 | 1-2 wk |
| 003 742<br>JUNCTION BOX, RAYCHEM<br>CAT # D1297 | Holyrood Warehous | 03/05/30 | 33.00 | EA | $ 132.11 | $4,359.63 | 1-2 wk |

ATTENTION: RICK MYERS AND/
OR PATRICK "T" BRAGG.

PLEASE REPLY AT YOUR EARLIEST
CONVENIENCE. TKS.

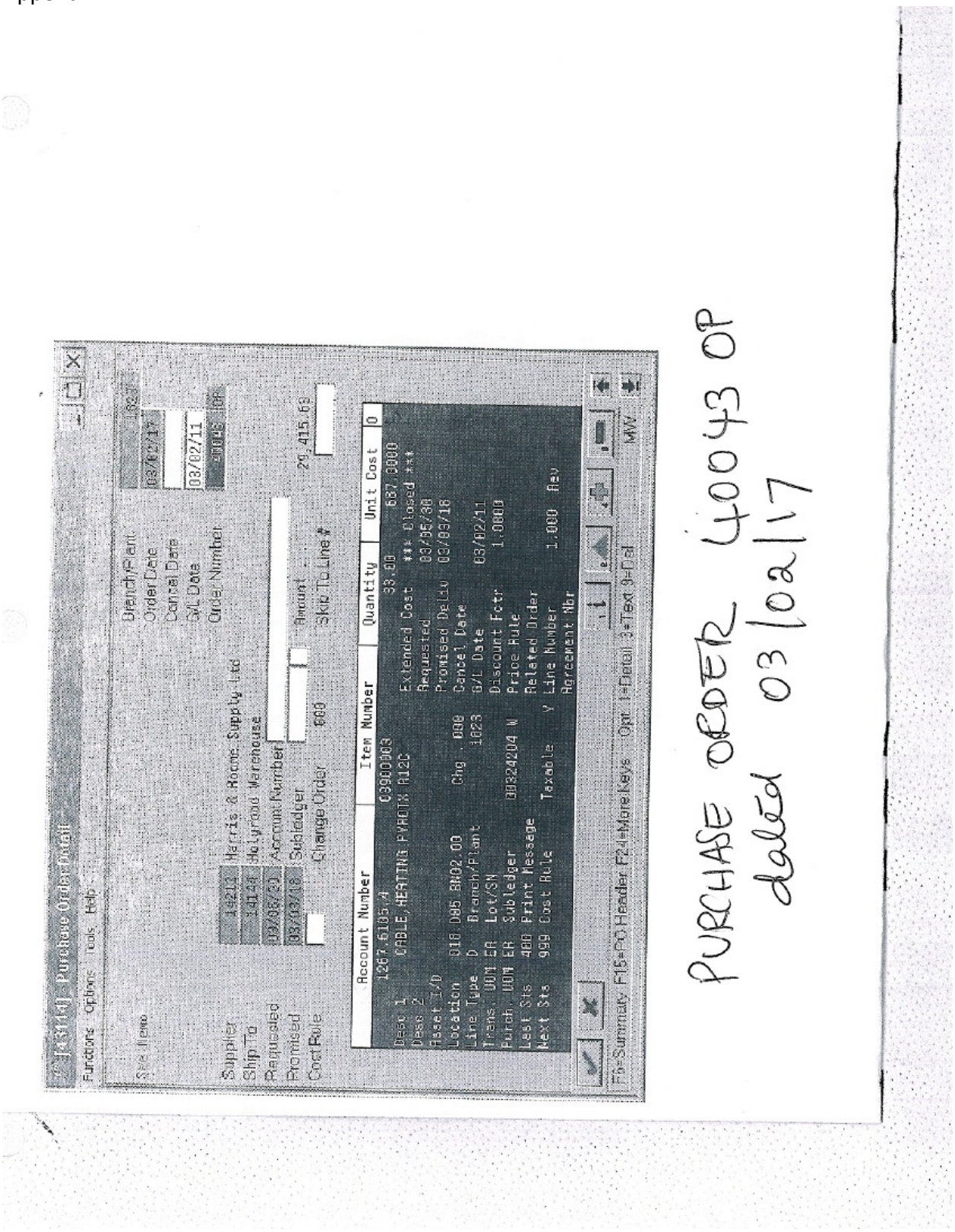
DIRECT INQUIRIES TO:
Theresa Barnes
PHONE NUMBER: (709) 737- 1490
FAX NUMBER: (709)737- 1795

PRICES QUOTED SHALL BE EXCLUSIVE OF HST AND GST. APPLICABLE TAXES TO BE CHARGED EXTRA ON SUPPLIER'S INVOICE.

SIGNATURE OF AUTHORIZED REPRESENTATIVE
TITLE
DATE 2/17/03

02/17/2003 11:17 FAX 709 722 8886 HARRIS ROOME SUPPLY 001/001

Appendix 11



Appendix 12

**HARRIS & ROOME** SUPPLY LIMITED

47 Pippy Place, St. John's, Nfld. A1B 3T1
Tel: (709) 722-6161 Fax: (709) 722-8886

FACSIMILE TRANSMITTAL SHEET

TO: Glen Winsor
COMPANY: Nfld Hydro.
FAX NUMBER:
PHONE NUMBER:
RE: Raychem.

FROM: Pat BRAGG
DATE: May 23/02
TOTAL NO. OF PAGES INCLUDING COVER: 1
SENDER'S REFERENCE NUMBER:
YOUR REFERENCE NUMBER:

☐ URGENT ☒ FOR REVIEW ☒ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

Glen.

Price and delivery as requested thru Keith Russell C.S.P Entp.

Qty 6. B/61CC5162/150/4007/41/7/6/Y CABLE.

C 615.50 each

Delivery approx 2 weeks A.R.O.

Regards
Pat Bragg

# Appendix D

## Fossil Operations & Maintenance Information Service – Above Ground Fuel Line Heat Tracing Cable

FOMIS Reports

Fossil Operations & Maintenance Information Service Copyright 2011 , Scientech - All Rights Reserved

| | | | |
|---|---|---|---|
| **DATE** | **3/10/2011 1:41 PM** | **REPORT** | **25942** |
| **FOMIS Contact** | **Roger Steinberg** | **REQUEST** | F11-03-008 |
| **PLANT/COMPANY** | Holyrood Thermal Generating Station/**Newfoundland and Labrador Hydro** | | |
| **REQUESTER/PHONE** | Christian Thangasamy **/ 709.229.2156** | | |
| **EMAIL** | **cthangas@nlh.nf.ca** | | |
| **SUBJECT** | **Fuel Hdl/Storage** | | |
| **ITEM** | **Heat Tracing** | | |
| **DESCRIPTION** | **Above Ground Fuel Line Electric Heat Tracing Cable** | | |

**F11-03-008**

**Our station is located where extended periods of sub-freezing temperatures are common in the winter. We burn # 6 fuel oil that is transferred from the marine terminal to the tank farm in pipe lines located above ground. The lines have electric heat tracing (EHT) and are wrapped with insulation. We have recently experienced an increased number of failures of the 3 phase 600 volt, mineral insulated, copper conductor EHT cable. For stations located in areas subject to freezing temperatures burning fuel oil, and having above ground, electrically heat traced fuel lines:**

**A. What type of EHT cable is used?**

**1. Mineral Insulated?**

**2. Self-regulating?**

**3. Other? please describe**

**B. What voltage is used for EHT?**

**C. What is the EHT cable conductor material?**

**D. What has been you experience with the EHT cable?**

**E. Are you aware of any codes that apply to EHT cable installations? If yes, what codes apply?**

**REPORTS - FOMIS Report numbers:** 24183 **- Fuel Oil Line Insulation Requirements address(es) this issue. For further assistance please contact FOMIS at 727.669.3000.**

RESPONSES:

Coleson Cove Generating Station/NB Power

A.

1. Yes: We use MI cable in various sizes and lengths. Also we use both copper and stainless steel. The sizes and lengths are determined by the pipe size/length and temperature requirements. The longest circuit here is 1800', there is a junction box at the 900' midpoint.

2. No

3. No

B. The voltage of the heat tracing runs from 3ph 600v down to 1ph 120v. Control is by contactors in conjuction with a monitoring/control system. It is programmable for temp/current for limits, alarms etc and is networked back to a central monitoring/control station.

C. The conductor(heater) is usually an alloy, but can also be copper or stainless steel.

D. The original tracing was supplied by Pyrotenax, I think they were bought out by Raychem.

The heat tracers have been in service for over 35 years. They have been a relatively heavy maintenance load for more than 20yrs. The majority of circuits are 3ph 600v copper. The copper outer sheath seems to react to the original pipe insulating material especially if there is a little dampness; it (pipe insulation) seems to be acidic and eats some of the outer sheath. Eventually, moisture seeps in and the conductor tracks to ground and the circuit fails.

We use a Riser Bond Model 3200 Coaxial Metallic Time Domain Reflectometer to find our faults. With practice this meter is easy to use and quite accurate.

E. No

Contact: Norman Garnier, Electrical Engineer, (506)674-7882 , ngarnier@nbpower.com.

**1060 Keene Road**
**Dunedin, FL 34698-6300 USA**
**Phone: 727.669.3100**
**800.637.2743**
**E-mail:** fomis@scientech.com

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# Appendix E

## Fuel Lines Engineering, Procurement and Construction (EPC) Services

*Pete Inglis*
*Regional Sales Manager*

*Tracer Industries Canada Ltd.*
*101 Webster Road*
*Kitchener, ON*
*N2C 2E7*

*Tele: (416)518-5934*
*Fax: (519) 894-1101*
*pinglis@tycothermal.com*
*www.tycothermal.com*

March 30th, 2011

**Q002479-R0**

Newfoundland and Labrador Hydro
Holyrood, NL A0A 2R0

**Attention:** Jeff Vincent

**Subject:** **Fuel Lines**
**Engineering, Procurement and Construction (EPC) Services**

Mr. Vincent:

Tracer Industries Canada Limited is pleased to submit budgetary pricing to provide engineering, procurement and construction services to replace the existing electric heat tracing system on the 4" and 18" fuel lines located in the Holyrood facility.

*Tyco International Ltd*. is a diversified global manufacturer and supplier of industrial products and systems with leadership positions in each of its five business segments: *ADT Worldwide, Fire Protection Services, Flow Control, Safety Products, and Electrical & Metal Products*. Residing within Tyco International's Flow Control Segment is *Tyco Thermal Controls (TTC)*. This group is specifically focused on Heat Management System solutions for the industrial marketplace, and is comprised of several well-known brands. These include *Raychem*, *Tracer*, *Pyrotenax, T2*, *Isopad, DigiTrace,* and *TraceTek*.

The Tracer Companies were founded in 1983, and continue to operate for the sole purpose of designing, supplying, and building high quality supplemental heating systems. Tracer is the leading turnkey heat tracing organization in North America. Tracer's people and work processes focus on the value-added capabilities of the highest quality heat tracing component manufacturers and service organizations that exist in the industry today to provide safe, reliable, and cost effective heat tracing installations. We offer complete project management and construction services and we are eager to accept complete "turn-key" project responsibility. Our personnel can manage the design, material logistics and installation of any heat-tracing and insulation project.

This cost forecast is only a budget and is not offered for sale. Further project details, specifications and contractual terms would be required before TICL can offer a proposal.

We appreciate the opportunity to provide these services and look forward to working with you. Should you have any questions, please contact me at (416) 518-5934.

Sincerely,
**Tracer Industries Canada Limited**

Pete Inglis
Area Sales Manager

PI/cc

**Tyco's Commitment to Fair Dealing:** Tracer Industries Canada Limited is proud to be a Tyco International Ltd. company.

Tyco is committed to obeying the law in all countries where the Company does business. **Tyco rejects and prohibits Bribery**. Bribery may expose Tyco and others involved with making, promising, soliciting or receiving improper payments to criminal prosecution and civil penalties. Bribery may also produce an enormously negative impact on the reputation of Tyco and its employees and may seriously disrupt Tyco business operations. Tyco is committed to prohibiting bribery anywhere in the world, in connection with any kind of business, directly by Tyco personnel or through intermediaries or third parties, to government or private individuals. Tyco maintains an active program to monitor the activities of third parties with whom it conducts business and will not interact with third parties who engage in improper activities or make improper payments.

## Basis for Proposal

This proposal is based on a meeting held on March 22nd, 2011 as well as the following supplied documents:

- HOLYROOD GENERATING STATION 18" DIA. FUEL OIL DELIVERY LINE HEAT TRACE, A0-238-05-0210-035 R2
- PLAN AND PROFILE OF 18" DIA. FUEL OIL DELIVERY LINE & TRACE HEATING, 238-05-0210-006-R2 (Dated February 19th, 1970)
- Site Pictures from Justin Baikie (email March 24th, 2011)

## Design Information

### Design Criteria

This proposal is based on the following design parameters:

| | |
|---|---|
| Maintain | 30°C |
| Min Ambient / Start-up | -17°C |
| Max Exposure | 40°C |
| Safety Factor | 25% (Minimum) |
| Area Classification | Non-Hazardous (Client to confirm) |
| Insulation | 2" Mineral Wool |
| Insulation Cladding | 0.016 Stucco Embossed Aluminum |
| **MI Option** | |
| Voltage | 600V, 3 phase |
| **STS Option** | |
| Voltage | 4160V, 3 phase<br>600V, 3 phase |

### Design Review

Our preliminary review suggests the following design information, to be confirmed during detailed design:

**MI Option**

- Total # circuits: 5
- Technology: Alloy 825 Mineral Insulated Cable
- Estimated total load: ~180 kW

**STS Option**

- Total # circuits: 2
- Technology: Skin Effect Tracing & Alloy 825 Mineral Insulated Cable
- Estimated total load: ~130 kW

## Scope of Work

The following budgetary proposal includes services to design, supply, and install an electric heat tracing (EHT) and insulation system for the 4" and 18" fuel oil lines located at the Holyrood generating facility. Removal of the existing insulation and EHT is included in the budget. Scaffolding has been included for the shore arm and three expansion joints on the 18" line.

The information below summarizes the general scope of work associated with the project and details / assumptions for the proposed system.

## Engineering

The following engineering deliverables have been included in the budget:

| Engineering | | |
|---|---|---|
| **Deliverable** | | **Units** |
| **Electric Heat Tracing Isometric / Zone Drawing** | | |
| ⊙ | Heat Trace Isometric- Piping and Equipment | per/dwg |
| ⊙ | Revision Type 1 (Minor Changes) | per/dwg |
| ⊙ | As Builts | per/dwg |
| **Cable and Panel Schedules** | | |
| ⊙ | Panel Board Schedule | per/circuit |
| ⊙ | Control Panel Setpoint Schedule | per/circuit |
| **Electric Heat Tracing Layouts & Supporting Documents** | | |
| ⊙ | Power and Control Point Layout Drawing | per/circuit |
| **Control Panel (CP) Drawings** | | |
| ⊙ | CP Drawing Dimensions / Generic Wiring Drawing | per/panel |
| **Miscellaneous Documents** | | |
| ⊙ | Bill of Materials | per/doc |
| **Manuals & Information** | | |
| ⊙ | Operation & Maintenance Manuals (Original Set) | per/doc |
| ⊙ | Operation & Maintenance Manuals (Copies up to 10) | per/print |
| ⊙ | All Documentation on CD | per/cd |
| ⊙ | Standard MI Installation Details | per/set |
| **Reimbursable Support Positions** | | |
| ⊙ | Project Manager | hours |

Our proposal assumes all engineering and drafting may be performed from client-supplied documents and will be performed one time and submitted for client acceptance. Any revisions as a result of subsequent design changes by the customer will be subject to our Time and Material Rate Schedules. Also, any required field sketches as a result of design changes or field routing other than that supplied with the client documents, will be provided at the same Time and Material Rate Schedule.

## Materials (Procurement)

The proposed heat trace system is comprised of the following major components:

## MI Option

***MI***

The Mineral Insulated cable that will be supplied on this project will be provided with an Alloy 825 sheath, which is capable of withstanding high intermittent temperature exposures (up to 1,238 °F). The Alloy 825 cables are recognized for their high temperature service, resistance to pitting, and protection against acid, salt and alkali corrosion. The sheath also acts as a ground path for personnel protection, as well as a method to detect ground fault locations.

**DigiTrace 920**



The proposed control & monitoring solution we have included within this proposal consists of our DigiTrace 920 (dual point) controllers. The DigiTrace 920 controllers are compact, full featured, microprocessor based controllers. The 920 offer a variety of monitoring parameters such as ground fault, temperature, current, voltage and resistance. Both controllers will be provided with solid-state relay (SSR) outputs. Both controllers measures temperatures with 3-wire platinum RTD's connected directly to the unit. Up to two RTD's can be supported for each control point.

## STS Option

**Heat Tracing Technology - STS –Skin Effect Tracing System**

The STS heating solution included within this budget includes the use of our STS – Skin Effect Tracing System. The Tracer STS System is a versatile engineered heat management system configured to deliver heat for medium to long pipelines. STS tracing has been utilized in the industrial environment for over 25 years. Tracer has developed its STS system based on the industry standards and 25 years worth of acquired skin effect engineering and construction experience. With over 1,000 km of total STS systems throughout the world, we take pride in being named as the industry leader in STS systems.

The STS tracing system consists of a heat release element (Schedule 40 carbon steel pipe) which is strapped or welded to the carrier pipe (See Figure 1). An insulated copper wire that serves as a connecting conductor is run through the heat tube.

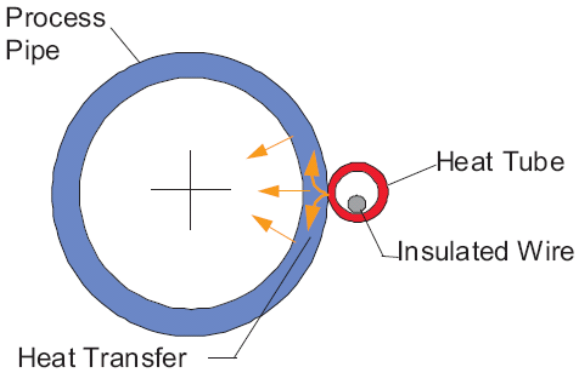



**Figure 1: Sample Cross Section for STS System**

The conductor is then terminated at the far end of the carrier pipe. The system current passes through the conductor, and then returns through the heat tube. Since the insulated copper wire is inside of a hollow steel conductor, the inductive interaction between the "go" and "return" currents causes the current in the carbon steel pipe to concentrate at its inner surface. The resistance to the current flow in the heat tube produces heat, which is then conducted into the carrier pipe (See Figure 2).

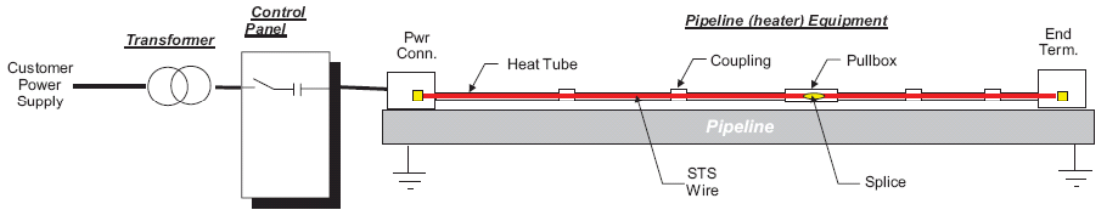



**Figure 2: Major STS System Components**

The STS systems are inherently safe with no electrical potential on the outside of the carrier pipe or heat tube, and useful heat is transferred to the carrier pipe at very low temperature differentials.

Since the heat tube is uniformly applied to the carrier pipe, temperature variations along the line are minimal. The heating element is a piece of pipe; therefore it is difficult to damage in the field. Should the conductor wire become damaged, pull boxes built-in to the system allow for easy removal and replacement of the wire. Additionally the STS system is Factory Mutual (FM) approved for use in hazardous locations.

**Control & Monitoring – STS System**
The power control system is a closed loop temperature control where the carrier pipe temperature is continuously monitored and compared to the reference set point maintenance temperature. As the pipe cools below its set point, the electrical tracing system is energized and the heat energy is replaced. On/Off power control is provided via a contactor within the panel enclosure. The entire power system is fed through a main circuit breaker. The primary power feed is assumed to be by others.

### Construction

The scope that is included in the budget is outlined below:

- Removal of existing insulation, cladding and mineral insulated heating cables is included
- Scaffolding for the shore arm and 3 expansion joint areas
- Installation of the new EHT system
- Installation of the new insulation and cladding
- Construction Management / Quality Assurance / Control
- Commissioning of the system
- Further project details to be clarified upon request for quotation

Construction Schedule MI Option – approximately 14 weeks

Construction Schedule STS Option – approximately 19 weeks

### Scope of Work by Others

The scope that is to be performed by others is outlined below:

- STS Option – 4160V feed to STS Scott-T transformer by others
- STS Option – 4160V primary protection by others
- Budget assumes all site facilities are provided by others
- Further project details to be clarified upon request for quotation

## Pricing Summary

We are pleased to submit the following Budgetary pricing to perform Engineering, Procurement and Construction (EPC) services as outlined above.

**MI Electric Heat Tracing Option = $ 1,600,000.00**

**STS Electric Heat Tracing Option = $ 1,700,000.00**

**Option for 0.016 Stainless Steel Cladding on Shore Arm and Jetty Head Piping = $40,000.00**

## Clarifications / Exceptions

To assist in the evaluation of this proposal we offer the following comments and clarifications to various inquiry documents:

- This cost forecast is only a budget and is not offered for sale. Further project details, specifications and contractual terms would be required before TICL can offer a proposal.
- No Terms & Conditions were provided. All Terms & Conditions to be negotiated.
- All prices are in Canadian dollars unless otherwise noted.
- Applicable taxes not included.

## Attachments

- Attachment A – MI Product Data Sheets
- Attachment B – STS Brochure
- Attachment C – Industrial Heat Tracing Products and Services Brochure

# APPENDIX F

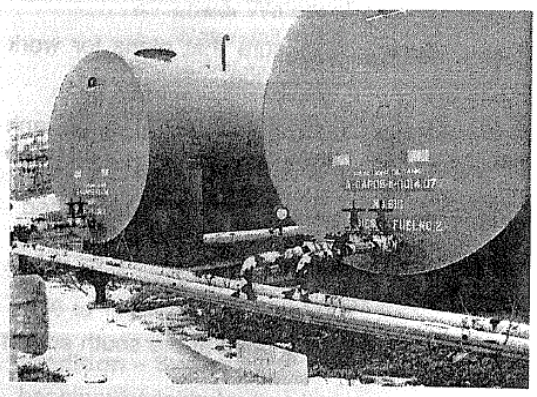
## AMEC – Condition Assessment & Life Extension Study

| | |
|---|---|
| Refurbishment – Heavy Oil | Tanks 2008 to 2012; Civil/Supports: last 5 Yrs |
| Refurbishment – Light Oil System | Tanks in last 5 years |
| Base Load Requirement End Date | Dec 2015 |
| Boiler Use End Date (Light/Heavy) | Dec 2020 |
| Requirement – GTG Use End Date | Dec 2023 |

**Condition – Summary**

The heavy oil main storage tanks are in the midst of a major refurbishment (floor and wall and roof repairs, drainage, painting) – between 2008 and 2012. Their auxiliary systems such as dikes and steam heat tracing and supports were also upgraded. Normally, they would be expected to last at least until the generation end date of 2020 with normal maintenance and inspections. They will require an external inspection before the generation end date, but will not require another internal inspection.

The heavy oil electrical trace heating system on the pipeline from the dock to the receiving point at the south end of the tank farm was replaced but has recently experienced failures. The plant has managed to get two phases back in working order, but the failure of these phases is very likely. This issue needs to be resolved and the system replaced.



The heavy oil steam trace heating system on the pipeline in and from the tank farm to the powerhouse and day tank have been refurbished (along with civil supports) in last few years. It is operating well and expected to last to the 2020 generation end date.

The heavy oil day storage tanks have been refurbished and repainted within the last ten years, as has their auxiliary systems (dikes, steam heat tracing). They are expected to last at least until the generation end date of 2020 with normal maintenance and inspections. They require an external inspection, and may require an internal inspection before the 2020 end date (needs confirmation).

The in-plant heavy oil heating and pumping systems receive regular maintenance and inspections. No specific information was available on their condition, but with an ongoing program of maintenance, refurbishment and replacement on an as-needed basis the system should continue to serve its purpose reliably for the period to 2020.

The light oil storage tanks are relatively new and used to supply the emergency boiler start-up fuel, the diesels, as well as fuel to the gas turbine. They are expected to last at least until the generation end date of 2020 and GTG 2023 end date with normal maintenance and inspections. They will require a major internal inspection about 2020 towards meeting the 2040 synchronous condensing end date. The light oil receiving, pumping, and piping system located at the gas turbine building are operational, but have experienced significant external corrosion due to the marine environment, as has the lines to the light oil storage tanks and to the powerhouse ignition oil system. They are considered in need of upgrade and/or refurbishment, as opposed to inspection. It is suggested that the receiving system and the lines to the storage tanks and t the gas turbine be replaced within the next five years.

**A REPORT TO**

**THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES**

| | |
|---|---|
|   | Electrical |
| | Mechanical |
| | Civil |
| | Protection & Control |
| | Transmission & Distribution |
| | Telecontrol |
| | System Planning |

# INSTALL OPERATOR TRAINING SIMULATOR

## Holyrood Thermal Generating Station

July 2011

newfoundland labrador hydro
a nalcor energy company

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# 1 INTRODUCTION

Newfoundland and Labrador Hydro (Hydro) owns and operates the Holyrood Thermal Generating Station (Holyrood) which has a generating capacity of 490 MW. Holyrood is an essential part of the Island Interconnected System. The station has the gross capability of generating over 3,000,000 MWh of energy annually which is approximately 40 percent of the Island Interconnected System's energy requirement.

Holyrood is composed of three thermal generating units along with sub-systems that are vital to its daily operation. The generating station consists of a central plant, which is an 11 story structure containing all thermal generating equipment used for the production of electricity and several support buildings in an area stretching over one square kilometer. The generating station was constructed in two stages. The first stage, which was commissioned in 1971, consists of two Combustion Engineering oil fired steam generators and two Canadian General Electric turbine generator sets. The second stage was commissioned in 1979 and consists of a Babcock and Wilcox oil fired steam generator and a Hitachi turbine generator set. All three generating units were originally rated at 150 MW, but in 1988 and 1989 the two Combustion Engineering/Canadian General Electric units were upgraded to a capacity of 175 MW each.

The generating units burn approximately 18,000 barrels of No. 6 heavy fuel oil per day at full load. This fuel is burned in a boiler to convert water to steam. The high-pressure, high-temperature steam is then directed into a multi-stage turbine that is connected to an electric generator that produces electricity.

The operation of a thermal generating station requires complex processes that must be monitored and regulated by plant operators. An Operating Training Simulator (OTS) is a platform that will provide the plant operators with a means by which these processes and various operating conditions can be simulated at any time and in a manner which is safe for personnel, the plant and the electrical grid. An OTS can be used to train new operators, test

new control logic before installation, develop response strategies for outages and adjust operating parameters to optimize efficiency.

This report addresses the need for an OTS at Holyrood and how it can be used to enhance operator training, plant operations and efficiency.

There are two driving factors behind this proposal at this critical stage in Holyrood's life cycle:

1. It is anticipated that new industrial growth, for example the Long Harbour Nickel Processing Facility, will provide job opportunities that will absorb candidates that would otherwise be available for hire as plant operators. A lack of candidates available to enter the training program due to job opportunities elsewhere presents a serious succession planning issue which could negatively impact plant operations and plant certification. At one time Hydro had the luxury of hiring temporary employees and over a period of time see them reach full competency at the Plant, and had a level of certainty that they would be available to replace permanent employees as people retired as there was little turnover. In recent years, Hydro moved to make these temporary positions permanent in an effort to mitigate those seeking opportunities elsewhere. While somewhat successful, it is still a challenge and many retirements are expected before Holyrood's future as a thermal plant is finished.

2. With the pending change in the fuel burning status of Holyrood, recruitment and retention will be more of a challenge and Hydro will need to fast track employee training to ensure safe, efficient, and effective operation of this complex plant. The emergence of heavy industrial process engineering demands on the Avalon Peninsula further complicate the retention issue. As well, it is anticipated that part time and short term employed thermal plant operators would likely be a part of the future operating scenario for Holyrood. Skill retention via a simulator would be an

essential aspect of safe operation of the plant. The operation of the high-temperature, high-pressure process is governed by the Boiler Pressure Vessel Act which dictates the number of competent operators required. Operating with less is simply not an option.

# 2 PROJECT DESCRIPTION

This project is for the development and purchase of an Operator Training Simulator (OTS) for Holyrood plant operations staff. A contract will be prepared to engage Invensys (SimSci-Esscor) to develop simulations of plant equipment using the control logic developed by Invensys, provide necessary hardware for an OTS and prepare a detailed training program based on the OTS. SimSci-Esscor is the simulation developer subsidiary of Invensys. Two simulations are to be modeled; one for Units 1 and 2 and a second for Unit 3. Only one simulation is required for Units 1 and 2 since these units are essentially identical in operation. Unit 3 requires its own model due to technical differences in equipment compared to Units 1 and 2. The modeling of these simulations is a complex, time consuming process that requires the collection and implementation of a significant amount of data on the three generating units including the existing Distributed Control Systems (DCS) logic. The data must accurately provide realistic simulations of plant processes. After the data is gathered by the manufacturer, the modeling process is undertaken to create software simulations of the plant equipment that operators review and skill practice regularly, similar to a pilot training simulator.

The OTS equipment consists of new computers, software and screens that will serve as the operator interface platform. Figure 1 below represents the OTS architecture as proposed by Invensys (SimSci-Esscor). This is a standalone system that does not directly connect to the DCS and therefore has no direct impact on physical equipment.




**Figure 1 – Operator Training Simulator – Equipment Architecture**

# 3 EXISTING SYSTEM

The existing Operator Training program is comprised of 622 tasks in two parts; Outside Training and Unit Control Board Training. Outside Training consists of a structured list of 394 tasks, each with specific accountabilities, which the operator trainee must complete prior to being allowed access to the generating unit control boards. Outside Training provides the trainee with detailed physical knowledge of the plant equipment outside the confines of the control room.

Since 228 of these tasks are to be performed directly on the Unit Control Board (UCB), a training simulator would allow the trainee to perform these tasks without having to wait for the availability of a console and to perform such tasks without placing any risk on actual equipment or inadvertently causing an outage. It takes approximately two years to complete UCB training but this time is anticipated to be considerably reduced through the use of a simulator. This allows faster proficiency for new employees and skill practice for others. The reduction in training is anticipated to be significant, with training taking six months instead of two years. Without a simulator, operator training has been inconsistent among the operator trainees as they are exposed to different system conditions and events that occur in real time. Real and stressful situations cannot be initiated on demand for training purposes. They are discussed verses experienced. The simulator allows emergency and other realistic offline situations to be experienced by operators. Therefore training has variable effectiveness depending on exposure.

As there is presently no simulator, less experienced operators have to be consistently supervised and guided by senior operators in order to learn how to operate the plant equipment and respond to abnormal system conditions.

Uniformity across all operations shifts has also been an issue since operating scenarios vary from shift to shift. If an event occurs during one shift, only that shift has gained knowledge of the event and the associated response mechanisms. Under the present training routine,

a system disturbance cannot be repeated for training purposes whereas such an event can be modeled on an OTS and reenacted by operators in order to develop proper response procedures.

Presently, out of the 28 plant operators, two operators are eligible for retirement, three more can retire before the end of 2016 and, in the event that the plant operating life is extended, four more can retire in 2017 (including one on long term disability). As stated previously, due to the projected shutdown of the Holyrood plant by the end of 2016, it is anticipated that replacement operators will be difficult to find when present operators retire between 2012 and 2016. It is essential that new operators be provided with accelerated training to ensure the plant is adequately staffed by qualified operators. The recruitment and retention of operators for this role given its publicly noted future will be more difficult and it is essential to have such a tool to fast track training, allow skill practice for existing staff as well as open the door to temporary or short term postings of operators. Hydro must have competent staff to operate the plant which is governed by the Boiler Pressure Vessel Act.

## 3.1 Age of Equipment or System

The existing operator training program had been developed at the time of construction of the plant in 1967. The training program was extended in 1979 to include generating Unit 3. It has been revised as required since, as dictated by equipment and other changes. It is approved by the Boiler Pressure Vessel section of the Department of Labor.

## 3.2 Major Work and/or Upgrades

There have been no major upgrades to the existing operator training program. The program has steadily evolved over the years. Events that have occurred on the System and within the Plant have resulted in adjustments to the operator training program.

## 3.3 Anticipated Useful life

The training simulator has an estimated service life of eight years, due to the anticipated interconnection to Labrador. Excluding those factors, the simulator could be expected to operate for 15 years. It can, if necessary, be adapted to other training uses with further evaluation and investment. For the purposes of this Application, Holyrood Thermal Plant is the only justification.

## 3.4 Maintenance History

There have been no maintenance costs associated with the existing operator training program.

## 3.5 Outage Statistics

There have been no system outages attributed to the operator training program.

## 3.6 Industry Experience

Hydro operates an OTS in the Energy Control Centre and Churchill Falls Labrador Corporation (CFLCo) operates an OTS in the Churchill Falls Generating Station Control Centre.

Also, Invensys has developed Operator Training Simulators for other utilities such as the following:

- Intermountain Power - Utah, USA (coal fired plant)
- Salt River Project - Arizona, USA (oil fired plant)
- Eskom Lethabo Power Station - South Africa (coal fired plant)

## 3.7 Maintenance or Support Arrangements

Hydro has a system support agreement in place with Invensys Systems Canada that was renegotiated in 2008. Because of the importance of the system that it serves, this service agreement has been renewed for the next five years. This agreement is a contract between Invensys Systems Canada and Hydro to have Invensys provide continued operational support on the existing Distributed Control System (DCS) system. It provides Hydro personnel with unlimited access to their system support program including local Invensys technical support, remote system support, ten hours of on-site support a year, as well as several reduced cost training benefits. Over the years, this service agreement has proven to be beneficial and has resulted in faster troubleshooting and recording of plant equipment problems. The Operator Training Simulator would be incorporated under this service agreement.

## 3.8 Vendor Recommendations

Invensys is able to develop an OTS for the Holyrood generating plant by acquiring data on the operation of the plant equipment and the using the existing the DCS logic developed by them.

## 3.9 Availability of Replacement Parts

The availability of replacement parts is not applicable to this project as it is for the procurement of a new OTS.

## 3.10 Safety Performance

The simulated operation of a power plant using an OTS has no impact on physical devices such as pumps and valves hence presents no danger to workers in the event of incorrect actions by the operator trainee. As well, system response to DCS logic changes can be

tested on the OTS prior to implementation thereby eliminating any possible damage to equipment and possible subsequent harm to employees.

## 3.11 Environmental Performance

It is anticipated that enhanced training on the OTS will enable operators to optimize plant operations to realize decreases in fuel consumption which would result in reductions in greenhouse gas emissions, however this is not quantifiable at the time of this report.

## 3.12 Operating Regime

The Holyrood Generating Station is in operation 24 hours a day, year round. Hydro has identified that the Holyrood Plant has the following maximum acceptable down times:

| | |
|---|---|
| Either Holyrood Unit 1, 2 or 3 | 336 days maximum |
| Holyrood Stage 1 (both Unit 1 and 2) | Less than 1 day |
| Entire Holyrood Generating Plant | Less than 1 day |

These requirements were based on average winter peak loads and assume that all other generating units are available for full rated generation.

Thermal Plant Operators monitor and control the operation of the three generating units for the provision of electrical power for the island through use of the Unit Control Board for each generator and boilers. Each of the three Unit Control Boards consists of an array of computer screens from which all aspects of the generator, boiler and auxiliary equipment are displayed. Controls and changes to operating parameters are issued by way of keyboard and mouse by the operator.

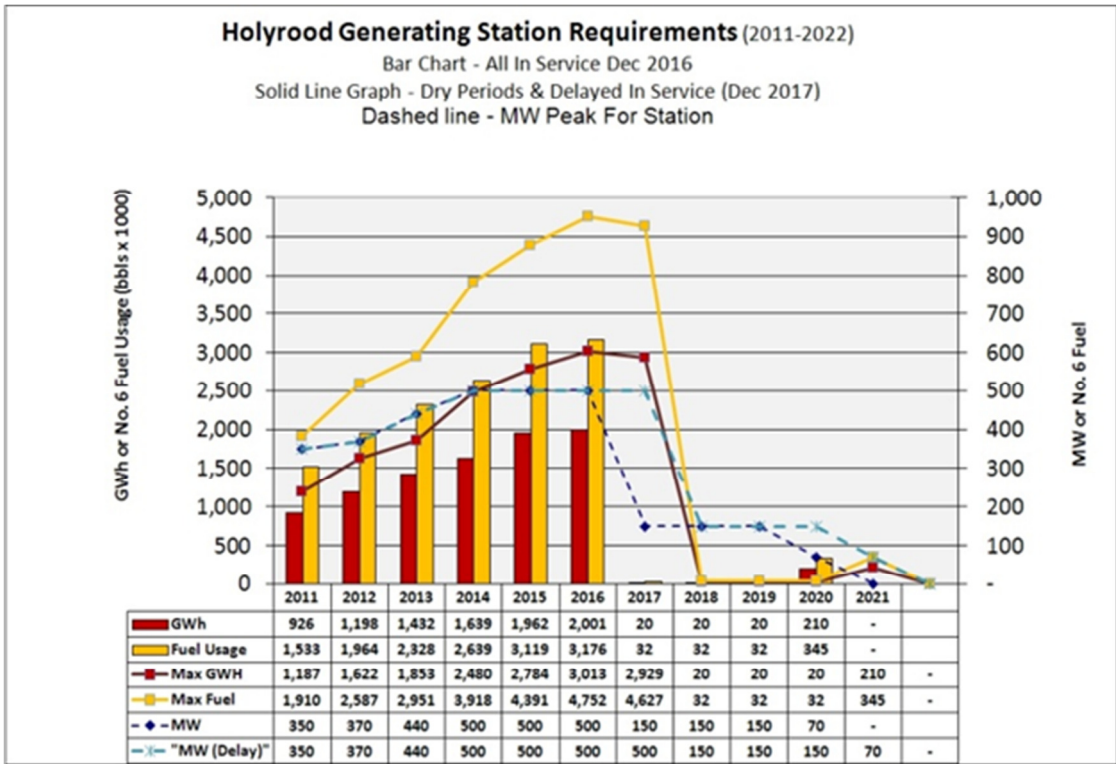
The minimum required numbers of fully trained operators to maintain 24 hour operation of a fully loaded plant are one Shift Supervisor, one Lead Thermal Plant Operator and four Thermal Plant Operator (one is required at each of the Unit Control Boards and one on the floor to check auxiliary equipment). This is dictated by the Department of Labor via the Boiler Pressure Vessel Act and is a minimum standard as part of Hydro's operating permit as issued by the Department.

# 4 JUSTIFICATION

This project is justified on the need to provide plant operators with a training simulator to optimize plant efficiency and operations, develop response schemes to system disturbances, test DCS logic changes before implementation, enhance operator training, reduce operator overtime, and maintain regulatory compliance. A detailed discussion follows for each case.

a) Optimize Plant Efficiency and Operations

The OTS can be used to determine settings to optimize boiler performance and improve heat rate. Heat rate improvements, which translate to lower fuel consumption, result in reductions to greenhouse gas emissions. In Volume 99, Issue 1 of PowerGen WorldWide magazine, an article entitled 'Compact simulators can improve fossil plant operation' by Roy Fray and S. Murthy Divakaruni of EPRI, the Electrical Power Research Institute, indicated a realizable cost saving based on improving heat rate by ¼% to ½% as a result of operators using an OTS. It is anticipated that Holyrood operators can achieve at least a ¼% heat rate improvement through adjustment of operating parameters on an OTS. The projected volumes of fuel use, denoted by the yellow bars in the following graph from 2014 through 2020 as 2639, 3119, 3176, 32, 32, 32, and 345 thousands of barrels of fuel respectively, were used in ¼% heat rate improvement calculations resulting in a potential total savings of approximately 23,000 barrels of oil. In addition to the critical issue of succession planning, there is a significant potential of savings through the use of an OTS.




| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWh | 926 | 1,198 | 1,432 | 1,639 | 1,962 | 2,001 | 20 | 20 | 20 | 210 | - | |
| Fuel Usage | 1,533 | 1,964 | 2,328 | 2,639 | 3,119 | 3,176 | 32 | 32 | 32 | 345 | - | |
| Max GWH | 1,187 | 1,622 | 1,853 | 2,480 | 2,784 | 3,013 | 2,929 | 20 | 20 | 20 | 210 | - |
| Max Fuel | 1,910 | 2,587 | 2,951 | 3,918 | 4,391 | 4,752 | 4,627 | 32 | 32 | 32 | 345 | - |
| MW | 350 | 370 | 440 | 500 | 500 | 500 | 150 | 150 | 150 | 70 | - | |
| "MW (Delay)" | 350 | 370 | 440 | 500 | 500 | 500 | 500 | 150 | 150 | 150 | 70 | - |

**Figure 2: Holyrood Generating Station Requirements**

The time it takes to bring a unit online from a complete unit shutdown with an unheated boiler, known as a 'cold start', can vary based on the experience level of the operator as well as mechanical issues. Plant and Unit cold start durations were recorded from 2006 through 2010 and analyzed to project possible savings. It is anticipated that the time it takes to bring a unit online will decrease to the optimal duration of two days for a cold unit and four days for a cold plant by using an OTS to practice unit starting procedures. Both light oil and crude oil are used during start-up. The usage of each type of oil depends on the conditions during start-up and actions of the operator. Cold starts form 2006 through 2010 were assessed and excess costs were estimated in consideration of optimal starting durations. The average annual excess cost was determined to be approximately $56,000. Due to inconsistencies in volumes of light oil and bunker C fuels used during start up, the estimated annual savings is a conservative value and is subject to fuel prices. These inconsistencies may be attributed to different levels of operator experience.

Through practice on an OTS, all operators would have the opportunity to reach the same level of knowledge of how to manage plant equipment thereby potentially saving on the cost of cold starts.

b) Develop Response Schemes to System Disturbances

When a system disturbance occurs, the operators that are on shift at the time have to deal with the situation. The event can be modeled on an OTS for further evaluation and training for those operators who did not experience the situation. The actions taken can be reenacted on the OTS and optimized for developing training scenarios. This would provide a uniform methodology for responding to system disturbances and enhance the training curriculum for all operators.

A representative from Intermountain Power, a coal fired plant in Utah that has had an OTS in operation since 2005, said during a phone conference that they have realized a reduction by approximately 50 percent in unit trips caused by operators. On the basis of conversation with the representative from Intermountain Power, an OTS is anticipated to aid the operators in making decisions during critical operations thereby decreasing the possibility of operator error and increasing plant availability.

c) Test DCS Logic Changes

An OTS will afford plant engineering the provision for testing logic changes to any of the DCS areas prior to implementation. Previously, any logic changes to the DCS could not be confirmed to operate correctly, effectively, and more efficiently without equipment damage prior to implementation. Although there are no reported issues relating to logic errors, an OTS could effectively eliminate any future possibility of logic or calibration error by evaluation of the simulated system response to the proposed changes. This is a very effective learning tool for the engineers and technologists who develop and adjust DCS logic for plant systems.

d) Enhance Operator Training

The present training program for the operators consists of two years of 'Outside Operator Training' and two years of 'Unit Control Board Training'. After completion of the very structured and regulated Outside Operator Training, the operator trainee is permitted access to the Unit Control Board where actual control of plant systems is performed. Since Unit Control Board training is done on functioning systems, system response to certain actions can vary due to grid or plant conditions. Up to this point, the trainee has no familiarity with the system and must be closely monitored by senior operators due to the potentially catastrophic impact of error.

It typically takes up to two years for an operator trainee to become knowledgeable on Unit Control Board operations due to the limited training possibilities of operating actual equipment. An OTS would provide the operator trainee a platform on which to perform any number of control strategies at any available time without impact to plant availability. It is anticipated that the use of an OTS would decrease the training duration from two years to six months thereby placing a more experienced operator at the unit control board earlier than ever before.

There are presently 28 operators at Holyrood; 12 of these operators have less than five years of experience, five have less than 12 years of experience, 14 have 22 or more years of experience, two are at retirement age. The experience gap within the group of operators substantiates the need for an OTS for junior operators, especially so as senior staff retire or are not on shift during abnormal system events. If the duration of training could be reduced from two years to six months, this would reduce the need for senior operating staff to be on overtime shift. The operator trainee would develop necessary skills in a shorter period and be able to attend to unit controls earlier. It is imperative that less experienced operators are provided with a training simulator environment in situations where a senior operator is not available in order to respond with utmost efficiency and operating knowledge during

start up, outage response and equipment failure. The simulator will also allow recurrent training to occur for more experienced operators or operators who may be returning for temporary duties.

e) Reduce Operator Overtime

When less experienced operators are attending to the plant unit control board, a senior operator is required to be present and may even be called in for support in the event of an outage or abnormal system event such as a load rejection. It is anticipated that the present overtime costs for operators can be reduced by $105,000 per year through the use of an OTS.

f) Maintain Regulatory Compliance

A power plant requires registration as granted by the Engineering and Inspections Services Branch of the Department of Government Services. Section 69 of the Boiler, Pressure Vessel and Compressed Gas Regulations under the Public Safety Act (O.C. 96-427) stipulates that 'A licensed plant shall establish and maintain an approved training program for the purpose of training employees prior to examination of those personnel for certification under section 71.' Holyrood has developed a training program and submitted it to the Engineering and Inspections Services Branch in order to be registered for operation. The Manager of the Engineering and Inspections Services Branch of the Department of Government Services set forth conditions for a minimum specific number and classification of trained operators to be on duty for the plant to maintain its registration based on the training program submitted by Holyrood Plant.

An OTS will enable new operators to undertake their prescribed training program at an accelerated rate thereby arriving at a fully trained status earlier. This will greatly assist the plant during times when vacation and sickness decrease the number of available fully trained operators.

Operator training on the Unit Control Board has been a contentious issue because its availability to operators and the experience gained through dealing with abnormal conditions has been inconsistent. An OTS would remedy this situation in that it would be frequently available to operators for new employee training and recurring training. It can also be configured to reenact system disturbances or equipment failures so that all operators could practice response strategies. An OTS would enhance the unit control board training regimen and better serve to facilitate plant registration with Government Services.

FM Global, the insurance provider for the Holyrood plant, stated in their report on Fire and Natural Hazards – Special Risk Evaluation (Index 000009.36-02) in section 10-03-001 "Expedite the operator training on the new emergency plan procedures to achieve oil pump shutdown" that '…This should be done within the next 6 months but a long-range plan includes having simulator exercising for training through a new DCS system'. In an e-mail received on July 7, 2011 from an Account Engineer at FM Global, it was stated that 'If there is a training simulator that meets this need at Holyrood Thermal Station, then using it to improve operator awareness can only help to better protect NLHydro/Nalcor Energy's assets, power delivery and reputation'. This recommendation from the insurance provider further supports the need for an OTS.

The Board also requires the plant to regularly practice black starts. A black start is a situation wherein all boilers are off-line and the plant is electrically disconnected from the provincial grid, thus requiring on-site generation from diesels and gas turbine to start the process of bringing the plant into service. Under the present training regime, there is no way to simulate a black start to instruct an operator trainee. Each year, one shift of operators has the opportunity to perform a black start. An OTS would provide all operators with the opportunity to exercise a black start annually thereby more frequently maintaining familiarity with the process and

honing skills as an operator.

Shutdowns and black starts cannot be performed when the units are required therefore there are limited occasions that such practices can be executed. Shutdowns and black starts are important exercises for both experienced and trainee operators. To do so without need, other than for insurance compliance, is wasteful and creates unnecessary wear on equipment. An OTS would provide for simulated shutdowns, black starts and other important operating schemes to be practiced and studied by all operators at any available time without direct impact to the plant. Simulations of this nature ensure expedient response times during emergency situations by way of allowing repeated practice of response measures.

## 4.1 Net Present Value

A net present value calculation was not performed for this project.

## 4.2 Levelized Cost of Energy

The levelized cost of energy is a high level means to compare costs of developing two or more alternative generating sources. Therefore, the levelized cost of energy is not applicable in this case.

## 4.3 Cost Benefit Analysis

A cost benefit analysis (CBA) was not performed for this project.

## 4.4 Legislative or Regulatory Requirements

Please see Section 4 (e), Maintain Regulatory Requirements

## 4.5 Historical Information

An ongoing controls upgrade program has resulted in Invensys (Foxboro) DCS throughout the Holyrood plant. This enables the DCS logic used to operate the plant to be integrated into operator training simulation software more effectively than if systems from different manufacturers existed.

## 4.6 Forecast Customer Growth

It is anticipated that the Holyrood generating plant will reduce operations of generating units as a result of the Muskrat Falls project. After this time, the plant will use the synchronous condensing function of Unit 3 and additional synchronous condenser capability will be added to Units 1 and 2. The synchronous condensing function of Unit 3 is not a significant part of the OTS. The graph in Section 4 (a) identifies projected load requirements.

## 4.7 Energy Efficiency Benefits

Please see Section 4 (a), Optimize Plant Efficiency and Operations.

## 4.8 Losses during Construction

Energy losses are not anticipated while installing the Operator Training System.

## 4.9 Status Quo

The existing training program is well implemented but has limited effectiveness. With the

present complement of operators with less than five years of experience and anticipated retirements, an OTS is required to expedite and enhance the training process.

## 4.10 Alternatives

There are no viable alternatives for this project.

# 5 CONCLUSION

Many benefits can be realized through the use of an OTS, including fuel and labor cost savings, efficiency, safety, and environmental improvements as previously discussed. Most importantly, operations, maintenance and engineering staff would use an OTS to learn all aspects of plant operations and how to respond optimally to system disturbances allowing faster training of new employees, recurring training for existing employees, and possible use of temporary employees as the challenges associated with staffing the plant to 2020 become evident. Waiting for a crisis is not an option which can be considered an acceptable risk.

If an OTS is not developed and installed at Holyrood, the benefits discussed in section 4 would not be realized. This would lead to the possibility of excesses in fuel consumption, greenhouse gas emissions and labour costs in training and supervision.

## 5.1 Budget Estimate

The budget estimate for this project is shown in Table 1.

**Table 1: Budget Estimate**

| **Project Cost:** *($ x1,000)* | **2012** | **2013** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 38.0 | 121.0 | 0.0 | 159.0 |
| **Consultant** | 16.6 | 13.9 | 0.0 | 30.5 |
| **Contract Work** | 899.7 | 736.1 | 0.0 | 1,635.8 |
| **Other Direct Costs** | 0.0 | 30.0 | 0.0 | 30.0 |
| **Interest and Escalation** | 73.9 | 134.7 | 0.0 | 208.6 |
| **Contingency** | 0.0 | 37.1 | 0.0 | 37.1 |
| **TOTAL** | **1,028.2** | **1,072.7** | **0.0** | **2,100.9** |

## 5.2 Project Schedule

The anticipated project schedule for this project is shown in Table 2.

**Table 2: Project Schedule**

| Activity | | Start Date | End Date |
|---|---|---|---|
| Procurement | Contract Development | February 2012 | February 2012 |
| Planning | Kick-off meeting | March 2012 | March 2012 |
| Design | Documentation gathering | March 2012 | March 2012 |
| | Pre Factory Acceptance Test | March 2013 | March 2013 |
| | Factory Acceptance Test | April 2013 | May 2013 |
| Installation | Install OTS | June 2013 | June 2013 |
| Commissioning | Commissioning OTS | June 2013 | June 2013 |
| Training | Operator Training | July 2013 | July 2013 |
| Closeout | Closeout Documents | September 2013 | September 2013 |