NEWFOUNDLAND POWER
A FORTIS COMPANY

Newfoundland Power Inc.

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HAND DELIVERED

June 16, 2014

Board of Commissioners
of Public Utilities
P.O. Box 21040
120 Torbay Road
St. John's, NL A1A 5B2

Attention: G. Cheryl Blundon
Director of Corporate Services
and Board Secretary

Ladies & Gentlemen:

Re: Application for approval of a capital expenditure supplemental to Newfoundland Power Inc.'s (the "Company") 2014 Capital Budget

Please find enclosed the original and twelve copies of an application for approval of a capital expenditure supplemental to the Company's approved 2014 capital budget (the "Application").

The Application
The Application seeks the Board's approval of a capital expenditure supplemental to the Company's approved 2014 capital budget (the "Application"). The need for this supplementary expenditure arises from the unforeseen requirement to refurbish thermal generation assets following the 2013/2014 winter season.

Supplementary Capital Expenditures
The Application is filed in accordance with the revised Capital Budget Application Guidelines issued in October 2007 (the "Guidelines"), in particular, part *B.1. Application for Approval of Supplemental Capital Expenditures*. The Guidelines provide for approval of a supplemental capital expenditure where a utility determines that a capital expenditure which was not anticipated and included in the annual capital budget is necessary in the year and should not be delayed until the following year. These capital expenditures were not anticipated at the time of preparation of the Company's 2014 Capital Budget Application. However, to ensure the Company's thermal generation is prepared to respond when called upon, it is necessary to proceed with the project prior to the 2014/2015 winter season.

In these circumstances, Newfoundland Power believes it is appropriate to seek approval at this time of a supplementary capital expenditure to complete the necessary work to prepare the Company's thermal generation for the upcoming 2014/2015 winter season.

In making application for approval of supplemental capital budget expenditures, the Guidelines require that, in addition to such evidence as would normally be required to support an application for the approval of capital expenditures, the utility must show why the project was not anticipated and included in the annual capital budget application for the year; and why the project cannot wait until next year and be included in the annual capital budget application.

As noted in the report titled *Thermal Generation Refurbishment, June 2014*, the Company's thermal generation must be refurbished to ensure its readiness for service. The estimated cost of completing the necessary refurbishment is approximately $1.7 million in 2014.

Concluding
A draft of the Order requested is enclosed for the Board's convenience. If there are any questions in relation to this matter, please contact the undersigned at the direct number noted below.

Yours very truly,

Gerard M. Hayes
Senior Counsel

Enclosure

c. Geoffrey Young
Newfoundland and Labrador Hydro

Paul Coxworthy
Stewart McKelvey

Roberta Frampton Benefiel
Grand Riverkeeper Labrador Inc.

Danny Dumaresque

Thomas Johnson
O'Dea Earle Law Offices

Thomas O'Reilly, QC
Vale Newfoundland and Labrador Limited

Sheryl Nisenbaum
Praxair Canada Inc.

Telephone: (709) 737-5609 *Email: ghayes@newfoundlandpower.com* *Fax: (709) 737-2974*

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

IN THE MATTER OF an Application by Newfoundland Power Inc. (the "Applicant") for approval to proceed with the construction and purchase of certain improvements and additions to its property pursuant to Section 41(3) of the Act.

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

THE APPLICATION OF Newfoundland Power Inc. (the "Applicant") **SAYS THAT:**

1. The Applicant is a corporation duly organized and existing under the laws of the Province of Newfoundland and Labrador, is a public utility within the meaning of the Act, and is subject to the provisions of the *Electrical Power Control Act, 1994.*

2. Newfoundland Power operates transmission lines, distribution lines and substations to deliver electricity to customers throughout its service territory on the island portion of the Province of Newfoundland and Labrador.

3. From January 2-8, 2014, Newfoundland Power's electrical system operated in extraordinary conditions. These conditions included rotating power outages and successive equipment failures on the Island Interconnected System which resulted in widespread interruptions of electrical service to large numbers of customers.

4. During the electrical system events of January 2-8, 2014, Newfoundland Power's thermal generation operated for extended periods of time.

5. Schedule A to this Application is a report titled *Thermal Generation Refurbishment, June 2014* which details work identified to refurbish Newfoundland Power's thermal generation and provides estimates of the expenditures necessary to execute that work.

6. The projects for which the Board's approval is sought by this Application are described in Schedule B to this Application and have a total estimated 2014 capital expenditure of $1,698,000.

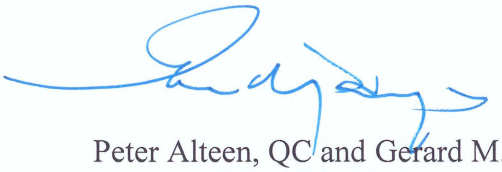
7. The Applicant submits that the proposed expenditures for 2014 as described in paragraphs 5 and 6 hereof, are necessary to provide service and facilities which are reasonably safe and adequate and just and reasonable, all as required pursuant to Section 37 of the Act.

8. Communications with respect to this Application should be sent to Peter Alteen, QC and Gerard M. Hayes, Counsel for the Applicant.

9. **THE APPLICANT REQUESTS** that the Board approve, pursuant to Section 41 (3) of the Act, the capital expenditures associated with the purchase and construction of the improvements and additions to the Applicant's property as set out in this Application.

DATED at St. John's, Newfoundland and Labrador, this 16th day of June, 2014

NEWFOUNDLAND POWER INC.



Peter Alteen, QC and Gerard M. Hayes
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Telephone: (709) 737-5859
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IN THE MATTER OF the *Public Utilities Act,* (the "Act"); and

IN THE MATTER OF an Application by Newfoundland Power Inc. (the "Applicant") for approval to proceed with the construction and purchase of certain improvements and additions to its property pursuant to Section 41(3) of the Act.

AFFIDAVIT

I, Gary J. Smith, of St. John's in the Province of Newfoundland and Labrador, make oath and say as follows:

1. That I am Vice-President, Engineering and Operations of Newfoundland Power Inc.
2. To the best of my knowledge, information and belief, all matters, facts and things set out in this Application are true.

SWORN to before me at St. John's in the Province of Newfoundland and Labrador this 16th day of June, 2014:

Barrister

Gary J. Smith

Thermal Generation Refurbishment

June 2014

Prepared by:

Gary Humby, P. Eng.

Jack Casey, P. Eng.

NEWFOUNDLAND POWER
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1.0 Introduction

In this 2014 Capital Budget Supplemental Application (the "Application"), Newfoundland Power Inc. ("Newfoundland Power" or the "Company") proposes to address the in-service failure of the Rolls Royce AVON gas generator at the Wesleyville gas turbine facility, and other issues identified in engineering assessments completed on 2 of its thermal generation facilities following the winter of 2013/2014.[1]

In its 2014 Capital Plan filed with its 2014 Capital Budget Application, Newfoundland Power had identified approximately $5 million in expenditures associated with the refurbishment of its Wesleyville and Greenhill gas turbines in the 2017 /2018 time frame. This planned refurbishment was based upon historical operating experience.[2] During the 2013/2014 winter season, Newfoundland Power was required to run its generation plants more frequently.[3]

Newfoundland Power's Wesleyville gas turbine is a thermal generator located in the Bonavista North area providing 10 MW of capacity in support of the Island Interconnected System. On the early morning of March 5, 2014, Newfoundland & Labrador Hydro ("Hydro") requested that Newfoundland Power operate its Wesleyville gas turbine in support of the Island Interconnected System. The unit shut down shortly after start-up due to high vibration on the power turbine gearbox.[4] On restart at 8:27 AM, the unit tripped again with high vibration levels this time in the gas generator. Upon investigation following the 2nd trip, the rotating members were found to have failed and the gas turbine could not be restarted.

Newfoundland Power's Greenhill Gas Turbine is a thermal generator on the Burin Peninsula providing 20 MW of capacity in support of the Island Interconnected System. For 39½ hours on January 3-5, 2014 the Greenhill Gas Turbine was shut down because its fuel supply was exhausted.[5] Otherwise the gas turbine system operated effectively throughout the winter of 2013/2014 and is currently available for service.[6]

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1 The system events experienced during the winter of 2013/2014 are fully described in Newfoundland Power's *Interim Report,* March 24, 2014 in *An Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System by the Board of Commissioners of Public Utilities of Newfoundland and Labrador.*

2 Historically, Newfoundland Power has run its 41.5 MW of thermal generation minimally for supporting system peaks and local generation for planned and unplanned transmission outages. Table 1 provides data on the generation run time hours for both the Wesleyville and Greenhill gas turbines.

3 Hydro requested Newfoundland Power to run its generation resources on 29 days in December 2013 and January 2014. Hydro typically requests Newfoundland Power to run its generation for a number of reasons. One is economic dispatch for the Island Interconnected System. Another is peak management. A third is to relieve short-term system limitations (i.e. voltage support).

4 Vibration is a known problem on the unit, and is the result of run-out and swash of the bull gear. The problem has been present since the unit was relocated from Salt Pond in 2003.

5 The Greenhill gas turbine is equipped with effective fuel oil capacity of 190,000 litres. This provides 24 to 32 hours of continuous operation. A blizzard on January 3rd and 4th, 2014 closed the highway access to the Burin Peninsula where the turbine is located, delaying fuel deliveries.

6 The Mobile Gas Turbine ("MGT") is a 6.5 MW gas turbine mounted on 2 trailers. The MGT was located at Holyrood Thermal Generating Station during the 2013/2014 winter season to provide backup power for loss of station service. The MGT operated effectively throughout the winter season. The 2014 Capital Plan has identified the purchase of a replacement unit for the MGT in the 2016/2017 timeframe.

Following the winter of 2013/2014 Newfoundland Power engaged the necessary engineering expertise to complete assessments on its thermal generation facilities at Wesleyville and Greenhill. These assessments identified a number of issues that need to be addressed prior to the 2014/2015 winter season.

The assessments also identified additional work to be considered over the next 3 year time horizon. This work will be considered as part of a broader assessment of the long-term viability of these assets.

The refurbishment proposed in this Application includes the following:

Wesleyville Gas Turbine ($1,345,000)

(i) Complete overhaul of the Rolls Royce AVON gas generator,
(ii) Refurbishment of the power turbine including replacement of insulating blanket and weld repairs to the power turbine disc and shroud,
(iii) Replacement of the automatic voltage regulator,
(iv) Minor repairs to the building roof, and
(v) Replacement of the lubricating oil cooler.

Greenhill Gas Turbine ($353,000)

(i) Refurbishment of the power turbine including replacement of the insulating blanket and repairs to the power turbine labyrinth seal and replacement of the inlet housing shroud,
(ii) Replace exhaust gas thermocouple wiring harness,
(iii) Minor repairs to the building enclosure, and
(iv) Installation of a new 100,000 litre fuel tank and associated piping.

The total estimated cost of the work is $1,698,000.

2.0 Background

Newfoundland Power operates 3 gas turbine generators. These include the Greenhill Gas Turbine located on the Burin Peninsula, the Wesleyville Gas Turbine located in the Bonavista North area, and the Mobile Gas Turbine normally located at Grand Bay Substation in Port aux Basques.

The Greenhill and Wesleyville gas turbine generating facilities consist of: (1) a gas generator, which is an aircraft engine producing exhaust gases that power the unit; (2) a power turbine, which uses the energy from the exhaust gases to turn a shaft, and (3) the electric generator, which converts mechanical energy from the turbine to electricity, and associated equipment.

Newfoundland Power's gas turbines range in age from 39 years to 45 years.[7] Historically, these

[7] The Greenhill Gas Turbine is 39 years old, the Wesleyville Gas Turbine is 45 years old and the Mobile Gas Turbine is 40 years old. There was no engineering assessment completed, or additional refurbishment planned in 2014, for the Mobile Gas Turbine. The refurbishment of the Mobile Gas Turbine's weather-tight enclosure was included in the approved 2014 capital budget as part of the *Facility Rehabilitation Thermal* project.

plants have been used to support system peaks for very limited periods of time each year, to allow for local system maintenance, and to provide backup in the event of localized outages. Increased use of the gas turbines in December 2013 and January 2014 is a significant change in usage.[8]

Table 1 provides a summary of the run time history for the past 5 years for the Greenhill and Wesleyville facilities.

Table 1
Thermal Generation Run Time
(Hours)

Unit	2009	2010	2011	2012	2013	2014 YTD[9]
Greenhill Gas Turbine	26.8	10.5	3.8	15.4	75.2	119.3
Wesleyville Gas Turbine	67.3	147.2[10]	68.0	35.1	70.5	32.8

The Wesleyville Gas Turbine is powered by a Rolls Royce AVON aero-derivative gas generator packaged by Associated Electrical Industries ("AEI").[11] The system is located near the Town of New-Wes-Valley in Bonavista North. The Wesleyville facility has been de-rated from 14.7 MW to 10.0 MW as a result of long-term vibration issues in the power turbine gearbox.[12] The system was originally installed in Salt Pond Burin in 1969. It was relocated to Wesleyville in 2003. At that time, the system underwent refurbishment at Wesleyville. A new building was constructed to house the equipment, and the balance of plant was upgraded.[13] In 2005, the Rolls Royce gas generator was replaced with a refurbished unit.

The Greenhill Gas Turbine is powered by a Rolls Royce OLYMPUS aero-derivative gas generator packaged by Curtis Wright Corporation. The system is located at Grand Bank on the Burin Peninsula. The Greenhill facility has been de-rated from 25 MW to 20 MW as a result of long-term issues with cracks in the power turbine casing. The protection, controls and governor were upgraded in 2002. During the January 2-8, 2014 period, Newfoundland Power's Greenhill

8 The rate of wear in a gas turbine is significantly affected by the number of times the turbine is stopped and started as each stop/start cycle involves extreme temperature changes and material expansion and contraction within the turbine. See, for example, *Technology Characterization: Gas Turbines* prepared for the Environmental Protection Agency, Washington, DC, December 2008, at page 18.

9 The 2014 YTD data covers the period from January 1, 2014 to May 31, 2014. The Wesleyville Gas Turbine was not available from January 5, 2014 to January 22, 2014 and after March 5, 2014.

10 During the March 2010 ice storm the Wesleyville Gas Turbine operated for 115.5 hours while repairs to transmission line 116L were undertaken. The damage to the transmission line was described on page 7 of Schedule A to the 2010 Capital Budget Supplemental Application file by the Company on April 30, 2010.

11 An aero-derivative gas generator is an aircraft jet engine adapted for use in electricity generation.

12 The gearbox suffers from higher than normal vibration levels due to run-out and bull gear swash. Essentially, this means that misalignment of parts that are rotating at high speed is resulting in increased vibration in the machinery.

13 "Balance of plant" refers to fuel system, motor control center, protection equipment, controls and governor.

facility was unavailable for a period because of unavailability of fuel delivery. The Rolls Royce OLYMPUS gas generator was last refurbished in 1995.

Newfoundland Power's 2014 Five Year Capital Plan included budgetary cost estimates for the anticipated overhaul of the Greenhill Gas Turbine in 2017 and the Wesleyville Gas Turbine in 2018. The timing, estimated scope of work and cost estimates for these overhauls was based upon the historical level of usage of the units. In light of recent events, there is potential for increased use of these units. Due to their age and present condition, it has been determined that condition assessments of the gas turbines are necessary to ensure their continued availability in support of the Island Interconnected System.

3.0 Engineering Assessment

Newfoundland Power has engaged experts to assess the condition of the thermal generating equipment at the Wesleyville and Greenhill facilities.

During the week of March 17, 2014, field service staff from Alba Power completed internal inspections of the Rolls Royce gas generators at both facilities. During the week of April 28, 2014, field service staff from Greenray Turbines completed internal inspections of the power turbines at both facilities.[14]

The results of these inspections are contained in Appendices C through F.

3.1 Wesleyville Facility

Gas Generator
The Wesleyville gas generator has been in service since 2005.[15]

A borescope inspection of the Rolls Royce AVON gas generator was completed on March 17th and 18th, 2014 on site at the Wesleyville facility.[16] As a result of damage sustained on March 5, 2014, the compressor was unable to rotate. This limited the scope of the inspection. The inspection identified areas where there was a loss of coating on the blades, stator and turbine sections of the gas generator. Rivets from the main line front bearing were found inside the gas generator. The failure of this bearing caused the gas generator failure. Based on the inspection results, it was determined that the gas generator must be removed and transported to an authorized repair facility for a complete overhaul.

[14] The purpose of these assessments was to identify the refurbishment necessary to have these 2 facilities ready for service in advance of the 2014/2015 winter season. No consideration was given to upgrades to increase output or extend service life. There is a separate assessment that will be ready in the 3rd quarter of 2014 that will examine the longer term need for gas turbine generation.

[15] In its 2005 capital budget Newfoundland Power included a project to replace the original 36 year old Rolls Royce AVON gas generator with a refurbished unit. The original gas generator had been overhauled in 1987 at 18 years of age and was due for another overhaul in 2005.

[16] A borescope is an optical device placed at the end of a flexible tube. A borescope is used to conduct visual inspections where the area to be inspected is inaccessible by other means.

Power Turbine
An inspection of the power turbine, gear box and all auxiliary systems was completed on May 2nd and 3rd, 2014 on site at the Wesleyville facility.

The power turbine inspection identified several cracks in the shrouds on the power turbine inlet duct. The power turbine inlet duct will have to be removed and weld-repaired. The power turbine insulating blankets require replacement as the cloth and refractory is broken away in several locations.[17]

The gearbox inspection did not show any additional wear to the bull gear or high speed pinion since it was last inspected in 2004. The gearbox vibration problems are the result of run out and swash of the bull gear. Previous repairs were unsuccessful in eliminating the vibration problem entirely. Unless the vibration problem is corrected, the unit will continue to be de-rated.

Other Plant & Equipment
On January 5th, 2014 the lubricating oil cooler developed leaks in the junction between the core and the expansion tanks. Repairs were completed and the cooler returned to service on January 22nd, 2014. Since the cooler was returned to service, other leaks have developed. On that basis, it has been determined that the cooler must be replaced.

The exhaust stack is in good condition with heavy surface corrosion due to the quality of steel used during manufacture. The roof flashing needs to be replaced in the area of the exhaust stack and cooling fans to prevent leaks.

The automatic voltage regulator incorporated with the unit control panel has failed and needs to be replaced.

3.2 Greenhill Facility

Gas Generator
The Greenhill gas generator has been in service since 1975 with no significant issues. The gas generator was last overhauled in 1995.

A borescope inspection of the Rolls Royce OLYMPUS gas generator was completed on March 19th and 20th, 2014 on site at the Greenhill facility. Debris found in the air intake plenum is attributable to corrosion of the walls and other surfaces. This debris could enter the gas generator and cause impact damage. The internal inspection of the gas generator identified many areas where there is a loss of coating. Some corrosion was found in the HP compressor and on the stators. The combustion chambers are showing carbon buildup and experiencing corrosion. Blades in the turbine section have lost coating and the leading edges are showing signs of degradation. The signs of wear and extensive coating loss throughout are consistent with the amount of time since the last overhaul. However, if this deterioration is allowed to continue indefinitely, it could lead to catastrophic failure of the gas generator.

[17] A refractory material is one that retains its strength at high temperatures. Refractory materials are used in linings for furnaces, kilns, incinerators and reactors. Power turbine insulating blankets are necessary to reduce the impact of heat from the power turbine on other equipment in the same enclosure.

The exhaust gas temperature thermocouple wiring harness is in need of replacement.

Based on the inspection results, the gas generator at Greenhill is serviceable in the immediate term; but, action will soon be required. It is therefore recommended that a plan be put in place for the gas generator be removed and transported to an authorized repair facility for a complete overhaul at an appropriate time subsequent to the next winter season.

Power Turbine
An inspection of the power turbine and all auxiliary systems was completed between April 29th and May 1st, 2014 on site at the Greenhill facility.

The power turbine inspection identified issues with the labyrinth seal and the inlet housing rear outer flange retaining ring. The front labyrinth seal clearance is outside the recommended tolerance and there is some material loss at the 6 o'clock position. The clearance needs to be re-established.[18] The power turbine inlet housing rear outer flange retaining ring has suffered some heat distortion and has migrated into the hot gas path. To avoid further deterioration, oil leaks and failure of the seal, the inlet housing shroud that includes the retaining ring should be replaced.

The power turbine insulating blankets require replacement as the cloth and refractory is broken away in several locations.

The inspection verified that the cracks in the power turbine casing have not migrated since the last inspection. Unless the power turbine casing is replaced, the de-rating of the unit should continue.

Other Plant & Equipment
During the January 2-8, 2014 period, the Greenhill Gas Turbine was unavailable for a period of approximately 39½ hours due to lack of fuel.[19] The Greenhill facility is equipped with effective fuel capacity of 190,000 litres. This provided approximately 24 to 32 hours of operation, depending upon the generator output. Increasing the fuel storage at the Greenhill facility will increase the duration of availability of the gas turbine during emergency situations.[20]

The building enclosure is original to the 1975 installation and has deteriorated from 40 years of normal use and exposure to the elements. The intake plenum door and frame need to be replaced. Some of the welds inside the intake plenum have cracked and need to be repaired.

[18] The clearance can be re-established by either (i) re-machining the seal or (ii) using a manufacturer's modification involving eccentric locating pins.

[19] A blizzard on January 3rd and 4th, 2014 closed the highway access to the Burin Peninsula where the turbine is located, preventing fuel deliveries to the facility.

[20] For example, increasing storage by an additional 100,000 litres will provide sufficient fuel to operate the gas turbine for approximately an additional 12 to 18 hours under normal operating conditions.

3.3 Conclusion

The results of inspections indicate that some refurbishment work is required at this time to ensure safe and reliable service of Newfoundland Power's Wesleyville and Greenhill gas turbine facilities for the upcoming winter season.

Both gas turbine systems are in advanced stages of deterioration as a result of their relatively long time in service. However, the historic duty cycles for both units have not been severe. As a result, these units have outlived other units manufactured at the same time. With reasonable expenditure, they can offer reasonable back-up generating capacity for the Island Interconnected System for the immediate term.

4.0 Continued Operation

The Company's gas turbines have provided reliable service for the past 4 decades. Table 2 shows the age, and the nameplate and de-rated capacity of the Wesleyville and Greenhill gas turbine systems.

Table 2
Year Commissioned and Capacity

Unit	Year Commissioned	Capacity (MW)	Notes
Wesleyville Gas Turbine	1969	14.7	De-rated to 10 MW
Greenhill Gas Turbine	1975	25.0	De-rated to 20 MW

Based on the engineering assessments completed in 2014, refurbishment of the Wesleyville and Greenhill gas turbines is necessary for their continued safe and reliable operation in the immediate term. The work proposed at this time is expected to ensure the availability of these systems to provide capacity support to the Island Interconnected System for at least the next 2 to 3 years.

Because of the age of the 2 systems, a further review is necessary to determine the long-term viability of continued investment in these assets. Newfoundland Power has commenced a process to identify an engineering firm with expertise in thermal generation systems to review the engineering assessments completed in 2014 and assess the long-term viability of continued investment in the 2 systems.[21] The review is expected to be completed in the 3rd quarter of 2014. The results of any recommendations will be reflected in the 2016 Capital Plan to be filed with the Company's 2016 Capital Budget Application.

[21] In May 2014, Newfoundland Power issued a Request for Information to various engineering consulting firms to identify a qualified consultant to assist in the review. Three proposals are currently under consideration.

5.0 Project Description

This Application involves refurbishment of the Wesleyville and Greenhill gas turbine systems as necessary to prepare them for availability in the 2014/2015 winter season. The refurbishment identified in this Application includes:

Wesleyville Gas Turbine ($1,345,000)

(i) Complete overhaul of the Rolls Royce AVON gas generator ($999,000);
(ii) Refurbishment of the power turbine including replacement of the insulating blanket, internal inspection of the power turbine disc and weld repairs to the shroud ($137,000);
(iii) Replacement of the automatic voltage regulator ($25,000);
(iv) Repairs to the building roof ($21,000); and
(v) Replacement of the lubricating oil cooler ($163,000).

Greenhill Gas Turbine ($353,000)

(i) Refurbishment of the power turbine including replacement of the insulating blanket and repairs to the power turbine labyrinth seal and replacement of the inlet housing shroud ($153,000);
(ii) Replace the exhaust gas thermocouple wiring harness ($26,000);
(iii) Minor repairs to the building enclosure ($21,000); and
(iv) New 100,000 litre fuel tank and associated piping ($153,000).

The engineering assessment also identified other impending issues including the need for an overhaul of the Greenhill Rolls Royce OLYMPUS gas generator, cracks in the Greenhill power turbine and the deterioration of the Wesleyville exhaust stack. Work associated with these items will be addressed, if necessary, following the review to be completed in the 3rd quarter of 2014, and included in the 2016 Capital Plan to be filed with the Company's 2016 Capital Budget Application.

6.0 Project Cost

6.1 Request for Proposals

The budget estimate for this project is based on engineering estimates for the cost of the individual items identified in **5.0 Project Description**. The largest cost item is the overhaul of the Rolls Royce AVON gas generator.

To facilitate approval of the associated capital expenditures by the Board, Newfoundland Power proceeded in 2014 with the engineering assessments and the soliciting of proposals from qualified repair facilities to develop an accurate estimate of the project costs.

In April 2014, Newfoundland Power issued a Request for Proposals (the "RFP") seeking proposals from qualified repair facilities for the overhaul of the Rolls Royce AVON gas generator at Wesleyville. Included in the RFP process was the opportunity for potential bidders to conduct a site visit and inspect the gas generator prior to submitting a proposal. The date set

for receipt of proposals under the RFP was April 25th, 2014. On that date, Newfoundland Power received 3 proposals. Following a detailed evaluation of the proposals received, the lowest priced technically compliant proposal was used as the basis of the project cost estimate.[22]

6.2 Estimated Costs

The estimated cost to complete all work associated with the Application is $1,698,000. Table 3 provides a detailed breakdown of the costs to be incurred.

Table 3
2014 Cost Estimate

Cost Category	Amount
Material	$1,250,000
Labour Internal	166,000
Engineering	96,000
Other	186,000
Total	**$1,698,000**

To ensure the project is completed at the lowest possible cost consistent with safe and reliable service, all materials and contract labour will be obtained through competitive bidding.

6.3 Estimated Benefits

The current cost of avoiding additional capacity for the Island Interconnected System for 1 year appears to be approximately $55/kW.[23] This value can be used as a proxy to estimate the benefit of ensuring the availability of the 30 MW of back up generation which will result from the projects included in this Application.

At $55/kW, the benefit associated with the projects proposed in the Application would be approximately $1.65 million/year.[24] This indicates the benefit of refurbishing the existing 30 MW of back up generation justifies the cost of refurbishment.

7.0 Project Schedule

The projects included in this Application are being proposed to refurbish the Company's thermal generation in advance of the 2014/2015 winter season. At Wesleyville the long delivery item is the overhaul of the gas generator which will take approximately 4 months to complete. The

[22] The awarding of the contract to complete the overhaul of the Rolls Royce AVON gas generator will take place following Board approval of this Application.

[23] This estimate is based upon Hydro's planned addition of 113 MW of combustion turbine back-up capacity in 2014. This capacity addition is forecast to cost $118,900,000. The $55/kW avoided cost estimate is based upon a 35 year life; a discount rate of 5.76%; and an assumed annual cost escalation of 2%; which yields an economic carrying charge of 5.23% for 1 year ($118,900,000 ÷ 113,000 kW x 5.23% = $55).

[24] $55/kW/yr x 30,000 kW = $1,650,000/yr.

remaining balance of plant and power turbine items will be completed during the period when the gas generator is off site being overhauled. The gas turbine will be returned and the entire system commissioned in early November 2014.

The Greenhill fuel tank will take approximately 3 months to manufacture and install on site. The power turbine refurbishment will take approximately 3 weeks to complete. This work will be undertaken simultaneously. The system will be commissioned in early November 2014.

To ensure all equipment is delivered and installed before the 2014/2015 winter season, timely approval of the Application by the Board is required.

8.0 Concluding

During December 2013 and January 2014, Newfoundland Power was required to run its generation plants more frequently. This trend of increased operating requests has been ongoing for the past 2 winter seasons and is expected to continue until the establishment of the Labrador infeed.

The engineering assessments completed in 2014 have determined that some refurbishment work is necessary for continued safe and reliable operation of the Wesleyville and Greenhill gas turbine facilities for the immediate future. The refurbishment included in this Application is necessary to return the Wesleyville Gas Turbine to service in advance of the 2014/2015 winter season, and to ensure the safe and reliable operation of the Wesleyville and Greenhill gas turbine system for the 2014/2015 and 2015/2016 winter seasons.

The age of the 2 gas turbine systems requires a review of the long-term viability of continued investment in these assets. To assist in determining the extent to which additional life extension can be achieved, Newfoundland Power will engage an engineering firm with expertise in thermal generation systems to review the engineering assessments completed in 2014 and make recommendations on the long-term viability of these assets.

The estimated cost to complete the 2014 refurbishment of the Wesleyville and Greenhill gas turbine systems proposed in this Application is $1,698,000.

Appendix A
Wesleyville Gas Turbine Photographs

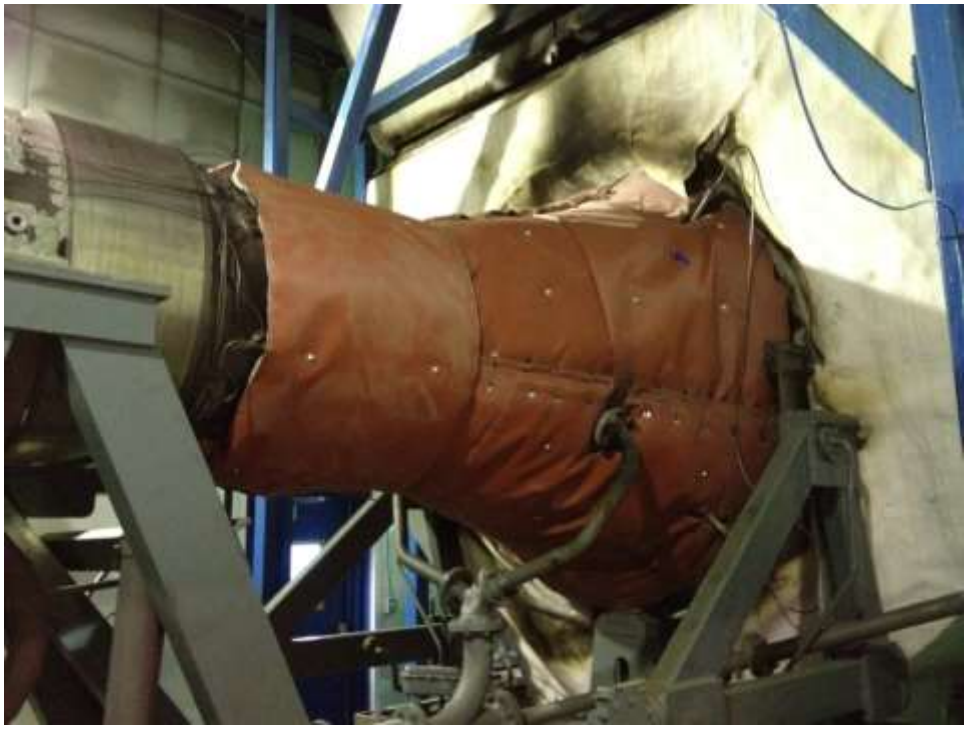

Figure 1 – Power Turbine Exterior View

Figure 2 – Lubricating Oil Cooler

Figure 3 – Crack in Power Turbine Inlet Duct

Figure 4 – Damaged Front Bearing

Appendix B
Greenhill Gas Turbine Photographs

Figure 1 – Air Intake Plenum

Figure 2 – Corrosion Damage Intake Plenum Door

Figure 3 – Insulating Blanket Damage

Figure 4 – Retaining Ring Distortion

Appendix C
Borescope Inspection Report
Wesleyville AVON Gas Turbine

Borescope Inspection Report For Avon Gas Turbine Serial No: 37116

Customer: Newfoundland Power

Date: 24th March 2014

Project Number: 4176

Alba Power Ltd
Tel: (44) 01569 730088
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Quality Certification
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Introduction

Mr Steven Collie was mobilised out to Wesleyville, Newfoundland and Labrador to the Wesleyville generating site for Newfoundland Power.

1 Purpose

The Purpose of the task was to carry out a borescope inspection on the Avon gas turbine serial number 37116 and to investigate why the compressor rotor does not rotate.

2 Introductory Summary

The gas turbine had been running for a period of time with no issues, the gas turbine then tripped as a result of vibration indicated on the gearbox. The gas turbine was then started and as the rpm increased to 4500rpm the gas turbine tripped with the centre vibration reaching 100mm/s, all other parameters were reading normal at this time.

3 Onsite Personnel

Steven Collie (Senior Field Service Technician Alba Power)
John Budgell (Maintenance Supervisor Newfoundland power)
Rick Tobin (Newfoundland Power)
Danny Shanahan (Newfoundland Power)

4 Daily Report

4.1 Monday 17th March

Onsite start 15:00Hrs Finish 19:00Hrs.

Travelled from St John's to Wesleyville, after the isolations and permits were in place Steven commenced the borescope inspection.

With the compressor not able to rotate this had an effect on how far back the borescope was able to go, just up to stage 6, no visible signs of any damaged blades or stators.

The front bearing housing is very pitted and heavily corroded especially around the VIGV bushes. The fuel nozzles were then removed from numbers 2 and 7 positions to inspect the combustion chamber areas and also the stage 15 compressor blades; and then the turbine section looking for any damage.

4.2 Tuesday 18th March

Onsite start 08:00Hrs Finish 13:30Hrs

Continued the borescope inspection of the gas turbine, all throughout the gas turbine there is coating loss on the compressor and turbine sections. The transition duct was removed from the exhaust to gain access and inspect the rear of the turbine section. There are slight rub indications on the HP turbine blades although not critical this will need to be inspected further.

With nothing conclusive being noted with the inside of the gas turbine my attention was now to remove the electric starter and inspect the planet gear, and pawl carrier. The starter bolt flange had to be heated to soften the Hylomar gasket sealant, once the starter was removed there were three small rivets lying inside the planet gear. The gear was removed to find all but two rivets were missing from the gas turbines mainline front bearing. It was at this point it was decided that the gas turbine would need to be removed for repair and that it be sent to Alba Power. Steven after completion of the Avon gas turbine inspection then travelled down to Marystown that afternoon.

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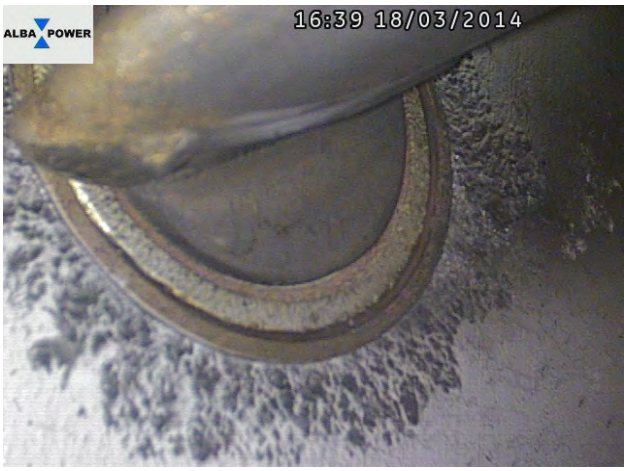
5 Digital Images

	
Air intake housing (Corrosion)	VIGV bush location (Corrosion)
	
Stage 00 blades (worn)	Stage 00 blades (worn)

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Coating degradation	Corrosion on stage 15 stators
	
Carbon build up on combustion chamber	Carbon build up on combustion chamber
	
Bridge piece on the combustion chamber	Bridge piece on the combustion chamber

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Discharge nozzle and HP NGV	HP NGV
	
Rub on HP turbine blade	Rub on HP turbine blade
	
LP NGV (old repair)	LP NGV (old repair)

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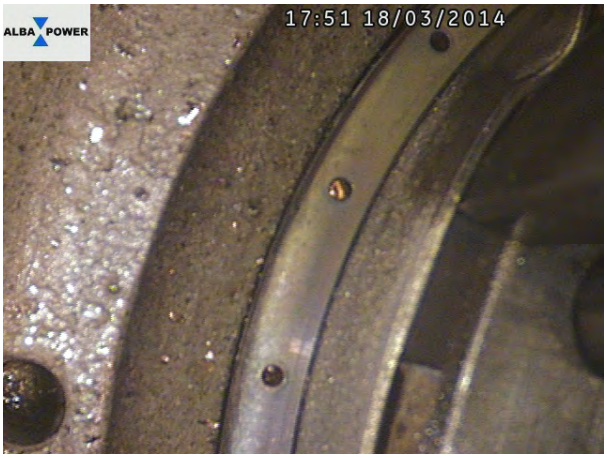
LP turbine blades (worn fir tree roots)	The hard face coating on the exhaust is very worn
	
Rivets missing from front bearing	Rivets lying next to the oil scavenge drain
	
Front bearing failure	Front bearing failure

6 Recommendations

To remove the failed Avon gas turbine 37116 and ship to the Alba Power facility for a bulk strip, detailed strip, and an investigation as to the cause for the front bearing to fail. At this time Alba Power would strongly recommend a full overhaul of all coatings on blades, stators and turbine sections. Also to inspect the entire gas turbine concentrating on the compressor discs and pin locations as there is extensive wear noted, also on the turbine blades and discs. For the package the entire off gas turbine oil system will need to be removed and flushed out eradicating any possible chance of contaminates getting back into the gas turbine when the reinstatement and commissioning is carried out, this is a standard practice when there is any bearing failure. Alba Power can assist with the removal and shipment of the gas turbine.

7 Conclusion

Is that the Avon gas turbine has suffered a catastrophic main line front bearing, causing the compressor to seize. The exact cause at this time is unknown and a detail strip of the gas turbine will need to be carried out within the Alba Power facility to determine the cause.

8 Customer Sign Off

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8 Customer sign off sheet

Customer Acceptance Sign Off Sheet

ALBA Job No: CO4176

Description of Works: Borescope Inspection

Site: Newfoundland Power, Wesleyville Site

Customer: Newfoundland Power

Designate: Avon

Manufacture: Rolls Royce

Eng. Serial No: 37116

Having witnessed the Borescope Inspection on Rolls Royce Avon S/N 37116 gas turbine, I the under signed, am satisfied with the work carried out and that it complies with the works being completed within the boundaries of the contract.

Signed: [signature]
Print: John Budgell
Position: Maintenance Supervisor
Date: Mar 21/14
For: Newfoundland Power

Signed: S. Collie
Print: STEVEN COLLIE
Position: SENIOR FIELD SERVICE TECHNICIAN
Date: 21/03/14
For: Alba Power Ltd

Alba Fitter 4

9 Report compiled by

Alba Power onsite personnel	Steven Collie	17st – 21st March2014
Report compiled by	Steven Collie	21st March 2014
Report Approved by	Grahame Martin	22nd March 2014

Appendix D
Borescope Inspection Report
Greenhill OLYMPUS Gas Turbine

Borescope Inspection Report For Olympus Gas Turbine Serial No: 202203

Customer: Newfoundland Power

Date: 24th March 2014

Project Number: 4176

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Introduction

Mr Steven Collie was mobilised out to Newfoundland and Labrador to the Grand Bank site for Newfoundland Power.

1 Purpose

The Purpose of the task was to carry out a borescope inspection on Olympus gas turbine serial number 202203, providing a condition report on the serviceability of the gas turbine.

2 Introductory Summary

The gas turbine has been in service since 1995.

Although there have been no recorded issues with the gas turbine there are obvious signs of wear and extensive coating loss throughout. Alba Power would recommended that a plan be put into place to allow the release of the gas turbine to the Alba Power facility for a detailed inspection to assess the extent of the wear, and also to safe guard the gas turbine against a potential failure, thus giving the gas turbine long serviceability.

3 Onsite Personnel

Steven Collie (Senior Field Service Technician Alba Power)
John Budgell (Maintenance Supervisor Newfoundland power)
Rick Tobin (Newfoundland Power)
Danny Shanahan (Newfoundland Power)

4 Daily Report

4.1 Wednesday 19th March

Onsite start 08:00Hrs Finish 18:00Hrs.

Travelled from Wesleyville to Grand Bank, after the isolations and permits were in place Steven commenced the borescope inspection.

The intake plenum had a lot of rust debris in the corners; also the walls within the plenum chamber need repairing to stop the rust from falling.

The air intake casing has coating loss on the struts leaving it exposed to the elements and salt air, IGV's and the compressor section are in a clean condition although with coating loss on the stators. The internal starter drive, and fuel pump bearings were found to be in a satisfactory condition, the HP compressor and stators are showing some signs of corrosion at this time, number 1&2 intermediate casing vane covers were removed to inspect the number seven bearing housing section. This was found to be in a good clean condition, all oil feed and scavenge pipes were also in a good clean order.

The fuel nozzles were removed to gain access to the turbine section, the combustion chambers were all showing carbon build up, but more importantly the chambers all look to be suffering from corrosion due to the length of time that they have been in service. It also looks like as some of the hard face coating on the air intake snouts is breaking up; images to follow in later section.

4.2 Thursday 20th March

Onsite start 08:00Hrs Finish 13:30Hrs

Continued the borescope inspection of the turbine section of the gas turbine. It was noted that the HP NGV's have total coating loss and the leading edges are showing signs of degradation. There was a blade pass carried out on the HP turbine blades and these were found to be in a serviceable condition. The LP NGV's have coating loss but at this time are also in a serviceable condition. A blade pass was carried out on the LP turbine blades and these are also in a serviceable condition.

Although most components are in a serviceable condition apart from the HP NGV's there is limited life remaining on these components. The exterior of the gas turbine is in a good order throughout.

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5 Running Data

Date:	20/03/2014		20/03/2014	
Time:	10:10		10:30	
N1:	4460		4384	
N2:	6250		6153	
N3:	3597		3599	
GG Inlet ^{o}F:	28		29	
GG Exhaust Temp ^{o}F:	777		765	
Gen Mw:	3.30		2.67	
CDP:	55		55	
GG Exhaust Temp:				
Actual:	Actual:	Diff:	Actual:	Diff:
1.	752	-28	734	-30
2.	781	0	767	-2
3.	821	33	816	39
4.	775	-14	757	-11
5.	815	26	789	22
6.	806	17	783	16
7.	776	-7	761	-7
8.	753	-29	739	-29

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6 Digital Images

Air intake plenum (rust debris)

Air intake plenum (rust debris)

Air intake casing

Air intake casing with IGV's

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Coating degradation on LP stators

Coating loss on the leading edge LP stators

Oil pipes inside the delivery casing

Number 7 bearing oil feed pipe

Carbon build up combustion chamber

Carbon build up combustion chamber

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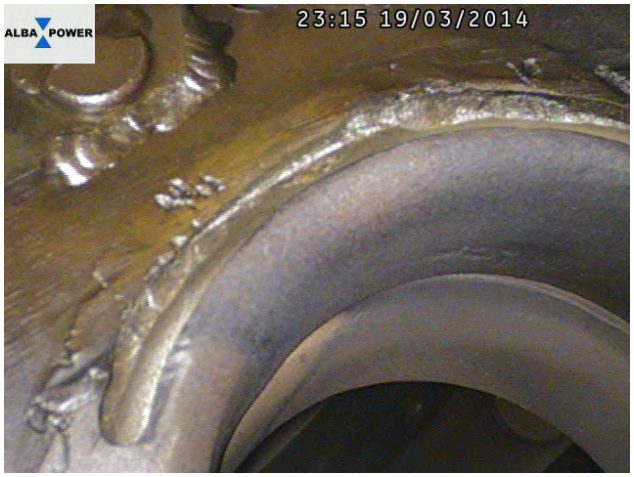
Combustion chamber corrosion	Combustion chamber corrosion
	
Old repair on No.5 combustion chamber	Old repair on No.5 interconnector
	
Leading edge HP NGV	Leading edge HP NGV

7 Recommendations

Alba Power's recommendation would be to check the magnetic chip detectors after every fired run, whether the gas turbine has run for 1 hour or 10 hours. This is to build on historical data. This would more importantly catch any early signs of possible bearing or gearing debris build up and this would help reduce further damage to the rest of the gas turbine if there were to be a failure.

The intake plenum needs work to eradicate the problem of rust falling from the walls which could be ingested into the gas turbine.

It would be a good idea to have the gas turbine lubricating oil pressure on the HMI to see if there are any changes in pressure, to also monitor the oil level to get a more accurate usage analysis.

Although the gas turbine starts and runs well, the fact that the gas turbine has coating loss throughout especially in the turbine section, should not be over shadowed and consideration should be made to remove the gas turbine and send it to the Alba Power Facility for overhaul or an exchange gas turbine can be arranged.

8 Conclusion

The gas turbine is serviceable for a time; there are some actions that need to be addressed in the near future to ensure the longevity of the Olympus gas turbine.

9 Customer Sign Off

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Customer Acceptance Sign Off Sheet

ALBA Job No: CO-4176

Description of Works: Olympus Borescope

Site: Newfoundland Power. Grand Back Site

Customer: Newfoundland Power

Designate: Olympus

Manufacture: Rolls Royce

Eng. Serial No: 202203

Having witnessed the Borescope on Rolls Royce Olympus S/N 202203 gas turbine, I the under signed, am satisfied with the work carried out and that it complies with the works being completed within the boundaries of the contract.

Signed:
Print: John Badgett
Position: Maintenance Supervisor
Date: Mar 21/14
For: Newfoundland Power

Signed:
Print:
Position:
Date: 21/03/14
For: Alba Power Ltd

Alba Fitter 4

Customer: Newfoundland Power
Project Number: 4176

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Date: 17/03/2014

10 Report compiled by

Alba Power onsite personnel	Steven Collie	17st – 21st March2014
Report compiled by	Steven Collie	21st March 2014
Report Approved by	Grahame Martin	25th March 2014

Appendix E
Turbine Service Report
Wesleyville AVON Gas Turbine

TURBINE SERVICE REPORT

TITLE	Package Inspection
REPORT BY	Stuart McLaren
DATE	03/05/14

REPORT NUMBER	60303
SERVICE REPRESENTATIVE	Stuart McLaren
POSITION	Senior Service Engineer
SERVICE ORDER NUMBER	GLL 11427
PERIOD OF VISIT	02/05/14 – 03/05/14
CUSTOMER	Newfoundland Power
SITE	Wesleyville
ENGINE TYPE	Avon
TURBINE SERIAL NUMBER	
CUSTOMER DESIGNATION	G330
GAS GENERATOR SERIAL NO.	37116
POWER TURBINE SERIAL NO	

Equipment overview

Equipment Details:

AVON

Model	- 1535-52L-10
Serial No	- 37116
Total Hours Run	- 592.35
Peak running hours	- 0
No of starts	- 288
Hours since last overhaul	- 529.35

POWER TURBINE

Model	- AP1
Serial No	-
Total Hours Run	-
Hours since last overhaul	-

GEARBOX

Make	-
Model	-
Serial No	-

ALTERNATOR

Make	- AE1
Model	- R 230435
Serial No	- AG 80/100

MAIN AIR INLET FILTERS

Make	- Farr
Model	- Camfill
Serial No	- R30/30WR

Work scope

Greenray Service Engineer was to be mobilised to Newfoundland Canada, where the AEI package located at the site in Wesleyville was to be inspected. This unit is utilised for peak power operation during periods of high demand, and is also run once a month for approximately 1 hour.

Work Carried Out

Visited the site in Wesleyville where the following areas were inspected:-

- Main combustion inlet system
- Power Turbine exhaust system
- Power Turbine gas path
- Power Turbine ducting
- Gearbox

The machine had been isolated prior to arrival, as the Gas Generator had failed due to a front end bearing failure. The Power Turbine transition piece and Gearbox top casings had already been removed to allow access for inspection. When asked, NP reported no running and/or operational issues with the machine prior to the bearing failure, other than the known vibration associated with the Gearbox. There had been history of high bearing temperatures on the non-drive end Power Turbine bearing however this has since been removed, cleaned, scraped and refitted with the result that it is now showing lower bearing temperatures.

Main Combustion Air Intake System

When this unit was relocated from Salt Pond to Wesleyville it had a new Air Intake System installed and is currently in good condition, however there are some areas of corrosion starting to appear which require cleaning and painting.

Exhaust System

Exhaust stack is the original unit with silencers and is in good condition with no signs of distortion or cracking. Due to the poor steel quality used, there is heavy surface corrosion present. The transition piece is believed to have been replaced when the unit was relocated, however this is not confirmed. The transition piece is in a good condition with no cracking and only minor distortion to the expansion piece.

Exhaust Volute externals are lagged with Plaster of Paris type lagging, which is in a fair condition, with all lagging material in place and no signs of flammable fluid contamination.

Exhaust Volute to exhaust stack transition does not have a flexible bellow/duct, meaning that there is an air gap around the circumference of the joint. This will allow hot gases to escape with the potential to increase the turbine hall temperatures to unacceptable levels during prolonged operational runs.

Exhaust Volute internals are in good condition with only surface corrosion being noted. The welded seams exhibited the heaviest corrosion and. although there was no cracking noted as being present, the corrosion may have weakened these areas and monitoring is recommended. There was no evidence of pooled fluids in the bottom of the volute.

Overall condition of the Exhaust System was good. See Fig 1 in appendices.

Power Turbine Gas Path

Visual inspections were carried using boroscope equipment and a camera for the Power Turbine gas path inspection.

There were no signs of cracking to the blading however foreign object damage to the rotor and stator blades was evident. Due to the physical location, and access limitations, it is difficult to assess the full extent of the damage to the blading.

The rotor disc exhibits heavy pitting around the blade root areas and is assumed to be the condition of the disc faces. During operation disc/blade roots operate under high stress and pitting/corrosion in this area increases the risk of cracking. See recommendations and Fig 2/Fig 3 in appendices.

Power Turbine Inlet Ducting

Inlet ducting consist of a sliding transition piece with an outer piston ring at either end, an outer ring with internal ceramic coating for the transition piece along with a one piece inner (cone) and outer ducts with 6 support struts.

The transition piece, outer ring and outer duct were in a good condition however the inner duct (cone) has five cracks at the downstream side of where the support struts pass through the inner duct. These cracks varied between 1”- 3” in length. The cone was also distorted around the 10 o’clock position (air craft convention) See Fig 4 in appendices

Gearbox

The Power Turbine is connected to the High speed pinion shaft via a single disc coupling, which in turns drives the low speed gear wheel. There is an auxiliary drive off the rear of the pinion which provides drive to the lubrication oil pump.

Both the high speed pinion and the low speed gears were found to have erosion marks believed to be from an earlier reported breakdown in the insulation between some lube oil pipework on the alternator allowing eddy currents to circulate. Newfoundland Power have set a load limit on this machine and do not run above 10Mw as vibration levels start to increase to an unacceptable level. When comparing the current erosion levels to those seen previously it is apparent that some areas have since polished up due to running of the machine.

The reported vibration levels have not increased since the visit from Greenray in 2004, and bearing temperatures are all normal. Due to the current running conditions and regime it was thought that a bearing inspection would not be a worthwhile exercise at this time.

The Lubrication oil pump flexible drive coupling membranes were showing signs of bowing. Checks were carried out and no cracks were noted o.
Although bowing is not reason to reject them, they should be checked for cracking on a regular basis as this would pose a risk of losing drive to the pump.

The gearbox internals were checked for any insecure items. Instrumentation was in a good condition and in general the gearbox was in a good condition with no oil leaks reported or witnessed.

Spares Used

None

Recommendations

1. Repair is required to the small areas of corrosion within the air intake plenum.
2. Installation of a flexible bellow between the Volute and exhaust stack if enclosure temperature become an issue. This will involve fabrication works.
3. Monitoring of corrosion and deterioration on exhaust volute welds is required.
4. Due to the heavy pitting seen on the rotor disc root areas and foreign object damage to the blading it is recommended that non-destructive testing is carried out to the rotor disk and blades. Particular attention should be made to inspection of the rotor disc, blade roots and lower portions of the blades and roots. Disc replacement should also be considered, dependant on the NDT results.
5. The cracking found to the inner duct (cone) requires repair. Removal of the duct to allow the cracks to be repaired will be required. In the current condition the inner duct is unserviceable due to risk of further fatigue failure/damage to the PT, and should be removed from service. When carrying out repairs welding procedures from the manufacturer should be closely followed as inappropriate repairs may cause further cracking and distortion.
6. Remove the EDLOP coupling and check the membranes for cracking on an annual basis. Replace as required.
7. Continue to observe Newfoundland Power requirement for maximum 10Mw load limit on this machine to maintain vibration levels within acceptable limits.

Appendices

Photographs of inspected items.

Fig 1 Corrosion in exhaust system.

Fig 2 Blade impact damage and pitting

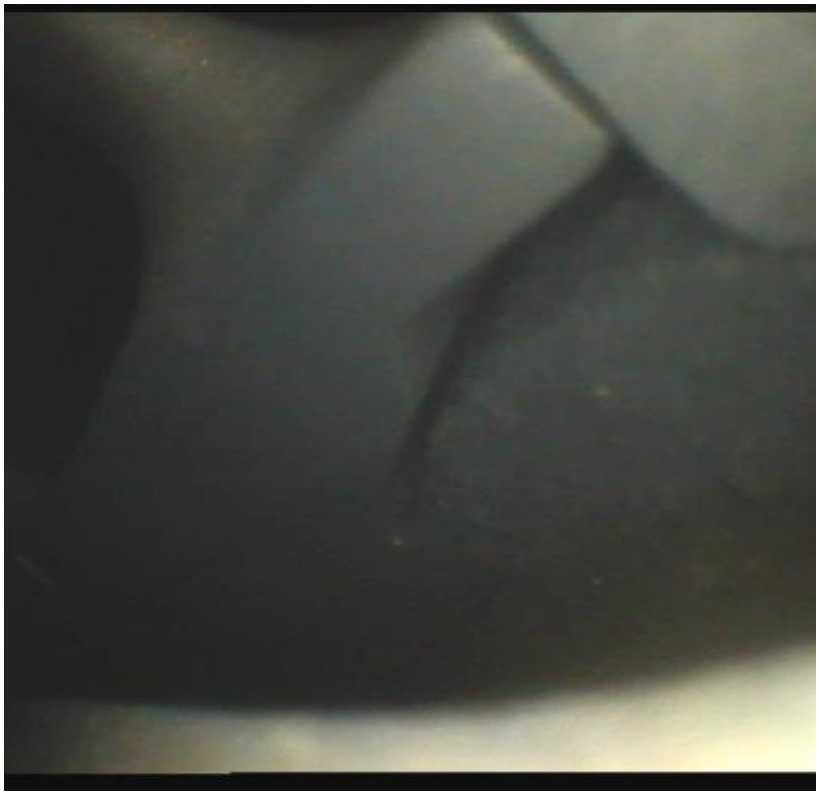

Fig 3 Blade and disc pitting at roots.

Fig 4 Crack in inner duct

Daily Logs

02/05/14

- Carried out borescope inspection to Power Turbine gas path, found cracking to the inlet inner duct cone. Requires welding.
- Carried out visual inspect to gearbox - ok
- Carried out exhaust volute inspection – ok
- Carried out air intake inspection – ok
- Refitted one of three gearbox covers.

03/05/14

- Refitted remaining gearbox covers
- Departed site.

S.McLaren
Senior Service Engineer

R.Lingard
Service Manager

Appendix F
Turbine Service Report
Greenhill OLYMPUS Gas Turbine

TURBINE SERVICE REPORT

TITLE	Package Inspection
REPORT BY	Stuart McLaren
DATE	01/05/14

REPORT NUMBER	60302
SERVICE REPRESENTATIVE	Stuart McLaren
POSITION	Senior Service Engineer
SERVICE ORDER NUMBER	GLL 11427
PERIOD OF VISIT	29/04/14 - 01/05/14
CUSTOMER	Newfoundland Power
SITE	Green Hill
ENGINE TYPE	Olympus
TURBINE SERIAL NUMBER	
CUSTOMER DESIGNATION	
GAS GENERATOR SERIAL NO.	OL202203
POWER TURBINE SERIAL NO	

Equipment overview

Equipment Details:

OLYMPUS

Model	- 2022
Serial No	- OL202203
Total Hours Run	- 4401
Peak running hours	- 446
No of starts	- 2813
Hours since last overhaul	- 2230

POWER TURBINE

Model	- Curtis Wright, CT2 MOD25
Serial No	-
Total Hours Run	-
Hours since last overhaul	-

GEARBOX

Make	-
Model	-
Serial No	-

ALTERNATOR

Make	- Brush
Model	- BD.A.X.70.76
Serial No	- 753641

MAIN AIR INLET FILTERS

Make	- Farr
Model	- HP
Serial No	- P85GT

Work scope

Greenray Service Engineer was to be mobilised to Newfoundland Canada, where the Curtis Wright CT2 package located at the Greenhill site in Grand Bank was to be inspected. This unit is utilised for peak power operation during periods of high demand, and is also run once a month for approximately 1 hour.

Work Carried Out

Visited Newfoundland Power (now referred to as NP) main office in ST. Johns 29/04/14 to carry out Health and Safety inductions relevant to NP, once completed visited Greenhill where the following areas were inspected:-

- Main combustion inlet system
- Power Turbine exhaust system
- Power Turbine gas path
- Power Turbine ducting
- Power Turbine Stators pressure casings
- Rotor Upstream Shroud Labyrinth Gland

When asked, NP reported no running and/or operational issues with the machine prior to shut down for maintenance.
The machine had been isolated prior to arrival to allow planned maintenance to be carried out.

Main Combustion Air Intake System

The air intake system has been refurbished within the last 7 years. Work included blasting and repainting of all internal and external surfaces. There is evidence of patch work repairs to several areas where it is assumed these had been holed due to corrosion.

The floor area (pre filtration) has galvanised steel sheeting fixed to it with stainless steel self-tapping screws. This has been done due to the floor being badly corroded pre blast cleaning and painting. The filtration consists of 48 x panel type filters of which are in a like new condition.

Post filtration, several holes were noted on the floor directly beneath the filter panel housings. This allows unfiltered air to enter the system, although this will be minimal. There were also 2 x blow in doors, however operation of these was not determined.

Overall condition of the air intake system was good with exception to the holed floor area post filtration.

Exhaust System

Exhaust stack has been replaced in the last 10 years for a like for like replacement and is currently in excellent condition. This consists of weather doors on top and an internal silencer. The internal bottom corners of the stack have previously been weld repaired and three of the four corners exhibit fresh cracking, all of which are very small, in the region of 1” to 3”and and are not considered to be cause for concern at this time, but require monitoring on a regular basis.

Exhaust Volute externals are lagged in blankets held in place with wire and lagging clips, the lagging materials are in a fair condition with all lagging in place and no signs of flammable fluid contamination.

Exhaust Volute to Exhaust stack bellow joint is in a like new condition.

Exhaust Volute internals are in good condition with only surface corrosion being noted, which is to be expected. There were small markings of pooled fluids which have since drained or evaporated.

Overall condition of the Exhaust System was good with only the cracks requiring to be monitored for further propagation. See Fig 1 in appendices.

Power Turbine Gas Path

Visual inspections were carried using boroscope equipment and a camera for the Power Turbine blades. The blading consisted of 1st stage stator, 1st stage rotor, 2nd stage stator and 2nd stage rotor. Fixing of the stator blades was not visible. Fixing of the 2nd stage rotor blades were seen to be typical fir tree roots with a locking strip to hold in the correct axial position, and it is assumed the first stage is a similar configuration.

Blading was viewed from the Inlet cone using the boroscope. Blades were inspected for foreign object damage, corrosion and for signs of cracking. All viewed blades were in a good condition with no obvious signs of cracking, however foreign object damaged was noted to the stator and rotor blades, along with some surface pitting which is likely to be due to corrosion. The blades also appeared to have salt deposit trails seen along various areas of the blade faces. There were also some slight signs of surface corrosion to the blading but this is to be expected with the running regime of the machine. See Fig 2 in appendices.

Upstream of the 1st stage stator blades there is an outer shroud ring that is made up of two halves, and is fixed in place by means of locating lugs and being clamped between the stator casing and the outer inlet cone. At the 3 o'clock position (aircraft convention) the shroud has broken loose encroaching into the gas path by approximately 3/8", and when pressure is applied it can be pushed back into position. This poses concern as continued running would allow the outer shroud to resonate in the turbulent air and could cause the shroud to fatigue and encroach further into the gas path, or worse case scenario of eventual failure causing catastrophic damage to the machine. During a previous report viewed on site, the shroud movement was also highlighted and measured to be encroaching into the gas path by 1/8". See Fig 3 in appendices.

Without reference to the manufacturer's guidelines on impact damage and surface pitting to blading, it is not possible to accurately state whether the unit is serviceable or if the damage seen can be construed as requiring immediate repair. However due to the physical size and robustness of the blading it is expected that the machine is serviceable, subject to continued maintenance and monitoring regimes. This is based upon experience and knowledge gained on many types of equipment of this type over several years, however Greenray cannot be held liable for any damage and/or consequential loss due to failure.

Power Turbine Inlet Ducting

Inlet ducting consists of a flexible bellow (Fern Duct) between the Gas Generator and Power Turbine. This has been replaced in the last 7 years and is in a like new condition, however two small leaks have been identified around the inlet circumference between the 7 and 8 o'clock position (aircraft convention) where the flexible bellow is fixed to the mating flange. There is an internal weld that runs round the circumference. This was checked for cracking and none were found. The leak is thought to be fed from the exit side of the Fern duct and back feeding to the leaking joint.

The inner and outer duct work is in a good condition with no signs of distortion or cracking.

Power Turbine Stators Pressure Casing

During a previous inspection surface cracking was found to the bottom half forward side of the casing at the 3 o'clock position (aircraft convention), as a result of this the machine was down rated from 25Mw to 20Mw. The pressure casing lagging blankets were removed and the horizontal casing joints were crack detected to identify any new cracks and to compare the known cracks current condition. The crack was not found to have propagated any further. See Fig 4 in appendices.

Rotor Upstream Shroud Labyrinth Gland

The opportunity was taken to measure the Rotor Upstream Shroud Labyrinth Gland as this had been done during a previous inspection. This required removing the Inner duct end cover **P/N: 494003** which was held in place with 36 bolts **P/N: MS9491-14** and 18 tab washers **P/N: 1523 P1.** Removal gave access to the disc cooling air pipework internal of the inner duct this was held in place with 16 Bolts **P/N: MS9490-18** and 16 nuts **P/N: 982D4** and 2 sealing rings **P/N: 181333.** After removal of the pipe, access was gained to allow removal of the diaphragm **P/N: 181329** which was held in place with 26 bolts **P/N: 181662** and 14 tab washers **P/N: 1525 P1.** This then exposed the shroud Labyrinth seal **P/N: 181327** which required to be measured. The labyrinth seal was in good condition with only minor wear seen. See clearances in appendices.

Spares Used

NP are to source replacement spares for the rebuild works.

Recommendations

1. Holes and heavy corrosion found within the air intake plenum should be cut out and patched to prevent further corrosion and ingress of particles to the filters and gas generator as a short term improvement. If the life of the machine was to be extended significantly then a replacement air intake plenum would be advised.
2. Continue to monitor cracks found in the exhaust for further propagation. Annual inspections, based on current running regime, are advised.

3. Outer shroud ring should be replaced/repaired on an urgent basis, as this poses a potential for catastrophic failure to the machine. This will involve removing the inlet outer ducting to allow removal of the shroud ring.
4. Repair is required to the Gas Generator to Power Turbine Inlet flexible joint (Fern Duct) to stop the current hot air leak, as this poses a potential fire hazard.
5. Continue to monitor cracking to the Power Turbine Stator pressure casings.
6. Monitor impact damage/corrosion of PT blading for further deterioration, and trend data. Annual inspection is advised.

Appendices

Photographs of inspected items.

Fig 1 Crack on weld in exhaust.

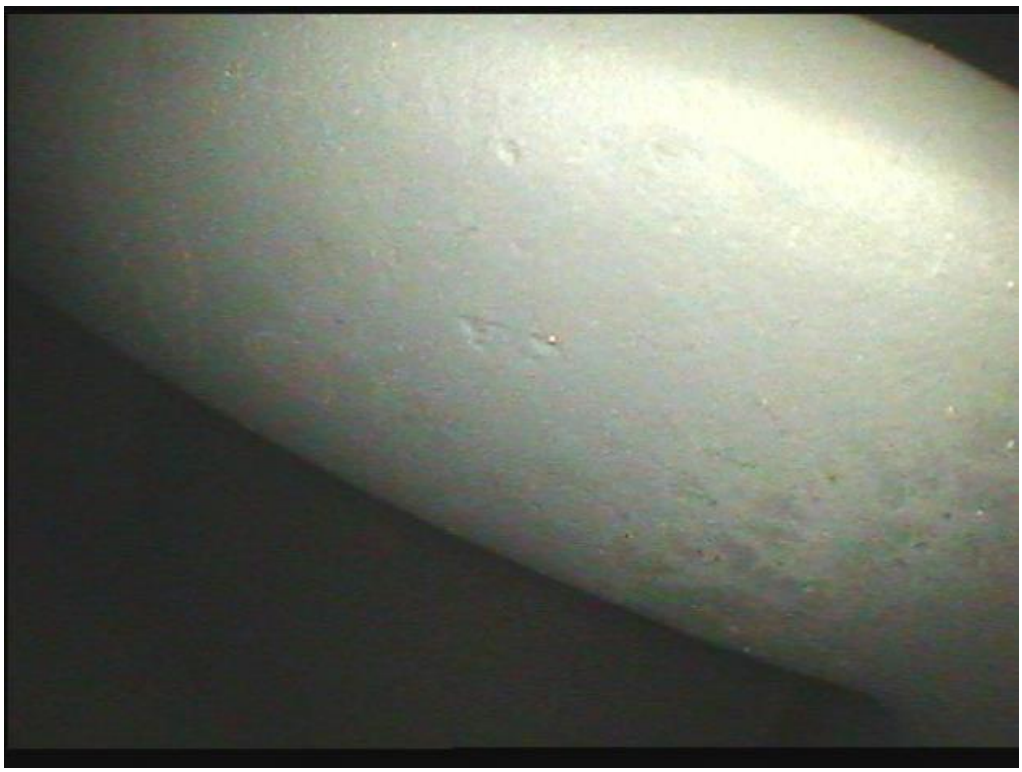

Fig 2 Typical Foreign Object Damage

Fig 3 Protrusion of stator shroud

Fig 4 Crack in pressure casing

Clearance figures

Shroud Labyrinth	12 o'clock	3 o'clock	6 o'clock	9 o'clock
Previous	0.087"	0.065"	0.060"	0.057"
Current	0.080"	0.055"	0.055"	0.077"

*Air Craft Convention

Inlet Inner Duct Support Lugs	12 o'clock	3 o'clock	6 o'clock	9 o'clock
Previous Axial	0.215"	0.117"	0.131"	0.128"
Previous Radial	-	0.020"	-	0.020"
Current Axial	0.234"	0.125"	0.191"	0.143"
Current Radial	0.020"	0.019"	0.022"	0.021"

*Air Craft Convention

Daily Log

29/04/14

- Arrived at site Green Hill site.
- Had a general look over unit in readiness for commencing work tomorrow.

30/04/14

- Carried out combustion plenum inspections – ok
- Carried out Exhaust Volute inspections – ok
- Carried out Power Turbine gas path inspection - ok
- Removed Power Turbine end cover to carry out labyrinth clearances checks on the 1st stage rotor disc.

01/05/14

- Removed lagging from Power Turbine Pressure casings to carry out dye penetrant checks on the casings themselves. Cracks were present, but these were identified during a previous inspection.
- Tidied site and travelled to Wesleyville.

S.McLaren
Senior Service Engineer

R.Lingard
Service Manager

Project Title: **2014 Thermal Generation Refurbishment**

Project Cost: **$1,698,000**

Project Description

This Generation project consists of expenditures to address thermal generation equipment issues that have become evident following the winter of 2013/2014. The Rolls Royce AVON gas generator at Wesleyville failed in service on March 5, 2014 while operating in support of system peak load conditions. A subsequent investigation has identified the failure of a bearing which has removed the Wesleyville Gas Turbine facility from service until the gas generator is refurbished.

Following the winter season, the Company engaged technical experts to assess the gas turbine facilities at Wesleyville and Greenhill to determine the necessary work to ensure the readiness of both facilities in advance of the 2014/2015 winter season. These assessments have identified the following work:

1. The refurbishment of the Rolls Royce AVON gas generator at an authorized Rolls Royce overhaul and maintenance facility ($999,000);

2. The refurbishment of the AEI power turbine and auxiliary systems on site at the Wesleyville Gas Turbine facility ($346,000); and

3. The installation of additional fuel storage capacity, refurbishment of the Curtis Wright power turbine and auxiliary systems on site at the Greenhill Gas Turbine facility ($353,000).

Details on the proposed expenditures are included in *Schedule A, Thermal Generation Refurbishment, June 2014*.

Justification

Newfoundland Power's thermal generation at Wesleyville and Greenhill is generally used to provide generation, both locally and for the Island Interconnected System, and to facilitate scheduled maintenance on transmission lines. These projects are necessary for the continued operation of thermal generation facilities in a safe, reliable and environmentally compliant manner.

Projected Expenditures

Table 1 provides a breakdown of the proposed supplemental expenditures for 2014 and a projection of expenditures through 2018.

Table 1
Project Cost
(000s)

Cost Category	2014	2015	2016 - 2018	Total
Material	$1,250	-	-	$1,250
Labour – Internal	166	-	-	166
Labour – Contract	-	-	-	-
Engineering	96	-	-	96
Other	186	-	-	186
Total	**$1,698**	**$0**	**$0**	**$1,698**

Costing Methodology

The budget estimate is based on detailed engineering estimates of individual requirements.

To ensure this project is completed at the lowest possible cost consistent with safe and reliable service, all material and contract labour will be obtained through competitive tendering.

Future Commitments

This is not a multi-year project.

NEWFOUNDLAND AND LABRADOR

AN ORDER OF THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

NO. P.U. ___ (2014)

IN THE MATTER OF THE PUBLIC
UTILITIES ACT, R.S.N. 1990,
CHAPTER P-47 (THE "ACT")

AND

IN THE MATTER OF AN APPLICATION BY
NEWFOUNDLAND POWER INC. (THE "APPLICANT")
FOR APPROVAL TO PROCEED WITH THE
CONSTRUCTION AND PURCHASE OF CERTAIN
IMPROVEMENTS AND ADDITIONS TO ITS PROPERTY
PURSUANT TO SECTION 41(3) OF THE ACT.

WHEREAS the Applicant is a corporation duly organized and existing under the laws of the Province of Newfoundland and Labrador, is a public utility within the meaning of the Act, and is also subject to the provisions of the *Electrical Power Control Act, 1994*, and

WHEREAS the Applicant operates thermal generation to deliver electricity to customers during emergencies, at time of high system demand and to support transmission and distribution work throughout its service territory on the island portion of the Province of Newfoundland and Labrador, and

WHEREAS on January 2nd through 8th, 2014, as a result of peak load conditions, a shortfall in available supply and a winter storm, the electricity system throughout the island of Newfoundland was stressed, and

WHEREAS throughout the winter of 2013/2014 Newfoundland Power's thermal generation was called upon to support peak load conditions, and

WHEREAS subsequent to the winter of 2013/2014 Newfoundland Power engaged experts to assess the thermal generation equipment at Wesleyville and Grand Bank, and

WHEREAS the Applicant through the expert assessments has identified refurbishments to the Applicant's thermal generation equipment necessary to return its thermal generation to normal service condition, and

WHEREAS the estimated capital expenditure to complete the refurbishment of the Applicant's property as proposed in the Application is $1,698,000, and

WHEREAS the proposed expenditure is necessary for the Applicant to provide service and facilities which are reasonably safe and adequate and just and reasonable pursuant to Section 37 of the Act.

IT IS THEREFORE ORDERED THAT: Pursuant to Section 41 (3) of the Act, the Board approves the capital expenditure of $1,698,000 associated with the improvements and additions to the Applicant's property as proposed in the Application.

DATED at St. John's, Newfoundland and Labrador, this _____ day of , 2014.

_____

_____

_____
G. Cheryl Blundon
Board Secretary