# NEWFOUNDLAND AND LABRADOR HYDRO

## 2004 CAPITAL BUDGET

### SUBMISSION TO PUBLIC UTILITIES BOARD

HYDRO
THE POWER OF COMMITMENT

# NEWFOUNDLAND AND LABRADOR HYDRO
# 2004 CAPITAL BUDGET



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**NEWFOUNDLAND AND LABRADOR HYDRO**
**2004 CAPITAL BUDGET**



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**Schedule of Reports:**

# APPLICATION

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

**IN THE MATTER OF** an Application by Newfoundland and Labrador Hydro for approval of: (1) its 2004 capital budget pursuant to s.41(1) of the Act; (2) its 2004 capital purchases, and construction projects in excess of $50,000 pursuant to s.41 (3) (a) of the Act; and (3) its estimated contributions in aid of construction for 2004 pursuant to s.41 (5) of the Act.

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

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

**STATES** that:

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

2. Section A to this Application is Hydro's proposed 2004 Capital Budget in the amount of $34.5 million prepared in accordance with the guidelines and conditions outlined in Order No. P.U. 7 (2002-2003).

3. Section B to this Application is a list of the proposed 2004 Construction Projects and Capital Purchases in excess of $50,000 prepared in accordance with Order No. P.U. 7 (2002-2003).

4. Section C to this Application contains a description of a project, located in Labrador, in a format consistent with the Guidelines for Minimum Filing Requirements for New Generation and Transmission Projects on the Island Interconnected System as set out in the Board's letter of August 19, 1999.

5. No new Leases in excess of $5,000 per year have been identified for 2004 in Section D.

6. Section E to this Application is a Schedule of Hydro's Capital Expenditures for the period 1998 to 2007.

7. Section F to this Application is a report on the status of the 2003 capital expenditures including those approved by Orders Nos. P.U. 29 (2002-2003), and P.U. 3 (2003), projects under $50,000 not included in these Orders, and the 2002 capital expenditures carried forward to 2003.

8. Section G to this Application contains the supplementary reports referred to in various capital budget proposals.

9. The proposed capital expenditures for 2004 as set out in this Application are required to allow Hydro to continue to provide service and facilities for its customers which are reasonably safe, adequate and reliable.

10. The Applicant has estimated the total of contributions in aid of construction for 2004 to be approximately $240,000. The information contained in the 2004 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.

11. Communications with respect to this Application should be forwarded to Maureen P. Greene, Q.C., Vice-President and General Counsel, P.O. Box 12400, St. John's, Newfoundland and Labrador, A1B 4K7, Telephone: (709) 737-1465.

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

(1) Approving Hydro's 2004 Capital Budget as set out in Section A hereto, pursuant to Section 41 (1) of the Act;

(2) Approving 2004 Capital Purchases and Construction Projects in excess of $50,000 as set out in Sections B and C hereto, pursuant to Section 41 (3) (a) of the Act; and

(3) Approving the proposed estimated contributions in aid of construction as set out in paragraph 10 hereof for 2004 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.

**DATED** at St. John's, Newfoundland, this 28th day of March, 2003.

**NEWFOUNDLAND AND LABRADOR HYDRO**

W. E. Wells
President and Chief Executive Officer

Newfoundland and Labrador Hydro
P.O. Box 12400
500 Columbus Drive
St. John's, Newfoundland and Labrador
A1B 4K7
Telephone: (709) 737-1291

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

**IN THE MATTER OF** an Application by Newfoundland and Labrador Hydro for approval of: (1) its 2004 capital budget pursuant to s.41(1) of the Act; (2) its 2004 capital purchases, and construction projects in excess of $50,000 pursuant to s.41 (3) (a) of the Act; and (3) its estimated contributions in aid of construction for 2004 pursuant to s.41 (5) of the Act.

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

## AFFIDAVIT

I, William E. Wells, Business Executive, make oath and say as follows:

1. That I am the President and Chief Executive Officer of Hydro and as such I have knowledge of and responsibility for the matters arising in the within matter.

2. That I have read the contents of the attached application and those contents are correct and true to the best of my knowledge, information and belief.

SWORN TO in the )
City of St. John's, in the )
Province of Newfoundland and Labrador)
this 28th day of March, 2003, )
before me: )

William E. Wells

Maureen P. Greene
Barrister (Nfld.)

# SECTION A

# NEWFOUNDLAND & LABRADOR HYDRO

## 2004 CAPITAL BUDGET - OVERVIEW

($,000)

| | Exp To 2003 | 2004 | Future Years | Total |
|---|---|---|---|---|
| GENERATION | 23 | 5,079 | 3,036 | 8,138 |
| TRANSMISSION & RURAL OPERATIONS | 118 | 12,177 | 0 | 12,295 |
| GENERAL PROPERTIES | 3,864 | 16,209 | 15,310 | 35,383 |
| ALLOWANCE FOR UNFORESEEN EVENTS | 0 | 1,000 | 0 | 1,000 |
| TOTAL CAPITAL BUDGET | 4,005 | 34,465 | 18,346 | 56,816 |

# NEWFOUNDLAND & LABRADOR HYDRO

## 2004 CAPITAL BUDGET - SUMMARY BY CATEGORY

($,000)

| | Exp To 2003 | 2004 | Future Years | Total |
|---|---|---|---|---|
| **GENERATION** | | | | |
| **HYDRO PLANTS** | | | | |
| Construction Projects | 20 | 2,507 | 0 | 2,527 |
| Tools & Equipment | 3 | 191 | 0 | 194 |
| **THERMAL PLANT** | | | | |
| Construction Projects | 0 | 2,281 | 1,034 | 3,315 |
| Property Additions | 0 | 78 | 2,002 | 2,080 |
| Tools & Equipment | 0 | 22 | 0 | 22 |
| **TOTAL GENERATION** | 23 | 5,079 | 3,036 | 8,138 |
| **TRANSMISSION & RURAL OPERATIONS** | | | | |
| **TRANSMISSION** | 111 | 4,216 | 0 | 4,327 |
| **SYSTEM PERFORMANCE & PROTECTION** | 0 | 303 | 0 | 303 |
| **TERMINALS** | 7 | 1,656 | 0 | 1,663 |
| **DISTRIBUTION** | 0 | 5,153 | 0 | 5,153 |
| **GENERATION** | 0 | 205 | 0 | 205 |
| **GENERAL** | | | | |
| Metering | 0 | 104 | 0 | 104 |
| Properties | 0 | 49 | 0 | 49 |
| Tools & Equipment | 0 | 491 | 0 | 491 |
| **TOTAL TRANSMISSION & RURAL OPERATIONS** | 118 | 12,177 | 0 | 12,295 |

# NEWFOUNDLAND & LABRADOR HYDRO

## 2004 CAPITAL BUDGET - SUMMARY BY CATEGORY

## ($,000)

| | Exp To 2003 | 2004 | Future Years | Total |
|---|---|---|---|---|
| **GENERAL PROPERTIES** | | | | |
| INFORMATION SYSTEMS & TELECOMMUNICATIONS | 2,280 | 13,817 | 13,905 | 30,002 |
| ADMINISTRATIVE | 1,584 | 2,392 | 1,405 | 5,381 |
| TOTAL GENERAL PROPERTIES | 3,864 | 16,209 | 15,310 | 35,383 |
| **ALLOWANCE FOR UNFORESEEN EVENTS** | 0 | 1,000 | 0 | 1,000 |
| TOTAL CAPITAL BUDGET | 4,005 | 34,465 | 18,346 | 56,816 |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERATION
## 2004 CAPITAL BUDGET - DETAIL

**($,000)**

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **HYDRO PLANTS** | | | | | | |
| **CONSTRUCTION PROJECTS** | | | | | | |
| Replace Unit No. 7 Exciter - Bay D'Espoir | 13 | 757 | | 770 | Oct. 04 | B-5 |
| Replace Gate Hoist No. 2 - Ebbegunbaeg Control Structure | 7 | 508 | | 515 | Sep. 04 | B-8 |
| Replace Unit 2 Governor Controls - Cat Arm | | 540 | | 540 | Oct. 04 | B-10 |
| Replace Unit 2 Exciter - Cat Arm | | 519 | | 519 | Nov. 04 | B-12 |
| Upgrade Controls Spherical Valve No. 3 - Bay D' Espoir | | 183 | | 183 | Aug. 04 | B-14 |
| TOTAL CONSTRUCTION PROJECTS | 20 | 2,507 | 0 | 2,527 | | |
| **TOOLS & EQUIPMENT** | | | | | | |
| Replace Loader/Backhoe - Bay D'Espoir | 3 | 121 | | 124 | Nov. 04 | B-16 |
| Purchase & Replace T & E Less than $ 50,000 | | 70 | | 70 | | |
| TOTAL TOOLS & EQUIPMENT | 3 | 191 | 0 | 194 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
# GENERATION
# 2004 CAPITAL BUDGET - DETAIL
# ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **THERMAL PLANT** | | | | | | |
| **CONSTRUCTION PROJECTS** | | | | | | |
| Upgrade Control System - Holyrood | | 1,553 | 1,034 | 2,587 | Aug. 05 | B-17 |
| Purch/Inst Ambient Monitoring System Enhancement | | 728 | | 728 | Oct. 04 | B-19 |
| TOTAL CONSTRUCTION PROJECTS | 0 | 2,281 | 1,034 | 3,315 | | |
| **PROPERTY ADDITIONS** | | | | | | |
| Upgrade Civil Structures | | 78 | 2,002 | 2,080 | Jul. 05 | B-22 |
| TOTAL PROPERTY ADDITIONS | 0 | 78 | 2,002 | 2,080 | | |
| **TOOLS & EQUIPMENT** | | | | | | |
| Purchase & Replace Tools & Equipment Less than $ 50,000 | 0 | 22 | 0 | 22 | | |
| TOTAL TOOLS & EQUIPMENT | 0 | 22 | 0 | 22 | | |
| **TOTAL GENERATION** | 23 | 5,079 | 3,036 | 8,138 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## TRANSMISSION & RURAL OPERATIONS
## 2004 CAPITAL BUDGET - DETAIL
($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **TRANSMISSION** | | | | | | |
| Upgrade TL214 - (138kV Bottom Brook - Doyles) | 111 | 2,836 | | 2,947 | Sep. 04 | B-25 |
| Replace Insulators TL233 - (230kV Buchans - Bottom Brook) | | 1,055 | | 1,055 | Oct. 04 | B-27 |
| Replace Wood Poles - Transmission | | 325 | | 325 | Dec. 04 | B-28 |
| TOTAL TRANSMISSION | 111 | 4,216 | 0 | 4,327 | | |
| **SYSTEM PERFORMANCE & PROTECTION** | | | | | | |
| Upgrade 138kV and 66kV Protection - Deer Lake and Sunnyside | | 150 | | 150 | Dec. 04 | B-29 |
| Replace Digital Fault Recorder - Bay D'Espoir | | 77 | | 77 | Aug. 04 | B-30 |
| Purchase and Install Remote Relay Data Acquisition Equipment | | 46 | | 46 | Aug. 04 | |
| Upgrade Breaker Controls - Western Avalon and Holyrood Terminal Stations | | 30 | | 30 | Aug. 04 | |
| TOTAL SYSTEM PERFORMANCE & PROTECTION | 0 | 303 | 0 | 303 | | |
| **TERMINALS** | | | | | | |
| Purchase and Install Transformer Addition - Happy Valley Terminal Station | 7 | 1,244 | | 1,251 | Nov. 04 | C-2 |
| Install Motor Drive Mechanisms on Disconnect Switches - West Coast | | 207 | | 207 | Oct. 04 | B-31 |
| Replace Instrument Transformers | | 77 | | 77 | Dec. 04 | B-33 |
| Replace Surge Arrestors | | 70 | | 70 | Dec. 04 | B-35 |
| Replace 125V Battery Banks - Bottom Brook and Holyrood Terminal Stations | | 58 | | 58 | Jul. 04 | B-37 |
| TOTAL TERMINALS | 7 | 1,656 | 0 | 1,663 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## TRANSMISSION & RURAL OPERATIONS
## 2004 CAPITAL BUDGET - DETAIL
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **DISTRIBUTION** | | | | | | |
| Provide Service Extensions | | 1,558 | | 1,558 | Dec. 04 | B-39 |
| Upgrade Distribution Systems | | 1,471 | | 1,471 | Dec. 04 | B-41 |
| Pole Replacements | | 993 | | 993 | Sep. 04 | B-43 |
| Insulator Replacements | | 945 | | 945 | Oct. 04 | B-45 |
| Purchase and Install Recloser L6 - Bear Cove | | 85 | | 85 | Oct. 04 | B-47 |
| Replace Substation Transformer - Rigolet | | 76 | | 76 | Oct. 04 | B-48 |
| Purchase and Install Recloser L1 - Conche | | 25 | | 25 | Oct. 04 | |
| TOTAL DISTRIBUTION | 0 | 5,153 | 0 | 5,153 | | |
| **GENERATION** | | | | | | |
| Upgrade Generator Relaying - Happy Valley North Plant | | 170 | | 170 | Sep. 04 | B-51 |
| Purchase and Install P.T.'s - Ramea | | 35 | | 35 | Sep. 04 | |
| TOTAL GENERATION | 0 | 205 | 0 | 205 | | |
| **GENERAL** | | | | | | |
| METERING | | | | | | |
| Purchase Meters & Equipment - TRO System | | 98 | | 98 | Dec. 04 | B-52 |
| Purchase Metering Spares - Bulk Electrical System | | 6 | | 6 | Dec. 04 | |
| TOTAL METERING | 0 | 104 | 0 | 104 | | |
| PROPERTIES | | | | | | |
| Survey of Hydro's Primary Distribution Line Right-of-Ways | | 49 | | 49 | Oct. 04 | |
| TOTAL PROPERTIES | 0 | 49 | 0 | 49 | | |
| TOOLS & EQUIPMENT | | | | | | |
| Purchase & Replace Tools & Equipment Less than $ 50,000 | | 102 | | 102 | | |
| Replace Light Duty Mobile Equipment Less than $ 50,000 | | 389 | | 389 | | |
| TOTAL TOOLS & EQUIPMENT | 0 | 491 | 0 | 491 | | |
| TOTAL GENERAL | 0 | 644 | 0 | 644 | | |
| TOTAL TRANSMISSION & RURAL OPERATIONS | 118 | 12,177 | 0 | 12,295 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERAL PROPERTIES
## 2004 CAPITAL BUDGET - DETAIL
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **INFORMATION SYSTEMS & TELECOMMUNICATIONS** | | | | | | |
| **SOFTWARE APPLICATIONS** | | | | | | |
| **Infrastructure Replacement** | | | | | | |
| Replace Energy Management System - Energy Control Centre | 1,214 | 4,293 | 6,780 | 12,287 | Oct. 06 | B-53 |
| **New Infrastructure** | | | | | | |
| Corporate Applications Environment | | 540 | | 540 | Dec. 04 | B-59 |
| Applications Enhancements | | 463 | | 463 | Dec. 05 | B-60 |
| Security Program - Centralized Log Monitoring & Analysis System | 57 | 83 | | 140 | Dec. 04 | B-62 |
| Security Program - Secure Remote Access | | 75 | 76 | 151 | Dec. 05 | B-64 |
| TOTAL SOFTWARE APPLICATIONS | 1,271 | 5,454 | 6,856 | 13,581 | | |
| **COMPUTER OPERATIONS** | | | | | | |
| **Infrastructure Replacement** | | | | | | |
| End User & Server Evergreen Program | | 2,811 | | 2,811 | Oct. 04 | B-66 |
| **New Infrastructure** | | | | | | |
| Peripheral Infrastructure Replacement - 2004 | | 101 | | 101 | Dec. 04 | B-69 |
| **Upgrade of Technology** | | | | | | |
| JDE Migration Assessment Study | | 231 | | 231 | May. 04 | B-70 |
| TOTAL COMPUTER OPERATIONS | 0 | 3,143 | 0 | 3,143 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERAL PROPERTIES
## 2004 CAPITAL BUDGET - DETAIL
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **INFORMATION SYSTEMS & TELECOMMUNICATIONS** | | | | | | |
| **NETWORK SERVICES** | | | | | | |
| Infrastructure Replacement | | | | | | |
| Replace VHF Mobile Radio System | | 3,048 | 5,802 | 8,850 | Dec. 05 | B-71 |
| Replace Powerline Carrier Equipment - Transmission System - West Coast | 1,009 | 419 | | 1,428 | Dec. 04 | B-73 |
| Replace Battery System - Multiple Sites - 2004 | | 274 | | 274 | Oct. 04 | B-75 |
| Replace Remote Terminal Unit for Hydro - Phase 5 | | 314 | | 314 | Oct. 04 | B-77 |
| Replace Telephone Isolation Equipment - Doyles | | 49 | | 49 | Jun. 04 | |
| Upgrade Site Grounding at Telecontrol Site - Phase 5 | | 49 | | 49 | Jun. 04 | |
| Network Infrastructure | | | | | | |
| Purchase Test Equipment | | 48 | | 48 | Jun. 04 | |
| Upgrade Local Area Networks (LANs) - Multiple Sites - 2004 | | 48 | | 48 | Oct. 04 | |
| Upgrade of Technology | | | | | | |
| Replacement of Operational Data & Voice Network - Phase 2 | | 971 | 1,247 | 2,218 | Oct. 05 | B-79 |
| TOTAL NETWORK SERVICES | 1,009 | 5,220 | 7,049 | 13,278 | | |
| **TOTAL INFORMATION SYSTEMS & TELECOMMUNICATIONS** | 2,280 | 13,817 | 13,905 | 30,002 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERAL PROPERTIES
## 2004 CAPITAL BUDGET - DETAIL
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| **ADMINISTRATIVE** | | | | | | |
| **Vehicles** | | | | | | |
| Replace Vehicles - Hydro System - 2003 | 1,584 | 1,142 | | 2,726 | Jun. 04 | B-81 |
| Replace Vehicles - Hydro System - 2004 | | 1,081 | 1,181 | 2,262 | Jun. 05 | B-83 |
| **ADMINISTRATION** | | | | | | |
| Purchase Cash Remittance Processor | | 60 | | 60 | Apr. 04 | B-85 |
| Electronic Metering Reading | | 36 | 224 | 260 | Dec. 05 | B-86 |
| Purchase & Replace Admin Office Equip less than $50,000 | | 73 | | 73 | | |
| **TOTAL ADMINISTRATIVE** | 1,584 | 2,392 | 1,405 | 5,381 | | |
| **TOTAL GENERAL PROPERTIES** | 3,864 | 16,209 | 15,310 | 35,383 | | |

# SECTION B

# NEWFOUNDLAND & LABRADOR HYDRO

## 2004 CAPITAL BUDGET - OVERVIEW

($,000)

| | Exp To 2003 | 2004 | Future Years | Total |
|---|---|---|---|---|
| GENERATION | 23 | 4,987 | 3,036 | 8,046 |
| TRANSMISSION & RURAL OPERATIONS | 111 | 10,251 | 0 | 10,362 |
| GENERAL PROPERTIES | 3,864 | 15,942 | 15,310 | 35,116 |
| ALLOWANCE FOR UNFORSEEN EVENTS | 0 | 1,000 | 0 | 1,000 |
| TOTAL CAPITAL BUDGET | 3,998 | 32,180 | 18,346 | 54,524 |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERATION
## 2004 CAPITAL BUDGET - PROJECTS OVER $50,000 BY CATEGORY

($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| Replace Unit No. 7 Exciter - Bay D'Espoir | 13 | 757 | | 770 | Oct. 04 | B-5 |
| Replace Gate Hoist No. 2 - Ebbegunbaeg Control Structure | 7 | 508 | | 515 | Sep. 04 | B-8 |
| Replace Unit 2 Governor Controls - Cat Arm | | 540 | | 540 | Oct. 04 | B-10 |
| Replace Unit 2 Exciter - Cat Arm | | 519 | | 519 | Nov. 04 | B-12 |
| Upgrade Controls Spherical Valve No. 3 - Bay D' Espoir | | 183 | | 183 | Aug. 04 | B-14 |
| Replace Loader/Backhoe - Bay D'Espoir | 3 | 121 | | 124 | Nov. 04 | B-16 |
| Upgrade Control System - Holyrood | | 1,553 | 1,034 | 2,587 | Aug. 05 | B-17 |
| Purch/Inst Ambient Monitoring System Enhancement | | 728 | | 728 | Oct. 04 | B-19 |
| Upgrade Civil Structures | | 78 | 2,002 | 2,080 | Jul. 05 | B-22 |
| **TOTAL GENERATION** | 23 | 4,987 | 3,036 | 8,046 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## TRANSMISSION & RURAL OPERATIONS
## 2004 CAPITAL BUDGET - PROJECTS OVER $50,000 BY CATEGORY
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| Upgrade TL214 - (138kV Bottom Brook - Doyles) | 111 | 2,836 | | 2,947 | Sep. 04 | B-25 |
| Replace Insulators TL233 - (230kV Buchans - Bottom Brook) | | 1,055 | | 1,055 | Oct. 04 | B-27 |
| Replace Wood Poles - Transmission | | 325 | | 325 | Dec. 04 | B-28 |
| Upgrade 138kV and 66kV Protection - Deer Lake and Sunnyside | | 150 | | 150 | Dec. 04 | B-29 |
| Replace Digital Fault Recorder - Bay D'Espoir | | 77 | | 77 | Aug. 04 | B-30 |
| Install Motor Drive Mechanisms on Disconnect Switches - West Coast | | 207 | | 207 | Oct. 04 | B-31 |
| Replace Instrument Transformers | | 77 | | 77 | Dec. 04 | B-33 |
| Replace Surge Arrestors | | 70 | | 70 | Dec. 04 | B-35 |
| Replace 125V Battery Banks - Bottom Brook and Holyrood Terminal Stations | | 58 | | 58 | Jul. 04 | B-37 |
| Provide Service Extensions | | 1,558 | | 1,558 | Dec. 04 | B-39 |
| Upgrade Distribution Systems | | 1,471 | | 1,471 | Dec. 04 | B-41 |
| Pole Replacements | | 993 | | 993 | Sep. 04 | B-43 |
| Insulator Replacements | | 945 | | 945 | Oct. 04 | B-45 |
| Purchase and Install Recloser L6 - Bear Cove | | 85 | | 85 | Oct. 04 | B-47 |
| Replace Substation Transformer - Rigolet | | 76 | | 76 | Oct. 04 | B-48 |
| Upgrade Generator Relaying - Happy Valley North Plant | | 170 | | 170 | Sep. 04 | B-51 |
| Purchase Meters & Equipment - TRO System | | 98 | | 98 | Dec. 04 | B-52 |
| **TOTAL TRANSMISSION & RURAL OPERATIONS** | 111 | 10,251 | 0 | 10,362 | | |

# NEWFOUNDLAND & LABRADOR HYDRO
## GENERAL PROPERTIES
## 2004 CAPITAL BUDGET - PROJECTS OVER $50,000 BY CATEGORY
## ($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| Replace Energy Management System - Energy Control Centre | 1,214 | 4,293 | 6,780 | 12,287 | Oct. 06 | B-53 |
| Corporate Applications Environment | | 540 | | 540 | Dec. 04 | B-59 |
| Applications Enhancements | | 463 | | 463 | Dec. 05 | B-60 |
| Security Program - Centralized Log Monitoring & Analysis System | 57 | 83 | | 140 | Dec. 04 | B-62 |
| Security Program - Secure Remote Access | | 75 | 76 | 151 | Dec. 05 | B-64 |
| End User & Server Evergreen Program | | 2,811 | | 2,811 | Oct. 04 | B-66 |
| Peripheral Infrastructure Replacement - 2004 | | 101 | | 101 | Dec. 04 | B-69 |
| JDE Migration Assessment Study | | 231 | | 231 | May. 04 | B-70 |
| Replace VHF Mobile Radio System | | 3,048 | 5,802 | 8,850 | Dec. 05 | B-71 |
| Replace Powerline Carrier Equipment - Transmission System - West Coast | 1,009 | 419 | | 1,428 | Dec. 04 | B-73 |
| Replace Battery System - Multiple Sites - 2004 | | 274 | | 274 | Oct. 04 | B-75 |
| Replace Remote Terminal Unit for Hydro - Phase 5 | | 314 | | 314 | Oct. 04 | B-77 |
| Replacement of Operational Data & Voice Network - Phase 2 | | 971 | 1,247 | 2,218 | Oct. 05 | B-79 |
| Replace Vehicles - Hydro System - 2003 | 1,584 | 1,142 | | 2,726 | Jun. 04 | B-81 |
| Replace Vehicles - Hydro System - 2004 | | 1,081 | 1,181 | 2,262 | Jun. 05 | B-83 |
| Purchase Cash Remittance Processor | | 60 | | 60 | Apr. 04 | B-85 |
| Electronic Metering Reading | | 36 | 224 | 260 | Dec. 05 | B-86 |
| **TOTAL GENERAL PROPERTIES** | 3,864 | 15,942 | 15,310 | 35,116 | | |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit No. 7 Exciter – Bay d'Espoir

**Location:** Bay d'Espoir

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

This project for 2004 is the continuation of a project which the Board has approved funds for 2003. The project consists of the purchase, installation and commissioning of a replacement static exciter for Unit 7 at Bay d'Espoir. The exciter will be an ABB Unitrol P similar to that used on Units 1 to 6 at Bay d'Espoir. The installation will be done during the planned maintenance outage for Unit 7 in 2004. This project is part of an ongoing replacement program started in 1995. To date, exciters have been replaced on six units at Bay d'Espoir, two units at Holyrood and most recently on Unit 1 at Cat Arm in 2002.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 510.0 | 0.0 | 510.0 |
| **Labour** | 0.0 | 65.0 | 0.0 | 65.0 |
| **Engineering** | 12.0 | 63.0 | 0.0 | 75.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 1.1 | 119.2 | 0.0 | 120.3 |
| **Total** | **13.1** | **757.2** | **0.0** | **770.3** |

**Operating Experience:**

The existing exciter is part of the original equipment installed in 1977. It has been in service for 96300 hours. The most recent repair on the exciter is a fan failure in September 2000 which resulted in a unit trip.

**Project Justification:**

The existing General Electric (GE) Silcomatic IV exciter is the original equipment installed in 1977. GE is no longer able to guarantee the availability of components needed to repair failed electronic cards.

A report titled "A Condition Assessment of Exciters within the Bay d'Espoir Powerhouse No.2, Hind's Lake, Upper Salmon, Cat Arm and Holyrood Generating Stations" dated March 28, 2000 was prepared by Generation Engineering and was submitted to the Board as part of Hydro's 2003 Capital Budget Application (Section G, Appendix I).

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit No. 7 Exciter – Bay d'Espoir **(cont'd.)**

**Project Justification: (cont'd.)**
This report looked at the service history of the Unit 7 exciter and the availability of technical support and spare parts from the original equipment manufacturer (General Electric).

At the time of the report, GE identified two cards that were obsolete and no longer manufactured. Hydro has one of these cards in stock but not the other. As well, GE stated that they would provide technical support for the near future but could not guarantee the repair of failed cards as the electronic components to repair the cards may not be available. If parts were to fail and spares were not available, it could result in a lengthy outage.

The report recommended the replacement of the Unit 7 exciter in 2004. The average service life of the six exciters replaced in Bay d'Espoir and two in Holyrood between 1995 and 2000 was 27 years. Based on an in service date of 1977 for the Unit 7 exciter, 2004 is an acceptable time to replace it.

The replacement of the Unit 7 exciter is a preventative measure to ensure that an exciter is in place that is fully supported by the manufacturer. The same model of exciter used at Bay d'Espoir on Units 1 - 6 is proposed for the Unit 7 replacement in 2004. The training for this type of exciter has been done and maintenance and engineering personnel will have familiarity with this model.

The loss of the exciter on Unit 7 would result in the unit (150 MW) being out of service until repairs could be made. If a working spare part is available, the outage duration would be short. If the part is not available, the outage will be lengthy while a spare is being found or a new exciter has to be purchased and commissioned. This will impact the reliability and availability of the unit and it could affect Hydro's ability to supply all of its customers. Depending on the time of year when an outage occurs, replacement capacity, if available, would have to be obtained through increased thermal production at Holyrood or gas turbine sites at significantly higher costs. The cost of replacement energy from Holyrood arising from an outage of this unit

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit No. 7 Exciter – Bay d'Espoir **(cont'd.)**

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

is approximately $168,000/day assuming fuel at $29.20/bbl. As well, a lengthy outage would increase the risk of spill during high inflow periods.

**Future Plans:**

This project will complete the exciter replacement at Bay d'Espoir.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Gate Hoist No. 2 - Ebbegunbaeg Control Structure

**Location:** Ebbegunbaeg Control Structure

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

This project for 2004 is a continuation of a project for which the Board has approved funds for 2003. The project consists of the replacement of the existing screw stem hoist mechanism on gate No. 2 at the Ebbegunbaeg Control Structure with a wire rope type hoist.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 279.0 | 0.0 | 279.0 |
| **Labour** | 0.0 | 106.0 | 0.0 | 106.0 |
| **Engineering** | 6.0 | 22.0 | 0.0 | 28.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 9.0 | 0.0 | 9.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 0.6 | 91.9 | 0.0 | 92.5 |
| **Total** | **6.6** | **507.9** | **0.0** | **514.5** |

**Operating Experience:**

The Ebbegunbaeg gates control the flow of water from Meelpaeg Lake into the Upper Salmon and Bay d'Espoir power plants and is in virtually continuous use. The structure and equipment are 35 years old. In 2000, two screw stems, drive nuts and extensions were replaced at a cost of $52,000. Engineering, delivery and installation took 5 months. Since then, slight bends have developed and drive nuts had to be replaced again.

**Project Justification:**

The existing screw stem hoists are 35 years old and require significant maintenance. Although screw stem gates are common across Canada, each installation is custom designed and "off the shelf" parts are not available for hoists of this age. Screw stems bend frequently, are expensive to replace and have a long lead time for manufacture. The gear boxes and other components are obsolete and replacement parts must be reverse engineered and custom manufactured. Depending on which component fails, a gate could be out of service for several months awaiting a replacement part. As the structure is remotely controlled, it is essential that the gates are capable of being operated at all times. If a screw stem were to break or brass drive nut strip during gate closure, the gate indication could be "closed" at the Energy Control Centre, while

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Gate Hoist No. 2 - Ebbegunbaeg Control Structure **(cont'd.)**

**Project Justification: (cont'd.)**
the gate is actually in the open position. Were such an event to occur when the unit at Upper Salmon is not available, water would have to be spilled around the Upper Salmon facility. The value of this lost production is equivalent to approximately 3,200 barrels of oil per day at Holyrood. At $29.20/barrel, this would represent a loss of $93,000 per day.

The Ebbegunbaeg gates are very important in the operation of the Bay d'Espoir reservoir system. The hoist removed will be retained to provide spare parts for the remaining two gates. For normal operation only one gate is used at Ebbegunbaeg. Gate No. 2 hoist will be replaced because, as the center gate, it is hydraulically preferred and receives the most use. Replacing the hoist mechanism with a new assembly will ensure that the most frequently operated gate has high reliability. Wire rope hoists are expected to be more reliable than screw stem hoists.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**
None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit 2 Governor Controls – Cat Arm

**Location:** Cat Arm

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

This project consists of the purchase, installation and commissioning of a replacement for the controls portion of the governor on Unit 2 at Cat Arm. The installation will be done during the planned outage of the unit in 2004.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 325.0 | 0.0 | 0.0 | 325.0 |
| **Labour** | 80.0 | 0.0 | 0.0 | 80.0 |
| **Engineering** | 50.0 | 0.0 | 0.0 | 50.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 85.0 | 0.0 | 0.0 | 85.0 |
| **Total** | **540.0** | **0.0** | **0.0** | **540.0** |

**Operating Experience:**

The governor controls are the original equipment which has been in service since 1984 and has been in operation approximately 33,000 hours. The most recent card repair on Unit 2 governor was the replacement of the speed setpoint control card on July 3, 2002.

**Project Justification:**

The governor on Unit 2 at Cat Arm is the original equipment put into service in 1984. It serves to regulate the speed of the generating unit. The governor controls are an analog electronic type that has been manufactured since 1974. The replacement is required due to the manufacturer's decision to discontinue repair or replacement of electronic cards by the end of 2004.

A report titled "Condition Assessment of Governor Controls for Upper Salmon and Cat Arm Units" was prepared by Generation Engineering dated June 2001 and is attached to Section G, Appendix 1. This report reviewed the service history of the Cat Arm governor controls and the availability of technical support and spare parts from the original equipment manufacturer.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit 2 Governor Controls – Cat Arm **(cont'd.)**

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

The report recommended that the governor controls for one unit should be replaced in 2004 as a preventative measure which will ensure that a supply of spare parts is available beyond 2004 for the remaining unit.

The loss of the governor controls would result in the unit being out of service until repairs could be made. While spares are available the problem can be corrected and the unit returned to service within a reasonably short time. After 2004 a failure could result in a lengthy outage to the unit while a replacement control system is purchased and installed. A typical delivery time frame for a governor control system is 120 days.

Depending on the time of year when an outage occurs, replacement capacity, if available, would have to be obtained through increased thermal production at Holyrood or gas turbines at significantly higher costs. Replacement energy from Holyrood as a result of an outage to this unit would cost approximately $71,000/day assuming fuel at $29.20/bbl. As well, a lengthy outage would increase the risk of spill during higher inflow periods.

To ensure that the project will be completed at lowest possible cost, Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit 2 Exciter – Cat Arm

**Location:** Cat Arm

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

The project consists of the purchase, installation and commissioning of a replacement static exciter for Unit 2 at Cat Arm. The replacement exciter will be an ABB Unitrol F model similar to that installed at Cat Arm - Unit No. 1 in 2002 and Granite Canal in 2003.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 305.0 | 0.0 | 0.0 | 305.0 |
| **Labour** | 80.0 | 0.0 | 0.0 | 80.0 |
| **Engineering** | 50.0 | 0.0 | 0.0 | 50.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 83.5 | 0.0 | 0.0 | 83.5 |
| **Total** | **518.5** | **0.0** | **0.0** | **518.5** |

**Operating Experience:**

The existing exciter is part of the original equipment in service since 1984. The unit has been in operation for 33,000 hours. The most recent problem with the exciter was in September 2001 when the field breaker repeatedly opened and closed.

**Project Justification:**

The existing Brown Boveri Type A 16030 exciter is the original equipment installed in 1984. Spare parts for the exciter are no longer manufactured or technically supported by the manufacturer.

A report titled “A Condition Assessment of Exciters within the Bay D’Espoir Powerhouse No. 2, Hinds Lake, Upper Salmon, Cat Arm and Holyrood Generating Stations” was prepared by Generation Engineering dated March 28, 2000. This report reviewed the service history of the Unit 2 exciter and the availability of technical support and spare parts from the original equipment manufacturer. The report was submitted to the Board as part of Hydro’s 2003 Capital Budget Application (Section G, Appendix I)

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Unit 2 Exciter – Cat Arm **(cont'd.)**

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

The manufacturer has advised that all parts are obsolete and no longer manufactured. The lack of engineering support was identified as a concern in addition to the spare parts availability. If parts were to fail and spares were not available, it could result in a lengthy outage.

Depending on the time of year when an outage occurs, replacement energy, if available, would have to be obtained through increased thermal production at Holyrood or gas turbines at significantly higher cost. Replacement energy from Holyrood as a result of an outage to this unit would cost approximately $71,000/day assuming fuel at $29.20/bbl. As well, a lengthy outage would increase the risk of spill during high inflow periods.

Training for the proposed type of exciter has been completed, spare parts are available, and maintenance and engineering personnel are familiar with the model. To-date, exciters have been replaced on six units at Bay d'Espoir, two units at Holyrood and most recently on Unit No. 1 at Cat Arm during 2002.

**Future Plans:**

This project will complete exciter replacements at Cat Arm.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Upgrade Controls Spherical Valve No. 3

**Location:** Bay d'Espoir

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

This project involves the upgrading of the control system for spherical valve No. 3 by replacing components, including control valves, piping, tubing, and control panel. It is a continuation of a program started in 2001 to upgrade control systems on spherical valves at Bay d'Espoir. The Board has previously approved upgrades on three of the six systems at Bay d'Espoir powerhouse No. 1. The new controls will have stainless steel mechanical components for corrosion protection and a programmable logic controller with manual overrides.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 100.0 | 0.0 | 0.0 | 100.0 |
| **Labour** | 39.0 | 0.0 | 0.0 | 39.0 |
| **Engineering** | 6.0 | 0.0 | 0.0 | 6.0 |
| **Project Management** | 7.0 | 0.0 | 0.0 | 7.0 |
| **Inspection & Commissioning** | 2.0 | 0.0 | 0.0 | 2.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 29.2 | 0.0 | 0.0 | 29.2 |
| **Total** | **183.2** | **0.0** | **0.0** | **183.2** |

**Operating Experience:**

Bay d'Espoir unit No. 3, along with the spherical valve and control system became, operational in October 1967. This generating unit typically operates for 5,500 hours each year. The spherical valve is the main shut-off valve for the turbine and also functions as an emergency shut-off device. In the last five years, there have been 28 maintenance events for this control system, which is much higher than expected. Control systems on Unit No. 4 and Unit No. 2 were upgraded in 2001 and 2002 respectively and the upgrade for Unit No. 1 is expected to be completed during 2003.

**Project Justification:**

The control system for spherical valve No. 3 is obsolete and unreliable. Replacement parts have to be reversed engineered and custom made. The failure of the existing control system can result in the following events:

## 2004 CAPITAL PROJECTS OVER $50,000
## EXPLANATIONS

**Project Title:** Upgrade Controls Spherical Valve No. 3 – Bay d'Espoir **(cont'd.)**

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

a) Single unit outage (75 MW) due to spherical valve not operating, with loss of generation and an extended outage;

b) Outage (150 MW) of two units on the same penstock and potential damage to the unit if the spherical valve stays open during a unit runaway condition and forcing the head gate closure.

c) Loss of all six units (450 MW) in powerhouse No. 1 if the spherical valve or seals fail while the turbine access door is open for maintenance resulting in the flooding of powerhouse No. 1, with the potential for loss of life.

Depending on the time of year when a failure occurs, replacement capacity and energy, if available, would have to be obtained through increased thermal production at Holyrood or gas turbine sites at significantly higher costs. As well, a lengthy outage would increase the risk of spill during high inflow periods. The cost of replacement energy from Holyrood arising from an outage of two units (150 MW) is approximately $168,000/day assuming fuel at $29.20/bbl. Given the significance of the generating capacity to the overall system, it would be unacceptable to maintain the status quo and risk the loss of capacity.

**Future Plans:**

It is currently planned to have control systems upgraded on two more units at Bay d'Espoir over the next two years.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Replace Loader/Backhoe

**Location:** Bay d'Espoir

**Division:** Production

**Classification:** Hydro Plants

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**Project Description:**

This project is a continuation of a project for which the Board has approved funds for 2003. The project consists of the replacement of loader/backhoe - V9770 at Bay d'Espoir.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 115.0 | 0.0 | 115.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 3.0 | 0.0 | 0.0 | 3.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 0.1 | 5.6 | 0.0 | 5.7 |
| **Total** | **3.1** | **120.6** | **0.0** | **123.7** |

**Operating Experience:**

The current machine is a 1990 JCB Model 1400 loader with an attached backhoe. It is the only loader/backhoe at the Bay d'Espoir facility and it is used extensively for maintenance on dams, dykes, roads and grounds at Bay d'Espoir, Upper Salmon, Hinds Lake, Cat Arm and Paradise River. It is also used for winter road maintenance such as clearing snow and handling salt and sand. Corrective maintenance costs on this machine has been averaging $9,000 annually, excluding preventative maintenance and routine maintenance costs.

**Project Justification:**

This machine is critical to the maintenance programs at the hydroelectric sites. A mechanical evaluation has indicated symptoms of serious engine deterioration and the body structure is showing signs of major wear. The number of breakdowns and associated repair costs have been increasing and the machine is nearing the end of its useful life.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for this equipment.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Control System

**Location:** Holyrood

**Division:** Production

**Classification:** Generation - Thermal

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**Project Description:**

This project involves the replacement of an obsolete Distributed Control System (DCS) on the three Holyrood units, which provide control for the boilers, boiler auxiliary systems, station service, burner management, turbine and generator monitoring and control for other plant systems. Replacement parts for these existing controls are no longer available from the vendor and only limited vendor support is available. It is proposed that some parts of the overall system (cabinets, I/O cards and terminations) will be reused. The unit 1 and 2 DCS will be upgraded in 2004 and Unit 3 in 2005.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 1,000.0 | 790.0 | 0.0 | 1,790.0 |
| **Labour** | 35.0 | 28.0 | 0.0 | 63.0 |
| **Engineering** | 277.0 | 30.0 | 0.0 | 307.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 240.6 | 186.1 | 0.0 | 426.7 |
| **Total** | **1,552.6** | **1,034.1** | **0.0** | **2,586.7** |

**Operating Experience:**

The existing DCS for Units No. 1 and 2 was implemented in 1988 and for Unit No. 3 in 1992. The manufacturer's commitment of support for these systems expired in January 2002 and January 2003 respectively.

**Project Justification:**

The manufacturer has informed Hydro that parts of the Distributed Control System (DCS) are obsolete and the system is no longer supported. Based on the spare parts available in Hydro's inventory and failure history, sufficient spare parts are available to maintain and operate the systems until 2004. Beyond this date it is expected that only used or refurbished parts would be available for some repairs, however, their availability would be uncertain. The Holyrood units cannot operate without the DCS functioning properly and a replacement is necessary to maintain plant availability and reliability. An outage to a unit (150-175 MW) could affect Hydro's ability to supply customers. Depending on the time of year, replacement capacity, if available,

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Control System **(cont'd.)**

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

may have to be obtained from gas turbines at significantly higher costs (e.g. $400,000/day assuming fuel is at $0.333/ℓ). It is proposed that the replacement be sourced to the same vendor (Westinghouse Process Controls Inc.) as parts of the existing system can be reused at a savings compared to a full replacement with another system. Based on the information from the vendor, the new technology would have guaranteed support for ten (10) years and it is expected that with minor software upgrades it will serve the plant for the next fifteen (15) years. A cost analysis report titled "Distributed Control System Lifecycle Planning" is attached in Section G, Appendix 2.

Besides improving plant reliability the replacement system will improve boiler efficiency due to a faster control system.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Purchase/Install Ambient Monitoring System Enhancement

**Location:** Holyrood Generating Station

**Division:** Production

**Classification:** Generation - Thermal

---

**Project Description:**

This project involves the expansion of the emission measurement capabilities of the existing ambient monitoring stations to include continuous monitoring of fine particulates and NOx (nitrogen oxides). These stations currently monitor ambient $SO_2$. Particulate monitors will be installed at each of four remote monitoring sites and at the plant main gate and NOx monitors will be installed at each of the four remote sites, but not at the plant main gate. (NOx will not be monitored at the main gate because this location is too close to the source for gas to reach ground level.)

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 523.0 | 0.0 | 0.0 | 523.0 |
| **Labour** | 36.0 | 0.0 | 0.0 | 36.0 |
| **Engineering** | 26.0 | 0.0 | 0.0 | 26.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 143.1 | 0.0 | 0.0 | 143.1 |
| **Total** | **728.1** | **0.0** | **0.0** | **728.1** |

**Operating Experience:**

The Holyrood Thermal Generating Station has been in operation since 1971. The ambient monitoring stations were placed in service in 1996.

**Project Justification:**

In recent years, the Holyrood plant has been called upon for increased production arising from higher customer demand and a period of lower than normal inflow at Hydro's hydroelectric facilities. This has resulted in increased scrutiny by the Provincial Department of Environment and the public, particularly those living in close proximity to the plant. Holyrood is one of the most significant sources of environmental emissions in the Province and as Hydro has made a commitment to take a proactive position with respect to environmental responsibility and stewardship, attention has been focused on quantifying these emissions with a view to identifying the most appropriate means to reducing the facilities environmental impact on the

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Purchase/Install Ambient Monitoring System Enhancement **(cont'd.)**

**Project Justification: (cont'd.)**
surrounding environs. Air emissions from the Holyrood plant include particulate matter, NOx, SOx, and acid aerosols. To quantify emissions at the source and as it impinges on the surrounding area, the following projects have been implemented or are in progress:

- In 1996, four permanent ambient monitoring stations were installed at locations identified through a computer dispersion model. These sites currently measure only SO2 and total suspended particulates (TSP);

- In 1999 and 2000, opacity meters were installed on the stacks to monitor visible emissions (smoke density) of the exit gases;

- In 2002, approval was received for a continuous emission monitoring (CEM) system to measure NOx, SO2, CO2, CO and O2 at the stacks and provided a means to manage emissions directly at the source through control of the combustion process. This project is expected to be completed this year: and,

- In 2002, approval was received for a mobile ambient monitoring station to monitor fine particulates, NOx and SOx at locations not covered by existing permanent monitoring stations. This was to address concerns that air quality events were occurring at locations other than the existing monitoring sites and not as predicted by dispersion models. As well, Hydro received approval for a study to investigate technologies to reduce air emissions including particulates at Holyrood.

The current proposal will enhance the permanent ambient monitoring stations by adding NOx and fine particulate monitoring capability. These stations along with the other monitoring facilities enable emission measurement at the source and in the surrounding area and where problems are identified will assist in the process of selection of the most cost effective abatement technologies from amongst the many that are available.

## 2004 CAPITAL PROJECTS OVER $50,000
## EXPLANATIONS

**Project Title:** Purchase/Install Ambient Monitoring System Enhancement **(cont'd.)**

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

Although current emissions are by and large below the statutory limits, a health risk assessment report by Cantox in 1999 concluded that further quantification of emissions is required. This report was supplied in response to NP-104 at Hydro's 2001 Rate Application. The expansion of monitoring capability at the permanent sites will provide additional data to support dispersion modeling. As well, the Department of Environment recommends monitoring fine particulate fallout.

To ensure that this project will be completed at the lowest possible cost, Hydro will solicit competitive bids for all material and external Labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Civil Structures – Holyrood

**Location:** Holyrood Generating Station

**Division:** Production

**Classification:** Generation - Thermal

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**Project Description:**

1. Boiler Stack

   The main components of Stack #2 are: concrete shell, steel liner, stack breeching and associated utilities. The scope of work involves the replacement of the interior steel liner. The liner consists of ¼" thick steel shell and has a diameter of 13.5 ft. and height of 302 ft. It is supported at the base by 35 ft. high steel framing. A similar replacement of the stack liner on Unit No. 1 was approved by the Board in 2003.

2. CW Screen Structure

   There are four Circulating Water (CW) screen structures located in pumphouse #1 and their function is to screen the salt water required for plant cooling. Two of the structures have been approved by the Board for replacement in 2003. The scope of this proposal involves the replacement of the two remaining steel structures that support the traveling screens. Each structure is 32 ft. high and fabricated from 3/8" thick angle iron and has a foot print of 5 ft. x 7 ft.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 0.0 | 1,355.0 | 0.0 | 1,355.0 |
| **Engineering** | 70.0 | 100.0 | 0.0 | 170.0 |
| **Project Management** | 0.0 | 140.0 | 0.0 | 140.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 8.5 | 406.5 | 0.0 | 415.0 |
| **Total** | 78.5 | 2,001.5 | 0.0 | 2,080.0 |

**Operating Experience:**

1. Boiler Stack

   The stack and steel liners are 34 years old and are in use whenever the unit is operating. The cost to provide inspection and emergency maintenance for the steel liner during the last 6 years was $232,300.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Civil Structures – Holyrood **(cont'd.)**

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

2. CW Screen Structure

   The CW Screen structures are 34 years old and are located in 20 ft. of salt water. They are in use whenever the units are operating. In 2000 the traveling screens and rollers were replaced because of increased operating and maintenance costs.

**Project Justification:**

1. Boiler Stack

   Regular annual inspections revealed the need for major upgrade work for Stack No. 2. Stack inspections in 2001 and 2002 identified increased metal loss and thin spots on the steel liner. The probability of liner buckling and failure continues to increase. Emergency repairs undertaken during the last several years involved covering holes with steel patches or rings. This approach is believed to be no longer sufficient to prevent buckling or to provide the level of reliability required.

   Several options to upgrade the steel liner were explored. Each of the options results in a similar overall cost to extend the life of the steel liner to 2020, however, replacement of the steel liner will provide the best reliability over the remaining plant life. The liner replacement will be done during the major outage to Unit No. 2 and therefore will have minimal impact on its availability for generation.

   Failure to replace the liner as recommended would result in continued deterioration of the steel liner until buckling occurs and then failure. This would result in costly repairs with the unit out-of-service for the duration of the repairs, which would impact the supply of power to customers.

   An analysis of the possible options report titled "Evaluation of Options to Refurbish Stack Liner #2" is attached in Section G, Appendix 3.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Civil Structures - Holyrood **(cont'd.)**

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

2. CW Screen Structure

   Inspections done in 1999 and 2000 confirm severe corroding, metal loss and the need for planned replacements of the CW screen structures. The probability of structure failure is increasing with time, corrosion, and mechanical wear.

   The failure to replace the structures as recommended would result in continued deterioration of the structures until their failure. This would result in costly repairs and reduced unit availability for the duration of the repairs, which would impact the supply of power to the customer.

   To ensure that this project will be completed at the lowest possible cost, Hydro will solicit competitive bids for all material and external labour.

**Future Plans:**

Work associated with this project is expected to be completed by 2005.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade TL214 (138kV Bottom Brook - Doyles)

**Location:** Bottom Brook and Doyles

**Division:** Transmission & Rural Operations

**Classification:** Transmission

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**Project Description:**

This project for 2004 is the continuation of a project which the Board has approved funds for 2003. The project involves the addition of structures, installation of counterweights and replacement of insulators, over the whole line. The proposal includes costs to provide temporary generation to serve customers during outages required to complete the upgrade.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 740.0 | 0.0 | 740.0 |
| **Labour** | 0.0 | 770.0 | 0.0 | 770.0 |
| * **Engineering** | 78.0 | 570.0 | 0.0 | 648.0 |
| **Environment** | 14.0 | 67.0 | 0.0 | 81.0 |
| **Internal Construction** | 0.0 | 40.0 | 0.0 | 40.0 |
| **Land and Survey** | 10.0 | 0.0 | 0.0 | 10.0 |
| **Project Management** | 0.0 | 90.0 | 0.0 | 90.0 |
| **Inspection & Commissioning** | 0.0 | 25.0 | 0.0 | 25.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 8.7 | 534.2 | 0.0 | 542.9 |
| **Total** | **110.7** | **2,836.2** | **0.0** | **2,946.9** |

* **Cost of Alternative Generation Included in Engineering Cost**

**Operating Experience:**

TL214 is a 138kV transmission line which was constructed in 1968. Outage records confirm that outages are caused mainly due to high winds, salt contamination and lightning. No major upgrades have been carried out on this line since its construction.

**Project Justification:**

The TL214 transient outage frequency rate is 8.31 per 100 km/year, and the sustained outage frequency is 1.90 per 100 km/year. From 1990 - 2001 there have been 46 interruptions attributed to lightning and salt contamination and 83 interruptions due to wind related causes.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade TL214 (138kV Bottom Brook - Doyles) **(cont'd.)**

**Project Justification:**

A condition assessment review was conducted to confirm the condition of the line and to recommend corrective action. The full report titled "TL214 Condition Assessment and Recommendations for Upgrading" was submitted to the Board as part of Hydro's 2003 Capital Budget Application (Section G, Appendix 3).

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

This is a two-year project with detailed engineering work and material ordering taking place in 2003 and the construction work taking place in 2004. There is no future work planned beyond 2004.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace Insulators TL233 (230kV Buchans - Bottom Brook)

**Location:** Buchans and Bottom Brook

**Division:** Transmission & Rural Operations

**Classification:** Transmission

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**Project Description:**

TL233 is a 230kV transmission line that runs from Buchans to Bottom Brook, a distance of 135 km. It is an H-Frame wooden pole line, which was constructed in 1973. This project is to replace all of the remaining Canadian Ohio Brass (COB) insulators on the line, from structure 250 to 577, inclusive.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 500.0 | 0.0 | 0.0 | 500.0 |
| **Labour** | 236.0 | 0.0 | 0.0 | 236.0 |
| **Engineering** | 62.0 | 0.0 | 0.0 | 62.0 |
| **Project Management** | 46.0 | 0.0 | 0.0 | 46.0 |
| **Inspection & Commissioning** | 14.0 | 0.0 | 0.0 | 14.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 196.6 | 0.0 | 0.0 | 196.6 |
| **Total** | 1,054.6 | 0.0 | 0.0 | 1,054.6 |

**Operating Experience:**

During the 2000 preventative maintenance program, a total of 1950 insulators were tested, with 77 insulators being found defective (i.e. 4%). During the 2001 program a total of 115 defective insulators were found (i.e.6%). Each year a significant quantity of defective COB insulators are found and defective insulators are showing up on strings that have had replacements during previous maintenance cycles (i.e. 5 years).

**Project Justification:**

This is the continuation of a program to replace pre-1974 vintage insulators manufactured by COB. These COB insulators are part of a group of insulators that has experienced industry-wide failures due to cement growth causing radial cracks that resulted in moisture intrusion. The section of line from structure 250 to 577 is the only section on TL233 with COB insulators in service. The insulators in the remaining section (structure 1 to 249) have been changed. Replacement is essential to maintain system security and reliability.

To ensure that the project will be completed at lowest possible cost, Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace Wood Poles - Transmission

**Location:** Various Sites

**Division:** Transmission & Rural Operations

**Classification:** Transmission

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**Project Description:**

This project consists of the replacement of deteriorated wood poles on Hydro's bulk electrical transmission system.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 90.0 | 0.0 | 0.0 | 90.0 |
| **Labour** | 175.0 | 0.0 | 0.0 | 175.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 60.9 | 0.0 | 0.0 | 60.9 |
| **Total** | **325.9** | **0.0** | **0.0** | **325.9** |

**Operating Experience:**

Newfoundland and Labrador Hydro operates approximately 2500 km of wood pole transmission lines at various voltage levels from 69kV to 230kV. This includes the maintenance of 26,000 transmission poles to deliver power to Hydro's terminal stations located on the Island and in Labrador. Approximately 35% of these poles are in excess of thirty-years old.

**Project Justification:**

Through the 2003 transmission preventative maintenance program, a number of wood poles will be identified which will require replacement in 2004 due to significant deterioration. Replacement of these poles will be essential to maintaining power system reliability.

To ensure that this project will be completed at the lowest possible cost, Hydro will solicit competitive bids for all material and external labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade 138kV and 66kV Protection

**Location:** Deer Lake and Sunnyside Terminal Stations

**Division:** Transmission & Rural Operations

**Classification:** System Performance & Protection

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**Project Description:**

This project consists of the purchase and installation of microprocessor based relays to improve protection on the 138kV lines: TL239 and TL245 at Deer Lake; 100L and 109L at Sunnyside; and, 66kV lines - TL225 and TL226 at Deer Lake. The existing relays will be removed and the new equipment installed on modified protection panels.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 80.0 | 0.0 | 0.0 | 80.0 |
| **Labour** | 31.0 | 0.0 | 0.0 | 31.0 |
| **Engineering** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 19.2 | 0.0 | 0.0 | 19.2 |
| **Total** | **150.2** | **0.0** | **0.0** | **150.2** |

**Operating Experience:**

The existing electromechanical relays are approximately 30 years old and are difficult to maintain and calibrate. As a result, system performance levels are adversely affected.

**Project Justification:**

This project will improve the protection on 138kV and 66kV lines which currently have electromechanical relays for both phase and ground protection. The relays will also provide faster back-up clearing times. They will have enhanced capabilities, self-diagnostics and alarm in the event of an internal failure. These relays can be remotely interrogated thus enabling more timely analysis of problems on the lines or with the relays themselves. This is part of ongoing initiative to improve protection systems on the bulk transmission system.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Digital Fault Recorder - Bay d'Espoir

**Location:** Bay d'Espoir Terminal Station

**Division:** Transmission & Rural Operations

**Classification:** System Performance & Protection

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**Project Description:**

This project consists of the purchase, installation and commissioning of a new 16 channel Digital Fault Recorder at Bay d'Espoir Terminal Station #2 to replace the existing unit.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 41.5 | 0.0 | 0.0 | 41.5 |
| **Labour** | 12.1 | 0.0 | 0.0 | 12.1 |
| **Engineering** | 6.6 | 0.0 | 0.0 | 6.6 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 2.2 | 0.0 | 0.0 | 2.2 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 14.6 | 0.0 | 0.0 | 14.6 |
| **Total** | 77.0 | 0.0 | 0.0 | 77.0 |

**Operating Experience:**

The existing recorder is approximately 16 years old. The technology is outdated and there are continuing problems with the operation of the unit.

**Project Justification:**

Fault recorders are required to provide real time and historical information on equipment operation during faults which will be used in the identification of problems which, when corrected, will enhance performance thereby improving customer service and reliability.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Install Motor Drive Mechanisms on Disconnect Switches - West Coast

**Location:** West Coast

**Division:** Transmission & Rural Operations

**Classification:** Terminals

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**Project Description:**

This project consists of the installation of motor drive mechanisms on seven 230kV disconnect switches at Stephenville (2), Massey Drive (4), and Bottom Brook (1). This will allow the disconnects to be motor operated rather than the current manual operation.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 51.0 | 0.0 | 0.0 | 51.0 |
| **Labour** | 58.0 | 0.0 | 0.0 | 58.0 |
| **Engineering** | 22.0 | 0.0 | 0.0 | 22.0 |
| **Project Management** | 11.0 | 0.0 | 0.0 | 11.0 |
| **Inspection & Commissioning** | 24.0 | 0.0 | 0.0 | 24.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 41.3 | 0.0 | 0.0 | 41.0 |
| **Total** | **207.3** | **0.0** | **0.0** | **207.3** |

**Operating Experience:**

Disconnects are used for equipment isolations either for system operations or for regular maintenance activities. These disconnects are the original 230kV units that were installed with the stations when they were first constructed in the late 1960's. They are inspected regularly, lubricated as required and insulators are replaced when they fail in service.

**Project Justification:**

When originally installed, the normal design practice was that disconnects be manually operated. The only motorized disconnects provided were those used for transformer protection and isolation. However, since that time, a workplace safety concern has identified the requirement for motorized disconnects.

The arrangement of the 230kV disconnect switches is such that the operator has to stand directly under the switch to operate it. From this position, the operator does not have a full clear view of the switch and cannot observe strain or breakage on the associated station post insulators and other switch components and is therefore at risk of serious injury.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Install Motor Drive Mechanisms on Disconnect Switches - West Coast **(cont'd.)**

**Project Justification: (cont'd.)**
During the period from 1988 to 1999, Hydro experienced three incidents associated with the failure of station post insulators on 230kV disconnects. This resulted in regular inspections being carried out to identify faulty insulators and have them replaced prior to in-service failure. However, this practice will not completely eliminate the risks associated with manual switching.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**
This is the second year of a three-year program to install motor operators on all manual 230kV disconnects on the system.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Instrument Transformers

**Location:** Various Terminal Stations

**Division:** Transmission & Rural Operations

**Classification:** Terminals

---

**Project Description:**

This project involves the purchase and installation of replacement instrument transformers (potential transformers, capacitive voltage transformers and current transformers) at various terminal stations across the system.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 60.0 | 0.0 | 0.0 | 60.0 |
| **Labour** | 3.2 | 0.0 | 0.0 | 3.2 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 13.8 | 0.0 | 0.0 | 13.8 |
| **Total** | **77.0** | **0.0** | **0.0** | **77.0** |

**Operating Experience:**

Instrument transformers have a typical service life of 30-40 years, depending on the service conditions. Units are inspected and tested regularly and replacements are made based on these maintenance assessments or on 'in-service' failures. The maintenance assessments for instrument transformers are visual inspection and voltage/current checks of the secondary circuits. Typically, approximately 6 instrument transformers fail or need to be replaced each year.

**Project Justification:**

Instrument transformers provide critical input 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.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Instrument Transformers **(cont'd.)**

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

When these units fail, the normal utility practice is to replace, as they are not repairable and to hold a reserve inventory sufficient to replace service units based on maintenance assessments or failure.

Project estimates are based on an equal number of units in each voltage class (69kV, 138kV and 230kV) requiring replacement.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials.

**Future Plans:**

This is an annual allotment, which will be adjusted from year to year depending on ongoing performance.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace Surge Arrestors

**Location:** Various Terminal Stations

**Division:** Transmission & Rural Operations

**Classification:** Terminals

---

**Project Description:**

This project involves the purchase and installation of replacement surge arrestors at various terminal stations across the system.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 46.8 | 0.0 | 0.0 | 46.8 |
| **Labour** | 10.0 | 0.0 | 0.0 | 10.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 13.5 | 0.0 | 0.0 | 13.5 |
| **Total** | 70.3 | 0.0 | 0.0 | 70.3 |

**Operating Experience:**

Surge arrestors provide critical overvoltage protection of the power system equipment from lightning and switching surges. Throughout the regions there are surge arrestors in the 69kV, 138kV and 230kV voltage classes, in service. Replacements are typically required as a result of maintenance assessments, in-service failures, and equipment that has reached the end of its useful service life. Equipment manufacturers indicate the useful service life of surge arrestors as 20 years. Typically, 15 surge arrestors will require replacement per year across the system.

**Project Justification:**

In-service failures due to severe lightning strikes and switching surges are unavoidable and require immediate replacement to ensure system overvoltage protection. Replacements based on maintenance assessments and the manufacturers' recommended useful service life are required to prevent additional in-service failures. Lightning arrestors can fail catastrophically resulting in system disturbances, and high potential for damage to adjacent equipment. The timely replacement of surge arrestors prior to age or condition related in-service failures will improve system reliability.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Surge Arrestors **(cont'd.)**

**Project Justification:**

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials.

**Future Plans:**

This is an annual allotment, which will be adjusted from year to year depending on ongoing performance.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace 125V Battery Banks

**Location:** Bottom Brook and Holyrood Terminal Stations

**Division:** Transmission & Rural Operations

**Classification:** Terminals

---

**Project Description:**

This project consists of the purchase and installation of a new 60 cell, 125 volt, and 300 ampere hour stationary battery bank for each of the terminal stations at Bottom Brook and Holyrood. Each battery will be a lead calcium flooded cell type. The new batteries will be designed to be compatible with the existing chargers at each station.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 37.0 | 0.0 | 0.0 | 37.0 |
| **Labour** | 8.0 | 0.0 | 0.0 | 8.0 |
| **Engineering** | 6.0 | 0.0 | 0.0 | 6.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 7.0 | 0.0 | 0.0 | 7.0 |
| **Total** | **58.0** | **0.0** | **0.0** | **58.0** |

**Operating Experience:**

The current station batteries were originally installed in 1984 and will be in service for 20 years by 2004. Regular maintenance work involves voltage, specific gravity and load discharge tests. For the two stations, the DC load requirements have not changed. Therefore, there is no requirement to change the capacity of the battery bank.

**Project Justification:**

The station battery bank provides the DC supply for the station and transmission line protection equipment, control and operation. Routine maintenance tests have confirmed a general deterioration in the battery cell conditions and a 15 to 20% reduction in battery cell capacity.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Replace 125V Battery Banks **(cont'd.)**

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

The batteries have shown the normal expected life deterioration until the past two years, when regular maintenance tests indicated an increased rate of growth of cell plates and a decrease in loading capability to less than 80% of the full battery rating. This increased rate of deterioration indicates that the battery is at the end of its life. The normal expected life of this type of battery is 18 to 20 years.

If the batteries are not replaced, remote control of the station from ECC will not be possible during system outages and the system protection and control equipment will not function properly and this will result in reduced system reliability.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Service Extensions

**Location:** All Service Areas

**Division:** Transmission & Rural Operations

**Classification:** Distribution

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**Project Description:**

This project is an annual allotment based on past expenditures to provide for service connections (including street lights) to new customers. This summary identifies the total budget for all regions.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 725.0 | 0.0 | 0.0 | 725.0 |
| **Labour** | 696.0 | 0.0 | 0.0 | 696.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 137.0 | 0.0 | 0.0 | 137.0 |
| **Total** | 1,558.0 | 0.0 | 0.0 | 1,558.0 |

**Operating Experience:**

An analysis of average historical expenditure (i.e. 1998 - 2002) on new customer connections is shown in the following table. All historical dollars were converted to 2002 dollars using the GDP Implicit Price Deflator and a 5-year average calculated.

| **Region** | **Avg. Yearly Expenditures (1998 - 2002) ($000)** |
|---|---|
| Central | $ 484 |
| Northern | $ 447 |
| Labrador | $ 569 |
| **Total** | $ 1,500 |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

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

**Project Justification:**

Based on the 5-year average of service extension expenditures for the period 1998 - 2002 (in 2002 dollars) the following budget was developed assuming escalation in 2003 and 2004 of approximately 2.0%.

| Region | 2004 Budget ($000) |
|---|---|
| Central | $ 503 |
| Northern | $ 464 |
| Labrador | $ 591 |
| **Total** | $ 1,558 |

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

This is an annual allotment, which will be adjusted from year to year depending on historical expenditures.

## 2004 CAPITAL PROJECTS OVER $50,000
## EXPLANATIONS

**Project Title:** Upgrade Distribution Systems

**Location:** All Service Areas

**Division:** Transmission & Rural Operations

**Classification:** Distribution

---

**Project Description:**

This project is an annual allotment based on past 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 damage caused by storms and adverse weather conditions and salt contamination. This summarizes the total budget for all regions.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 773.0 | 0.0 | 0.0 | 773.0 |
| **Labour** | 560.0 | 0.0 | 0.0 | 560.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 138.0 | 0.0 | 0.0 | 138.0 |
| **Total** | **1,471.0** | **0.0** | **0.0** | **1,471.0** |

**Operating Experience:**

An analysis of historical expenditures (i.e. 1998 - 2002) on distribution upgrades is shown in the following table. All historical dollars (table below) were converted to 2002 dollars using the GDP Implicit Price Deflator and 5-year average calculated.

| **Region** | **Avg. Yearly Expenditures (1998 - 2002) ($000)** |
|---|---|
| Central | $ 511 |
| Northern | $ 588 |
| Labrador | $ 316 |
| **Total** | $ 1,415 |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

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

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

Based on this 5-year average for distribution system upgrades for the period 1998 - 2002 the following budget was developed using an escalation in 2003 and 2004 of approximately 2.0%.

| Region | 2004 Budget ($000) |
|---|---|
| Central | $ 531 |
| Northern | $ 611 |
| Labrador | $ 329 |
| **Total** | $ 1,471 |

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

This is an annual allotment which will be adjusted from year to year depending on historical expenditures.

## 2004 CAPITAL PROJECTS OVER $50,000
## EXPLANATIONS

**Project Title:** Pole Replacements

**Location:** Distribution Lines in Bottom Waters and St. Anthony Systems

**Division:** Transmission & Rural Operations

**Classification:** Distribution

---

**Project Description:**

This project consists of the replacement of 75 deteriorated poles on the Bottom Waters distribution system and 168 deteriorated poles on the St. Anthony system between Ship Cove and Raleigh.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 195.0 | 0.0 | 0.0 | 195.0 |
| **Labour** | 388.0 | 0.0 | 0.0 | 388.0 |
| **Engineering** | 91.0 | 0.0 | 0.0 | 91.0 |
| **Project Management** | 35.0 | 0.0 | 0.0 | 35.0 |
| **Inspection & Commissioning** | 84.0 | 0.0 | 0.0 | 84.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 200.2 | 0.0 | 0.0 | 200.2 |
| **Total** | **993.2** | **0.0** | **0.0** | **993.2** |

**Operating Experience:**

The systems are operating satisfactorily. As deteriorated poles fail, repair crews are dispatched to do the repairs. Customer outages are incurred during these repairs. Outages are extensive if the repair site is difficult to access.

**Project Justification:**

The Preventative Maintenance Program, identified selected poles on each system which were rated “B” condition (replace within 5 years). It is determined that a certain number of these poles must be replaced in 2004 in order to maintain service reliability. The remainder of the poles are regularly inspected to determine their deterioration rate and these will be replaced as required. A deteriorated pole represents a safety hazard to lineworkers in the event the pole has to be climbed for planned or emergency maintenance. Failure of a pole also has a significant impact on the performance for the system. This is due to the higher probability of failure under adverse weather conditions, and the length of time it takes to replace a pole, especially in the case of a remote location. Often, failures of deteriorated poles causes a domino affect resulting in more failures of consecutive poles, which might not be deteriorated.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Pole Replacements **(cont'd.)**

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

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Insulator Replacements

**Location:** Distribution Lines Bottom Waters, Fleur de Lys and South Brook

**Division:** Transmission & Rural Operations

**Classification:** Distribution

---

**Project Description:**

This project consists of the replacement of suspension and pin type insulators that were manufactured by Canadian Ohio Brass (COB) and Canadian Porcelain (CP) and installed on the following distribution lines:

1. Bottom Waters Line 1, which serves the communities of Paquet and Mings Bight, and the Stogger Tite Mine. This line was constructed in 1973.

2. Fleur de Lys Line 1, which serves the community of Fleur de Lys and Line 2 which serves the community of Coachman's Cove. Both lines were constructed in 1970.

3. South Brook Line 1, which serves the community of South Brook. This line was constructed in 1968.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 250.0 | 0.0 | 0.0 | 250.0 |
| **Labour** | 363.0 | 0.0 | 0.0 | 363.0 |
| **Engineering** | 52.0 | 0.0 | 0.0 | 52.0 |
| **Project Management** | 33.0 | 0.0 | 0.0 | 33.0 |
| **Inspection & Commissioning** | 93.0 | 0.0 | 0.0 | 93.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 153.5 | 0.0 | 0.0 | 153.5 |
| **Total** | **944.5** | **0.0** | **0.0** | **944.5** |

**Operating Experience:**

Bottom Waters

Line 1 has experienced 18 major outages, due to defective insulators, from September 1996 to February 2003.

Fleur de Lys

Lines 1 and 2 have experienced a total of 27 major outages, due to defective insulators, from January 1996 to February 2003.

South Brook

Line 1 has experienced 30 major outages, due to defective insulators, from December 1996 to February 2003.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Insulator Replacements **(cont'd.)**

**Project Justification:**

The design of the insulation system for distribution lines includes multiple suspension insulators in a string, along with pin or post-type single multi-skirt units mounted on top of the poles and cross arms. Therefore, having an individual suspension or pin-type insulator fail usually causes an immediate reliability problem.

In the 1980s, Hydro, through its transmission preventative maintenance (PM) inspections, detected an insulator problem similar to that being experienced by other utilities. It was determined that some COB suspension insulators were prematurely failing due to a cement problem. However, on Hydro's distribution systems, testing was not performed due to safety hazards associated with testing the relatively lower number of insulator units per insulator string.

This project is the continuation of the initiative to replace pre-1974 vintage COB suspension insulators. These insulators are part of a group that has experienced industry-wide failures due to cement growth causing radial cracks that resulted in moisture intrusion. Pin-type insulators, particularly double-skirt COB and CP insulators at the 12.5kV to 25kV levels, have been experiencing the same problems resulting in the tops of these insulators cracking off. Replacement of both types is essential to improve system security and reliability. A normal life expectancy for an insulator is approximately 40 years, however for these COB insulators, the life has been between 10 - 30 years.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Install Recloser on Feeder L6 - Bear Cove
**Location:** Bear Cove
**Division:** Transmission & Rural Operations
**Classification:** Distribution

---

**Project Description:**

This project consists of the purchase and installation of a 3-phase recloser and associated equipment on 12.5kV feeder L6 at Bear Cove.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 40.0 | 0.0 | 0.0 | 40.0 |
| **Labour** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Engineering** | 7.0 | 0.0 | 0.0 | 7.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 18.2 | 0.0 | 0.0 | 18.2 |
| **Total** | **85.2** | **0.0** | **0.0** | **85.2** |

**Operating Experience:**

A power line fault which involves some level of fault impedance is very typical for distribution systems, in particular those that are more susceptible to conductor contact and/or breakage during severe storms. Sleet storms that involve heavy ice and wind have resulted in the most severe power line damage over the last two decades, with the latest storm in Feb., 2003 causing conductor contact and breakage on overhead distribution lines throughout Northern Newfoundland.

**Project Justification:**

The fault protection for the 12.5kV Bear Cove distribution feeder L6 is currently provided by one 3-phase recloser at the terminal station. The addition of a new 3-phase recloser downstream of the terminal station will provide more sensitive ground protection should the conductor break and fall. It will provide the detection and isolation required for the various types of distribution system faults which are potentially harmful to the distribution system and its customers.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labor.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Substation Transformer

**Location:** Rigolet

**Division:** Transmission & Rural Operations

**Classification:** Distribution

---

**Project Description:**

This project consists of the purchase and installation of a 1000kVA 600/2400V transformer bank and removal of the existing 500kVA diesel plant step-up transformer bank.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 50.4 | 0.0 | 0.0 | 50.4 |
| **Labour** | 5.0 | 0.0 | 0.0 | 5.0 |
| **Engineering** | 3.0 | 0.0 | 0.0 | 3.0 |
| **Project Management** | 3.0 | 0.0 | 0.0 | 3.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 14.4 | 0.0 | 0.0 | 14.4 |
| **Total** | 75.8 | 0.0 | 0.0 | 75.8 |

**Operating Experience:**

The original 500kVA bank went into service in 1983. The existing transformers will be removed and returned to inventory.

**Project Justification:**

Projected load growth will result in overloading the 500kVA diesel plant substation step-up transformer bank during peak demand periods. A 1000kVA bank is sufficient to address the peak demand for the foreseeable future.

The following was derived from Hydro's latest projections as presented in Economic Analysis' Operating Load Forecast Hydro Rural Systems 2002 - 2007 (November 2002):

| Year | | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| Peak Demand (kW) (Net) | | 512 | 526 | 539 | 551 | 564 |
| Peak Demand (kVA@0.9pf) | | 569 | 588 | 599 | 612 | 627 |
| % Overload (Existing Bank) | 14% | 18% | 20% | 22% | 25% | |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Substation Transformer **(cont'd.)**

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

Other options considered:

1. The opportunity for a Demand Side Management (DSM) based capital deferral was reviewed and it was determined that DSM was not a viable alternative resource in this particular circumstance. See analysis on next page.

To ensure that this project will be completed at the lowest possible cost, Hydro will solicit competitive bids for all material and external labour.

**Future Plans:**

None.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

## Demand Side Management Analysis for Capital Budget Proposal

**Project Title:** Rigolet - Replace Substation Transformers
**Description:** replace 3 x 167 kVa with 3 x 333 kVa in 2004

Overview: NLH views DSM as an opportunity to defer or postpone capital costs. The deferral can be evaluated in economic terms as the difference in the present value of the utility revenue requirement under varying commencement years for the investment. The difference represents a DSM budget constraint and is the maximum amount of money that can be expended in order to defer the investment. The analysis proceeds by determing the necessary demand or energy savings required to defer the investment and then evaluates whether the DSM budget constraint can achieve the required saving. This DSM review represents a preliminary screening to ensure there are no obvious DSM opportunities missed.

The most economic peak demand DSM option, namely, domestic hot water (DHW) load control, is evaluated against the required demand savings with the calculated DSM budget.

Conclusion :
The DSM deferral budget does not provide sufficient funds to achieve the load deferral targets. DSM is not a viable alternative in this circumstance. The salient details of the DSM review follow below.

| | 2004 | 2005 | 2006 | 2007 | |
|---|---|---|---|---|---|
| Load Forecast (HR OPLF Dec 2002) | | | | | |
| Peak Demand Forecast (Net kW) | 526 | 539 | 551 | 564 | |
| Domestic Customers | 126 | 129 | 132 | 135 | |
| Existing Transformer Capacity | 500 | kVa | | | |
| Capital Budget Proposal for Transformer Replacement | $76,000 | | | | |

| | 1 Yr | 2 Yr | 3 Yr | 4 Yr | - |
|---|---|---|---|---|---|
| Required Demand Savings for Capital Deferral (kW) | 76 | 89 | 101 | 114 | |
| (Difference of forecast peak amp demand and existing rating) | | | | | |
| DSM Budget Calculation (Calculated assuming 2% inflation and 6.8% isolated debt cost as per 2002 COS) | | | | | |
| Capital Budget Deferral Factors* | 4.5% | 8.8% | 12.9% | 16.8% | 20.5% |
| Total DSM Deferral Budget | $3,202 | $6,262 | $9,180 | $11,955 | $14,588 |
| DSM Budget Per Required Demand Savings kW | $42 | $70 | $91 | $105 | na |

* Percentage of capital cost that can be incurred to defer project for 1 to 5 years, and still be indifferent in economic terms.

| DSM Supply Cost - $ per kW Achieved | $/kW* |
|---|---|
| Cooking Range Fuel Substitution | $1,294 |
| Domestic Hot Water (DHW) Fuel Substitution | $1,290 |
| Compact Fluorescent Lighting (CFL) | $352 |
| Domestic Hot Water (DHW) Load Control | $344 |

* includes provision for distribution losses.

| Maximum Achievable Winter Peak Demand Reduction | 1 Yr | 2 Yr | 3 Yr | 4 Yr | 5 Yr |
|---|---|---|---|---|---|
| (Max kW reduction at lowest DSM supply cost and full DSM deferral budget) | | | | | |
| DHW Load Control | 9 | 18 | 27 | 35 | na |
| Achievable DSM Versus Required DSM Savings | (67) | (71) | (74) | (79) | na |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Upgrade Generator Relaying Happy Valley North Plant

**Location:** Goose Bay North Side Diesel Plant

**Division:** Transmission & Rural Operations

**Classification:** Generation

---

**Project Description:**

This project consists of the purchase and installation of new generator relaying equipment for the eight standby diesel units at the North Plant. A multi-function microprocessor relay will be installed on each unit. The existing relays will be removed.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 110.0 | 0.0 | 0.0 | 110.0 |
| **Labour** | 25.0 | 0.0 | 0.0 | 25.0 |
| **Engineering** | 15.0 | 0.0 | 0.0 | 15.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 20.0 | 0.0 | 0.0 | 20.0 |
| **Total** | **170.0** | **0.0** | **0.0** | **170.0** |

**Operating Experience:**

The existing relay equipment has been in service for 30 to 50 years. There are no technical manuals or spare parts available. Although the relays are operable, there is no way to function test them against prescribed specifications to ensure they will operate properly under fault conditions.

**Project Justification:**

The existing relays are antiquated. There is no overcurrent protection on three of the units; there is no differential protection on one unit. The proposed relays are required to provide adequate protection to the plant, operations and maintenance personnel and the public. This protection will continue to ensure the service reliability of the North Diesel Plant.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Purchase Meters & Equipment - TRO System

**Location:** All Service Areas

**Division:** Transmission & Rural Operations

**Classification:** General

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**Project Description:**

This project consists of the purchase of demand/energy meters, current and potential transformers, metering cable and associated hardware for use throughout the Transmission & Rural Operations system.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 96.0 | 0.0 | 0.0 | 96.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 2.1 | 0.0 | 0.0 | 2.1 |
| **Total** | **98.1** | **0.0** | **0.0** | **98.1** |

**Operating Experience:**

Revenue meters are required for new customer services and the replacement of old, worn, damaged or vandalized meters.

**Project Justification:**

As a rule, meters are expected to last a minimum of twenty years. Each is evaluated after that time for condition and either retired from service or refurbished and returned to service. Failure to supply metering equipment as required could result in customer hook-up delays of up to three months.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials.

**Future Plans:**

This is an annual allotment which will be adjusted from year to year depending on historical information.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Energy Management System - Energy Control Centre

**Location:** Hydro Place

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project for 2004 is the second year of a four (4) year project for which the Board has approved funds for 2003. The project consists of the replacement of the existing Energy Management System (EMS) computer software and hardware infrastructure with state of the art hardware and software which provides greater flexibility for future technology changes and integration with Hydro's IT Infrastructure. The existing EMS is used by Hydro's Energy Control Centre to monitor, control and manage the power system and related water resources across the Province. The EMS is critical to the continued efficient and reliable operation of the electric power system and generation facilities owned by Hydro. The EMS is reaching the end of its projected life of 15 years with manufacturer supplied spare parts discontinued and technical support severely limited.

Project costs are based on a joint procurement with Churchill Falls (Labrador) Corporation.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|---|
| **Material Supply** | 544.5 | 2,238.0 | 2,178.0 | 544.5 | 5,505.0 |
| **Labour** | 0.0 | 18.0 | 64.0 | 0.0 | 82.0 |
| **Engineering** | 453.8 | 1,315.2 | 1,326.2 | 115.2 | 3,210.4 |
| **Project Management** | 97.2 | 103.2 | 151.9 | 13.2 | 365.5 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 118.0 | 618.3 | 1,038.5 | 1,349.5 | 3,124.3 |
| **Total** | **1,213.5** | **4,292.7** | **4,758.6** | **2,022.4** | **12,287.2** |

**Operating Experience:**

The Energy Management System was purchased from Harris Controls (now a part of General Electric) on the 15th of March 1988 and placed in service on the 20th of August 1990. It has been in continuous operation since that time. In 1993 an Information System was added to allow the export of EMS data to a server platform to make information easily accessible to internal users over the corporate Local Area Network. Used parts were purchased over a period of time and in 1999 a spare computer was obtained when another utility retired its system. There have been no other upgrades or major repairs. Our current operating status can be summarized as

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Replace Energy Management System - Energy Control Centre **(cont'd.)**

**Operating Experience: (cont'd.)**
(1) System Availability has averaged 99.985% over the system's lifetime; (2) there are no functional deficiencies; (3) there is no vendor support available; and (4) new spare parts are not available.

**Project Justification:**
Please refer to the documents Energy Management System Replacement Project Justification on the following pages and a report by KEMA titled "Newfoundland and Labrador Hydro Energy Management System Assessment" which was filed with the Board as part of Hydro's 2003 Capital Budget Application (Section G, Appendix 5).

**Future Plans:**
The KEMA report in Section 7.11 outlines the "Life Cycle Management" of the EMS. The new EMS will be using "non-proprietary" hardware and therefore will offer more flexibility for maintenance, upgrading and replacement. However, this type of equipment quickly becomes obsolete as vendors of computer hardware upgrade their systems. Therefore the EMS hardware will require an "Evergreening Program" similar to other IT Infrastructure. KEMA recommends that 20 to 33% of the base hardware costs be budgeted each year to keep hardware current. This is forecast to be $350,000 per year beginning in the third year following the system commissioning.

Similarly software upgrades will be required periodically. This cost will depend on the frequency of vendor software upgrades. KEMA are suggesting this will amount to approximately $700,000 every 3 years following project in service.

2004 CAPITAL PROJECTS OVER $50,000
EXPLANATIONS

HYDRO
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COMMITMENT

# ENERGY MANAGEMENT SYSTEM REPLACEMENT

## PROJECT JUSTIFICATION

August, 2002

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

## Introduction

An assessment of Hydro's EMS was conducted by KEMA Consulting, an industry leader in studying and assisting utilities in their EMS and SCADA projects. The results of the study are provided in the attached report entitled "Newfoundland and Labrador Hydro Energy Management System Assessment". This report makes a strong recommendation to begin the process of replacement immediately because of the high risk of a failure of the EMS as the age of its electronic components is beyond their design life. Concurrent with the study on Hydro's EMS, KEMA performed a similar assessment for Churchill Falls (Labrador) Corporation (CF(L)Co) on their Supervisory Control and Data Acquisition (SCADA) system. This system was also identified to require replacement in the next several years.

Alternatives for this project were identified and discussed in Section 5 of the KEMA report. These are as follows:

1. Maintain Existing Systems and Process
2. Implement New EMS Independent of CF(L)Co
3. Implement New EMS Together with CF(L)Co
4. Purchase a Turnkey System implemented by the Vendor.

### Cost of EMS Failure

In addition to the discussion in the KEMA report on the advantages and disadvantages of each of the alternatives the following highlights the critical nature of the EMS and the costs of a major failure of the EMS.

The EMS provides a mission critical function for Hydro and the operation of the Interconnected Power System. If this system failed for an extended period of time while a replacement was procured the reliability of the power system and electrical service to all of Hydro's customer would fall to unacceptable levels. Remote control of any station would be impossible and therefore all major stations would have to be staffed. There are eight stations that would have to be staffed 24 hours per day with 16 others having to be staffed for varying

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

durations depending on the system condition. The eight stations alone would cost, provided staff are available, approximately $41,000 per week in overtime. This will result in a significant reduction in maintenance activity, as the staff performing monitor and control functions normally performs maintenance. In order to continue with routine maintenance additional staff would have to be hired and trained to replace those assigned to operating duties. This could add an additional $32,000 per week, while repairs or replacement are being done. If the failure was catastrophic and full replacement was the only option the cost of the foregoing could be as high as $3.8M per year.

In addition to the wage costs there would be a cost of lost efficiency due to the loss of economic dispatch functionality. At $28 per barrel this can quickly add a significant expense to the loss of the EMS. Economic Dispatch balances the load between all generating units so that the water at each plant is used as efficiently as possible with consideration to electrical losses from the plant to customer loads. Without Economic Dispatch this balancing between plants would be very difficult and ineffective resulting in loss of efficiency.

There would also be a severe loss in reliability. During the last major outage to the Avalon Peninsula in October 1998, customers were restored between 8 and 53 minutes using the EMS. Without the EMS this can be estimated to take at least two to three times longer if all stations on the Avalon Peninsula were staffed. If some stations were not staffed outages would extend for several hours allowing for contact and for travel. This would result in an intolerable level of service. Similar and more severe service deterioration would occur throughout the system particularly in remote areas and during poor weather conditions.

A delay in approving the project increases the probability of failure because as the electronic components age the likelihood of failure increases. A decision to delay is a risk assessment on how long the EMS could perform at an acceptable level. The failure rate cannot be estimated by KEMA as it does not have data on EMS systems failures because most other similar EMS computer systems have already been removed from service and replaced before this point in their service life. While we have done well to-date without major problems, KEMA have suggested in the report that this risk of failure is high, and we should not delay replacing the existing GE/Harris EMS system.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

The alternatives mentioned above are highlighted in the KEMA report. The report clearly identifies the least cost option is alternative 3 which is to procure the system at the same time as CF(L)Co. In addition to the savings in system procurement costs identified by KEMA there are internal engineering and project management cost savings of $560,000 and corporate overhead, AFUDC, Escalation and Contingency savings of $390,000. Therefore the total savings for a joint procurement are approximately $1,500,000. Hydro has obtained a commitment by CF(L)Co for joint procurement and therefore the cost estimate has been prepared on that basis.

Operator Training Simulator

There is an option mentioned in the KEMA report that may be included in the EMS replacement depending on the purchase, implementation and operating cost. It is an Operator Training Simulator (OTS). An OTS is a power system simulator used to train power system operators. It is used by setting up scenarios on the EMS to train operators how to respond to certain incidents or conditions on the power system, similar to a flight simulator used by aircraft pilots. These scenarios would include replaying disturbances on the power system for staff that were not working at the time of the disturbance. In this way operator response to these incidents will be enhanced and customer service restoration improved during real situations.

The need for an OTS has increased with recent retirements of experienced staff. Many of the staff have not experienced black-outs to major portions of the power system such as the entire east or west coast because of reliability improvements and cooperative weather, however they must be ready at all times for such circumstance. An OTS would simulate these incidents and help train the operators for the appropriate response.

Safety Issues

There are no direct safety issues that require the EMS to be replaced. Safety issues may arise if there was a failure of the EMS. The EMS provides methods for the system operators to track workers on transmission lines for contact if any incident should arise. This functionality would be lost. However, a paper tracking system could be implemented to ensure safety. The impact would then be reflected in loss of work time and slower maintenance activities.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Corporate Applications Environment

**Location:** St. John's

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project includes labour to apply modifications and test the applications affected by the vendor upgrade. Software requiring upgrades are:

a) JDEdwards;

b) Showcase Strategy ;

c) Lotus Notes; and,

d) AS400 O/S.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 30.0 | 0.0 | 0.0 | 30.0 |
| **Engineering** | 352.0 | 0.0 | 0.0 | 352.0 |
| **Project Management** | 132.0 | 0.0 | 0.0 | 132.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 26.0 | 0.0 | 0.0 | 26.0 |
| **Total** | **540.0** | **0.0** | **0.0** | **540.0** |

**Operating Experience:**

N/A

**Project Justification:**

This project includes upgrades to currently held software application products. Software must be regularly upgraded to maintain the benefits of vendor advancements in system functionality. As well, this provides continued vendor support of applications and a stable application environment for Hydro's key business functions. Out-dated and non-maintained software would lead to breakdowns in business functions that would ultimately yield higher costs.

**Future Plans:**

Software vendor maintenance and upgrades is an on-going occurrence.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Applications Enhancements

**Location:** Hydro Place

**Division:** Production

**Classification:** Information Systems & Telecommunications

---

**Project Description:**

The application enhancement project provides for:

(1) The unforeseen modification, enhancements & additions to software to address the required changes to business processes initiated by Customers, Stakeholders & Regulators or to provide efficiencies to existing processes.

(2) The continuing design, build and implementation of enhancements to Hydro's Internet/Intranet.

(3) An Enterprise Project Management Software Application.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 113.0 | 0.0 | 0.0 | 113.0 |
| **Labour** | 70.5 | 0.0 | 0.0 | 70.5 |
| **Engineering** | 190.0 | 0.0 | 0.0 | 190.0 |
| **Project Management** | 44.0 | 0.0 | 0.0 | 44.0 |
| **Inspection & Commissioning** | 27.0 | 0.0 | 0.0 | 27.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 18.7 | 0.0 | 0.0 | 18.7 |
| **Total** | **463.2** | **0.0** | **0.0** | **463.2** |

**Operating Experience:**
N/A

**Project Justification:**
This project involves:

a) Various Minor Enhancements:
It is imperative that Hydro be able to react to requests to provide enhancements to software applications in response to unforeseen requirements, such as legislative and compliance changes; vendor driven changes, and enhancements designed to improve customer service or staff productivity. Previous changes have included changes initiated by Canada Post, changes to income tax calculations, providing equal billing to customers, and other enhancements to provide environmental & operational processes.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Applications Enhancements **(cont'd.)**

b) Internet/Intranet:
This involves the design, build and implementation of enhancements to Hydro's external Web site to improve access to information to our customers and stakeholders. Additions and enhancements to Hydro's Intranet will allow staff and customers access to information. This will improve information flow, eliminate redundant processes and reduce the manual effort associated with distributing information and provide an enhanced level of customer service.

c) Enterprise Project Management software:
In order to ensure that better real time decisions regarding resource needs and the portfolio of projects can be made, a tool is needed to improve the project management process and resource utilization. To ensure efficiencies in the completion of multi department and external projects, this tool will provide integrated collaboration between the different projects and to automate skillset and resource management. This software tool will be introduced to the IS&T department and then rolled out to other groups within Hydro.

**Future Plans:**
Application enhancements are a continuing requirement.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Security Program Centralized Log Monitoring & Analysis System

**Location:** Hydro Place

**Division:** Production

**Classification:** Information Systems & Telecommunications

---

**Project Description:**

This project for 2004 is the continuation of a project which the Board has approved funds for 2003. The scope of this project is to purchase and implement a server and associated software to centralize reporting and presentation of security data gathered from distributed operating systems. This project will provide a central mechanism to gather security log information from the various systems, enhance analysis and reporting capabilities, and address due diligence and audit responsibilities as required by management.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 30.0 | 35.0 | 0.0 | 65.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 24.0 | 26.4 | 0.0 | 50.4 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 3.3 | 21.7 | 0.0 | 25.0 |
| **Total** | 57.3 | 83.1 | 0.0 | 140.4 |

**Operating Experience:**

N/A

**Project Justification:**

A key to an effective security program is the ability to detect any suspicious activity. There are numerous system and application logs that keep track of any user activity within the Hydro Group's networks. Disseminating the volume of information generated by these logs is not easily done yet, however, reviewing these logs on a timely basis and taking appropriate action is mandated by our internal and external audit departments. Centralizing all logging activity and producing meaningful reports from this information is the key goal of this project.

Two of the main goals of IT security deal with integrity and the confidentiality of information. Users have the right to expect that the data they work with on a daily basis is not disclosed to unauthorized individuals and not destroyed or modified - either intentionally or accidentally. Having a centralized log monitoring and analysis system in place will provide these assurances.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Security Program Centralized Log Monitoring & Analysis System **(cont'd.)**

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

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**

None.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Security Program - Secure Remote Access

**Location:** Hydro Place

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

The scope of this project focuses on the evaluation, design and implementation of a product(s) that will ensure a secure method of accessing corporate Information Technology resources from multiple locations. The product chosen will have to meet industry standards, address the inter-operability of existing and future applications, and incorporate existing in-house technology where possible. The chosen product must address both internal (employees accessing the company network) and external (vendors connecting to the Hydro Group's network for different transactions) concerns.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 35.0 | 35.0 | 0.0 | 70.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 30.0 | 30.0 | 0.0 | 60.0 |
| **Project Management** | 3.0 | 3.0 | 0.0 | 6.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 7.1 | 8.1 | 0.0 | 15.2 |
| **Total** | **75.1** | **76.1** | **0.0** | **151.2** |

**Operating Experience:**

N/A

**Project Justification:**

Secure remote access involves development of a solution for Hydro Group employees and vendors. This project will include recommendations and implementation of the most economical and secure solution for the Hydro Group. The solution may include one method of access or an effective combination to meet all corporate needs and will attempt to incorporate the Hydro Group’s existing investment in both RSA’s Secure ID technology and Virtual Private Network (VPN) technology where applicable.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Security Program - Secure Access **(cont'd.)**

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

Access to computer based information in a timely manner from a mobile workforce is essential for business. Hydro Group employees benefit from the ability to access computer resources quickly and efficiently. Properly securing this remote access is essential to ensure that this access is granted to the employees and vendors who are authorized and all other invalid attempts to access the information are denied.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** End User & Server Evergreen Program

**Location:** St. John's

**Division:** Production

**Classification:** Information Systems & Telecommunications

---

**Project Description:**

This is the second year of a five (5) year program. This evergreen program will refresh the end user workstation, servers, operating systems and office productivity programs on a 3-5 year life cycle. The consolidation of servers is also part of the server refresh & upgrade program. Server refresh will be on 4-5 year cycle based on industry standards and application demands. This will allow for reduced costs over the long term and improve efficiency through standardization and reduced support needs.

End User workstations will be refreshed based on industry standard lifecycles and the device (thin client, desktop, laptop), will be determined by an analysis of the work needs of each user.

Based on industry standards and the age of existing servers, each year an appropriate number of servers will be refreshed and the latest version of the server operating system will be applied. This year will allow for the planning and migration to Microsoft's new operating system (Windows 2000.NET).

The enterprise server and operating system has a longer refresh cycle and is based more on application demands and capacity. (Storage needs will be handled through the enterprise storage (SAN) project).

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 2,404.2 | 0.0 | 0.0 | 2,404.2 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 262.0 | 0.0 | 0.0 | 262.0 |
| **Project Management** | 5.2 | 0.0 | 0.0 | 5.2 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 140.0 | 0.0 | 0.0 | 140.0 |
| **Total** | **2,811.4** | **0.0** | **0.0** | **2,811.4** |

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** End User & Server Evergreen Program 2004 **(cont'd.)**

**Operating Experience:**

Industry standards indicate that end user devices have a useful life of between 3-5 years and beyond this timeframe reliability and support become issues. Hardware vendors offer new models about twice a year which offer more functionality and performance. The useful life cycle for these devices is based on the type of device. Thin client devices can be expected to provide effective service for up to 5 years. Desktops are now expected to last 4 years, while laptops have a life expectancy of 3 years. This refresh cycle is based on industry standards and the equipment has little value at the end of their useful life.

The operating system and office productivity programs for these devices follows a similar life cycle and as well as offering new functionality, these systems will take advantage of the improved features in the newer hardware devices. Tying the end user hardware, operating systems and office productivity programs together in a planned upgrade program, allows Hydro to exploit the enhancements of each.

**Project Justification:**

This evergreen program will allow Hydro to take advantage of new functionality offered in new end user and server hardware models, and in new releases of the operating system and office productivity programs. This keeps the end user component of the infrastructure in line with the technologies in the server infrastructure being deployed.

The rational for moving to a thin client environment and server refresh, is supported by the IT Technical Architecture Strategy report filed with the Board on February 28, 2002 as #U - Hydro - 37. By maximizing the deployment of thin client devices, Hydro can achieve lower total cost of ownership over the life cycle of these devices and improved efficiency through standardization and reduced support needs.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** End User & Server Evergreen Program 2004 **(cont'd.)**

**Project Justification: (cont'd.)**
The consolidation of the server infrastructure is also part of the program. This will allow for a reduction of maintenance costs and system administration work load. The existing systems have been in production since 1997 and an increase in computer capacity plus new technology to support enhanced applications is needed.

The replacement of these servers will allow for the new server to attach to a Storage Area Network which will allow for greater control of disk space across all computer platforms. The risk of not doing this upgrade will result in greater administration workload, reduced application growth and poor performance of applications.

There is no opportunity to share this infrastructure with Newfoundland Power or any other organization. The intent of the refresh program is to prevent excessive maintenance to end user devices, servers and office tools. As reliability and performance become issues, the cost to maintain these devices and products becomes extremely high. Thus, as per industry experience, it becomes cheaper to replace than to maintain.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**
This will be an on-going refresh program. The cycle will be over 3 - 5 years based on the device.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Peripheral Infrastructure Replacement

**Location:** Hydro System

**Division:** Production

**Classification:** Information Systems & Telecommunications

---

**Project Description:**

This project consists of the replacement of peripherals such as printers, projectors, scanners in area offices and Hydro Place .

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 73.0 | 0.0 | 0.0 | 73.0 |
| **Labour** | 10.0 | 0.0 | 0.0 | 10.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 17.9 | 0.0 | 0.0 | 17.9 |
| **Total** | **100.9** | **0.0** | **0.0** | **100.9** |

**Operating Experience:**

As the age of the peripherals increase so does the operating and maintenance expenses.

**Project Justification:**

A five-year replacement program for peripheral equipment is in place. This project is to allow for the refresh of peripheral equipment.

To ensure that this project will be completed at the lowest possible cost, Newfoundland & Labrador Hydro will solicit bids for all materials and external labour.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** JDE Migration Assessment Study

**Location:** St. John's

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

The scope of this project will be an assessment study of the business and technology issues that need to be addressed to support the migration of Hydro's existing JDE's World Vision implementation to JDE's One World implementation. The study will provide a migration strategy which will address the business and technology requirements of the migration as well as identifying the opportunities to leverage the technology to further improve the business processes. The study will also provide an implementation plan which will identify the timing and sequencing of the various JDE modules as well as identifying the resource requirements to support the migration.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 190.0 | 0.0 | 0.0 | 190.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 41.2 | 0.0 | 0.0 | 41.2 |
| **Total** | **231.2** | **0.0** | **0.0** | **231.2** |

**Operating Experience:**

N/A

**Project Justification:**

The JDE World Vision financial suite was implemented in 1999. One World, a business process based implementation has been released to replace the World Vision. This study will identify the business and technology issues associated with this migration. This assessment will enable Hydro to properly identify the costs and risks associated with this migration.

One World has functionality which will enable and enhance workflow capability and functionality in areas like depreciation calculations which will better support the cost of service model.

**Future Plans:**

Future plans for the JDE financial suite will be determined by this project.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace VHF Mobile Radio System

**Location:** Various

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project involves the replacement of the Corporation's existing VHF mobile radio system with a trunked radio system. The replacement of the existing system involves replacing the equipment at 29 repeater sites, as well as the replacement of a central switch located in Gander, approximately 250 mobile and base station radios, and approximately 100 portable radios. The proposed system will provide additional coverage to meet the Corporation's requirements.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 25.0 | 105.0 | 0.0 | 130.0 |
| **Labour** | 2,520.0 | 3,840.0 | 0.0 | 6,360.0 |
| **Engineering** | 175.0 | 200.0 | 0.0 | 375.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 328.0 | 1,657.0 | 0.0 | 1,985.0 |
| **Total** | 3,048.0 | 5,802.0 | 0.0 | 8,850.0 |

**Operating Experience:**

The existing system was purchased in 1989 and is obsolete. The failure statistics for the VHF have increased considerably over the past year. There are no longer trained resources at Aliant knowledgeable about the VHF switch which also puts the system at risk.

**VHF Failure Statistics**

| Year | Facility | Repeater | Switch | Other |
|---|---|---|---|---|
| 1998 | 14 | 6 | 0 | 9 |
| 1999 | 3 | 4 | 1 | 5 |
| 2000 | 6 | 4 | 0 | 5 |
| 2001 | 4 | 4 | 1 | 1 |
| 2002 | 5 | 7 | 5 | 0 |
| 2003* | 9 | 4 | 19 | 3 |
| * Represents 2 months (January & February) | | | | |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace VHF Mobile Radio System **(cont'd.)**

**Project Justification:**

The proposed replacement system is a standards-based trunked mobile radio system. By purchasing a standards-based system, the Corporation's investment is protected in the long-term, as the system is not tied to a single manufacturer. A trunked system permits the deployment of additional users or applications seamlessly and without the need for large scale changes to the system.

The business case analysis is attached to Section G, Appendix 4.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Powerline Carrier Equipment Transmission System - West Coast

**Location:** Various

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project for 2004 is the continuation of a project which the Board approved funds for 2003. In 2004, this Project requires the purchase, installation and commissioning of new Power Line Carrier (PLC) to replace the existing PLC's on TL247. Associated PLC equipment, including wavetraps, line matching units, teleprotection and high voltage coupling equipment will be replaced in a phase-to-phase arrangement.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 757.0 | 269.0 | 0.0 | 1,026.0 |
| **Labour** | 33.7 | 39.2 | 0.0 | 72.9 |
| **Engineering** | 28.2 | 22.0 | 0.0 | 50.2 |
| **Project Management** | 6.3 | 5.0 | 0.0 | 11.3 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 183.8 | 83.8 | 0.0 | 267.6 |
| **Total** | 1,009.0 | 419.0 | 0.0 | 1,428.0 |

**Operating Experience:**

The equipment proposed for replacement was installed during the power system generation additions in the early 1980's at Hinds Lake, Upper Salmon and Cat Arm. During the 20+ year operating life of this equipment, there have been many requirements for corrective maintenance and upgrades. With each additional year of operation, the inventory of spare modules decreases due to increased equipment failures, and the in-house expertise for corrective maintenance and, when possible, the repair of modules is dwindling due to technical personnel retirements.

**Project Justification:**

Most of the equipment slated for replacement has been in service for over 20 years and is now obsolete. The manufacturer no longer supports the product, and has discontinued the manufacture and sale of replacement components. In addition, there is no known third party that provides repair services for defective modules. Continued utilization of this equipment poses the risk of failure and hence loss of communications required for the protection and control of the power system.

**2004 CAPITAL PROJECTS OVER $50,000**
**EXPLANATIONS**

**Project Title:** Replace Powerline Carrier Equipment Transmission System - West Coast **(cont'd.)**

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

Hydro has standardized on ABB PLC radio equipment. As such, Hydro will sole source this equipment to ABB. This allows Hydro to minimize its spares inventory and standardize on training, documentation and maintenance practices, thus reducing costs.

**Future Plans:**

There are no plans for any major replacements, upgrades or repairs to this plan expected to be undertaken within the next three years.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Battery System - Multiple Sites - 2004

**Location:** Bottom Brook, Hardwoods, Holyrood, Massey Drive & Stephenville

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project consists of the supply and installation of five (5) 48 VDC battery systems at the Bottom Brook Terminal Station, Hardwoods Terminal Station, Holyrood Terminal Station, Massey Drive Terminal Station and the Stephenville Gas Turbine Station. This includes all 240 VAC to 48 VDC rectifiers, rectifier control panels, battery banks and associated cabling.

| **Project Cost:** *($ x1,000)* | 2004 | 2005 | Beyond | Total |
|---|---|---|---|---|
| **Material Supply** | 161.2 | 0.0 | 0.0 | 161.2 |
| **Labour** | 36.4 | 0.0 | 0.0 | 36.4 |
| **Engineering** | 22.1 | 0.0 | 0.0 | 22.1 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 54.5 | 0.0 | 0.0 | 54.5 |
| **Total** | 274.2 | 0.0 | 0.0 | 274.2 |

**Operating Experience:**

There have been no failures to date for the battery banks, primarily due to a rigorous preventative maintenance program and the nature of flooded cell technology. Annual maintenance costs is about $800 per battery per year consisting of two procedures per year including capacity testing and conductance measurements. All test results confirm the natural expected degradation with time for these type of batteries. It should be noted that the maintenance procedures and their costs will not be affected by the installation of new battery banks which require an equal amount of maintenance.

**Project Justification:**

The equipment has been in operation for 20+ years which has exceeded the 20 year design life and proven industry standard life expectancy of large stationary batteries of the flooded cell type. In some sites cell plates are warping and showing signs of deterioration. In some sites there is significant corrosion of battery terminals. The capacitors in some older types of rectifiers are deteriorating. This replacement is necessary to provide emergency power to equipment necessary for the remote control and monitoring of Hydro's transmission and

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Battery System - Multiple Sites **(cont'd.)**

**Project Justification: (cont'd.)**
generation system and is justified by reliability considerations. Failure to replace this equipment will result in a battery bank failure or reduced reliability which will extend or cause customer outages. An unacceptable failure probably will occur after the battery design life is exceeded.

To ensure that this project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**
None. While this is part of a multi-year plan to replace battery systems, this budget does not include any future commitments to replace battery systems in other years.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Remote Terminal Units for Hydro - Phase 5

**Location:** Cat Arm, Hinds Lake, Long Harbour and Happy Valley

**Division:** Production

**Classification:** Information Systems & Telecommunications

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**Project Description:**

This project consists of the replacement of three (3) Quindar Remote Terminal Units (RTUs) and one (1) Westronic M4 Remote Terminal Unit used for remote monitoring and control of plants and terminal stations from the Energy Control Center. The sites are: Cat Arm Plant, Hinds Lake Plant, Long Harbour Terminal Station and Happy Valley terminal station. This is phase five of a nine-phase plan to replace all obsolete RTUs. The de-commissioned equipment has no value and will be scrapped.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 148.1 | 0.0 | 0.0 | 148.1 |
| **Labour** | 70.2 | 0.0 | 0.0 | 70.2 |
| **Engineering** | 33.4 | 0.0 | 0.0 | 33.4 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 62.1 | 0.0 | 0.0 | 62.1 |
| **Total** | 313.8 | 0.0 | 0.0 | 313.8 |

**Operating Experience:**

There have been few failures of this equipment to date. The average mean time between failures experienced in the last few years is approximately seven years with an estimated repair cost of $1800 dominated by circuit board repair costs.

**Project Justification:**

The equipment has been in operation for over 20 years and is nearing the end of its useful life. It is no longer supported by the equipment manufacturer, and spares are no longer available for these systems. Third party spares and repair services are not available. This is a replacement necessary to maintain reliability of equipment for the control and monitoring of Hydro's transmission and generation system. Failure to replace this equipment could result in reduced reliability which would extend or cause customer outages. The replacement RTUs will support additional functionality such as newer protocols and polling of Intelligent Electronic Devices (IEDs). The replacement of the Hinds Lake RTU will allow the obsolete binary coded decimal analogs in the plant control cubicle to be upgraded.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Remote Terminal Unit for Hydro - Phase 5 **(cont'd.)**

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

Hydro has standardized on the General Electric (GE) line of Remote Terminal Units. As such, Hydro will sole source this equipment to the manufacturer, GE. This allows Hydro to minimize its spares inventory and standardize on training, documentation and maintenance practices.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replacement of Operational Data & Voice Network - Phase 2

**Location:** St. John's

**Division:** Production

**Classification:** Information Systems & Telecommunications

---

**Project Description:**

This is phase 2 of a two-year program to plan, design and install a wide area network (WAN) communications infrastructure to replace the existing operational data (SCADA) and operational voice network currently using General DataComm (GDC) infrastructure. This will provide an architecture that can support the operational data, administrative data and voice traffic over a standard network infrastructure.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **2006** | **Beyond** | **Total** |
|---|---|---|---|---|---|
| **Material Supply** | 512.0 | 503.0 | 0.0 | 0.0 | 1,015.0 |
| **Labour** | 180.0 | 228.0 | 0.0 | 0.0 | 408.0 |
| **Engineering** | 199.0 | 199.0 | 0.0 | 0.0 | 398.0 |
| **Project Management** | 33.0 | 37.8 | 0.0 | 0.0 | 70.8 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 47.0 | 279.0 | 0.0 | 0.0 | 326.0 |
| **Total** | 971.0 | 1,246.8 | 0.0 | 0.0 | 2,217.8 |

**Operating Experience:**

The existing operational data network supporting SCADA traffic was installed in 1988, and is now 15 year-old technology. It is a Time Division Multiplex architecture with General DataComm (GDC) equipment designed to carry the SCADA traffic between remote RTU's and the energy management system (Harris) at Hydro Place, and operational voice traffic between the sub-stations & plants and the energy control centre (ECC).

The GDC equipment is at the end of its useful life. GDC will soon discontinue support and thus problems will no longer be investigated and resolved. The following table gives the number of incidents recorded over the past 8 years and this year to-date.

| | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|---|---|
| **Incidents Reported** | **4** | **10** | **6** | **23** | **11** | **11** | **15** | **19** | **16** |

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replacement of Operational Data & Voice Network - Phase 2 **(cont'd.)**

**Project Justification:**

GDC is no longer in the transport market segment but have focused their strategic direction elsewhere. Table 5, page 19, of the Telecommunications Plan, which was submitted to the Board as part of Hydro's 2003 Capital Budget Application (Section H), indicates that the GDC equipment that Hydro has installed over the past 15 years is no longer under development and many components have been manufacturer discontinued for a number of years.

The operational, administrative and voice traffic currently run on separate communications equipment and standards. This upgrade would combine these services into one communications system with common equipment and standards. This would decrease the demands on staff to be trained to support different communications protocols and equipment.

This upgraded communications network will support all applications and devices that have a standard protocol (IP centric). All existing administrative applications support this protocol and the upgrade to the Energy Management System will have this as a requirement. All new RTU devices will have IP as a communications protocol. This new technology will provide added functionality, reliability and manageability.

Integrating all applications and devices, including SCADA, onto a single communications platform will streamline operational activities and improve overall management and control of the WAN. The improved reliability will benefit the power grid management, provide better control and reduce operational costs.

To ensure that the project will be completed at the lowest possible cost, Newfoundland and Labrador Hydro will solicit competitive bids for all materials and external labour.

**Future Plans:**

There are no further plans under consideration at this time.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace Vehicles - 2003

**Location:** System Wide

**Division:** Transmission & Rural Operations

**Classification:** Administrative

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**Project Description:**

This project for 2004 is the continuation of a project given approval by the Board in 2003. The project involves replacing 28 light vehicles (cars, pick-ups and vans) and 17 medium/heavy vehicles (line trucks and boom trucks).

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 1,520.0 | 844.0 | 0.0 | 2,364.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 10.0 | 10.0 | 0.0 | 20.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 53.7 | 288.2 | 0.0 | 341.9 |
| **Total** | 1,583.7 | 1,142.2 | 0.0 | 2,725.9 |

**Operating Experience:**

It has been our experience that vehicles experience increased downtime and decreased reliability as they reach the replacement criteria outlined below.

**REPLACEMENT CRITERIA**

**VEHICLES**

| **Category** | **Description** | **REPLACEMENT CRITERIA** | |
|---|---|---|---|
| | | **Age** | **Other** |
| 1000 | Cars/Mini-vans | 5-7 yrs. | >150,000 kms, maintenance cost, condition |
| 2000 | Pick-ups/Service Vans | 5-7 yrs. | >150,000 kms, maintenance cost, condition |
| 3000 | Light Trucks | 6-8 yrs. | >180,000 kms, maintenance cost, condition |
| 4000 | Medium/Heavy Trucks | 7-9 yrs. | >200,000 kms, maintenance cost, condition |

Category 1000 and 2000 vehicles being replaced will have an average age of six years and 150,000 km, while category 3000 will have an average age of eleven years and 100,000 km and category 4000 will have an average age of 10 years and 200,000 km.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Vehicles - Hydro System - 2003 **(cont'd.)**

**Project Justification:**

New vehicles are required in order to ensure maximum reliability with minimum equipment downtime. Having work crews equipped with reliable and technologically current work vehicles, ensures their safety while at the same time enhancing efficient delivery of services. Operating vehicles beyond their economical life cycle will result in delays to work crews and have a negative impact on customer service.

Vehicles are screened against a replacement criteria before being evaluated for replacement. When a unit has met the age or kilometer criteria, the unit is further evaluated for its condition and maintenance history.

The budget for each class of vehicle is shown below.

| Vehicle Class | Budget Amount |
|---|---|
| 1000 (Cars/Mini-vans) | $ 250,600 |
| 2000 (Pick-up/ Service Vans) | 497,700 |
| 3000 (Light Trucks) | 78,400 |
| 4000 (Medium/Heavy Trucks) | 1,557,300 |
| Contingency | 341,900 |
| **Total** | **$ 2,725,900** |

New vehicles are acquired through competitive tendering with a lease/purchase analysis used to determine the least cost alternative.

**Future Plans:**

Categories 1000, 2000, and 3000 vehicles will be purchased in 2003, however due to long delivery schedules of category 4000 vehicles, these vehicles will not be delivered until 2004.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Replace Vehicles - 2004

**Location:** System Wide

**Division:** Transmission & Rural Operations

**Classification:** Administrative

---

**Project Description:**

This project involves replacing 33 light vehicles (cars, pick-ups and vans) and 11 medium/heavy vehicles (line trucks and boom trucks).

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 1,020.0 | 912.0 | 0.0 | 1,932.0 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 10.0 | 10.0 | 0.0 | 20.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 10.0 | 0.0 | 10.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 51.2 | 259.2 | 0.0 | 310.4 |
| **Total** | **1,081.0** | **1,181.2** | **0.0** | **2,262.4** |

**Operating Experience:**

It has been our experience that vehicles experience increased downtime and decreased reliability as they reach the replacement criteria outlined below.

| **REPLACEMENT CRITERIA VEHICLES** | | | |
|---|---|---|---|
| **Category** | **Description** | **REPLACEMENT CRITERIA** | |
| | | **Age** | **Other** |
| 1000 | Cars/Mini-vans | 5-7 yrs. | >150,000 kms, maintenance cost, condition |
| 2000 | Pick-ups/Service Vans | 5-7 yrs. | >150,000 kms, maintenance cost, condition |
| 3000 | Light Trucks | 6-8 yrs. | >180,000 kms, maintenance cost, condition |
| 4000 | Medium/Heavy Trucks | 7-9 yrs. | >200,000 kms, maintenance cost, condition |

Category 1000 and 2000 vehicles being replaced will have an average age of seven years and 165,000 km, while category 3000 will have an average age of seven years and 220,000 km and category 4000 will have an average age of 10 years and 200,000 km.

# 2004 CAPITAL PROJECTS OVER $50,000
# EXPLANATIONS

**Project Title:** Replace Vehicles - Hydro System - 2004 **(cont'd.)**

**Project Justification:**

New vehicles are required in order to ensure maximum reliability with minimum equipment downtime. Having work crews equipped with reliable and technologically current work vehicles, ensures their safety while at the same time enhancing efficient delivery of services. Operating vehicles beyond their economical life cycle will result in delays to work crews and have a negative impact on customer service.

Vehicles are screened against a replacement criteria before being evaluated for replacement. When a unit has met the age or kilometer criteria, the unit is further evaluated for its condition and maintenance history.

The budget for each class of vehicle is shown below.

| Vehicle Class | Budget Amount |
|---|---|
| 1000 (Cars/Mini-vans) | $ 250,000 |
| 2000 (Pick-up/ Service Vans) | 530,000 |
| 3000 (Light Trucks) | 200,000 |
| 4000 (Medium/Heavy Trucks) | 972,000 |
| Contingency | 310,400 |
| **Total** | **2,262,400** |

New vehicles are acquired through competitive tendering with a lease/purchase analysis used to determine the least cost alternative.

**Future Plans:**

Categories 1000, 2000, and 3000 vehicles will be purchased in 2004, however due to long delivery schedules of category 4000 vehicles, these vehicles will not be delivered until 2005.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Purchase Cash Remittance Processor

**Location:** Hydro Place

**Division:** Finance

**Classification:** Administrative

---

**Project Description:**

This project consists of the replacement of the existing cash remittance processor which processes mail-in customer payments.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 57.7 | 0.0 | 0.0 | 57.7 |
| **Labour** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 2.3 | 0.0 | 0.0 | 2.3 |
| **Total** | **60.0** | **0.0** | **0.0** | **60.0** |

**Operating Experience:**

The existing equipment was acquired in 1999.

**Project Justification:**

The current processor was acquired when Hydro ceased to use Newfoundland Power to manage its customer billings and payments processes and implemented the Utility Customer Information System (UCIS) and will reach its projected useful life of five-years in 2004. The equipment provides for electronic capture and storage of customer payment data, which would be much more labour-intensive and costly using manual processes.

**Future Plans:**

None.

# 2004 CAPITAL PROJECTS OVER $50,000 EXPLANATIONS

**Project Title:** Electronic Metering Reading

**Location:** Hydro Place

**Division:** Finance

**Classification:** Administrative

---

**Project Description:**

This project consists of a study to provide recommendations on a replacement system for the Radix FW200 in 2004 and to purchase equipment and install the system in 2005.

| **Project Cost:** *($ x1,000)* | **2004** | **2005** | **Beyond** | **Total** |
|---|---|---|---|---|
| **Material Supply** | 0.0 | 180.0 | 0.0 | 180.0 |
| **Labour** | 35.0 | 35.0 | 0.0 | 70.0 |
| **Engineering** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Project Management** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Inspection & Commissioning** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 0.8 | 8.5 | 0.0 | 9.3 |
| **Total** | **35.8** | **223.5** | **0.0** | **259.3** |

**Operating Experience:**

N/A

**Project Justification:**

The handheld meter-reading units facilitate meter reading and billing processes and it is essential that a source is available for equipment maintenance and support.

Hydro has been notified by the Radix Corporation that the FW200 handheld meter-reading unit presently being used by Hydro is being phased out in 2003 and they will support Hydro's system through 2005. The equipment estimate used for this budget is based on prices provided by the Radix Corporation to upgrade to the FW300 handheld model but other suppliers will also be evaluated.

**Future Plans:**

None.

# SECTION C

# NEWFOUNDLAND & LABRADOR HYDRO
## TRANSMISSION & RURAL OPERATIONS
## 2004 CAPITAL BUDGET
## PROJECTS SUBJECT TO MINIMUM FILING REQUIREMENTS - OVERVIEW
($,000)

| PROJECT DESCRIPTION | Exp To 2003 | 2004 | Future Years | Total | In-Ser Date | Explanation Page Ref. |
|---|---|---|---|---|---|---|
| Purchase and Install Transformer Addition - Happy Valley Terminal Station | 7 | 1,244 | | 1,251 | Nov. 04 | C-2 |
| **TOTAL TRANSMISSION & RURAL OPERATIONS** | 7 | 1,244 | 0 | 1,251 | | |

## Purchase and Install Transformer – Happy Valley Terminal Station

### 1. Project Description

This project includes all work involved with the purchase and installation of a 30/40/50 MVA 138/25kV transformer and associated terminal station equipment to replace one of the existing 15/20/25/28 MVA units

### 2. Project Scope

This project is being justified on the basis that additional transformer capacity will be required to meet the anticipated load requirements in Happy Valley – Goose Bay.

The scope of work is as follows:

- Replace one of the existing 138/25kV 15/20/25/28 MVA transformers with a 30/40/50 MVA unit.
- Install a new 25kV circuit breaker and two 1200 amp disconnect switches
- Upgrade 25kV bus conductor from 559.5 mcm to 1192.5 mcm

The new equipment will be installed on the existing foundations and structures and no foundation modifications are expected to be required. The existing circuit breaker's current transformers (C.T.'s) are rated at 600 amps which is not adequate for the increased transformer capacity resulting in the requirement for the new breaker. Likewise the existing 25kV bus conductor cannot carry the additional capacity resulting in the requirement for the bus conductor upgrade.

### 3. Project Timetable/Cash Flow

The preliminary design and engineering work will commence in the late fall of 2003 with the actual installation taking place in the fall of 2004.

| **Project Cost:** *($ x1,000)* | **2003** | **2004** | **Total** |
|---|---|---|---|
| **Material Supply** | 0.0 | 875.0 | 875.0 |
| **Labour** | 0.0 | 54.0 | 54.0 |
| **Engineering** | 7.0 | 32.0 | 7.0 |
| **Project Management** | 0.0 | 8.0 | 8.0 |
| **Inspection & Commissioning** | 0.0 | 35.0 | 35.0 |
| **Corp O/H, AFUDC, Esc. & Contingency** | 0.4 | 240.2 | 40.6 |
| **Total** | **7.4** | **1,244.2** | **1,251.6** |

**Purchase and Install Transformer – Happy Valley Terminal Station (cont'd.)**

**4. Customer Impact**

If additional transformer capacity is not added at Happy Valley - Goose Bay the existing transformers will be approximately 4% overloaded during the 2004 peak load period. Continued operation in an overloaded state will result in loss of transformer life and premature failure resulting in an outage to customers.

**5. Statement of Need**

At present there are two 15/20/25/28 MVA transformers at the Happy Valley Terminal Station for an installed capacity of 56 MVA. Based on Hydro's December 2002 load forecast these units will be slightly overloaded during the 2003 peak and by 2004 the overload at time of peak will be approximately 4%. Hydro's criteria for its major power transformers, which is consistent with industry standard, is to add capacity when projected load exceeds the transformer installed nameplate rating, which in the case of Happy Valley is 56 MVA. The projected load for the period 2003 – 2007 and the resultant % station loadings are shown below:

| YEAR | MVA LOAD | %STATION LOAD |
|---|---|---|
| 2003 | 56.9 | 101.6 |
| 2004 | 58.3 | 104.1 |
| 2005 | 60.0 | 107.1 |
| 2006 | 61.2 | 109.3 |
| 2007 | 62.6 | 111.8 |

**6. Description of Corrective Options**

The alternatives investigated for Happy Valley were to change out one of the existing transformers for a larger unit or to add a third transformer of equal rating to the existing units. The transformer change out, as being proposed, has a cost of $1.25 million while the addition of a third unit would cost approximately $ 2.4 million where the additional cost is attributed to the station expansion required to accommodate a third transformer.

**Purchase and Install Transformer – Happy Valley Terminal Station (cont'd.)**

**7. Documentation of Decision Rational**

Based on the forecasted load growth in Happy Valley- Goose Bay it is essential that additional transformer capacity be added by 2004 if the capability of the system is to be maintained. Of the alternatives investigated, it is recommended that the lower cost alternative of the transformer change out be implemented. While the addition of the third unit does offer minor improvements in operating flexibility it is believed that the additional expenditure is not warranted. It is proposed that the unit being removed from service be maintained as a system spare that will be kept at Happy Valley but made available to other areas on the system if required. Demand Side Management was investigated as an option to mitigate the load increase but it was determined the project could not be deferred through the application of this measure (see analysis on next page).

## Demand Side Management Analysis for Capital Budget Proposal

**Project Title:** Happy Valley Goose Bay - Transformer Replacement
**Description:** Replace 15/20/25 MVA transformer with 30/40/50 MVA

Overview: NLH views DSM as an opportunity to defer or postpone capital costs. The evaluated in economic terms as the difference in the present value of the utility revenue varying commencement years for the investment. The difference represents a DSM budget is the maximum amount of money that can be expended in order to defer the investment. The proceeds by determing the necessary demand or energy savings required to defer the investment evaluates whether the DSM budget constraint can achieve the required saving. This DSM review a preliminary screening to ensure there are no obvious DSM opportunities

The most economic peak demand DSM option, namely, domestic hot water (DWH) load evaluated against the required demand savings with the calculated DSM

Conclusion
The DSM deferral budget does not provide sufficient funds to achieve the load deferral targets. DS viable alternative in this circumstance. The salient details of the DSM review follow

| | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Load Forecast (HR OPLF Dec | | | | | |
| Peak Demand Forecast | 58,271 | 59,712 | 61,161 | 62,618 | na |
| Domestic | 3,660 | 3,765 | 3,876 | 3,975 | na |

| | | |
|---|---|---|
| Existing Transformer | 56,000 | kva, unit power |
| Capital Budget | $1,251,60 | |

| | 1 Yr | 2 Yr | 3 Yr | 4 Yr | 5 Yr |
|---|---|---|---|---|---|
| Required Demand Savings for Capital Deferral | 2,271 | 3,712 | 5,161 | 6,618 | na |
| DSM Budget Calculation (Calculated assuming 2% inflation and 7.2% rate base return as per | | | | | |
| Capital Budget Deferral | 4.9% | 9.5% | 13.9% | 18.0% | 22.0% |
| Total DSM Deferral | $57,209 | $110,916 | $162,288 | $210,157 | $256,85 |
| DSM Budget Per Required Demand Savings | $25 | $30 | $31 | $32 | na |

* Percentage of capital cost that can be incurred to defer project for 1 to 5 years, and still be indifferent in economic terms.

| DSM Supply Cost - $ per kW | $/kW* |
|---|---|
| Cooking Range Fuel | $1,331 |
| Domestic Hot Water (DHW) Fuel | $1,327 |
| Compact Fluorescent Lighting | $362 |
| Domestic Hot Water (DHW) Load | $354 |

* includes provision for distribution losses.

| Maximum Achievable Winter Peak Demand (Max kW reduction at lowest DSM supply cost and full DSM deferral budget) | 1 Yr | 2 Yr | 3 Yr | 4 Yr | 5 Yr |
|---|---|---|---|---|---|
| DHW Load | 162 | 314 | 459 | 594 | na |
| Achievable DSM Less Required DSM | (2,109) | (3,398) | (4,702) | (6,024) | na |

# SECTION D

**NEWFOUNDLAND & LABRADOR HYDRO**

**2004 LEASING COSTS**

| ***ITEM*** | ***2004 COST*** |
|---|---|

There are no new leases identified for 2004.

# SECTION E

## Capital Expenditures/Budgets 1998 - 2007
**($000)**

| | ACTUALS 1998 | ACTUALS 1999 | ACTUALS 2000 | ACTUALS 2001 | ACTUALS 2002 | FORECAST 2003 | BUDGET 2004 | BUDGET 2005 | BUDGET 2006 | BUDGET 2007 |
|---|---|---|---|---|---|---|---|---|---|---|
| GENERATION | 6,667 | 8,185 | 3,463 | 3,956 | 5,233 | 6,188 | 5,233 | 8,537 | 16,256 | 6,351 |
| TRANSMISSION & RURAL OPERATIONS | 17,456 | 24,711 | 28,658 | 28,929 | 29,560 | 10,993 | 12,821 | 12,486 | 10,690 | 8,665 |
| GENERAL PROPERTIES | 7,638 | 3,757 | 6,442 | 14,616 | 5,424 | 18,071 | 16,411 | 23,396 | 9,217 | 4,479 |
| TOTAL CAPITAL EXPENDITURES | 31,761 | 36,653 | 38,563 | 47,501 | 40,217 | 35,252 | 34,465 | 44,419 | 36,163 | 19,495 |

# SECTION F

NEWFOUNDLAND & LABRADOR HYDRO

2003 CAPITAL EXPENDITURES - OVERVIEW

FOR THE MONTH ENDING FEBRUARY 28, 2003
($,000)

| | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures |
|---|---|---|---|---|---|---|
| GENERATION | 219 | 5,704 | 174 | 5,530 | 5,704 | 0 |
| TRANSMISSION & RURAL OPERATIONS | 1,055 | 10,276 | 413 | 9,863 | 10,276 | 0 |
| GENERAL PROPERTIES | 1,925 | 17,869 | 358 | 17,511 | 17,869 | 0 |
| ALLOWANCE FOR UNFORESEEN EVENTS | 0 | 1,000 | 0 | 1,000 | 1,000 | 0 |
| PROJECTS APPROVED BY PUB | 73 | 321 | 8 | 313 | 321 | 0 |
| NEW PROJECTS LESS THAN $50,000 APPROVED BY HYDRO | 12 | 82 | 0 | 82 | 82 | 0 |
| TOTAL CAPITAL BUDGET | 3,284 | 35,252 | 953 | 34,299 | 35,252 | 0 |

| | |
|---|---|
| Approved P.U. 29 (2002-2003) | 33,070 |
| Approved P.U. 3 (2003) | 281 |
| Carryover Projects 2002 to 2003 | 1,852 |
| New Projects Under $ 50,000 Approved by Hydro | 49 |
| TOTAL APPROVED CAPITAL BUDGET | 35,252 |

## NEWFOUNDLAND & LABRADOR HYDRO

### 2003 CAPITAL EXPENDITURES - OVERVIEW

### FOR THE MONTH ENDING FEBRUARY 28, 2003
($,000)

| | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | |
|---|---|---|---|---|---|---|---|
| **GENERATION** | | | | | | | |
| **HYDRO PLANTS** | | | | | | | |
| Construction Projects | 64 | 773 | 7 | 766 | 773 | 0 | 4 |
| Property Additions | 0 | 327 | 0 | 327 | 327 | 0 | 4 |
| Tools & Equipment | 0 | 117 | 0 | 117 | 117 | 0 | 4 |
| **THERMAL PLANT** | | | | | | | |
| Construction Projects | 155 | 2,423 | 108 | 2,315 | 2,423 | 0 | 5 |
| Property Additions | 0 | 1,991 | 59 | 1,932 | 1,991 | 0 | 5 |
| Tools & Equipment | 0 | 73 | 0 | 73 | 73 | 0 | 5 |
| **TOTAL GENERATION** | 219 | 5,704 | 174 | 5,530 | 5,704 | 0 | |
| **TRANSMISSION & RURAL OPERATIONS** | | | | | | | |
| **TRANSMISSION** | 1,055 | 782 | 34 | 748 | 782 | 0 | 6 |
| **SYSTEM PERFORMANCE & PROTECTION** | 0 | 546 | 0 | 546 | 546 | 0 | 6 |
| **TERMINALS** | 0 | 581 | 0 | 581 | 581 | 0 | 6 |
| **DISTRIBUTION** | 0 | 6,685 | 375 | 6,310 | 6,685 | 0 | 7 |
| **GENERATION** | 0 | 681 | 0 | 681 | 681 | 0 | 7 |
| **GENERAL** | | | | | | | |
| Metering | 0 | 102 | 4 | 98 | 102 | 0 | 7 |
| Properties | 0 | 49 | 0 | 49 | 49 | 0 | 7 |
| Tools & Equipment | 0 | 850 | 0 | 850 | 850 | 0 | 7 |
| **TOTAL TRANSMISSION & RURAL OPERATIOI** | 1,055 | 10,276 | 413 | 9,863 | 10,276 | 0 | |

## NEWFOUNDLAND & LABRADOR HYDRO

### 2003 CAPITAL EXPENDITURES - OVERVIEW

### FOR THE MONTH ENDING FEBRUARY 28, 2003
($,000)

| | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | |
|---|---|---|---|---|---|---|---|
| GENERAL PROPERTIES | | | | | | | |
| INFORMATION SYSTEMS & TELECOMMUNICATIONS | 416 | 15,536 | 129 | 15,407 | 15,536 | 0 | 8 |
| ADMINISTRATIVE | 1,509 | 2,333 | 229 | 2,104 | 2,333 | 0 | 10 |
| TOTAL GENERAL PROPERTIES | 1,925 | 17,869 | 358 | 17,511 | 17,869 | 0 | |
| ALLOWANCE FOR UNFORESEEN EVENTS | 0 | 1,000 | 0 | 1,000 | 1,000 | 0 | 11 |
| PROJECTS APPROVED BY PUB | 73 | 321 | 8 | 313 | 321 | 0 | 11 |
| PROJECTS APPROVED FOR LESS THAN $50,000 | 12 | 82 | 0 | 82 | 82 | 0 | 11 |
| TOTAL CAPITAL BUDGET | 3,284 | 35,252 | 953 | 34,299 | 35,252 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **HYDRO PLANTS** | | | | | | | |
| **CONSTRUCTION PROJECTS** | | | | | | | |
| Install Fault Recorder - Upper Salmon Generating Station | 64 | 63 | 3 | 60 | 63 | 0 | |
| Upgrade Controls Spherical Valve No. 1 - Bay d'Espoir | | 223 | 4 | 219 | 223 | 0 | |
| Replace Vibration/Data System - Bay d'Espoir | | 153 | 0 | 153 | 153 | 0 | |
| Replacement of Draft Tube Stoplogs at Paradise River | | 156 | 0 | 156 | 156 | 0 | |
| Replace Fuel Storage Tanks at Burnt Spillway - Bay D' Espoir | | 97 | 0 | 97 | 97 | 0 | |
| Install Early Warning System - Victoria Dam | | 40 | 0 | 40 | 40 | 0 | |
| Frazil Ice Monitoring - Granite Canal | | 21 | 0 | 21 | 21 | 0 | |
| Replace Gate Hoist No. 2 - Ebbegunbaeg Control Structure | | 7 | 0 | 7 | 7 | 0 | |
| Replace Unit No. 7 Exciter - Bay d'Espoir | | 13 | 0 | 13 | 13 | 0 | |
| TOTAL CONSTRUCTION PROJECTS | 64 | 773 | 7 | 766 | 773 | 0 | |
| **PROPERTY ADDITIONS** | | | | | | | |
| Replace Site fencing - Bay d'Espoir | | 250 | 0 | 250 | 250 | 0 | |
| Purchase and Install Security Locks at Hydro Plants | | 77 | 0 | 77 | 77 | 0 | |
| TOTAL PROPERTY ADDITIONS | 0 | 327 | 0 | 327 | 327 | 0 | |
| **TOOLS & EQUIPMENT** | | | | | | | |
| Replace Loader/Backhoe - Bay d'Espoir | | 3 | 0 | 3 | 3 | 0 | |
| Purchase & Replace Tools & Equipment Less than $50,000 | 0 | 114 | 0 | 114 | 114 | 0 | |
| TOTAL TOOLS & EQUIPMENT | 0 | 117 | 0 | 117 | 117 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **THERMAL PLANT** | | | | | | | |
| **CONSTRUCTION PROJECTS** | | | | | | | |
| Purchase and Install Continuous Emission Monitoring | 132 | 669 | 83 | 586 | 669 | 0 | |
| Replace Turbine Electrohydraulic Control System - Unit No. 1 - Holyrood | 23 | 965 | 25 | 940 | 965 | 0 | |
| Purchase and Installation of a Neutralization Pit - Holyrood | | 343 | 0 | 343 | 343 | 0 | |
| Purchase Mobile Ambient Monitoring System - Holyrood | | 184 | 0 | 184 | 184 | 0 | |
| Flue Gas Particulate Removal Study - Holyrood | | 150 | 0 | 150 | 150 | 0 | |
| Purch/Inst Partial Discharge Analysis Equip - Unit No. 1 - Holyrood | | 112 | 0 | 112 | 112 | 0 | |
| TOTAL CONSTRUCTION PROJECTS | 155 | 2,423 | 108 | 2,315 | 2,423 | 0 | |
| **PROPERTY ADDITIONS** | | | | | | | |
| Upgrade Civil Structures - Holyrood | | 1,991 | 59 | 1,932 | 1,991 | 0 | |
| TOTAL PROPERTY ADDITIONS | 0 | 1,991 | 59 | 1,932 | 1,991 | 0 | |
| **TOOLS & EQUIPMENT** | | | | | | | |
| Purchase & Replace Tools & Equipment Less than $50,000 | 0 | 73 | 0 | 73 | 73 | 0 | |
| TOTAL TOOLS & EQUIPMENT | 0 | 73 | 0 | 73 | 73 | 0 | |
| TOTAL GENERATION | 219 | 5,704 | 174 | 5,530 | 5,704 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **TRANSMISSION** | | | | | | | |
| Upgrade TL227 - (69 kV Berry Hill - Daniels Harbour) | 654 | 179 | 31 | 148 | 179 | 0 | |
| Replacement of Insulators TL228 (230kV Buchans - Massey Drive) | 401 | 49 | 3 | 46 | 49 | 0 | |
| Uprate of TL203- (230kv Sunnyside - Western Avalon) | | 207 | 0 | 207 | 207 | 0 | |
| Replace Insulators TL209 - ( 230kV Stephenville - Bottom Brook) | | 236 | 0 | 236 | 236 | 0 | |
| Upgrade TL214 - (138kV Bottom Brook - Doyles) | | 111 | 0 | 111 | 111 | 0 | |
| TOTAL TRANSMISSION | 1,055 | 782 | 34 | 748 | 782 | 0 | |
| **SYSTEM PERFORMANCE & PROTECTION** | | | | | | | |
| Upgrade Circuit Switcher South Brook Terminal Station | | 355 | 0 | 355 | 355 | 0 | |
| Purchase and Install 138kV Breaker Fail Protection | | 82 | 0 | 82 | 82 | 0 | |
| Upgrade Breaker Controls - SunnysideTerminal Station | | 33 | 0 | 33 | 33 | 0 | |
| Replace Digital Fault Recorder - Holyrood Terminal Station | | 76 | 0 | 76 | 76 | 0 | |
| TOTAL SYSTEM PERFORMANCE & PROTECTION | 0 | 546 | 0 | 546 | 546 | 0 | |
| **TERMINALS** | | | | | | | |
| Replace Fence - Holyrood Terminal Station | | 32 | 0 | 32 | 32 | 0 | |
| Upgrade Access Road - Farewell Head Terminal Station | | 22 | 0 | 22 | 22 | 0 | |
| Replace 125v Battery Banks | | 83 | 0 | 83 | 83 | 0 | |
| Upgrade Station Services - Long Harbour Terminal Station | | 83 | 0 | 83 | 83 | 0 | |
| Install Motor Drive Mechanisms on Disconnect Switches - Sunnyside T.S. | | 217 | 0 | 217 | 217 | 0 | |
| Replace Surge Arrestors | | 69 | 0 | 69 | 69 | 0 | |
| Replace Instrument Transformers | | 75 | 0 | 75 | 75 | 0 | |
| TOTAL TERMINALS | 0 | 581 | 0 | 581 | 581 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **DISTRIBUTION** | | | | | | | |
| Service Extensions | | 1,448 | 216 | 1,232 | 1,448 | 0 | |
| Distribution Upgrades | | 1,476 | 154 | 1,322 | 1,476 | 0 | |
| Upgrade Line - Little Bay Distribution System | | 317 | 0 | 317 | 317 | 0 | |
| Upgrade Line - St. Anthony Distribution Systems | | 557 | 0 | 557 | 557 | 0 | |
| Insulator Replacements | | 795 | 0 | 795 | 795 | 0 | |
| Pole Replacements | | 852 | 5 | 847 | 852 | 0 | |
| Protection Upgrades - Isolated Systems | | 720 | 0 | 720 | 720 | 0 | |
| Replace Corroded Transformers | | 172 | 0 | 172 | 172 | 0 | |
| Replace Voltage Regulators | | 176 | 0 | 176 | 176 | 0 | |
| Protection Upgrade North Diesel Plant - Goose Bay | | 172 | 0 | 172 | 172 | 0 | |
| **TOTAL DISTRIBUTION** | 0 | 6,685 | 375 | 6,310 | 6,685 | 0 | |
| **GENERATION** | | | | | | | |
| Install Nox Emission Monitor - McCallum | | 103 | 0 | 103 | 103 | 0 | |
| Install Fire Alarm Systems | | 98 | 0 | 98 | 98 | 0 | |
| Upgrade Service Cables | | 60 | 0 | 60 | 60 | 0 | |
| Increase Generation - Mary's Harbour | | 212 | 0 | 212 | 212 | 0 | |
| Fuel Storage Upgrades | | 208 | 0 | 208 | 208 | 0 | |
| **TOTAL GENERATION** | 0 | 681 | 0 | 681 | 681 | 0 | |
| **GENERAL** | | | | | | | |
| **METERING** | | | | | | | |
| Purchase Meters & Equipment - Rural System | | 96 | 2 | 94 | 96 | 0 | |
| Purchase Metering Spares - Bulk Electrical System | | 6 | 2 | 4 | 6 | 0 | |
| **TOTAL METERING** | 0 | 102 | 4 | 98 | 102 | 0 | |
| **PROPERTIES** | | | | | | | |
| Construct Storage Shed - Harbour Breton | | 19 | 0 | 19 | 19 | 0 | |
| Purchase Land - Mud Lake | | 30 | 0 | 30 | 30 | 0 | |
| **TOTAL PROPERTIES** | 0 | 49 | 0 | 49 | 49 | 0 | |
| **TOOLS & EQUIPMENT** | | | | | | | |
| Purchase & Replace Tools & Equipment Less than $ 50,000 | 0 | 306 | 0 | 306 | 306 | 0 | |
| Replace Light Duty Mobile Equipment Less than $50,000 | | 544 | 0 | 544 | 544 | 0 | |
| **TOTAL TOOLS & EQUIPMENT** | 0 | 850 | 0 | 850 | 850 | 0 | |
| **TOTAL GENERAL** | 0 | 1,001 | 0 | 0 | 0 | 0 | |
| **TOTAL TRANSMISSION & RURAL OPERTIONS** | 1,055 | 10,276 | 409 | 8,866 | 9,275 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **INFORMATION SYSTEMS & TELECOMMUNICATIONS** | | | | | | | |
| **SOFTWARE APPLICATIONS** | | | | | | | |
| **INFRASTRUCTURE REPLACEMENT** | | | | | | | |
| Acquire Document Management & Imaging System | | 104 | 32 | 72 | 104 | 0 | |
| Replace Energy Management System - Energy Control Centre | | 1,214 | 0 | 1,214 | 1,214 | 0 | |
| **NEW INFRASTRUCTURE** | | | | | | | |
| Purchase Additional Corporate Applications | 43 | 84 | 1 | 83 | 84 | 0 | |
| Security Program Centralized Log Monitoring & Analysis System | | 57 | 0 | 57 | 57 | 0 | |
| **TOTAL SOFTWARE APPLICATIONS** | 43 | 1,459 | 33 | 1,426 | 1,459 | 0 | |
| **COMPUTER OPERATIONS** | | | | | | | |
| **INFRASTRUCTURE REPLACEMENT** | | | | | | | |
| Enterprise Storage Management Infrastructure | | 2,049 | 0 | 2,049 | 2,049 | 0 | |
| End User & Server Evergreen Program | | 893 | 2 | 891 | 893 | 0 | |
| **NEW INFRASTRUCTURE** | | | | | | | |
| Peripheral Infrastructure Replacement | | 99 | 0 | 99 | 99 | 0 | |
| **TOTAL COMPUTER OPERATIONS** | 0 | 3,041 | 2 | 3,039 | 3,041 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **INFORMATION SYSTEMS & TELECOMMUNICATIONS** | | | | | | | |
| **NETWORK SERVICES** | | | | | | | |
| **INFRASTRUCTURE REPLACEMENT** | | | | | | | |
| Install New Microwave System Interconnection Between East/West Coast | 208 | 8,734 | 68 | 8,666 | 8,734 | 0 | |
| Replace UHF Radio Link - Abitibi - Stephenville | | 89 | 1 | 88 | 89 | 0 | |
| Replace Powerline Carrier Equipment West Coast Transmission System | | 1,009 | 0 | 1,009 | 1,009 | 0 | |
| Replace Voice, Data & Teleprotection Equip - Upper Salmon Intake | | 88 | 0 | 88 | 88 | 0 | |
| Upgrade Site Grounding at Telecontrol Site - Phase 4 | | 48 | 0 | 48 | 48 | 0 | |
| Replace Battery System - Multiple Sites | | 224 | 0 | 224 | 224 | 0 | |
| Replace Remote Terminal Unit for Hydro - Phase 4 | | 285 | 1 | 284 | 285 | 0 | |
| **NETWORK INFRASTRUCTURE** | | | | | | | |
| Purchase Equipment for Physical Facilities Upgrade | | 71 | 0 | 71 | 71 | 0 | |
| Deer Lake Building Improvements | | 103 | 0 | 103 | 103 | 0 | |
| Upgrade Local Area Networks (LANs) - Multiple Sites | | 47 | 2 | 45 | 47 | 0 | |
| **UPGRADE OF TECHNOLOGY** | | | | | | | |
| Provide Global Positioning System Time Synchronization - Phase 2 | 165 | 46 | 21 | 25 | 46 | 0 | |
| Replacement of Operational Data & Voice Network - Phase I | | 292 | 1 | 291 | 292 | 0 | |
| **TOTAL NETWORK SERVICES** | 373 | 11,036 | 94 | 10,942 | 11,036 | 0 | |
| **TOTAL INFORMATION SYSTEMS & TELECOMMUNICATIONS** | 416 | 15,536 | 129 | 15,407 | 15,536 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **ADMINISTRATIVE** | | | | | | | |
| **VEHICLES** | | | | | | | |
| Replace Vehicles - 2002 | 1,509 | 498 | 204 | 294 | 498 | 0 | |
| Replace Vehicles - Hydro System | 0 | 1,584 | 25 | 1,559 | 1,584 | 0 | |
| **ADMINISTRATION** | | | | | | | |
| Replace Engineering Wide Format Printing System | | 62 | 0 | 62 | 62 | 0 | |
| Automatic Meter Reading (AMR) - Pilot Project | | 52 | 0 | 52 | 52 | 0 | |
| Purchase & Replace Admin Office Equip less than $50,000 | 0 | 137 | 0 | 137 | 137 | 0 | |
| **TOTAL ADMINISTRATIVE** | 1,509 | 2,333 | 229 | 2,104 | 2,333 | 0 | |
| **TOTAL GENERAL PROPERTIES** | 1,925 | 17,869 | 358 | 17,511 | 17,869 | 0 | |

| PROJECT DESCRIPTION | Expenditures Prior To 2003 | PUB Approved Budget 2003 | 2003 Expenditures To February 28 | Expected Remaining Expenditures 2003 | Expected Total Expenditures 2003 | Var. from Approved to Expected Expenditures | Variance Explanation Reference |
|---|---|---|---|---|---|---|---|
| **ALLOWANCE FOR UNFORESEEN EVENTS** | | | | | | | |
| Allowance for Unforeseen Events | | 1,000 | 0 | 1,000 | 1,000 | 0 | |
| **TOTAL ALLOWANCE FOR UNFORESEEN EVENTS** | 0 | 1,000 | 0 | 1,000 | 1,000 | 0 | |
| **PROJECTS APPROVED BY PUB** | | | | | | | |
| Carryover Project | | | | | | | |
| Replace Diesel Unit #2006 with Unit #2052 - Cartwright | 73 | 40 | 8 | 32 | 40 | 0 | |
| Project Approved in 2004 | | | | | | | |
| Replacement of Timber Crib Headwall at Grey River Fish Compensation Str | | 281 | 0 | 281 | 281 | 0 | |
| **TOTAL PROJECTS APPROVED BY PUB** | 73 | 321 | 8 | 313 | 321 | 0 | |
| **NEW PROJECTS LESS THAN $50,000 APPROVED BY HYDRO** | | | | | | | |
| Carryover Project | | | | | | | |
| Install Alternate 69kV Feed to Transformer SST-12 - Holyrood | 12 | 33 | 0 | 33 | 33 | 0 | |
| Project Approved in 2004 | | | | | | | |
| Purchase Auxiliary Cooling Water Pump - Holyrood | | 49 | 0 | 49 | 49 | 0 | |
| **TOTAL PROJECTS LESS THAN $50,000 APPROVED BY HYDR** | 12 | 82 | 0 | 82 | 82 | 0 | |

# SECTION G

Tab 1

# CONDITION ASSESSMENT
# OF GOVERNOR CONTROLS
# FOR UPPER SALMON AND
# CAT ARM UNITS

**Prepared by: Generation Engineering**
**(P & C Section)**
**Date: June, 2001**

## 1) Purpose of Review

Hydro Generation requested Generation Engineering to prepare a condition assessment of the control portions of the governors for Upper Salmon (1 unit) and Cat Arm (2 units). The purpose of the assessment is to review the service history of the control components and to determine what technical support and spare parts are available from the original equipment manufacturers.

The end result of the review is to determine if and when the control sections of these governors should be replaced.

A section has been included on possible replacement controllers with a cost comparison.

## 2) Introduction

Upper Salmon is a single unit plant rated at 88.4 MVA (84MW). It has a Francis turbine and a Woodward Governor Mod II analog control system. This governor is the original equipment that has been in service since late 1982.

Cat Arm is a two-unit plant with each unit rated at 75.5 MVA (72MW). Each unit has a Pelton turbine with a governor made by Escher Wyss. These governors are an analog electronic type that has been manufactured by Escher Wyss since 1974. The governors at Cat Arm have been in service since 1984.

There have been notices from both Woodward (hydro turbine controls section now part of General Electric Global Controls Services) and Escher Wyss (now Vatech Hydro) that support for these systems will become difficult to provide in the next few years.

The report gives information on replacement systems and the estimated costs of these replacements.

## 3) Upper Salmon

### a. Technical Support and Spare Parts

The need for a review of the Upper Salmon governor controls was highlighted by a memo dated 97-12-16 from Ron Bland of Woodward Governor to Louis Barnes concerning support for the Mod II governor. In this memo he states that "Through this process [product rationalization] we have determined that it is becoming increasingly difficult to provide support for the Woodward Mod I and Mod II Analog control systems. This is mainly due to our inability to procure electrical components from our vendors. This means we can no longer manufacture new modules. We can, in many cases, still offer repair services on these modules as long as the components that are unavailable are still functional".

It was later confirmed with Woodward that new boards are not available and repairs can only be done as long as components are available. The Woodward representative stated in a note dated 99/07/06 that board repair for the Mod II governor was still available but limited. He stated that "Many of the necessary components are no longer available from our suppliers and we do not know which components have been discontinued until we try to purchase them. Unfortunately, this puts Mod II owners in a precarious situation. We will repair boards so long as we can get the parts, but at this point, there are no guarantees".

Hydro has a good supply of spare parts for the Mod II. However, if the spare is used, it may be difficult to replace it or have the removed card repaired. Technical Support (service representatives) is available for the Mod II.

b. Service History

The maintenance records between 1995 and 1999 were checked for the governor controls and brief descriptions are given below.

(i) 95-03-28 (W.O. #12906) *Problem: Unit will not load past 10% gate; Action: Investigated speed control circuit; replaced 65MS motor and relay 33XYZ (coil burned out).*

(ii) 95-11-01 (W.O. # 16013) *Problem: Check governor load setpoint fluctuations; Action: 2 pots replaced.*

(iii) 97-09-16 (W.O. # 25198) *Problem: Governor power setpoint control not responding to load control below 75MW; Action: Adjusted tension on slip clutch; adjusted mechanical end stop.*

(iv) 97-11-13 (W.O. # 25730) *Problem: Adjust SNL setting on speed/load control; Action: Replaced speed sensor card.*

| | | |
|---|---|---|
| (v) | 97-11-14<br>(W.O. # 25731) | *<u>Problem:</u> Replace relay 04T2;*<br>*<u>Action:</u> Installed a new relay.* |
| (vi) | 97-12-04<br>(W.O. # 26000) | *<u>Problem:</u> Investigate discrepancies between load setpoint and the actual load;*<br>*<u>Action</u>: Replaced defective pot assembly.* |
| (vii) | 97-12-12<br>(W.O. # 26056) | *<u>Problem:</u> Investigate difference between governor load setpoint and actual load;*<br>*<u>Action:</u> Replaced operational amplifier on speed sensor card.* |
| (viii) | 97-12-21<br>(W.O. # 24726) | *<u>Problem:</u> Check controls to determine why unit shed load on 97-08-15;*<br>*<u>Action:</u> Hydro personnel did some checks after the problem first occurred. The problem reoccurred and a service representative was called in from Woodward. Amplifier IC14 was replaced and some bent pins on the speed sensor were straightened.* |

This is not a complete list of all service trips made by Bay d'Espoir but it does give an overview of the problems that have occurred.

4) <u>Cat Arm</u>

a. <u>Technical Support and Spare Parts</u>

A memo dated January 31, 1996 from Urs Gantenbein of Sulzer Hydro to Darren Moore highlighted the need for review of the Cat Arm Governor Controls. In this memo it was stated that replacement parts and the repair of cards would be available until the end of 2004. The last sales for new projects were July 31, 1996.

This was further confirmed in January 2000 by Sulzer Hydro that card repairs would be available only until 2004.

Hydro has a good supply of spare parts for the governor controls. With repair services available until 2004, Hydro is covered until then.

b. <u>Service History</u>

As per Bay d'Espoir maintenance records, there have been 4 cards and 3 power supplies replaced since 1990. Brief descriptions of the card problems are given below:

| | | |
|---|---|---|
| (i) | 1990 (W.O. # 24159) | *<u>Problem:</u> Unit # 1 governor needle # 6 would not open;* *<u>Action:</u> Replaced defective relay card SRA-11 used for needle # 6 switch on circuit.* |
| (ii) | 1990 (W.O. # 24793) | *<u>Problem:</u> Unit # 1 governor needle # 6 picking up and dropping out suddenly;* *<u>Action:</u> Replaced card with spare (card not described).* |
| (iii) | 1990 (W.O. # 26825) | *<u>Problem:</u> Unit # 1governor failure of 24V power supply;* *<u>Action</u>: Power supply replaced.* |
| (iv) | 1993 (W.O. # 28447) | *<u>Problem:</u> Unit # 1limiter setpoint will not rise;* *<u>Action:</u> Limiter setpoint card replaced.* |
| (v) | 1994 (W.O. # 29992) | *<u>Problem:</u> Unit # 1 power supply;* *<u>Action:</u> Temporary DC power supply installed. New power supply ordered from Escher Wyss (1994). Received and installed under W.O. # 23342.* |
| (vi) | 1995 (W.O. # 30658) | *<u>Problem:</u>* Unit # 1 defective 24V power supply; *<u>Action</u>: Replaced power supply.* |
| (vii) | 2000 (W.O. # 118723) | *<u>Problem:</u> Unit # 2 second needle does not cut in until the first is 100%;* *<u>Action:</u> Replaced and adjusted needle switch on card RUM-20 (damping switchover card).* |

5) <u>Replacement Systems</u>

Woodward Governor Company manufactured the governor controls at Upper Salmon and Escher Wyss manufactured those at Cat Arm. The hydro governor business of Woodward has been sold to General Electric and is now covered by GE Global Controls Services. Escher Wyss was later sold to Sulzer Hydro which became a part of Vatech Hydro.

Since Woodward and Escher Wyss were the original manufacturers, they were asked to provide information on replacements for Upper Salmon and Cat Arm respectively.

a. Upper Salmon

(i) GE Global Controls Services (Woodward) Proposal

Woodward submitted a proposal in 1999 (before sale to GE Global Controls Services) based on the Micronet Turbine Control System. Since then they have produced a new turbine control system called the Atlas PC. The Atlas PC has been accepted as the governor control at Granite Canal. GE Global Controls Services now use the Atlas PC as their standard product rather than the Micronet.

The upgrade from analog to digital controls also involves the replacement of the mechanical feedback systems with electronic feedback devices. The pilot stage of the hydraulic system will be replaced with an electrohydraulic interface. The analog cards will be replaced with the Micronet or Atlas PC system.

The Micronet was originally proposed by Woodward and it can be used to control gas turbines, steam turbines, gas engines or hydro turbines. It has a number of functions besides being a governor. The Micronet is available in both simplex, as originally proposed for Upper Salmon, and triple modular redundant (TMR) configurations.

The Atlas PC controller is based on an embedded PC technology using an industrial Pentium processor. There are two (2) models of the Atlas PC control system called the Atlas HMOD and the Atlas HC.

GE Global Controls Services have a CD titled "Hydro Solutions" where you can enter the type of turbine you wish to control and the best GE solutions will be presented. The Francis turbine such as at Upper Salmon can use either the Atlas HMOD or Atlas HC models with the Atlas HMOD being the recommended choice.

The differences between the Atlas HMOD, the Atlas HC, and the Micronet HC are shown in the comparison chart below. This chart is applicable to both Upper Salmon and Cat Arm if GE solutions are used at both sites. The chart shows the base model and which options are available for each model.

| Functionality | Atlas HMOD | | Atlas HC | | Micronet HC | |
|---|---|---|---|---|---|---|
| Servo Control | Base | Option | Base | Option | Base | Option |
| - Off line Speed Control (Dedicated Gains) | X | | X | | X | |
| - Integrated Manual Position Cntl | X | | X | | X | |
| - Blade Position Control (3-D CAM) | | X | | X | | X |
| - Needle Control | | | | X | | X |
| - Load Control (Frequency/Load – Dedicated Gains) | X | | | X | | X |
| - Gate Position Control (Frequency/ Load – Dedicated Gains) | X | | X | | X | |
| - Level Control | | | | X | | X |
| - Flow Control | | | | X | | X |
| - Pumping Control (pump turbine) | | | | X | | X |
| - Synch. Condense | | | | X | | X |
| - Isochronous Control | | X | | X | | X |
| - Loadsharing (DSLC) | | | | X | | X |
| - Gate Limit | X | | X | | X | |
| - Integrated Electronic Overspeed Protection | X | | X | | X | |
| Sequencing | | | | | | |
| - Start Permissive | X | | X | | X | |
| - Start Ramp | X | | X | | X | |
| - Breaker Control | X | | | X | | X |
| - Synchronization (DSLC) | | X | | X | | X |
| - Integrated Synchronization | | X | | X | | X |
| - Rough Zone Avoidance | | | | X | | X |
| - Stop Ramp (soft unloading) | X | | X | | X | |
| - Emergency Shutdown | X | | X | | X | |
| - Black Start | | | | X | | X |
| - Creep/Dead Stop Detection | | X | | X | | X |
| - Blade Lock/Tilting | | X | | X | | X |
| - Needle Sequencing | | | | X | | X |
| - Gate Lock | | X | | X | | X |
| Auxiliary Control | | | | | | |
| - Speed and Gate Position Switches | X | | X | | X | |
| - Var/PF (DSLC) | | | | X | | X |
| - HPU (echelon control) | | | | | | X |
| - Lift Oil Pumps | | | | X | | X |
| - Brake Control | X | | | X | | X |
| - Lube Oil/Water Cooling Pumps | | | | X | | X |
| - Pressure Tank Air Charging | | | | X | | X |
| - Black Start Diesel (start/stop) | | | | X | | X |
| - Spill Gate | | | | X | | X |
| - Standalone Manual Positioning (723MP) | | | | | | X |
| - Additional Auxiliary Control | | | | X | | X |

| Functionality | Atlas HMOD | | Atlas HC | | Micronet HC | |
|---|---|---|---|---|---|---|
| Monitoring | Base | Option | Base | Option | Base | Option |
| - Trips/Alarms | X | | X | | X | |
| - Control I/O (status) | X | | X | | X | |
| - Generator variable (real/reactive Power, etc) | | X | | X | | X |
| - Temperature/Pressure | | X | | X | | X |
| - Levels (head, tail and/or net head) | | X | | X | | X |
| - Vibration | | | | X | | X |
| - Expanded Capability | | | | X | | X |
| Operator Inferfaces | | | | | | |
| - Operator Control Panel (OCP) (hardwired) | | X | | X | | X |
| - Operator Interface Terminal (mini touchscreen HMI) | X | | | X | | X |
| - HMI (local and/or remote) | | X | | X | | X |
| - SCADA | | X | | X | | X |
| - Interface Expansion | | | | X | | X |
| Service Tools | | | | | | |
| - Two-line Display/Handheld Programmer | | | | | | |
| Maintenance Mode | X | | X | | X | |
| Calibration Mode | X | | X | | X | |
| Dynamic Tuning | X | | X | | X | |
| - Servo Timing | X | | X | | X | |
| - Maximum Speed Capture | X | | X | | X | |
| - Integrated Index Testing | | | | X | | X |
| - PC Diagnostic and Configuration Software | | | | | | |
| Watch Window (configuring/ viewing control variables) | | X | | X | | X |
| Trender | | X | | X | | X |
| Control Assistant (datalog viewing, tunable maintenance) | | X | | X | | X |
| Port Monitor SOE (sequence of events) | | X | | X | | X |
| Port Monitor DEC (data event capture) | | X | | X | | X |
| - GAP License | | X | | X | | X |
| - Remote Service & Support (dialup) | | X | | X | | |
| Communication (Modbus) | | | | | | |
| - 1 Serial Port (RS-232, RS-422, RS-485) | X | | X | | X | |
| - Ethernet | X | | X | | | X |
| - Expanded Communications (Profibus) | | | | X | | |

NOTE:

1) Atlas HC refers to Hydro Custom. The custom work is in the hydraulic interface to non-Woodward units.

2) DSLC - Digital Synchronizer and Load Control (separate device)

3) OCP - Operator Control Panel – hardwired that provides minimum control inputs (switches) and outputs (meters) for local unit operation. The OCP is generally provided on the door of the electrical enclosure.

4) HMI - As per the description, Standard HMI operator interface consists of an industrial flat panel display or a commercial desktop computer running Intellution Software. It provides integrated sequencing, unit mode control, auxiliary control and monitoring of the individual unit from a graphic display. The HMI can also provide first out alarm/trip annunciation, data acquisition and trending.

5) GAP - Graphical Application Programmer is the software used to write the control application.

The recommended choice by GE Global Control Services for Upper Salmon is the Atlas HMOD. As can be seen from the comparison chart, the Atlas HMOD has fewer features than the Atlas HC or the Micronet HC. Some of these features are not necessary for a Francis turbine such as Needle Control, Level and Flow Control or Pumping Control.

Plant personnel would have to review the functionality to see if features not included in the Atlas HMOD are needed, such as some of the items under Sequencing (Rough Zone Avoidance, Black Start) or Auxiliary Control (Lift Oil Pumps, Lube Oil/Water Cooling Pumps, etc.)

For use as a governor only, the Atlas HMOD appears adequate.

The cost estimate for the Atlas HMOD and Micronet is given in Appendix A.

<u>Pros:</u>

1) GE Global Controls Services, purchaser of Woodward hydro controls section was the original equipment supplier.

2) GE Global Controls Services through their purchase of Woodward has a great deal of experience in hydro turbine control.

3) The Atlas PC will be in service at Granite Canal in 2003. There would be benefits in spare parts and training to use the same system at other sites.

Cons:

1) The Micronet and Atlas PC are proprietary systems and GE Global Controls Services would have to supply all spare parts.

2) Higher cost then for PLC system. (See cost estimate page 12).

(ii) PLC Based System

When the Digitek Plant Controller with the governing function was replaced at Paradise River in 1998, a programmable logic controller was supplied by Russelectric using a GE Fanuc Series 30. Therefore, PLC based systems should be considered for governor controls replacement at Upper Salmon.

Both Russelectric (Boston, Mass.) and L & S Electric (Schofield, Wisconsin) were asked to provide an estimate for replacement of the existing Woodward governor controls with a PLC based system.

a) Russelectric

Russelectric is a company based in Hingham, Massachusetts (outside Boston) that does "power protection and control systems for critical facilities" (as per their website). They are represented by C-Tech of North America Inc. based in Florida and the estimates in this report were provided by C-Tech.

Hydro has experience with Russelectric with the replacement of the Digitek controller at Paradise River. Russelectric did a good job and the replacement was successful. The PLC based governor and control system has worked well during the two and one half years it has been in service.

A copy of the estimate and scope of work from Russelectric is given in Appendix B. The estimate is for a governor controls replacement only and it does not include other control functions.

b) L & S Electric

L & S Electric are based in Schofield, Wisconsin. They have been providing automation systems, governors, excitation systems and SCADA systems for 18 years. They have about 165 governor and/or gate positioner units in service. L & S Electric have done governor projects in Canada for West Kootenay Power, B.C. and Ontario Hydro (Red Rock, Ear Falls)

L & S Electric bid on the Paradise River Digitek replacement using an Allen Bradley PLC, but their quotation was higher than the one from Russelectric.

A copy of the estimate and scope of work from L & S Electric is given in Appendix C. The estimate is for a governor controls replacement only and it does not include other control functions.

Pros:

1) Russelectric has supplied a system at Paradise River (GE Fanuc 30) that is working well.

2) The hardware and software for the PLC (GE Fanuc, Modicon, Allen Bradley) is readily available.

3) Russelectric has given good service on the Paradise River control system.

4) Both Russelectric and L & S Electric provided quick responses to the request for automation.

5) Lower cost than GE Global Controls Services. (See cost estimate page 12).

6) L & S have a number of former Woodward employees on staff.

Cons:

1) Neither company has the experience that GE Global Control Services (Woodward) has.

2) Both companies' experience is mainly with smaller machines.

(iii) Cost Estimate (Upper Salmon)

Based on purchase and installation in 2002. All estimates were given in U.S. dollars. The conversion rate used is 1.50. All costs below are shown in Canadian dollars.

| **Item** | **GE Global Controls Services** | | **Russelectric** | **L & S Electric** |
|---|---|---|---|---|
| | **Micronet** | **Atlas HMOD** | | |
| a) Equipment<br>- controller<br>- interface cards<br>- display | $270,000 | $187,500<br>See Note 1 | $164,000<br>Note 2 | $127,000<br>Note 2 |
| b) Installation supervision | $40,000 Note 3 | $40,000 | 10 days<br>(Included in Item a) | (10 days)<br>$30,000 |
| c) On-site training | $25,000 Note 4 | $25,000 | $25,000 | $25,000 |
| Subtotal | $335,000 | $252,500 | $189,000 | $182,000 |
| d) Misc. Material | $25,000 Note 5 | $25,000 | $25,000 | $25,000 |
| e) Installation (Internal) | $100,000 | $100,000 | $100,000 | $100,000 |
| f) P & C Engineering | $50,000 | $50,000 | $50,000 | $50,000 |
| Total Direct Costs | $510,000 | $427,500 | $364,000 | $357,000 |
| g) Corporate Overheads | $33,600 | $28,200 | $23,900 | $23,500 |
| h) IDC | $6,100 | $5,400 | $5,300 | $520 |
| i) Contingency | $51,000 | $43,000 | $36,000 | $36,000 |
| j) Escalation | $11,700 | $9,900 | $8,300 | $8,000 |
| **TOTAL** | **$612,400** | **$514,500** | **$437,500** | **$429,800** |

NOTES:

1. The cost is based on a new EHI pilot valve version that retains the existing distributing valve.
2. The PLC based systems do not include a separate operator interface. The existing switches and meters are used. The Atlas PC has a mini touchscreen HMI included.
3. GE Global Control Services - based on 3 weeks for a commissioning engineer.
4. Training – based on 5 days for technicians and 5 days for operators; includes presentation materials and all instructor costs/expenses.

5. Miscellaneous material – all Hydro supplied material such as laptop computer, terminal blocks, cable & mounting hardware.

6. All estimates are based on using the turbine controllers as governors only. Additional control and monitoring could be added.

<u>CONCLUSION:</u>

Based on the cost comparison, a PLC based system would be the least cost.

b. <u>Cat Arm</u>

(i) <u>Sulzer Hydro Proposal:</u>

Sulzer Hydro (now Vatech Hydro) submitted a price based on their model DTL 595 digital turbine control system. This controller has been used by Newfoundland Power at their Rose Blanche plant.

Vatech Hydro did not provide detailed information on the capabilities of the DTL 595. There is a two page description on their website and this is included in Appendix D. The references show that the DTL595 has been used on large machines.

(ii) <u>PLC Based System:</u>

As with the Upper Salmon governor controls, Russelectric and L & S Electric can provide a PLC based system.

The Pros and Cons of using a PLC based system are the same as for Upper Salmon. Neither Russelectric nor L & S Electric has the experience of Vatech Hydro on machines of this type and size.

(iii) The Atlas HC by GE Global Controls Services could be used as a replacement for the governor controls at Cat Arm. They have done a replacement for a six-needle impulse Escher Wyss system at NCPA Collierville (2001).

Cost Estimate (Cat Arm)

Based on purchase and installation of first unit in 2004. The estimates from Russelectric and L & S Electric were given in U.S. dollars. The conversion rate is 1.50. All costs below are shown in Canadian dollars.

| Item | Vatech Hydro | Russelectric | L & S Electric | GE Atlas HC |
|---|---|---|---|---|
| (a) Equipment<br>-controller<br>-interfaces<br>-mux | $80,000 | $220,000 | $355,000 | $277,500 |
| (b) Installation supervision | 10 days included | 10 days included | $30,000 (10 days) | $30,000 |
| (c) On-site training | $25,000 | $25,000 | $25,000 | $25,000 |
| Subtotal | $105,000 | $245,000 | $410,000 | $332,500 |
| (d) Misc. material | $15,000 | $15,000 | $15,000 | $15,000 |
| (e) Installation (Internal) | $100,000 | $100,000 | $100,000 | $100,000 |
| (f) P & C Engineering | $50,000 | $50,000 | $50,000 | $50,000 |
| Total Direct Costs | $270,000 | $410,000 | $575,000 | $497,500 |
| (a) Corporate Overheads | $17,800 | $27,000 | $37,900 | $32,600 |
| (b) IDC | $4,200 | $5,500 | $6,500 | $6,000 |
| (c) Contingency | $27,000 | $41,000 | $58,000 | $50,000 |
| (d) Escalation | $19,200 | $29,100 | $40,900 | $35,100 |
| **TOTAL** | **$338,200** | **$512,600** | **$718,300** | **$618,700** |

Based on the cost comparison, the controller from Vatech Hydro is the least cost.

The cost estimates are given in Appendices A, B, C & D.

Recommendations:

1. The governor controls at Upper Salmon should be replaced due to the unavailability of components for the cards.

2. The governor controls for one unit at Cat Arm should be replaced by 2004 when card repairs are no longer available. The second unit should be replaced within a year or two of the first one with the same model and type.

3. The specifications for both sites should be written to include the use of proprietary equipment or PLC based systems.

4. The Plant should review their long term governor replacement plans for the mechanical units at Bay d'Espoir. If it is decided to use GE Global Controls Services (Woodward) only, there may be some value in using that product at Upper Salmon and Cat Arm.

# APPENDIX A

## ATLAS PC and MICRONET TURBINE CONTROLLERS
## AND COST ESTIMATE

**doug.nolan@ps.ge.com on 02/28/2001 03:47:47 PM**

To: Rick Leggo/NLHydro@NLHydro
cc:
Subject: FW: Newfoundland Hydro - Upper Salmon, Cat Arm

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Rich,
Please see our basic rough order of magnitude pricing and descriptions below.

Upper Salmon

Our standard upper-end product is now Atlas, so a MicroNet quote is not needed. A budgetary estimate at this unit takes two forms - 1) Atlas control with a new EHI pilot valve version that retains the existing distributing valve, or 2) Atlas control with a new FC-5000 distributing valve. Option 1 is estimated at $125,000. Option 2 is estimated at $145,000. These prices include a site visit, manuals and engineering for the above solutions. Note that the MicroNet/EHI quote given by Scott two years ago was for $160,000. This shows the improvement that the Atlas has given us in pricing.

Cat Arm

This is based somewhat on the NCPA Collierville job that we're doing, which is also a six-needle impulse Escher-Wyss system. Again, the Atlas is the control of choice and EHI's are the way to go with multiple-needle units. Assuming the six-needles and one deflector (so, 7 EHI's), the price for Unit #1 is estimated at $185,000. If Unit #2 is identical and we don't have to re-engineer any differences, then it is estimated at $112,000. Again, these prices include the typical level of site visit, manuals and engineering.

Values are in USD. Our standard terms and conditions apply to any resulting order. Our prices are subject to review and acceptance of complete project specifications.

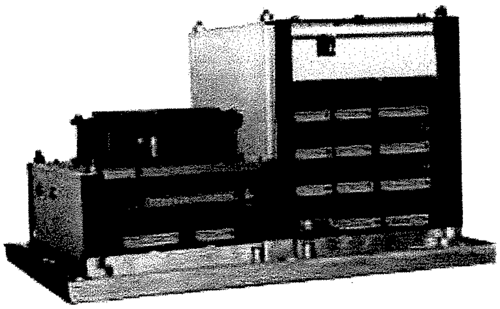
If a Micronet system is still desired for Upper Salmon the current pricing would be estimated as $181,000. Is there some compelling reason to use Micronet rather than Atlas here ? Are there additonal requirements which we need to consider ? What are your needed on site dates for this equipment ?
Rick, of course we are interested in working with you on this project.
Please advise if we can be of any further assistance.
Regards,

Douglas

-----Original Message-----
From: Rick_Leggo/NLHydro@nlh.nf.ca [mailto:Rick_Leggo/NLHdro@nlh.nf.ca]

# AtlasPC

## TURBINE AND ENGINE CONTROL SYSTEM



## APPLICATIONS

The AtlasPC Control System is a new generation of turbine and engine control that provides the power of PC technology in a rugged and deterministic system. The flexible and powerful software tools and exceptional computational power make AtlasPC an ideal solution for controlling a variety of Prime Movers:

- Industrial Gas Turbines (large and small)
- Aero-derivative Gas Turbines
- Gas and Diesel Engines
- Steam Turbines
- Hydro Turbines

The AtlasPC control is well suited to many specific applications:

- Generator Applications – Main, Peak, Stand-by, Marine
- Mechanical Drive – Compressors, Marine
- Any Application Requiring a Low Cost, Powerful and Rugged Control

The AtlasPC Control System scales up and down extremely well. Through field bus expansion, the system fits almost every application. Whether used as a core fuel control or an entire package control, AtlasPC is the solution.

## DESCRIPTION

AtlasPC is a powerful and rugged industrial control with embedded PC technology and dedicated I/O for real time control of turbines and engines. At the heart of the small and powerful AtlasPC Platform is an industrial Pentium Processor with Real Time Operating System (RTOS). The AtlasPC platform utilizes the industry standard PC/104 bus structure to leverage "PC Economics," resulting in lower costs and greater feature flexibility.

AtlasPC environmental specifications allow it to move out of the control room and closer to the prime mover, even on the turbine skid in many cases. It is generally bulkhead mounted in an enclosure. Engineering and service interface is through serial or Ethernet ports. An optional display and keypad may be added to provide a limited local interface (future - check for availability).

AtlasPC contains on-board I/O optimized for prime mover control. The performance of these channels gives precise turbine and engine control not always possible with general-purpose I/O products. Configurability on many channels maximizes flexibility and channel usage, usually offering the least expensive I/O choice available.

Where additional I/O expansion is required, AtlasPC makes use of a field bus networking strategy. Field bus networks like Profibus DP or Ethernet (TCP/IP ModBus) are used to distribute I/O and smart devices from a variety of different vendors. Entire package control, including auxiliary sub-system control, system monitoring, and overall sequencing, becomes very economical.

## AtlasPC CONFIGURATIONS

AtlasPC supports two bus technologies and two "stacks" of modules, the PC/104 stack and the Power Bus stack. The modules utilize connectors that build the bus structure as they are stacked together. See the graphic next page.

Each bus structure supports different types of modules. The PC/104 stack uses the PC industry PC/104 standard and supports most I/O modules, the Pentium processor, and the communications modules. The Power Bus stack supports the power supply and limited I/O modules.

- Powerful Real Time PC Control for Turbines and Engines
- Low Cost – Sensible Alternative to a General Purpose PLC
- Produced and Backed By Woodward - Turbine and Engine Control Experts
- Pentium Processor Provides Exceptional Processing Power
- Real time Multi-tasking Operating System with Deterministic Update Rates
- Fast, Accurate On-Board I/O Modules
- Profibus and Other Field Bus Options for Additional I/O Expansion
- Excellent Networking Capabilities
- Scalable From Core Fuel Control to Total Package Control
- Generator Synchronizing and Power Management Functions Optional

Modular construction allows considerable flexibility in meeting market requirements. Module options are listed at the end of this document.

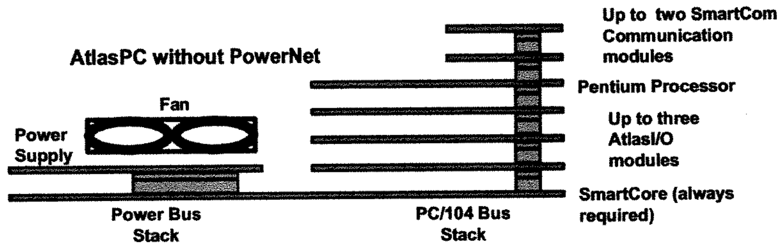
Every system contains the "SmartCore" module that bridges the power bus and the PC/104 bus. It contains I/O required by many prime mover control applications.

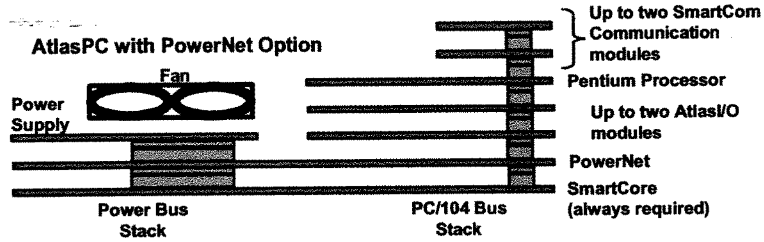
The PowerNet board (future - check for availability) is a specialized I/O module for Generator Control including Synchronizing, Load Management, and Load Control. PowerNet extends across both bus stacks.

"AtlasI/O" personality modules are placed on the PC/104 bus stack to tailor AtlasPC to the particular needs of certain market segments. Up to three AtlasI/O modules may be used (two if PowerNet is present).

The Pentium CPU Module always sits on top of the AtlasI/O modules on the PC/104 stack. One or two small "SmartCom" Communications Modules (E.G. Profibus DP Master) can stack on top of the Pentium.

The "Power Bus" distributes power to the control. The power supply provides regulated power for AtlasPC and also contains the relay driver outputs. The power bus stack will also support certain actuator options (future - check for availability).




**High Performance On-Board I/O**

AtlasPC on-board I/O is optimized for prime mover control

- High Speed and Deterministic update times
- High CMRR and control specific filtering result in high degree of noise immunity
- 15 bit resolution differential inputs, allowing very precise control
- I/O is accurate across temperature range
- I/O is isolated in groups to prevent ground loops and other induced noise issues

## PROGRAMMING AND SIMULATION

AtlasPC makes use of the same powerful and proven tools used by all of Woodward's PC control systems. Engineers create powerful and flexible programs through the IEC 1131-3 programming environment:

- Function Block Diagrams - through Graphical Application Programmer (GAP)
- Sequential Function Charts - through Graphical Application Programmer (GAP)
- Structured Text
- Ladder Logic (On-line Programmable)

GAP (Graphical Application Program) software is Woodward's pictures-to-code programming tool. GAP accesses libraries of control objects to quickly and efficiently implement complex (or simple) control strategies. The GAP environment lets application engineers concentrate on system level control rather than software coding details.

NetSim is the virtual simulation environment for testing Atlas code without hardware in the loop. NetSim links prime mover and package models (created in standard modeling packages - MatLab/Simulink, MatrixX, ACSL) to the GAP environment. With NetSim, the control code can be completely tested in the office before field commissioning begins. The performance of NetSim is optimized to provide simulation results that correlate very tightly to actual field results.

AtlasPC's programming and simulation tools are optimized for controlling turbines and engines, and their driven loads. Rather than providing a generic environment that is adaptable to any industrial automation requirement, GAP and NetSim are specific. The libraries of supported functions have been proven over many years and countless applications.

Woodward's worldwide organization has unequaled turbine and engine control expertise. To support its OEM and Packager customers, Woodward can supply software tools, or entire solutions, or a variety of options in-between.

## REAL TIME OPERATING SYSTEM (RTOS)

AtlasPC utilizes the same field-proven real time operating system (RTOS), as the MicroNet™ NT control. The RTOS utilizes the power of Windows NT together with Venturcom's RTX real time extension.

The Rate Group structure of the GAP development environment, integrated with the NT RTOS, enforces fast, deterministic, and completely repeatable dynamic behavior. Thorough and extensive FFT testing has proven the control system response is exactly as expected at all times, regardless of what is happening elsewhere in the system. The response is also identical to previous proprietary Woodward RTOS architectures. PLC's often make use of a less rigid looping structure that can introduce dynamic instability as code is added or removed.

The GAP/NT RTOS has leveraged the power of Windows NT while ensuring the highest reliability. Unnecessary components of Windows NT are removed to reduce the footprint size and complexity. All required drivers have been extensively tested for robustness and inability to affect system reliability or real-time control. To ensure integrity, no unapproved drivers can be added.

## CONTROL AND PLANT LEVEL COMMUNICATIONS

The AtlasPC supports multiple protocols and physical mediums for communications to DCS systems, PLC's, HMI's and SCADA systems.

Protocols Supported:

- ModBus (RTU and ASCII) over serial or Ethernet
- Ethernet TCP/IP
- Ethernet UDP
- OPC (Ethernet) – OLE for Process Control
- DDE - Dynamic Data Exchange (serial)
- EGD (Ethernet)
- Additional Communications Options may be available – check with Woodward.

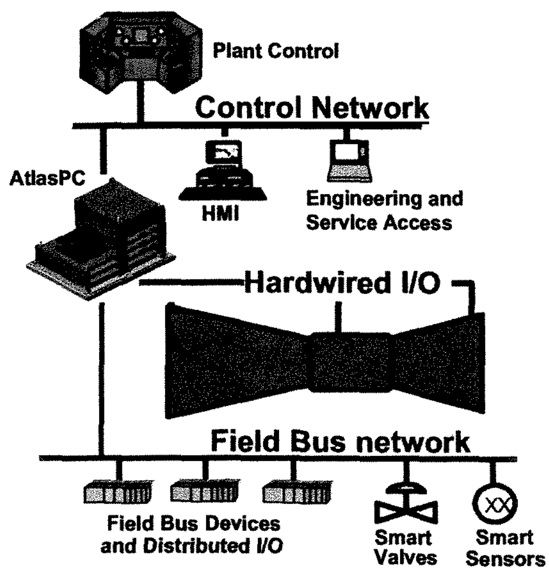
## FIELD BUS INTERFACE

Field bus technologies provide the ultimate flexibility in control I/O and distributed intelligence. AtlasPC embraces this trend while still providing on-board I/O for those signals that are not commercially or technically ready for field bus distribution.

Field bus standards supported:

- Profibus DP (12MBaud) - optional SmartCom communications module
- Ethernet TCP/IP ModBus - standard on Pentium CPU
- Check with Woodward for additional options - other common field bus protocols can be added through optional SmartCom communications modules.

Many field bus standards currently compete for market share in engine and turbine control. AtlasPC is a platform that can adapt to changing requirements.




**Typical AtlasPC Configuration – Networked Control Strategy**

## ENGINEERING AND SERVICE ACCESS

Woodward offers a complete suite of software products for service interface. From simple monitoring of any system variable to high resolution plotting of control variables, service tools are available to simplify troubleshooting.

- Watch Window - Ethernet or Serial connection to Windows-based control variable viewing (see product spec 03202)
- Control Assistant - Ethernet connection to Windows-based viewing of high-speed data log captures and other useful utilities (see product spec 03201)
- Other Engineering Interface Tools - Ethernet access to AtlasPC for program loading, network configuration and support, and system diagnostics (refer to manual)
- Remote Access - Powerful and seamless remote connectivity is inherent in the Windows NT operating system of AtlasPC. Remote viewing, access and diagnostics are as close as a network or a modem.
- Human Machine Interface (HMI) - Standard commercial HMI programs interface through Ethernet or serial to provide operator access.

WOODWARD

PO Box 1519
1000 East Drake Road
Fort Collins CO, USA
80522-1519
Ph: (1)(970) 482-5811
Fax: (1)(970) 498-3058
www.woodward.com

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CORPORATE HEADQUARTERS
Rockford IL, USA
Ph: (1)(815) 877-7441

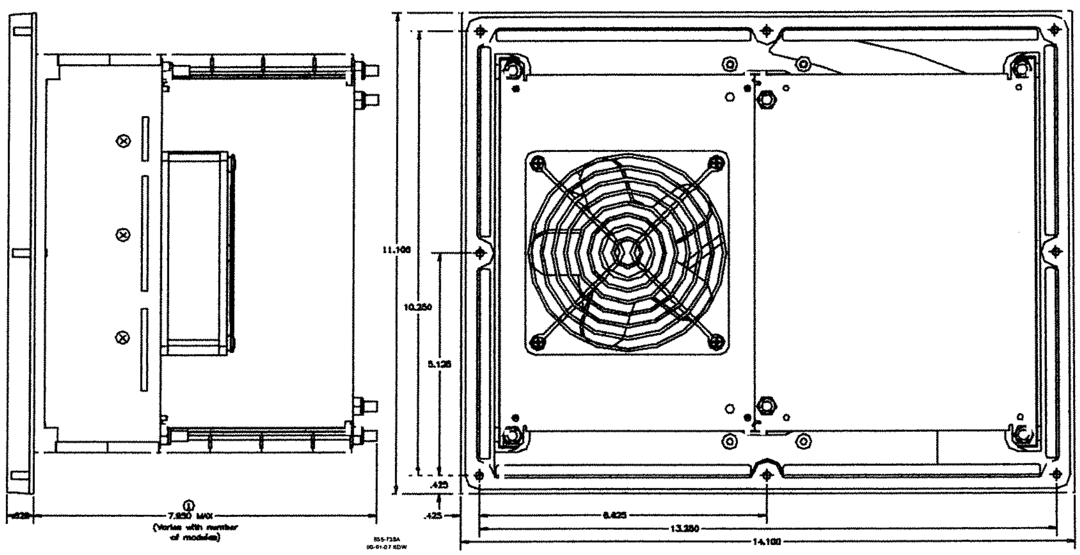


## AtlasPC Modules

- **Pentium CPU Board**
  - 266MHz Pentium, 64MB RAM
  - On-board solid state hard drive
  - Hard Real Time NT operating system
  - Ethernet (communications, distributed I/O)
    - *10/100 Base T auto sensing and auto switching*
  - 2 Serial Ports (Service Interface and Remote Access Services)
- **SmartCom Profibus Communications Board**
  - 12 MBaud Profibus DP Master
- **AtlasI/O Analog Input/Output Board**
  - (2) MPU speed pickups
  - (4) RTD (100 or 200 ohm, 3 wire) /4-20 mA inputs (software selectable)
  - (11) Thermocouple (E, J, K, N, R, S, T) /4-20 mA inputs (software selectable)
  - (2) 4-20 mA analog outputs
  - On-board cold junction sensor
- **SmartCore Board**
  - 3 serial ports
    - *1 RS232*
    - *2 configurable RS232, RS422, or RS485*
  - 2 MPU/Proximity
  - 16 Discrete Inputs
  - 4 Analog Inputs (4-20mA, 0-5V)
  - 4 Analog Outputs (4-20mA)
- **Primary Power Supply**
  - 18-32 VDC
  - 12 Relay Drivers
- **PowerNet Board**
  (Check with factory for availability)
  - 120/240/277 VAC PT sensing
  - 0-5 Amps CT sensing
  - Speed Bias (PWM, 0-5V, V, +/-1V +/-3V)
  - Voltage Bias (PWM, 4-20mA, +/-3V, +/-9V)
  - Redundant LON Channel – communicate to other Woodward Power Management Controls

## Environmental Specifications

- **Skid Mount Packaging**
  - Class I, Div 2 and Zone 2 HAZLOC Environment
  - CE compliant - Low Voltage Directive, Machinery Directive, Heavy Industrial EMC Directive
  - Operating temperature: -20 to 70° C (55° C with Profibus)
  - Storage Temp: -20 to 85° C
  - Vibration: Lloyds RS Env 2 (0.7g, 15-150 Hz)
  - Shock: Mil-Std-810C, M16.2 (30g, 11msec, 1/2 sine)
  - IP56 Front Panel with optional *Display and Keypad (future)*




**AtlasPC Control Outline Drawing**

For more information contact:

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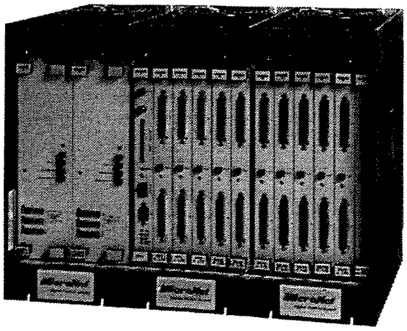
**WOODWARD**

Product Specification
85583B

# MicroNet•
# CONTROL SYSTEM



## APPLICATIONS

The MicroNet™ Control System is a state-of-the-art digital controller that is programmable for many types of applications in the control of:

- Gas Turbines
- Steam Turbines
- Hydro Turbines
- Diesel Engines
- Gas Engines

The MicroNet Control System provides a flexible platform to control any prime mover and its associated processes such as high speed control functions, system sequencing, auxiliary system control, surge control, monitoring and alarming, and station control. The MicroNet digital control is available in both simplex and triple modular redundant (TMR) configurations. Each version is expandable into multiple chassis as required by the system size and will support any mix of I/O, including networked, distributed I/O.

## PROGRAMMING

The MicroNet Control System provides an IEC1131-3 environment for programming.

- Function Block Diagrams - through Graphical Application Programmer (GAP)
- Sequential Function Charts - through Graphical Application Programmer (GAP)
- Structured Text
- Ladder Logic (On-line Programmable)

GAP software is the graphical programming tool specifically designed for quick and easy implementation of complex control strategies. Gap provides an environment where application engineers can concentrate on control and application issues, not on software coding details.

## SYSTEM DESCRIPTION - MicroNet™ DIGITAL CONTROL

The MicroNet control is available in two chassis sizes with either 6 or 12 VME slots. Both have a dedicated power supply section and control section located in a single chassis. The power supply section supports simplex or redundant power supplies.

### PROGRAM EXECUTION

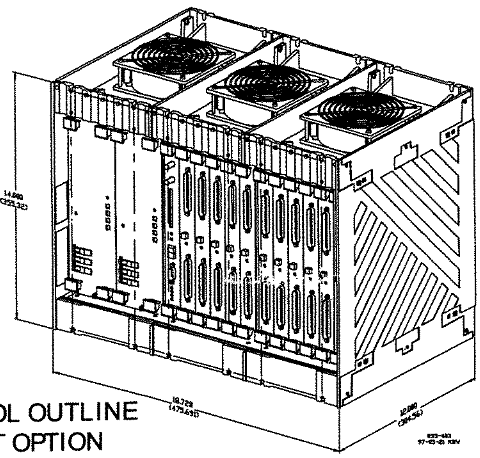
The MicroNet Operating System, together with GAP, produces a very powerful control environment. Woodward's unique rate group structure ensures that control functions will execute deterministically at rate groups defined by the application engineer. Critical control loops can be processed within 5 milliseconds. Less critical code is typically assigned to slower rate groups. The rate group structure prevents the possibility of changing system dynamics by adding additional code. Control is always deterministic and predictable.

### CPU OPTIONS

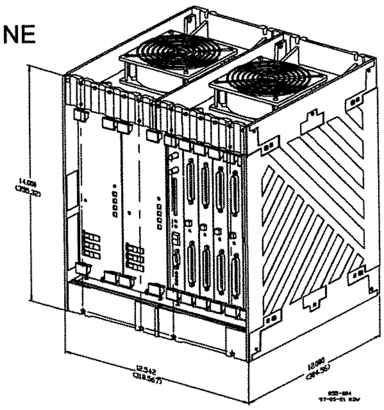
Two families of Central Processing Unit (CPU) modules are available which provide different levels of performance and features. Both use the same programming methods and rate group structure.

- Pentium/NT CPU - the newest offering for the MicroNet gives very high performance for the most complex (size, speed of execution, math intensive, etc.) applications imaginable.

- Provides Total System Control
- Expandable to Meet System Needs
- Communication via Serial Ports and EtherNet LAN's
- Available in Either Simplex or TMR Configurations
- Hot Replacement of Modules
- Simplex or Dual Redundant Power Supplies
- Real time Multitasking Operating System with Deterministic Update Rates
- Based Upon Proven NetCon® Control Hardware and Software
- High-Density I/O Modules With Time Stamping



CONTROL OUTLINE
(12 SLOT OPTION



CONTROL OUTLINE
(6 SLOT OPTION

The Windows NT• operating system is enhanced with areal-time extension that, together with the rate group structure of GAP, provides determinism. This CPU is only available in the Simplex architecture.
- Ethernet Port (10/100 BaseT)
- Two RS232 Serial Ports
- Video, Keyboard, Monitor output for local display support
- Program loading over Ethernet TCP/IP network using standard Windows Explorer

- Motorola 68040 CPU - the traditional workhorse of the MicroNet and its predecessor (NetCon) that gives excellent performance for most applications. The proprietary operating system supports both Simplex and Triple Modular Redundant (TMR) architectures. Features include:
  - RS232 Serial Port
  - Fiber optic port for local display support
  - PCMCIA port for program and data file loading

COMMUNICATIONS
The MicroNet supports multiple protocols and physical mediums for communications to DCS systems, PLC's, other controllers, distributed I/O, and actual field devices. In addition to the physical ports available on the selected CPU, other ports are available.
- Ethernet UDP module available for Motorola CPU family
- Serial I/O (SIO) communication card with 4 ports (2 RS232, 2 configurable for RS232, RS422, RS485)
- LON network for LinkNet• Distributed I/O Modules
- Specialized serial communications modules for a variety of specific communications applications such as mechanical device drivers and sensor interfaces

Protocols Supported:
- Modbus (RTU and ASCII) over serial or Ethernet
- Ethernet TCP/IP (Pentium/NT CPU only)
- Ethernet UDP
- Dynamic Data Exchange (DDE)
- Printer Drivers, Modems, Data Loggers
- Custom Proprietary Drivers for communicating to specific devices

HUMAN MACHINE INTERFACE (HMI)
PC-based Human Machine Interface software provides a powerful interface to operators and technicians. Communications to the HMI are through Serial or Ethernet connections. The HMI provides operational and analytical information such as graphical display of operating data, historical trending, event logging, X-Y plotting, system overviews, calibration pages, and other functions.

SERVICE INTERFACE
Woodward offers several software products for service interface. From simple monitoring of any system variable to high resolution plotting of control variables, service tools are available to simplify troubleshooting.

EXPANSION
The MicroNet Control is expandable for systems requiring more I/O than that accommodated in the base chassis. Depending on the type of I/O and control functions required, the expansion can be accomplished by adding an additional MicroNet chassis, LinkNet or other distributed I/O modules, or any combination.

I/O MODULES AND FIELD TERMINATION
The MicroNet digital control can accommodate any combination of Woodward I/O modules to provide maximum application flexibility. Standard I/O modules available are:
- Thermocouple inputs
- Resistance Temperature Devices (RTD)
- Analog inputs (mA, V)
- Discrete inputs
- Discrete outputs
- Magnetic pickup (MPUs)
- LVDT and RVDT position inputs
- Proportional and Integrating Actuator Drivers
- Serial Communication cards (SIO)
- Local Area Network, EtherNet
- Special hardware cards
- Chassis expansion modules
- Relay interface modules
- High-Density Discrete I/O
- High-Density Analog I/O
- High-Density Combo Card

MicroNet I/O modules are designed and tested for the specific needs of Prime Mover control and monitoring. Exceptional accuracy, fast updates, high channel to channel isolation and other features differentiate them from common industrial I/O modules.

Hot-replacement of most modules allows modules to be exchanged while power is applied. Many modules are "Smart Modules" with an on-board micro-controller to manage the module's internal operations and to provide continuous self-diagnostics. Smart modules are self-calibrating and provide periodic on-line calibration monitoring to ensure the integrity of I/O measurement and control. The high-density modules allow for very cost effective I/O and can time stamp discrete signals with 1 ms resolution and analog signals with 5 ms resolution.

Termination of field wiring is accomplished using Woodward Field Termination Modules (FTM's). The FTM's mount to a standard DIN rail and provide easy access to field wiring. Standard cables connect the FTMs to the control I/O modules.

DISTRIBUTED I/O MODULES

Distributed I/O gives a cost effective solution for sequencing and monitoring functions that do not require the performance available with the standard control modules. Distributed I/O is a concept where I/O modules are distributed on a Local Area Network. Modules can be located in the field to minimize the wiring runs of many sensors and devices. Only the network connection comes back to the control system. Distributed I/O can also be located in the control room (in the control cabinet or simply nearby) as an alternate means of gathering I/O.

The MicroNet supports several distributed I/O options. Woodward's LinkNet distributed I/O modules connect to a dedicated LON driver card located in the MicroNet. The Pentium/NT CPU provides a Modbus over TCP/IP Ethernet alternative that allows the use of commercially available Distributed I/O products. Contact Woodward to determine which products are supported.

## SYSTEM DESCRIPTION - MicroNet TMR

The MicroNet TMR control system incorporates the features of the MicroNet described above in a Triple Modular Redundant (TMR) control architecture. The MicroNet TMR uses the Motorola CPU architecture (the Pentium/NT CPU does not presently support TMR) with double exchange voting and the same software synchronization routines as the NetCon F/T. The MicroNet TMR consists of three isolated kernel sections. Each section includes its own CPU, CPU power supply and up to 4 I/O modules. The I/O modules can be used for simplex I/O, redundant I/O, triple redundant I/O or any redundancy combination. Each kernel I/O section is expandable into one or more of the MicroNet chassis discussed above. Interface modules provide inter-rack communications.

The kernel sections individually monitor all input data, perform all application calculations and generate all output values and responses. Outputs are assessed with the 2-out-of-3 voting logic. With this configuration any fault or number of faults associated with a kernel can be tolerated without affecting system operation. The advantages of triplex architecture as compared to duplex architecture are as follows:

- 2-out-of-3 voting provides superior fault detection of all I/O, hardware and control algorithms.
- Eliminates single point failures
- Reliability is vastly improved by extending fault coverage to nearly 100%
- Greater flexibility for implementing a variety of fault-tolerant configurations.
- Superior latent fault detection
- On-line serviceability

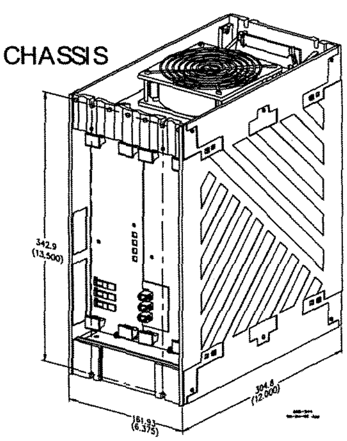
The high-density MicroNet cards provide first-out indication for monitored system events to reduce troubleshooting time. These cards will time stamp the event within 1 ms for discrete inputs and 5 ms for analog inputs.

The MicroNet TMR uses two power supplies, each of which powers the control from a separate power source. Inside each power supply are three independent power converters, one for each CPU and I/O section. The triplicated power architecture provides maximum protection against hardware failures.

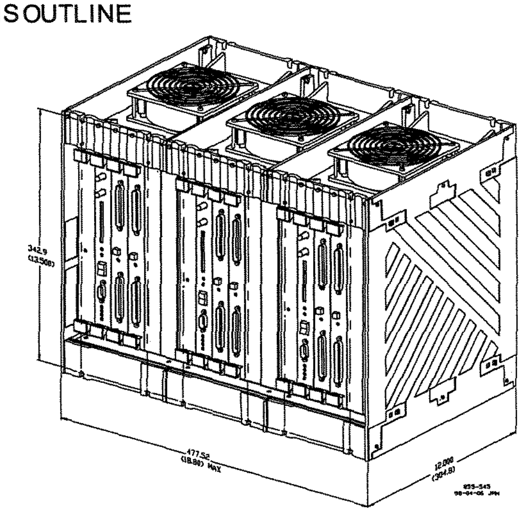
Woodward also provides full TMR relay modules for critical discrete outputs. To accomplish this, a six relay configuration is used. If any one relay fails in a normally open configuration, or if any two relays fail in a normally closed configuration, the contact path is not interrupted, and the fault does not interrupt normal operation. Latent fault detection is used to monitor and detect any relay faults.

The MicroNet TMR control will drive multiple actuator coils and current drivers to support dual redundant and triple redundant field devices.

MicroNet TMR
POWER SUPPLY CHASSIS




MicroNet TMR CONTROL
CHASSIS OUTLINE



WOODWARD

PO Box 1519
1000 East Drake Road
Fort Collins CO, USA
80522-1519
Ph: (1)(970) 482-5811
Fax: (1)(970) 498-3058
www.woodward.com

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# SPECIFICATIONS

## OPERATING CONDITIONS

Temperature
0°C to +55°C (32°F to 131°F) ambient air temperature range
0°C to +50°C (32°F to 122°F) for Pentium/NT CPU

Shock
MIL-STD-810C, method 516.2-1, procedure 1B

Vibration
Lloyd's ENV2 test #1

Emissions*
EN55011, Class A, Gr 1

Immunity*
EN50082-2 (1995)

Certifications*
CE, UL/cUL (Class I, Div 2), LR for Cat ENV1 & ENV2, ABS

## MicroNet CHASSIS

All versions are bulkhead mounted or adaptable to 19" rack mount back panel.

## MicroNet WITH POWER SUPPLY SECTION AND 6 I/O SLOTS

Dimensions
12.6" wide x 14.3" high x 12.1" deep (320.04 mm wide x 363.22 mm high x 307.34 mm deep)

Approximate weight
35 lbs (15.9kg)

## MicroNet WITH POWER SUPPLY SECTION AND 12 I/O SLOTS

Dimensions
18.8" wide x 14.3" high x 12.1" deep (477.52 mm wide x 363.22 mm high x 307.34 mm deep)

Approximate weight
53 lbs (24 kg)

## MicroNet TMR—18 SLOT CHASSIS

Control chassis dimensions
18.8" wide x 14.3" high X 12.1" deep (477.52 mm wide x 363.22 mm high x 307.34 mm deep)

Control chassis weight
55 lbs (25 kg)

Power chassis dimensions
6.4" wide x 14.3" high x 12.1" deep (162.56 mm wide x 363.22 mm high x 307.34 mm deep)

Power chassis weight
16 lbs (7.3 kg)

## POWER SUPPLY INPUT OPTIONS

18-36 Vdc, 100-150 Vdc, 88-132 Vac (47-63 Hz), 180-264 Vac (47-63 Hz)

*Specifications apply to most components and modules. Some certifications may be pending. Contact Woodward for further information.

For more information contact:

99/8/F

# APPENDIX B

## COST ESTIMATE FOR RUSSELECTRIC PLC SYSTEM

**C-TECH of North America, Inc.**
**4201 Sawgrass Point Drive #204**
**Bonita Springs, FL 34134**

**Phone: 941-947-9185**
**Fax: 941-947-0842**
**E-Mail: ctech.crider.tom@worldnet.att.net**

VIA e-mail
(Rick_Leggo/NLHydro@nlh.nf.ca)

February 8, 2000

Mr. Rick Leggo
Newfoundland and Labrador Hydro
P.O. Box 12400
Materials Management Department
4th Level, Hydro Place
St. John's, Newfoundland A1B 4K7

Re: Budget Prices for Governor Replacements

Dear Rick:

I have looked at your general description of the workscope for each of the following projects and offer the following budgetary prices:

**Upper Salmon**

Based on reusing the existing switches and meters as the operator interface, the hardware scope would generally consist of providing a GE-Fanuc PLC mounted either on a sub-panel or in its own cubicle with required I/O modules and a hydraulic interface manifold. Based on similar Woodward cabinet actuator governor only retrofits, I estimated the I/O at:

Digital In = 64
Digital out = 32
Analog In = 16
Analog Out = 16

The panel would require redundant main power supplies, terminations, fusing, and two speed signal transducers that will interface directly to the existing Woodward speed sensors. These transducers convert to a 4-20 ma output and maintain an update rate of less than 50 ms.

We would also supply you with a hydraulic interface manifold that mounts in the governor cabinet. The manifold contains the control servovalve and separate shutdown circuit logic. It replaces virtually everything inside the cabinet actuator except the main distributing valve, which is retained. We provide a porting block that mounts directly to the work ports on the distributing valve's servomotor (top of the dist. valve). We also furnish a LVDT and mounting bracket that connects to end of the distributing valve spool and provides position feedback to the PLC for the distributor valve position. A Temposonics linear position transducer is provided for mounting on one of the gate servomotors and replaces the existing cable feedback.

I assume that N&LH would do the installation with Russelectric providing a startup technician. I have included 10 days of on site support.

Based on the above, a budgetary price, including hardware, engineering, programming, documentation and field support would be $140,000 Canadian ($97,000 USD).

**Cat Arm**

I assume that the six deflectors are controlled via one common control valve, and likewise for the six nozzles. Assuming this is correct, the governor retrofit scope is very similar to that listed above. The primary difference is that the hydraulic manifold now requires a second control circuit for the needles. Also, a second Temposonics linear position transducer is required for needle position (the first being used for deflector position).

Assuming two (2) systems bought together and including 10 days of field support for each system, a budgetary price would be $168,000 Canadian EACH ($115,000 USD).

These prices are based on 2000 delivery and a current exchange rate of $1 US = $1.45 Canadian. Delivery is typically 20 weeks.

Thank you for this opportunity. Please call if I can be of further assistance.

Best regards,

Thomas F. Crider

# APPENDIX C

## COST ESTIMATE FOR
## L & S ELECTRIC PLC SYSTEM

L&S ELECTRIC INC.

CORPORATE

Post Office Box 740
5101 Mesker Street
Schofield, WI 54476.0740 USA
Phone: 715.359.3155
Fax: 715.355.5931
Web: www.lselectric.com

# BUDGETARY ESTIMATE

To: Newfoundland & Labrador Hydro
PO Box 12400
St. John's, NF A1B 4K7
CANADA

| | |
|---|---|
| Estimate No: | E00197-JCG-060200 |
| Terms: | Progress Payments |
| Delivery: | 22-24 weeks |
| D.D.P: | Destination |
| V.A.T: | Unpaid |
| Freight: | Prepaid and Charged |
| Prices: | Budgetary |
| Date: | June 02, 2000 |

Attn: Mr. Rick Leggo

Subj: Cat Arm and Upper Salmon – Digital Governor Upgrades

L&S Electric, Inc. is pleased to estimate the following:

| Item | Qty | Description |
|---|---|---|
| A | 1 | Supply of low-pressure governor retrofit for the Cat Arm Pelton Units. The existing hydraulics and main distributing valves will be retained.<br><br>Estimated Price for first unit ........ U.S. $210,000.00<br>Estimated Price for second unit ........ U.S. $195,000.00 |
| B | 1 | Supply of low-pressure governor retrofit for the Upper Salmon Francis Unit. The existing hydraulics and main distributing valves will be retained.<br><br>Estimated Price ........ U.S. $75,000.00 |

C All on-site time including preliminary site visits, installation supervision, commissioning and training shall be made available at the following rate:

Rate (per individual) .................................U.S. $1,000.00/Day + (Expenses x 1.1)

1. Hourly rates are based on 8 hours/day Monday-Friday 7 A.M. to 6 P.M.
2. Overtime (standard) rate weekday hours prior to 7 A.M. or beyond 6 P.M.; all Saturday time. Total time not to exceed 16 hours/day.
3. Overtime (premium) rates are Sundays and Holidays; all time in excess of 16 hours/day.
4. Minimum billing is 4 hours.
5. Stand-by and holdover will be charged, up to 8 hours, at the listed rate.
6. Travel time is to be considered service time and will be charged at the listed rate. However, the maximum charge per person for any one calendar day will be 8 hours.
7. Expenses will be charged at cost plus 10%.
8. Mileage will be charged at $0.60 per mile

*Payment Terms*
Prices shall be based upon a milestone progress payment schedule. L&S Electric will propose a schedule at the time of a firm quotation.

*Prices*
All prices included with this estimate are provided in *U.S.* Dollars. All invoices and payments shall be made in U.S. Dollars. Prices include all applicable customs duties.

*Canadian provincial and federal sales and service taxes*
As stated on the first page of this estimate, shipping terms are "D.D.P., V.A.T. unpaid" (Deliver Duty Paid, Value Added Taxes unpaid). Canadian provincial and federal sales and service taxes (PST and GST) are not included as part of this quotation and shall be payable by the customer. Customer shall be the "Importer of Record" and shall pay all applicable taxes directly to the government of Canada.

*Warranty*
The warranty provides for the supply of replacement hardware due to failure of components during intended operation, along with warranty of system performance as defined in the project technical proposal. Labor required to replace hardware due to warranty claims shall be the responsibility of the customer. Labor responsibilities necessary to correct items on L&S Electric's supply in reference to system performance based on project specifications shall be borne by L&S Electric, Inc. Costs associated with materials being damaged due to improper field installation shall not be the responsibility of L&S Electric, Inc. This warranty shall be effective for a period of one (1) year. The one (1) year period shall begin after successful completion of the project or 120 days after delivery of the system equipment, whichever is first.

Our estimate is based on the preliminary information supplied by Newfoundland & Labrador Hydro. A firm quotation will be provided after the receipt of additional system information. Please advise us of any additions or deletions that you would like to make to the scope of supply.

Thank you for the opportunity to estimate your requirements. If you have any questions or require additional information, please feel free to contact us.

Sincerely,

L&S ELECTRIC, INC.

J. Christian Grul

J. Christian Grul
Applications Engineer

Ronald J. Hahn
Manager, Application Engineering
Engineering Division

AM-SM-MF

# APPENDIX D

## VATECH HYDRO
## DTL595 TURBINE CONTROLLER
## AND COST ESTIMATE

"Pomeroy, Keith" <pomeroy.keith@vatech.ew.fpt.ca> on 07/26/2000 12:16:38 PM

To: Rick Leggo/NLHydro@NLHydro
cc: "Hunkeler, Dieter" <hunkeler.dieter@vatech.ew.fpt.ca>
Subject: RE: Cat Arm Governors

---

Dear Rick

We have prepared a budget offer which we will send by courier with some literature about the DTL governor system and a reference list. The basics of the budget ( in Canadian dollars) are:

Design, program and supply 2 X DTL 595 digital governors:
including installation and commissioning, and documentation: $150,000 lot

This includes about $25,000 for the field work portion.
We have assumed that the old ETRs would be removed from the panel by yourselves.
Installation and commissioning is roughly 10 days/unit.
Delivery is approximately 10 weeks after clarification of all technical details.

During the commissioning some hands on training is possible including a review of the documentation provided. Additional time at site for training or fore delays not caused by us would be charged at $120/hr plus expenses.

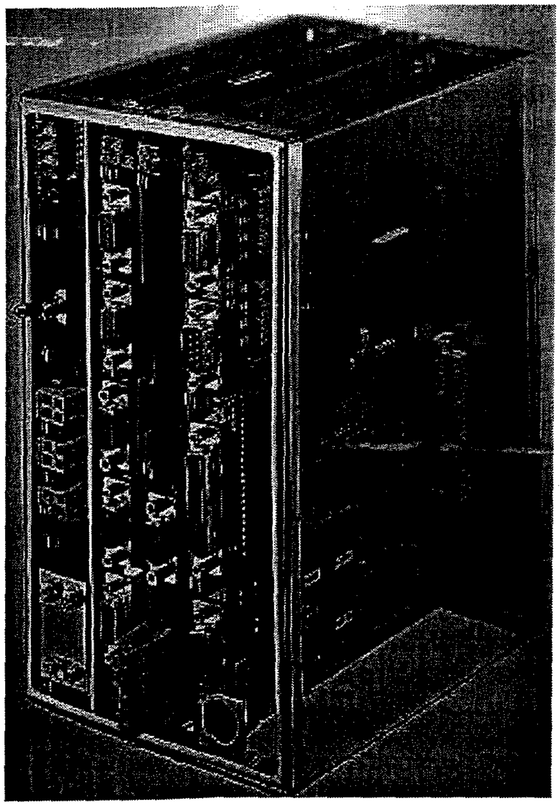
I trust that this is sufficient for your planning purposes but do not hesitate to ask any questions you my have.

Kind Regards
Keith Pomeroy

> -----Original Message-----
> From: Rick_Leggo/NLHydro@nlh.nf.ca [SMTP:Rick_Leggo/NLHydro@nlh.nf.ca]
> Sent: Tuesday, July 25, 2000 7:33 AM
> To: pomeroy.keith@vatech.ew.fpt.ca
> Subject: Cat Arm Governors
>
> I am preparing a report on the need and cost to replace the governor
> controls.
> Based on an earlier letter from Sulzer Hydro saying that parts for the
> controls
> would not be available after 2004 we have put an estimate in the 5 year
> budget
> to replace one unit in 2004 with the specification being prepared in 2003.
> My
> report is to look at what is available for governor controls replacement
> and the
> cost.
>
> Therefore, a budgetary price with the cost of on site assistance and
> training

> would be adequate. I would also like some information on the new system.
> The
> scope of the project is just to replace the governor controls. However, if
> there
> are features on the new controls that are worthwhile it could be decided
> to
> include some of those also. However, I would need the information first.
>
> Thank-you
> Rick Leggo
> Generation Engineering
>

# DTL595
# Digital Turbine Control System



### Water turbine applications
- speed / power / level control
- joint control
- unit start / stop
- distributed control
- field signal conditioning and data acquisition

### Powerful turbine control system with control and monitoring functions
- realtime - multitasking operating system
- local and remote I/O
- galvanic isolation of process signals
- operator interface (MMI)

### High-performance computer
- 32-bit computer, MC68341
- Flash-PROM operation
- floating point math
- realtime and calendar clock
- watchdog

### Functional block programming
- visual / graphical programming
- self documenting
- sophisticated software module library
- interfaces: C / Fuzzy

### Communication
- serial interfaces
- SCADA / RTU
- CAN-Bus, Profibus SINEC-L2 FMS
- Modbus
- Modbus Plus

| General Performance Data - DTL595 | |
|---|---|
| Speed dead band | <= 0.02 % |
| Range of speed measurement | 0 - 300 % |
| Resolution of speed measurement | <= 5 × 10-5 |
| Nonlinearity of linear position transducer | < 0.05 % F.S. |
| Blade control dead band | <= 1.0 % |
| Governor dead time | <= 0.2 s |
| Speed stability index | <= 0.3 % |
| Power stability index | <= 0.4 % |

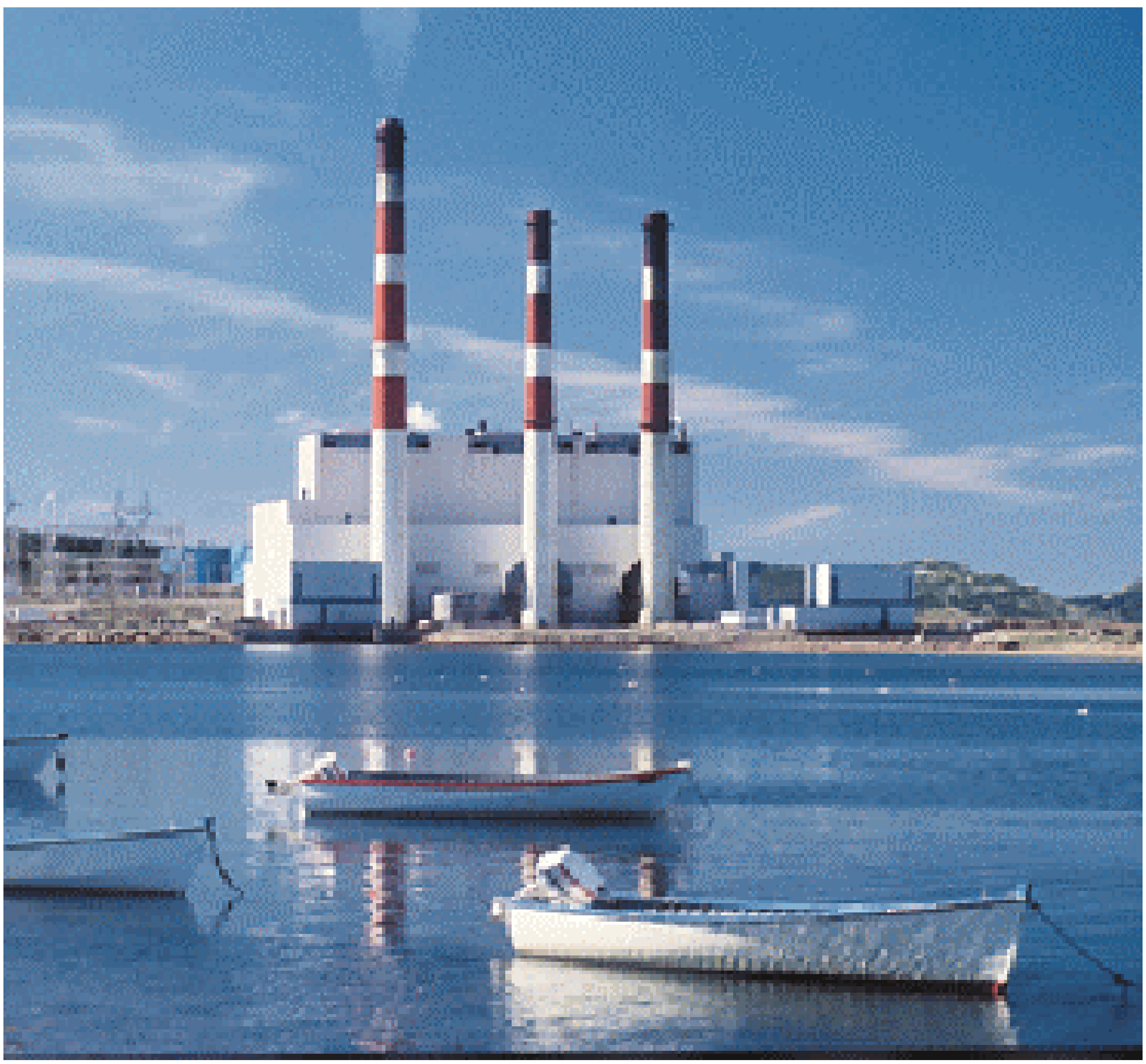
| Highlights from the Reference List: | |
|---|---|
| Tarbela | Four Francis turbines 440 MW each |
| Macagua | Twelve Francis turbines 198 MW each |
| Iron Gates | Two Kaplan turbines 200 MW each |
| Brisay | Two Kaplan turbines 234 MW each |
| San Agaton | Two Pelton turbines 349 MW each |
| Soutelo | One Pelton turbine 127 MW |

Back | Top<ALT="GO Top? to>

Tab 2

# DISTRIBUTED CONTROL SYSTEM

# LIFECYCLE PLANNING

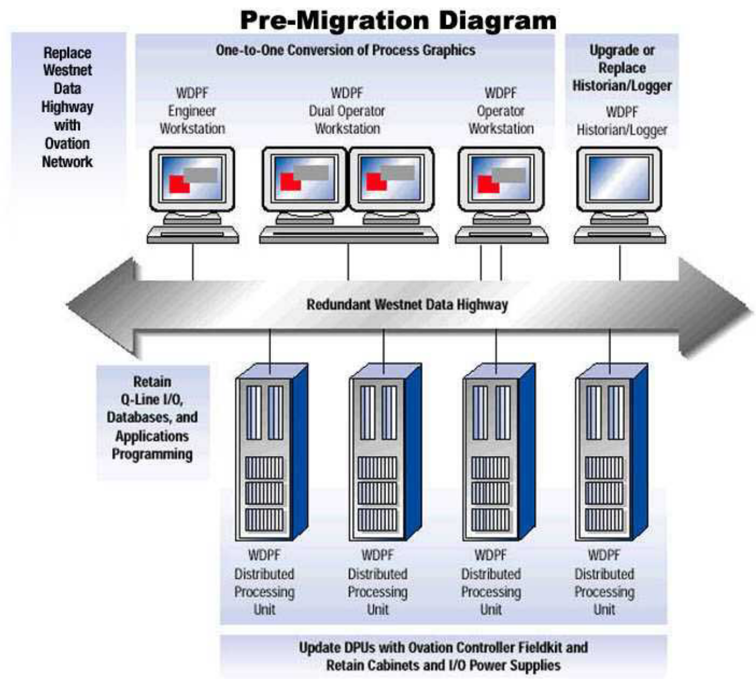


Holyrood Thermal Generating Station November 2002

**Background**

The distributed control system (DCS) in the Holyrood Thermal Generating Station provides boiler control, boiler auxiliary systems control, station service control, burner management control (stage 2 only), turbine and generator monitoring, and control for other plant systems. DCS reliability is essential to the overall operation of the generating units. The existing DCS on stage 1 is a Westinghouse Distributed Processing Family (WDPF) level 6 system that was implemented in 1988. The existing DCS on stage 2 is a WDPF level 7 system that was implemented in 1992 (active technology that was used primarily to maintain consistency with stage 1). Picture 1 illustrates all sections of the WDPF DCS.

Picture1:




Westinghouse Process and Control (now Emerson Process Management) implemented a ten year service commitment with four life stages:

1) Current – Current technology with a 10 year or greater support commitment. Current technology is recommended for new systems or major expansions.
2) Active – Technology early in the defined 10 year support commitment period. Active technology is only recommended for expanding existing systems.
3) Maintained – Technology that is no longer available for new acquisitions, but spares are guaranteed to support existing systems. Generally not available for new systems or expansions.
4) Retired – Technology that has passed the 10 year support commitment time frame. Retired technology is no longer available for purchase. Availability and pricing is not guaranteed for repairs and spares for existing systems.

Support commitment expired for WDPF level 6 systems in January 2002 and will expire for WDPF level 7 systems in January 2003. An action plan is essential to allow time for the budgeting process to allocate funding for new equipment and the inevitable increase in maintenance costs for the present system. The obsolescence issue regarding the DCS at the Holyrood Generating Station is:

> What is the best life-cycle cost decision to ensure reliable and effective operation of the DCS?

**Life-Cycle Planning Basics**

Emerson defines System Life-Cycle Planning as:

> A user business plan that reviews the current maintenance and support level of a control system versus future requirements and expectations

The practical end-of-life of a DCS is determined by the time when spare parts (both hardware and software) are no longer available to maintain the system for reliable operation. New technologies with new features and lower costs lead to obsolescence as the new components replace the previous generation of components and reduce demand for the older components. Manufactures adjust to the changing demands and reduce production of the older components in favor of the newer components that are in higher demand. Control systems companies are impacted by component obsolescence and thus are forced to advance with technology. Emerson has developed three programs to assist their customers with obsolescence issues:

1) Stocking refurbished spares for parts with components that do not have direct replacements
2) Providing direct replacement parts where possible
3) Internet software for self-assessment of obsolescence issues

Equipment obsolescence is an inevitable aspect of the control system industry. Newfoundland and Labrador Hydro must properly manage control system obsolescence to prevent major production outages and ensure reliable power for the people of Newfoundland and Labrador. An active life-cycle planning program will ensure awareness of all obsolescence issues with sufficient time to prepare for them and continue reliable production.

**Future Direction of Control Systems**

WDPF level 8 will not remain a current system much longer and will most likely enter it's ten year sourcing commitment stage by the time we are ready to implement a new system. This platform already has sourcing problems – two problems with alternate solutions are posted on Emerson's website.

Emerson has stated that they plan to utilize the Ovation platform as the current platform for the foreseeable future. Their plan is to upgrade to newer versions of Ovation as required. Presently Emerson is stating that they intend to fully support (at least for the next ten years) both NT and Solaris Ovation systems. The one factor affecting system life unknown to everyone including Emerson is the operating system suppliers (Microsoft and Solaris) intention for future development and support. Most Ovation systems in operation are Solaris, while most new Ovation customers are choosing NT. Traditionally unix based operating systems including Solaris have a reputation for being more stable and more secure than Windows operating systems. Emerson is unaware of any stability problems with either system. Since the price for Ovation systems with either operating system is essentially the same, system stability and operating system supplier support will be the deciding factors for choosing NT or Solaris at the time of purchase.

The trend in DCS investment today focuses on software and non-proprietary off-the-shelf hardware compared to previous self-contained proprietary systems. Data loggers, tuning packages and other add-ons do not have to be purchased from the same controls manufacturer.

**Lifecycle Planning Alternatives**

Existing cabinets, I/O, terminations graphics and logic are preserved when upgrading to WDPF level 8 or migrating to Ovation from the current WDPF systems. This reuse of assets saves equipment and labour costs, and reduces outage time to implement the changes. Labour related to commissioning I/O terminations can easily match equipment costs. Thus upgrading or migrating is more cost efficient than implementing a DCS from a different supplier.

Planning for maintenance and upgrades to the existing Holyrood DCS is essential to ensure a functional system and reliable production. Many parts for the existing DCS are no longer available and economic replacements do not exist. When spare parts are depleted, redundancy required for reliable control will be lost. Further operational failures will block operational control leaving the unit unavailable for production. Some parts with obsolete components have replacement parts that can be substituted when all spares are consumed. Table 1 illustrates the parts with obsolete components that do not have direct replacements. Emerson will repair these parts as long as components are available but prices will escalate as components become more expensive. Eventually Intel co-processors – like the Matrox boards – will not be available.

Table 1: Obsolete Parts

| Drop | Quantity | Part | Sourcing Issue | Comments |
|---|---|---|---|---|
| Level 7 DPU | 12 | MSX card | Intel processor obsolete | Stock enough spares to last until the existing system is upgraded or Migrated |
| Classic MMI | 12 | Matrox MMI interface Board | No longer manufactured | WPC Source obsolescence Start upgrading MMIs with WeStations in 2004 |
| | | MSP card | Intel co-processor obsolete | Stock enough spares to last until the existing system is upgraded or Migrated |
| PCH MMI | 4 | OS2 operating system | Discontinued IBM operating system | Difficult to obtain compatible software and hardware |

A Drop is a distinct section of the control system including distributed processing units (DPU), and man machine interfaces (MMI). The MMIs are operator consoles and engineering workstations. A PCH is a type of MMI technology consisting of a personal computer and a proprietary interface to the DCS communication highway. MSX and MSP cards are parts of the DPU and Classic MMI respectively that perform processing functions with obsolete 8088 and 8086 technology.

Eventually an Ovation system will need to be implemented considering WDPF level 8 is the last generation of WDPF.

The list of life-cycle alternatives analyzed has been reduced to include:

1) Replace the existing WDPF systems with an Ovation system in 2004/2005
2) Gradually upgrade the existing WDPF systems with a WDPF level 8 system
3) Extend the life of the existing WDPF systems and assess migration to Ovation annually

**<u>Replace The Existing WDPF Systems With an Ovation System in 2004/2005</u>**

Replacing the existing WDPF systems with an Ovation system in 2004/2005 is the least complicated alternative to implement with the least number of unknowns in equipment performance and costs. The only negative aspect to this option is the requirement for large expenditures earlier than for all other alternatives. This alternative utilizes the most current technology available from Emerson which will provide the longest new system life before a replacement is required. Extra work required in either of the other two alternatives is eliminated. Migration tools have been proven by Emerson through previous successful migrations in other generating stations with minimal outage requirements (less than two days). Emerson is focusing on Ovation technology which will translate into better support in the future for an Ovation system than for a WDPF system. Phasing the project over two years will provide time for operators and technicians to adjust to the new system while one unit is still operating with the existing system. As with all alternatives, technicians will require training to maintain the new equipment. The changes will be almost transparent from an operations perspective, so Operators will only require minimal orientation by plant personnel. This alternative results in minimal requirements of plant engineering for active life-cycle planning during the first 5 years after migration.

**Gradually Upgrade The Existing WDPF Systems With a WDPF Level 8 System**

Gradually replacing the existing WDPF systems with a WDPF level 8 system will spread the bulk costs over more time and will defer the large lump sum costs to a later date. Level 8 WDPF components purchased in 1999 to expand the stage 1 system will be utilized for a longer period of time for this option. Less training is required in the short term for technicians, however overall training requirements will be greater. This alternative will require stocking of “last-buy” and used spares to support existing equipment until it is replaced. Two major impacts with this alternative are that the plant will be operating with a “mix-and-match” system, and WDPF level 8 systems may not be available long enough for a complete gradual upgrade. Considerable time will be required by plant engineering to ensure obsolescence issues are addressed accordingly.

**Extend The Life of The Existing WDPF Systems and Assess Migration to Ovation Annually**

Extending the life of the existing WDPF systems is the alternative that carries the greatest risk and requires constant attention by plant engineering to locate sources of used spare parts and to address obsolescence issues. Reliability and availability of the electrical system and generating units is compromised by the uncertainty of available spares. Unbudgeted costs are highly probable to purchase WDPF level 8 equipment once spares are depleted. WeStation man machine interfaces (MMI) have to be purchased in the near future because Matrox (communication) boards are no longer available for the Classic MMI. This alternative postpones the inevitable expense of a new system and promotes a future migration to Ovation due to the age of WDPF level 8 technology.

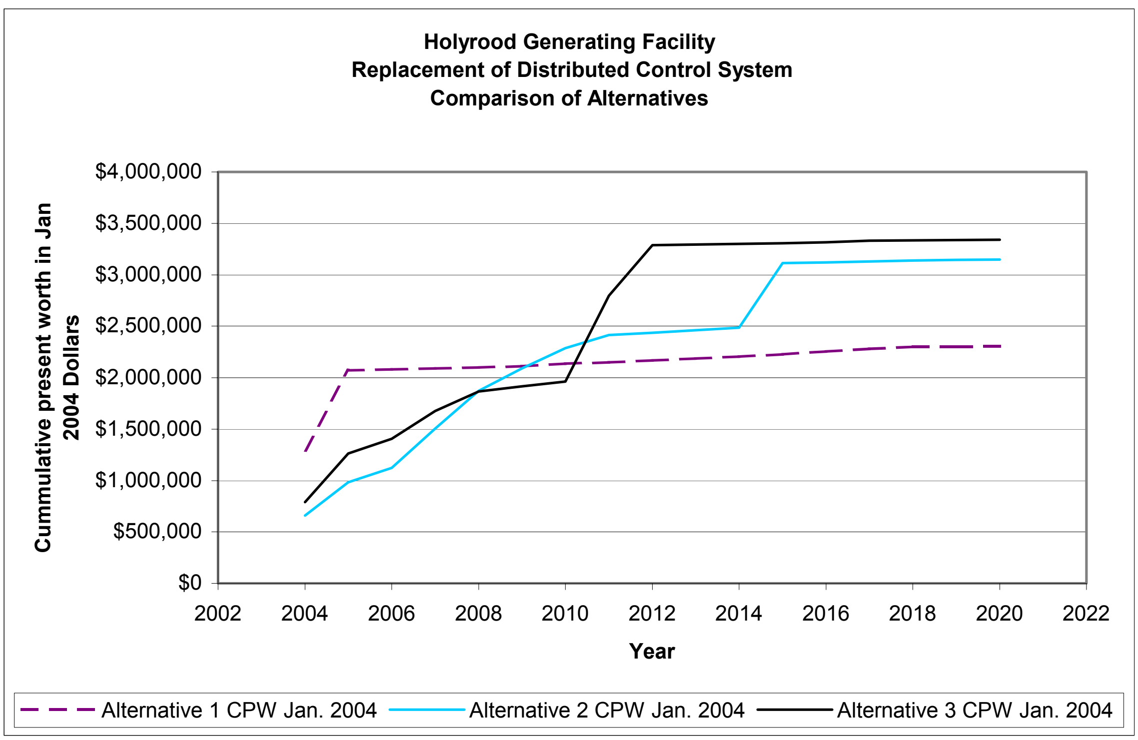
**Comparison of Replacement Options**

Cost analysis was performed based on a planning horizon to the year 2020. Standard inflation and interest rates and the Conference Board of Canada’s projected exchange rates were used to normalize costs. Total present cost over the time frame service life and the time when a given alternative becomes the lowest cost alternative are the two main measures of cost comparison. Alternative 1 – Migrating to Ovation in 2004/2005 – has the lowest present cost of all three alternatives for the period up to 2020, with alternatives 2 and 3 being 35% to 45% more expensive. Table 2 and Chart 1 on page 5 illustrate the cost analysis for the three options. The cross over point, which identifies the year in which Alternative 1 has the lowest present cost, occurs in the 6$^{th}$ year after the completion of the project.

Capital costs for Alternative 1 include purchase and installation of new equipment, spare parts, and Hydro labour for 2004 and 2005. The 2004 capital cost also includes training for Technicians. The 2010 and 2016 capital costs are for software upgrades. A table containing a brief list of capital and operating expenses is located on page 7.

**Net Present Cost Analysis of Holyrood's Distributed Control System**
**Capital & Operating Costs**

| | Alternative 1 | | | | Alternative 2 | | | | Alternative 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Capital | Operating | Total Cap and Operating | CPW Jan. 2004 | Capital | Operating | Total Cap and Operating | CPW Jan. 2004 | Capital | Operating | Total Cap and Operating | CPW Jan. 2004 |
| 2004 | 1,368,463 | 36,397 | 1,404,860 | 1,294,802 | 482,812 | 231,557 | 714,369 | 658,405 | 619,911 | 235,751 | 855,663 | 788,629 |
| 2005 | 906,960 | 5,753 | 912,713 | 2,070,111 | 225,400 | 155,835 | 381,235 | 982,247 | 392,716 | 163,775 | 556,491 | 1,261,343 |
| 2006 | 0 | 12,749 | 12,749 | 2,080,092 | 0 | 177,839 | 177,839 | 1,121,479 | 0 | 185,969 | 185,969 | 1,406,940 |
| 2007 | 0 | 13,055 | 13,055 | 2,089,512 | 404,117 | 126,016 | 530,133 | 1,504,009 | 239,808 | 134,341 | 374,148 | 1,676,916 |
| 2008 | 0 | 13,368 | 13,368 | 2,098,402 | 470,304 | 86,002 | 556,306 | 1,873,978 | 166,455 | 120,048 | 286,503 | 1,867,453 |
| 2009 | 0 | 23,371 | 23,371 | 2,112,727 | 298,966 | 55,633 | 354,599 | 2,091,328 | 0 | 80,327 | 80,327 | 1,916,690 |
| 2010 | 8,898 | 31,779 | 40,677 | 2,135,707 | 290,742 | 52,813 | 343,555 | 2,285,411 | 0 | 81,662 | 81,662 | 1,962,823 |
| 2011 | 0 | 24,506 | 24,506 | 2,148,466 | 214,661 | 32,465 | 247,126 | 2,414,082 | 1,570,920 | 29,735 | 1,600,655 | 2,796,235 |
| 2012 | 0 | 43,719 | 43,719 | 2,169,446 | 0 | 45,921 | 45,921 | 2,436,118 | 1,015,525 | 7,181 | 1,022,706 | 3,287,011 |
| 2013 | 0 | 36,342 | 36,342 | 2,185,520 | 0 | 55,072 | 55,072 | 2,460,476 | 0 | 15,051 | 15,051 | 3,293,667 |
| 2014 | 0 | 47,244 | 47,244 | 2,204,778 | 0 | 57,046 | 57,046 | 2,483,730 | 0 | 15,412 | 15,412 | 3,299,950 |
| 2015 | 0 | 55,443 | 55,443 | 2,225,608 | 1,655,643 | 24,412 | 1,680,055 | 3,114,930 | 0 | 15,782 | 15,782 | 3,305,880 |
| 2016 | 9,436 | 71,963 | 81,399 | 2,253,794 | 0 | 12,883 | 12,883 | 3,119,391 | 0 | 27,592 | 27,592 | 3,315,434 |
| 2017 | 0 | 84,958 | 84,958 | 2,280,908 | 0 | 34,862 | 34,862 | 3,130,517 | 9,605 | 37,518 | 47,123 | 3,330,473 |
| 2018 | 0 | 61,244 | 61,244 | 2,298,922 | 0 | 26,930 | 26,930 | 3,138,438 | 0 | 17,664 | 17,664 | 3,335,668 |
| 2019 | 0 | 9,488 | 9,488 | 2,301,494 | 0 | 17,507 | 17,507 | 3,143,184 | 0 | 8,019 | 8,019 | 3,337,842 |
| 2020 | 0 | 9,716 | 9,716 | 2,303,922 | 0 | 17,927 | 17,927 | 3,147,663 | 0 | 8,211 | 8,211 | 3,339,894 |




Alternative 1: Replace the current WDPF systems with ovation systems in 2004/2005
Alternative 2: Gradually replace the current WDPF systems with level 8 WDPF systems
Alternative 3: Extend the life of the current WDPF systems and analyze migration annually

Capital costs for Alternative 2 include the purchase of used and/or 'last buy' spares. Between 2004 and 2011 the Capital costs are to purchase and install parts of a WDPF level 8 system. The 2004 figure includes upgrade training for technicians to cover the major differences in the newer technology. The 2015 capital cost is to purchase and install new equipment for Stage 1 and allocate the retired WDPF level 8 equipment as spares for Stage 2. A table containing a brief list of capital and operating expenses for this alternative is located on page 8.

Capital costs for Alternative 3 include the purchase of used and/or 'last buy' spares. Between 2004 and 2008 WDPF level 8 equipment will be required in addition to the purchase of used spares to ensure sufficient components are available for reliable operation. Purchase and installation of new equipment, training for new equipment, spare parts, and hydro labour is allocated for 2011 and 2012. The 2017 capital cost is for a software upgrade. A table containing a brief list of capital and operating expenses for alternative 3 is located on page 9.

Operating costs for all alternatives include the repair of failed components, and labour associated with changing failed components and modifying graphics and logic. The differences between each year reflect the increase in failure rates and repair costs as the technology ages and is based on experience from the current WDPF system. Consideration was taken that not all parts will need to be repaired to maintain an adequate number of spares in the 2 years before a system is retired, and that retired equipment can be used as spares while upgrading in stages.

Risk analysis of spare parts on-hand and extrapolated failure rates show sufficient plant spares to operate the WDPF system until 2004. If migration to Ovation is delayed until after 2004, used or refurbished spare parts would have to be purchased (potentially at a premium price if available) to maintain the WDPF systems. Availability of used and rebuilt spares for purchase or repair is uncertain and expected to be minimal and costly at best. Compatible equipment may not be available for all other alternatives. The existing systems will not last to the end of the study period. An Ovation system (with minor software upgrades) will serve the plant over this time frame unless an unforeseeable major technological advancement stops production of compatible components for spare parts.

Non-monetary considerations include a faster control time of the Ovation system compared to all levels of WDPF systems. All levels of WDPF communicate over a coax-cable based highway while Ovation communicates over a fast Ethernet network. Ovation utilizes Pentium processors in comparison to WDPF level 8 which utilizes 486 processors, WDPF level 7 which utilizes 286 processors, and WDPF level 6 which utilizes 8086 processors. Ovation is the most current control system offered by Emerson and is the focus of their control system technology for the foreseeable future.

**Recommendations**

Implement an Ovation control system for stage 1 in 2004 and for stage 2 in 2005. This alternative has the lowest net present cost, has the longest predictable life expectancy, is the most reliable, and will require the least maintenance resources.

Analyze other suppliers during the tendering stage. Future technologies by other manufacturers may enable another supplier to adapt the WDPF cabinets, I/O, graphics and logic to their controllers and MMI allowing for more competitive pricing.

**Updates**

1) Since this analysis was performed, Emerson has announced that WDPF level 8 has been assigned Active status with a support commitment date of January 2012. This move to Active status eliminates Alternative 2 for all practical purposes.

2) Components are no longer available to repair Matrox boards and Emerson has sold all of their reserve Matrox board stock. There are sufficient plant spares to operate until, but not beyond, the 2004 outage season.

<table>
<tr><th colspan="7">Alternative 1: Migrate to Ovation in 2004/2005</th></tr>
<tr><th rowspan="2">Year</th><th rowspan="2">Component</th><th colspan="2">Capital</th><th colspan="2">Operating</th><th rowspan="2">Comments</th></tr>
<tr><th>2002 Cost (CDN$)</th><th>Year Total (CDN$)</th><th>2002 Cost (CDN$)</th><th>Year Total (CDN$)</th></tr>
<tr><td rowspan="2">2004</td><td>Ovation System & Training</td><td>$1,223,068</td><td rowspan="2">$1,305,068</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Migrate Stage 1 in 2004</td></tr>
<tr><td>Engineering & Labour</td><td>$82,000</td></tr>
<tr><td rowspan="2">2005</td><td>Ovation System & Installation</td><td>$786,672</td><td rowspan="2">$844,672</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Migrate Stage 2 in 2005</td></tr>
<tr><td>Engineering & Labour</td><td>$58,000</td></tr>
<tr><td>2010</td><td>Software Upgrade</td><td>$7,360</td><td>$7,360</td><td></td><td></td><td></td></tr>
<tr><td>2016</td><td>Software Upgrade</td><td>$6,770</td><td>$6,770</td><td></td><td></td><td></td></tr>
<tr><td>2007 to 2020</td><td>Card and Monitor repair/replacement</td><td></td><td></td><td>$8,201 per Card & $6,491 per Monitor</td><td>Range from $8,201 to $56,000 per year</td><td>Number of Card/monitor Repairs increase With System Age</td></tr>
</table>

| Alternative 2: Gradualy Replace with a Level 8 WDPF | | | | | | |
|---|---|---|---|---|---|---|
| Year | Component | Capital | | Operating | | Comments |
| | | 2002 Cost (CDN$) | Year Total (CDN$) | 2002 Cost (CDN$) | Year Total (CDN$) | |
| 2004 | Operator Interface & Processing Equipment | $340,770 | | | | WEStations & WPC components |
| | MSP Last Buy Spares | $92,760 | | | | |
| | Labour/Engineering | $26,916 | $460,446 | | | Plant and Head Office |
| 2005 | Operator Interface & Processing Equipment | $197,884 | | | | WEStations & WPC components |
| | Labour/Engineering | $12,036 | $209,920 | | | Plant and Head Office |
| 2007 | Operator Interface & Processing Equipment | $332,012 | | | | WEStations & WPC components |
| | Labour/Engineering | $26,916 | $358,928 | | | Plant and Head Office |
| 2008 | Operator Interface & Pr | $377,468 | | | | WEStations & WPC components |
| | Labour/Engineering | $30,456 | $407,924 | | | Plant and Head Office |
| 2009 | Operator Interface & Processing Equipment | $229,090 | | | | WEStations & WPC components |
| | Labour/Engineering | $24,144 | $253,234 | | | Plant and Head Office |
| 2010 | Operator Interface & Processing Equipment | $220,800 | | | | WEStations & WPC components |
| | Labour/Engineering | $19,696 | $240,496 | | | Plant and Head Office |
| 2011 | Operator Interface & Processing Equipment | $159,170 | | | | WEStations & WPC components |
| | Labour/Engineering | $14,232 | $173,402 | | | Plant and Head Office |
| 2015 | Ovation System,Training | $999,190 | | | | Migrate Stage 1 in 2015. |
| | Processing Equipment | $135,185 | | | | WPC Components |
| | Labour/Engineering | $82,000 | $1,216,375 | | | Plant and Head Office |
| 2004 to 2014 | Card and Monitor repair/replacement | | | $5,138 per Card & $6,000 per Monitor, Plus Labour and Engineering | Range from $36,000 to $180,000 per year | Number of Card/monitor Repairs decrease as introduction of new system approaches, Per unit cost increases are 10% yearly |
| 2015 to 2020 | Card and Monitor repair/replacement | | | Warranty work in Early Years | Range from $2,000 to $18,000 per year | Number of Card/monitor Repairs increase as new system ages |

| Alternative 3: Maintain Current WDPF and Analyze Migration Annually | | | | | | |
|---|---|---|---|---|---|---|
| Year | Component | Capital | | Operating | | Comments |
| | | 2002 Cost (CDN$) | Year Total (CDN$) | 2002 Cost (CDN$) | Year Total (CDN$) | |
| 2004 | Operator Interface & Processing Equipment | $333,380 | | | | WEStations & WPC components |
| | Used & Last Buy Equipment | $230,898 | | | | |
| | Labour/Engineering | $26,916 | $591,194 | | | Plant and Head Office |
| 2005 | Operator Interface & Processing Equipment | $197,884 | | | | WEStations & WPC components |
| | Used Equipment | $155,825 | | | | |
| | Labour / Engineering | $12,036 | $365,745 | | | Plant and Head Office |
| 2007 | Operator Interface | $52,605 | | | | WEStations |
| | Used Equipment | $147,159 | | | | |
| | Labour / Engineering | $13,228 | $212,992 | | | Plant and Head Office |
| 2008 | Operator Interface | $52,290 | | | | WEStation |
| | Used Equipment | $78,015 | | | | |
| | Labour / Engineering | $14,072 | $144,377 | | | Plant and Head Office |
| 2011 | Ovation System & Training | $1,047,991 | | | | Migrate Stage 1 in 2011 |
| | Processing Equipment | $138,988 | | | | WPC Components |
| | Labour / Engineering | $82,000 | $1,268,979 | | | Plant and Head Office |
| 2012 | Ovation System | $693,108 | | | | Migrate Stage 2 in 2012 |
| | Processing Equipment | $50,000 | | | | WPC Components |
| | Labour / Engineering | $58,000 | $801,108 | | | Plant and Head Office |
| 2017 | Software Upgrade | $6,730 | $6,730 | | | |
| 2004 to 2010 | Card and Monitor repair/replacement | | | $5,138 per Card & $6,000 per Monitor, Plus Labour and Engineering | Range from $47,000 to $180,000 per year | Number of Card/monitor Repairs decrease as introduction of new system approaches, Per unit cost increases are 10% yearly |
| 2015 to 2020 | Card and Monitor repair/replacement | | | $7,710 per Card & $6,000 per Monitor, Plus Labour and Engineering | Range from $8,200 to $23,000 per year | Number of Card/monitor Repairs increase as new system ages |

Tab 3

# NEWFOUNDLAND & LABRADOR HYDRO

**Holyrood Generating Station**

**Evaluation of Options to**
**Refurbish Stack Steel Liner #2**

**Prepared By:**

**Generation Engineering**

**March 2003**

## 1.0 Stack Liner

The existing steel liner, which is held in position laterally by the concrete shell, is 34 years old and was constructed from ¼" thick mild steel to a vertical height of 300 ft.

A combination of many factors, such as age, chemical composition and velocity of the flue gas, temperature variations, proximity to marine climate (salt), etc., has lead to its present state of deterioration.

## 1.1 Identification of Major Maintenance and Liability Issues

Annual inspections, and in particular those of recent years, have identified several areas of concern. These include:

- 27 locations of thin steel (less than 60% of original thickness);
- 3 thin rings (4 ft high for the full circumference);
- 2 locations of buckling (from elevation 83 ft to 229 ft);
- Thin steel and holes developed within portions of the hopper;
- Numerous locations of pitting of the steel surface;
- Numerous locations of missing insulation (including the top half that cannot be easily or economically replaced); and
- Substantial loss of metal through out its full height such that the ability to support its own weight (originally 60 tons) is much more questionable.

It is estimated that it would take 3 months to replace the stack liner (on-site) on a planned basis. A catastrophic failure of the stack liner (buckling) will likely result in an outage that could extend beyond 6 months, assuming that the failure does not cause any damage to the concrete shell or any consequential damage to the ductwork or the boiler. This would depend upon the failure mechanism. It could possibly affect the whole plant, if it fails during operation. Additional factors that could affect the length of the outage include: material availability, time of the year, weather, removal of steel liner and components, etc.

## 2.0 Alternatives

Various alternatives have been investigated for the upgrade of the Stack #2 liner at the Holyrood Generating Station. These include:

1. Reinforcement and continue with current practice consisting of inspection, maintenance and repair to the stack liner;
2. Perform immediate repair and maintenance to the stack liner and provide vertical reinforcement during the next major unit outage planned in 2011;
3. Replace the entire stack liner.

## 2.1 Reinforcement and Continue with Current Practice

Under the current practice the entire stack, including the stack liner, concrete shell, breeching and associated utilities are inspected on an annual basis by an experienced chimney/stack inspection company. The inspection identifies stack maintenance requirements and only the repairs that are deemed to be necessary to maintain generation for the immediate operating season are performed.

To structurally reinforce and then continue with emergency maintenance to provide the minimum reliability for this liner will require:

| Description of Work | Estimated Value |
|---|---|
| Vertical Reinforcement | $500,000 |
| Replace Hopper | $50,000 |
| Reinforce 3 identified thin rings | $104,000 |
| Patch 20% of identified thin steel | $60,000 |
| Total: | $714,000 |

Subsequent annual inspection, maintenance and repair costs are estimated to be $70,000/year.

Note: Adding vertical reinforcement (columns) to the inside of the liner would likely reduce the output capability of the generating unit.

These expenditures are considered adequate in the next few years to provide an acceptable level of reliability but may not be sufficient to extend the life of the stack liner until 2020.

## 2.2 Perform Immediate Repairs and Maintenance and Plan Future Reinforcement

This option is similar to the option described above, except that the main vertical reinforcement identified will be delayed until 2011.

To perform immediate repairs in 2005, then continue with emergency maintenance and future vertical reinforcement in 2011, to provide the minimum reliability for this liner will require:

| Description of Work | Estimated Value |
|---|---|
| Replace Hopper | $50,000 |
| Reinforce 3 identified thin rings | $104,000 |
| Patch identified thin steel | $303,000 |
| Sub-Total (Work 2005): | $457,000 |
| Vertical Reinforcement (in 2011) | $500,000 |
| Total (Work 2005 & 2011): | $957,000 |

Subsequent annual inspection, maintenance and repair costs are estimated to be $70,000/year.

Note: Adding vertical reinforcement (columns) to the inside of the liner would likely reduce the output capability of the generating unit.

This option would also provide an acceptable level of reliability but is dependent on the continued rate of deterioration of the 34 year old mild steel in a very harsh environment.

## 2.3 Replace Steel Liner

This option involves the removal of the existing stack liner and support structure and the installation of a new stack liner at a cost of $1,200,000 in 2005. This option will provide the greatest reliability with respect to the stack liner and hence generation availability. It is expected that bi-annual inspections of the new liner would be required for continuous reliable operation.

## 3.0 Evaluation of Alternatives

The previous section presented three alternatives for the refurbishment of the stack liner. These options are evaluated below to determine the most cost effective solution.

### 3.1 Evaluation

All alternatives were evaluated on their respective capital and operating costs.

The table below indicates each alternative and associated cost.

| | **Option #1** | **Option #2** | **Option #3** |
|---|---|---|---|
| | Reinforcement and Continue Current Practice | Perform Immediate Repairs and Maintenance and Plan Future Reinforcemnt | Replace Stack Liner |
| | | | |
| Capital Cost** | $714,000 | $457,000 | $1,200,000 |
| | | $500,000 Vertical Reinforcement - 2011 | |
| | | | |
| O & M Costs | $70,000/Year | $70,000/Year | $20,000/Bi-Annual |
| | | | |

** Capital cost excluding internal engineering & construction management, environment cost, overhead or contingency.

### 3.2 Cost Comparison

A cumulative present worth comparison was conducted for the three options listed above. The cumulative present worth calculation assumed an 16-year horizon, discount rate of 9%, average inflation rate of 1.6%, and an increase in annual maintenance and repair costs of 3% due to larger areas requiring repairs.

The results of these calculations revealed that the replacement of the stack liner is the least cost option over the 16-year evaluation period. The results of the comparison are shown in Appendix A, Cumulative Present Worth Comparison.

### 3.3 Summary

The analysis does not consider the possibility of a catastrophic failure, which, would impact the overall plant and make the unit unavailable for at least six months and would significantly increase the cost of repairs.

In addition, any shortfall in power or energy supply would have to be replaced by the gas turbines, assuming that sufficient capacity is available, at approximately double the cost of Holyrood energy.

The option that provides the best reliability (lowest risk) and availability until 2020 and at the lowest cost is the replacement of the liner (Option #3) during the major outage scheduled in 2005. This, also, avoids the risk of catastrophic failure and its associated increased cost and potential increased maintenance cost.

PUB granted approval in 2002 for the replacement of Stack Steel Liner #1. This work is scheduled to be complete in August 2003.

# APPENDIX A

# CUMULATIVE PRESENT WORTH COMPARISON

| Annual Stats | | Notes |
|---|---|---|
| Annual Escalation (%) | 1.6 | Inflation |
| Annual Discount Rate | 9.0 | Hydro |

**Option #1**

| Capital Cost (2003 dollars) | |
|---|---|
| Construction | 714,000 |

| Operating Cost (2003 dollars) | |
|---|---|
| Annual Inspection & Maintenance | 70,000 |
| Annual Maintenance Cost (%) | 3 |
| | |

| | Year | Cash Flow | CPW |
|---|---|---|---|
| 0 | 2005 | $725,424 | $725,424 |
| 1 | 2006 | $73,220 | $792,598 |
| 2 | 2007 | $76,588 | $857,061 |
| 3 | 2008 | $80,111 | $918,922 |
| 4 | 2009 | $83,796 | $978,285 |
| 5 | 2010 | $87,651 | $1,035,252 |
| 6 | 2011 | $91,683 | $1,089,920 |
| 7 | 2012 | $95,900 | $1,142,380 |
| 8 | 2013 | $100,312 | $1,192,723 |
| 9 | 2014 | $104,926 | $1,241,034 |
| 10 | 2015 | $109,753 | $1,287,395 |
| 11 | 2016 | $114,801 | $1,331,884 |
| 12 | 2017 | $120,082 | $1,374,577 |
| 13 | 2018 | $125,606 | $1,415,547 |
| 14 | 2019 | $131,384 | $1,454,864 |
| 15 | 2020 | $137,427 | $1,492,593 |
| 16 | 2021 | $143,749 | $1,528,799 |
| 17 | 2022 | $150,362 | $1,563,543 |

**Option #2**

| Capital Cost (2003 dollars) | |
|---|---|
| Construction | 457,000 |

| Operating Cost (2003 dollars) | |
|---|---|
| Annual Inspection & Maintenance | 70,000 |
| Annual Maintenance Cost (%) | 3 |
| Install Vertical Reinforcement (2011) | 500,000 |

| | Year | Cash Flow | |
|---|---|---|---|
| 0 | 2005 | $464,312 | $464,312 |
| 1 | 2006 | $73,220 | $531,486 |
| 2 | 2007 | $76,588 | $595,949 |
| 3 | 2008 | $80,111 | $657,810 |
| 4 | 2009 | $83,796 | $717,173 |
| 5 | 2010 | $87,651 | $774,140 |
| 6 | 2011 | $591,683 | $1,126,941 |
| 7 | 2012 | $95,900 | $1,179,402 |
| 8 | 2013 | $100,312 | $1,229,745 |
| 9 | 2014 | $104,926 | $1,278,056 |
| 10 | 2015 | $109,753 | $1,324,416 |
| 11 | 2016 | $114,801 | $1,368,906 |
| 12 | 2017 | $120,082 | $1,411,599 |
| 13 | 2018 | $125,606 | $1,452,569 |
| 14 | 2019 | $131,384 | $1,491,885 |
| 15 | 2020 | $137,427 | $1,529,614 |
| 16 | 2021 | $143,749 | $1,565,820 |
| 17 | 2022 | $150,362 | $1,600,565 |

**Option #3**

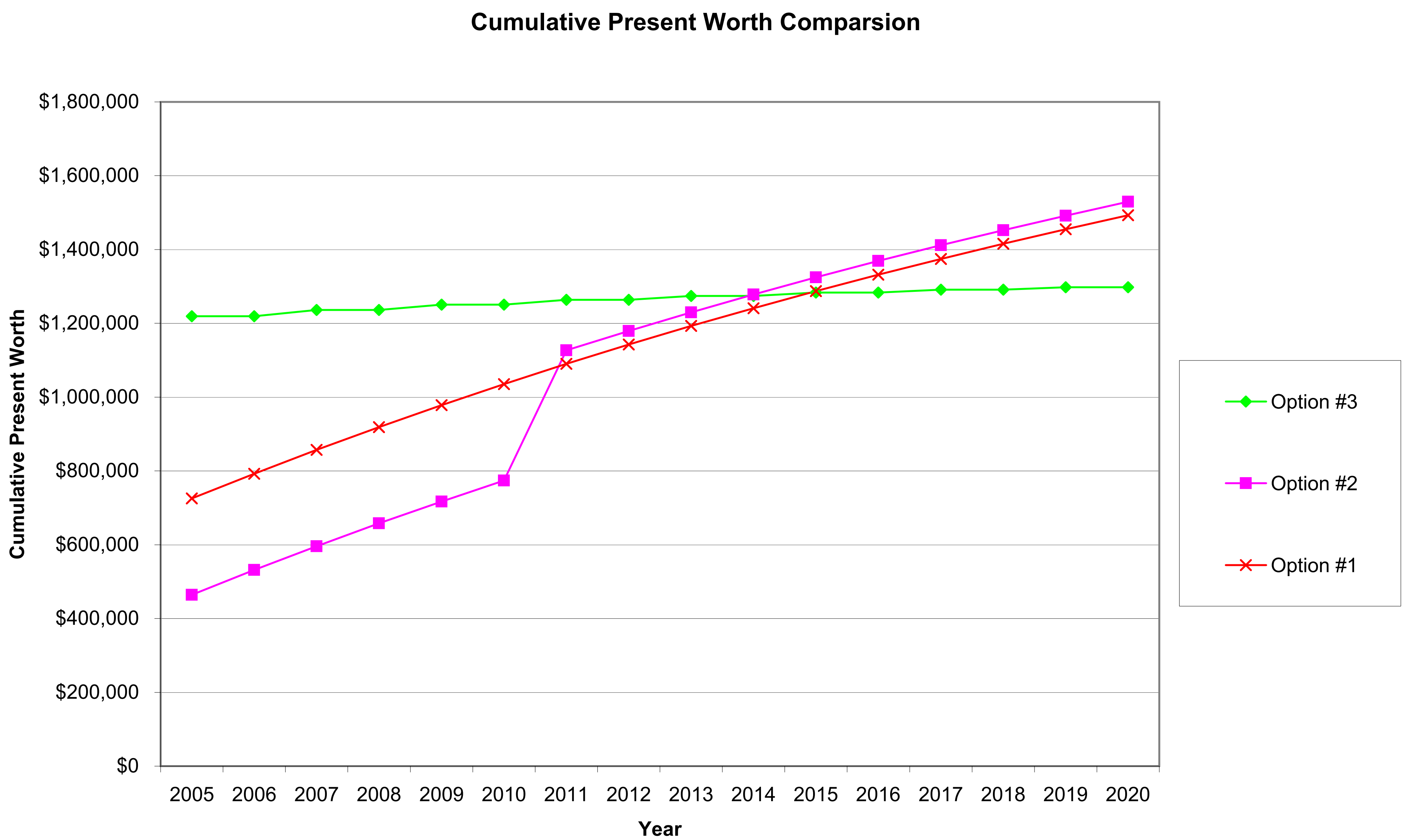
| Capital Cost (2003 dollars) | |
|---|---|
| Construction | 1,200,000 |

| Operating Cost (2003 dollars) | |
|---|---|
| Bi-Annual Inspection & Maintenance | 20,000 |
| | |
| | |

| | Year | Cash Flow | CPW |
|---|---|---|---|
| 0 | 2005 | $1,219,200 | $1,219,200 |
| 1 | 2006 | $0 | $1,219,200 |
| 2 | 2007 | $20,320 | $1,236,303 |
| 3 | 2008 | $0 | $1,236,303 |
| 4 | 2009 | $20,645 | $1,250,928 |
| 5 | 2010 | $0 | $1,250,928 |
| 6 | 2011 | $20,975 | $1,263,435 |
| 7 | 2012 | $0 | $1,263,435 |
| 8 | 2013 | $21,311 | $1,274,131 |
| 9 | 2014 | $0 | $1,274,131 |
| 10 | 2015 | $21,652 | $1,283,277 |
| 11 | 2016 | $0 | $1,283,277 |
| 12 | 2017 | $21,998 | $1,291,098 |
| 13 | 2018 | $0 | $1,291,098 |
| 14 | 2019 | $22,350 | $1,297,786 |
| 15 | 2020 | $0 | $1,297,786 |
| 16 | 2021 | $22,708 | $1,303,506 |
| 17 | 2022 | $0 | $1,303,506 |

NOTES: Capital and Operating Costs have been escalated from 2003 dollars to 2005 dollars.

Since the Work is expected to be completed in 2005, the Cummulative Present Worth Comparsion is calculated for that year.


Cumulative Present Worth Comparsion
$1,800,000
$1,600,000
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$0
Cumulative Present Worth
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
Option #3
Option #2
Option #1

Tab 4

# BUSINESS CASE

**FOR**

# VHF Mobile Radio System Replacement

**March 25, 2003**

# TABLE OF CONTENTS

# 1.0 EXECUTIVE SUMMARY

Newfoundland & Labrador Hydro presently owns a VHF mobile radio system which serves both its employees and the provincial Department of Works, Services, and Transportation (WS&T) with mobile radio services for their respective personnel and vehicles. This system has been in service since 1989 and has now reached the end of its useful life, owing primarily to the unavailability of parts and service for the equipment.

It is concluded that the most viable option for Hydro is to replace the current system with a trunked radio system. Unlike the existing conventional system, trunked radio allows users to share radio channels, thereby providing economies of scale when multiple radio channels are required for traffic requirements. Trunked radio is also much more user friendly than conventional radio, with a user interface similar to a telephone.

Alternatives evaluated to provide mobile communications include cellular telephone, satellite telephone, and mobile radio and the analysis concluded that a trunked mobile radio solution is the preferred alternative. The mobile radio alternative has been demonstrated to be the only feasible alternative for a variety of reasons.

The estimated capital cost of this system, including indirect costs, is $8.85 million, with $5.8 million in direct costs. Annual operating costs of $690,000 (2005 dollars) are also anticipated. WS&T will share in the costs of the system on a prorated number of users basis.

Based on the analysis undertaken in this report, it is recommended that the Corporation purchase and install a trunked VHF mobile radio system that provides coverage on the Island of Newfoundland and selected areas of Labrador. While the trunked radio solution has a Net Present Value of $130,000 or approximately 2% more than the conventional radio, it provides greater technical flexibility for adding future users and the utilization of other features.

# 2.0 PROJECT DEFINITION

## 2.1 Purpose

The purpose of this project is to replace Newfoundland & Labrador Hydro's (the Corporation's) existing VHF Mobile Radio System (MRS). The existing system was installed in 1989 and has reached the end of its useful life. It is proposed to be replaced by a trunked radio system capable of providing service to the corporation's employees and its' current, as well as future, customers.

The MRS would provide mobile radio service on the Island of Newfoundland, the southern coast of Labrador and Happy Valley - Goose Bay. Coverage (the area of service) will include major roads, communities, and the Corporation's transmission lines and generating stations.

## 2.2 Justification

Mobile communication is a fundamental requirement for the efficient deployment of a utility's workforce whose work site covers virtually all the province where its transmission, distribution and generation facilities are located. In fact all major utilities have mobile radio systems as an essential component of their operation. Mobile communication is used for employee dispatch, status communications, communication between crews working separately on a geographically distributed asset, such as a transmission line, and for emergency communications. The Corporation has used a mobile radio system since at least the 1970's; the existing system is the second generation of MRS owned and operated by the Corporation. The Corporation's users regard the system as an absolute necessity in the performance of daily operations and the requirement for communications is an integral part of the corporation's work protection code.

Ownership of the MRS by the Corporation is consistent with standard industry practice. The majority of major utilities in Canada own their MRS facilities (see Appendix B), as opposed to leasing service from a service provider. This is done for a variety of reasons, but primarily because without ownership, the utility is subject to the business priorities of a service provider who may change the coverage, technology, service level, and cost of a leased system at any time. As an example, Aliant has reduced the coverage and service for its mobile telephone system as cellular telephony has eliminated most of the customer base, and it has now sought permission from its regulator to discontinue this service completely. Ownership of the utility's MRS brings control of a critical piece of infrastructure required to operate and maintain the electrical grid of a major utility.

With the requirement for mobile communications established, the next issue is the necessity of replacement of the existing system. The existing MRS is one of a handful that were installed in Canada by the original manufacturer; and is one of two systems still in service today. It consists of a central switch located in Gander, and 29 repeaters scattered across the Island of Newfoundland; each repeater consists of one site controller, one mobile transmitter/receiver, and one transmitter for paging. The switch/site controller system was Manufacturer Discontinued (MD'd) in 1991, and service and spare parts are no longer available. The switch is non-redundant, meaning that failure of a key component can render the entire system inoperable. The transmitters and receivers were MD'd in 1996, but can be replaced with compatible equipment. Typically manufacturers will discontinue support completely after equipment has been MD'd for 10 years. The graph shown in Appendix A.8 indicates the failure statistics for the period 1999 to February 2003 and clearly demonstrates the increasing failure rate.

When the original budget for this project was prepared in early 1997 the scope of the project was to replace only the central switch in 2000. The estimate at that time was approximately $1.2 million. The scope of this project was revisited in 1998, after the Corporation became aware of the manufacturer's intent to MD the repeater equipment, and a decision was made at that time that the most viable alternative was to replace the system completely, as much of the equipment was reaching the end of its useful life and would have to be replaced in the near future in any case. At that time a capital estimate of approximately $8.2 million was submitted. Further refinement of the estimate for resubmission caused the estimate to change to its current value of $8.85 million.

In late 1999, a consultant was tasked with analysis of the Corporation's mobile communications requirements and determination of the most cost effective solution. The consultant that was hired has extensive experience in the design and analysis of MRS.

The consultant's report is contained in Appendix C attached. In summary, it demonstrates that a standards-based trunked radio system is the most cost effective solution to the mobile communication needs of the Corporation. It also contains cost estimates that were used in the preparation of the capital job cost, as well as the cost-benefit analysis contained in Section 6 of this document.

## 2.3 Objectives

The objectives of this project are as follows:

- To provide the most cost-effective, reliable mobile communications system for the Corporation's workforce and customer;
- To maximize the life and minimize installation and operating costs by using standards-based technology wherever possible;
- To maintain and where feasible increase coverage of the system;
- To utilize Hydro-owned facilities wherever possible to minimize installation and operating costs.

## 2.4 Scope/Major Deliverables

This is a one-phase project to be implemented over two years. The major deliverables include the following:

- Trunked MRS infrastructure, including but not limited to standards-based switching equipment, site controller equipment, and system management hardware/software;
- Mobile repeater equipment, including transceivers, antennas, filtering equipment, and all associated hardware;
- Approximately 350 mobile and portable radios are apportioned in the approximate ratio of 70% mobile and 30% portable;
- Increased coverage where required, as long as it is demonstrated to be economically and technically feasible;
- User and maintenance training;
- Spare parts.

## 2.5 Assumptions

Assumptions used in the development of this business case, the project capital job cost, and related documentation include the following:

- Repeaters will be installed at microwave radio sites owned by the Corporation whenever it is technically sound;
- The system will be designed to maximize the use of interconnect facilities owned by the Corporation, as opposed to leasing these facilities;
- Ongoing maintenance of the system will be performed by a third party at sites not owned by the Corporation, and by internal personnel at sites owned by the Corporation.

## 2.6 Constraints and Prerequisites

Constraints on this project include the following:

- Service must be maintained on the existing system during the installation and commissioning of the new system, in order to minimize outage time for users;
- The East-West Microwave Interconnect project must be completed in advance of installing facilities in the Central, Western, and Northern Newfoundland areas in order to provide the required facilities;
- Available VHF channels may be restricted in certain areas by Industry Canada licensing restrictions.

# 3.0 STRATEGIC ALIGNMENT

## 3.1 Specific Strategic Initiatives

The corporation's Mission Statement is as follows:

*Newfoundland & Labrador Hydro is a Crown Corporation committed to providing cost-effective and reliable energy services to our customers for the benefit of all people of the province.*

*Our skilled and committed employees will use innovative methods and technologies, and will maintain high standards of safety and health, and environmental responsibility.*

The project maintains this mission by allowing employees to perform their work more efficiently, while helping maintain a safe working environment when operating remotely.

## 3.2 Project Stakeholders

The project stakeholders include all IS&T sections from a management, installation, and maintenance standpoint, and all divisions of the Corporation, as well as WS&T.

Within IS&T, Infrastructure & Software Support is responsible for the maintenance and ongoing support for the system. Technology Planning is responsible for standards compliance and integration into the overall IS&T Strategic Plan. Project Delivery is responsible for project management of the installation.

# 4.0 APPROACHES

## 4.1 Identification of Alternatives

In a preliminary analysis of this project, the following alternatives were identified:

- Cellular telephone;
- Satellite telephone;
- Replace of existing switch and maintain radio equipment;
- Install new radio system.

## 4.2 Comparison of Alternatives

**Cellular Telephone**

The possibility of using cellular telephones was explored to see if it could meet the corporation's requirements. Cellular telephone could provide some of the capability of a mobile radio system, but not all. The major problems with cellular are:

*Poor Coverage*

Cellular coverage does not extend to many of the more remote areas where the Corporation requires mobile communications, including central Newfoundland and large portions of the West Coast and Northern Peninsula, as well as southern Labrador.

*Insufficient Facilities*

As a shared communications system, cellular telephone, like traditional telephone networks, does not have sufficient resources to permit all its users to communicate simultaneously. Instead, channels are allocated based on an acceptable level of service and statistical analysis of usage patterns. In practical terms, in a major emergency, or any time when a large number of users try to access the system simultaneously, many users will not receive service. This unavailability of service is totally unacceptable from a service restoration and safety perspective and is sufficient to eliminate cellular as a meaningful alternative. Emergency situations like major storms are the times when the Corporation's personnel, as well as WS&T, need guaranteed communications.

*Lack of Functionality*

Some features of mobile radio systems greatly assist operations such as line maintenance, where several personnel at different locations have a need to communicate simultaneously. These are functions which cellular telephone does poorly, if at all.

*Industry Practices*

In the utility industry, mobile radio systems are recognized as the standard communications medium to support operations. Cellular telephone has been used in some instances but only to enhance the coverage of the mobile radio system in a particular area or for routine business communications.

*Conclusion*

For the reasons given above, it was determined that the cellular telephone was not a viable replacement for a corporate mobile radio system.

**Satellite Telephone**

Satellite telephone systems address the issue of coverage that limits the usefulness of cellular telephony, but the other disadvantages, namely insufficient facilities and lack of functionality, remain.

When discussing satellite telephony it is important to distinguish between two types of service. Geostationary (GEO) satellite service requires a directional antenna with a clear view to the southwest and is unsuitable for backcountry mobile service and therefore not a viable alternative. Low Earth Orbit (LEO) services are second generation and are not directional. LEO services are discussed herein.

*Stability of Service Providers*

Most LEO satellite service providers are operating on the edge of insolvency. The customer numbers that were envisioned when the original business plans for these systems never materialized, as cellular telephony coverage increased. As well, the high cost of satellite service has deterred many potential customers. Iridium, the original low earth orbit satellite telephony service, declared bankruptcy shortly after providing its original service and only continues to provide service through a last minute contract from the United States government. Globalstar, the second satellite service to be placed in service, sought bankruptcy protection in February of 2002. To attempt to use either of these services as a mobile communications system would be an extremely high-risk proposition. If the service is abandoned the time to install an alternate would expose the customer to unacceptable business and safety risk.

*Availability of Advanced Services*

LEO satellite telephones are acceptable for point-to-point communications; however, a large proportion of the calls made on a typical MRS are multipoint calls, involving several users. Also, network management requires visibility of the service to determine if the service is working or not. These are a few examples of services that are required for a critical communications system that are not available using satellite telephony.

*Utility Practices*

In the utility industry, mobile radio systems are recognized as the standard communications medium. Similar to cellular telephones, satellite telephones are used in some instances but only to enhance the coverage of the mobile radio system in a particular remote area. Because of the per unit cost of a satellite phone and the airtime cost, the satellite phone is typically the last option to be pursued.

*Conclusion*

Because of the reasons given above, it was determined that the satellite telephone was not a viable replacement for a corporate mobile radio system.

**Replacement of Switch in 2004 Alternative**

One possible solution to the problem of switch obsolescence would be to replace the switch and site controllers only, and leave the rest of the system intact. This scenario was originally proposed in the Corporation's Telecommunications Plan of 1997. This could be achieved without significantly changing the functionality of the system. Under this scenario, mobile and repeater radios would not change until they were replaced as they began to fail. When the switch replacement option was proposed, the corporation was unaware that the repeaters had been manufacturer discontinued (MD'd) in 1996.

This scenario has several significant disadvantages.

*Age of Equipment*

The remaining mobile and portable radios as well as the repeater equipment are at the end of their useful lives, and as a result, maintenance costs and failures are increasing. The equipment was MD'd in 1996 and typically manufacturers will provide best effort support for 10 years and after that no support is provided. Based on this, in 2006 support for the repeater equipment will no longer be available. To delay the replacement of the repeaters for a few years will only result in increased maintenance costs and delay the inevitable replacement of the system.

*Lack of Functionality*

By replacing the switch now and leaving the rest of the system intact, the Corporation would be unable to take advantage of any of the modern features that a replacement system would have to offer. Essentially, the corporation would be restricted to the same technology until the complete system is replaced. Additional features of a new system would include privacy, individual calling, remote unit registration, ease of expansion, as well as the ability to provide data capability to mobile personnel and isolated sites accessible only by VHF radio.

Additional repeaters are required to meet the corporation's existing coverage requirements. These new repeaters may not be able to be re-used when the MRS is ultimately replaced.

*Inability to Use Existing Corporate Infrastructure*

Because of the West Coast Microwave upgrade completed in 1999, the East Coast Microwave project completed in 2001, and the East-West Interconnect being completed in 2003, the Corporation is now in a position to use its infrastructure to support part of the VHF mobile radio system. Doing this, however, will mean the removal of approximately ten repeaters from Newtel sites, and their installation in Hydro sites.

**Complete Radio System Replacement**

Over the past several years, the Corporation has worked with Newtel Mobility to solicit support from major provincial users of mobile radio systems for a province wide VHF mobile radio system. This initiative has not been successful, and therefore the Corporation has little choice but to proceed with a replacement of the existing system.

Replacing the existing system with a new solution allows the Corporation to provide its employees and customers an advanced, private system that meets both current and planned needs for mobile communications.

*Coverage*

Internal users have indicated a desire to see the coverage, i.e. the geographical area of service availability, of the existing system increased. In particular, the South Coast of Labrador and Happy Valley-Goose Bay and the Granite Canal area have been identified as areas where additional coverage will be needed. In order to achieve this, six additional repeaters have been included in the budget. The actual number of sites will be determined upon performance of a detailed coverage analysis. If WS&T requires any additional coverage outside of the Corporation's requirements, it will be at the expense of WS&T and outside the scope of this project.

In addition to extra repeaters, the second variable that determines the coverage for a given power level and tower height is the frequency of the transmitted signal. Analysis has demonstrated that the VHF (170 MHz) mobile band currently used by the Corporation's mobile radio system will provide the best coverage using the minimum number of repeater sites.

Trunked radio refers to a mobile radio technology whereby a single repeater location may have more than one radio channel for user traffic. The channels are shared between users in a manner that permits more simultaneous conversations than the total number of channels, a feat that is achieved by reallocating a channel to a new conversation as soon as the user is finished, instead of having the traditional "hold time" of a conventional radio channel.

Technology Alternatives

Several types of trunked radio systems are available, each with its own unique properties. A consultant was hired in early 2001 to assist with the evaluation of the alternatives. Broadly speaking, the trunked radio systems can be classed as either proprietary or standards-based. Standards based systems are, in general, less expensive owing to the availability of multiple vendors.

# 5.0 COST/BENEFIT ANALYSIS

## 5.1 Switch Only Replacement

The analysis for a switch only replacement was completed. Attached in Appendix A are two switch replacement options. Option 1 is a Switch Replacement in 2004 followed by a complete replacement of the MRS by 2008. Option 2 is a Switch Replacement in 2004 followed by a complete replacement of the MRS by 2011. Both of these options are compared to a MRS replacement in 2005.

Option 1 allows the repeater equipment to go 2 years beyond the end of any manufacturer support and option 2 allows the repeater equipment to go 5 years beyond the end of manufacturer support.

The evaluation period was from 2004 to 2019 and is summarized in the following table:

| Option | NPV |
|---|---|
| Mobile Trunked Radio System (MRS) | $10,827,896 |
| Switch Replacement in 2004 with MRS in 2008 | $12,008,866 |
| Switch Replacement in 2004 with MRS in 2011 | $12,229,819 |

These results are indicated in tabular and graph form in Appendix A as A.1, A.2 and A.3.

As is evident from the analysis, the most viable long-term alternative is to install a mobile trunked radio system in 2004/2005 rather than pursue a piece meal approach.

## 5.2 Conventional vs. Trunked Mobile Radio Systems

The preliminary NPV analysis contained in Appendix A evaluates the cost over 15 years of a conventional radio system, such as the existing system, and a trunked radio system. Two alternatives are presented: one is a Hydro only system and the second with WS&T contributing 50% of the costs. As shown, over the assumed 15-year life, the trunked radio system cost is marginally higher than the conventional system, owing to higher leasing costs for the assumed configuration. If however the required number of leased circuits were to increase, the increased cost for trunked radio is proportionally lower, meaning that this estimate is probably conservative.

The following table summarizes the results for the scenario under which Hydro is the sole user:

| Option | Capital | Operating | Total |
|---|---|---|---|
| Trunked | $5,700,000 | $5,127,896 | $10,827,896 |
| Conventional | $6,625,000 | $3,972,828 | $10,597,828 |
| Difference | | | $230,068 |

The tabular and graphical representation are illustrated in Appendix A.4 and A.5 respectively. As shown, the difference in total cost is negligible (approximately 2%) compared to the total cost of ownership of the system over 15 years.

If it is assumed that WS&T bears 50% of the total cost, the difference is halved:

| Option | Capital | Operating | Total |
|---|---|---|---|
| Trunked | $2,850,000 | $2,563,948 | $5,413,948 |
| Conventional | $3,312,500 | $1,986,414 | $5,298,914 |
| Difference | | | $115,034 |

The tabular and graphical representation are illustrated in Appendix A.6 and A.7 respectively. Again, the difference for trunked radio compared to conventional is on the order of 2% of the total cost of ownership.

## 5.3 Proposed Technical Alternative

It is recommended that a mobile trunked radio system be installed in 2004/2005. While the NPV indicates a marginally preference for a conventional mobile radio system, the mobile trunked radio system allows for greater flexibility for the users and will provide a more economic alternative if additional users are added to the system.

Benefits of the proposed solution have already been enumerated; however, in summary form, the major benefits are as follows:

- The system will provide the Corporation's mobile communications needs for the foreseeable future;
- The modular nature and standards-based design of the proposed solution ensures that future expansion needs will be met;
- The same system can be used to provide communications for CF(L)Co in future, thereby ensuring that the most efficient solution for both organizations is maintained;
- The trunked solution will be able to be expanded to include mobile data capability, thereby improving the efficiency of the mobile workforce.

# 6.0 RESOURCE REQUIREMENTS

## 6.1 Human Resource Requirements

The attached is an order of magnitude estimate of the effort involved in the design, installation, and commissioning of this project.

| 1.1.1 Role | Responsibility | 1.1.1.1 Time Commitment | 1.1.1.2 Duration | Source (internal, external) |
|---|---|---|---|---|
| Project Manager | Overall coordination of project | 1 person year | 2 years | Internal |
| Technical Lead | Project engineering | 1.5 person years | 2 years | Internal |
| Technologist | Installation/commissioning | 3 person years | 2 years | Internal |
| Project Manager | Coordination of supplier effort | 1 person year | 2 years | External |
| Design Engineer | Detailed design of proposed solution | 1 person year | 2 years | External |
| Installer | Installation/commissioning | 3 person years | 2 years | External |

## 6.2 Material/Equipment Procurement

The proposed solution will be obtained through a detailed design/supply/install/commission contract. This is the approach normally taken by IS&T in a system of this magnitude. This allows the Corporation to take advantage of the skills normally contained in-house by a reputable supplier, and at the same time focus its resources on the areas in which it has expertise.

# 7.0 BUSINESS IMPACT

## 7.1 Changes to the Business Process

Changes to business processes will be minimal. Staff complements in St. John’s, Bishop’s Falls, and Deer Lake already possess the necessary skills to operate and maintain the system, needing only training on the specific equipment being provided. Engineering support and software/hardware support will be provided with existing complement, primarily from St. John’s.

Because the replacement system is similar to the existing MRS in size and complexity, process changes will be minimal. Preventive Maintenance, which is currently performed on the existing system, will be adapted to the new system, and Network Management will be performed using the resources of the Network Management Centre located in St. John’s.

## 7.2 New Staff Training Needs

As with any new installation, some training will be required. All users will have to be trained on the use of the system. Network Services personnel will be trained on the maintenance and service of the equipment. The cost of this training is included in the capital cost estimate.

## 7.3 Changes with Stakeholders

In preliminary discussions, WS&T has indicated a desire to participate in the venture by contributing to the cost, to be prorated based on the number of radios each party uses. In the current installation, the radios are divided roughly evenly between the Corporation and WS&T; it is therefore reasonable to assume that WS&T will contribute approximately half the capital and operating cost of the system.

Discussions with Newfoundland Power personnel indicate that they are not interested in proceeding as a partner in the development of this system because they still have a viable system; however, they may wish to participate at some later date.

Discussions with other parties, e.g. provincial government agencies, on the possibility of participation in this system are ongoing.

# 8.0 CONCLUSION

The analysis presented addressed the possibility of using cellular as well as satellite telephony and both were eliminated as viable alternative as they do not fulfill the demands of the utility environment.

Consideration was given to a switch replacement as was proposed in 1997; however, it is not economic in the long-term. Two technologies of mobile radio were compared namely conventional and trunk. The conventional mobile radio system is marginally less expensive than a trunked system, however, the benefits of the trunked radio make it the preferred option for our industry.

These benefits include ease of use of additional users, data capability (with some additional capital) amongst others. It will provide Hydro over the long-term a reliable and flexible system that serves the needs of the work force across the province for safety and efficiency reasons.

It is concluded that Hydro should proceed with the installation of a mobile trunked radio system as soon as possible, as any further delay will likely result in the unavailability of any system due to the deteriorating performance of the current system.

# APPENDIX A

# VHF Mobile Radio Replacement

## Switch Replacement in 2004 (Option 1)

Study Discount Rate: 9.60%

| | Switch Replacement | | | | Trunked Radio System | | | | NPV Comparison (Alt. 2 - Alt. 1) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Capital Costs | O&M Costs | Total | CPW to 2004 | Capital Costs | O&M Costs | Total | CPW to 2004 | CPW to 2004 |
| 2004 | 1,444,842 | 551,250 | 1,996,092 | 1,996,092 | 3,000,000 | | 3,000,000 | 3,000,000 | $ 1,003,908 |
| 2005 | | 633,938 | 633,938 | 2,574,502 | 2,700,000 | 689,250 | 3,389,250 | 6,092,381 | $ 3,517,880 |
| 2006 | | 729,028 | 729,028 | 3,181,410 | | 689,250 | 689,250 | 6,666,175 | $ 3,484,765 |
| 2007 | 3,200,508 | 838,382 | 4,038,891 | 6,249,234 | | 689,250 | 689,250 | 7,189,709 | $ 940,475 |
| 2008 | 2,880,457 | 964,140 | 3,844,597 | 8,913,690 | | 689,250 | 689,250 | 7,667,386 | $ (1,246,304) |
| 2009 | (103,322) | 689,250 | 585,928 | 9,284,193 | | 689,250 | 689,250 | 8,103,223 | $ (1,180,970) |
| 2010 | | 689,250 | 689,250 | 9,681,855 | | 689,250 | 689,250 | 8,500,885 | $ (1,180,970) |
| 2011 | | 689,250 | 689,250 | 10,044,684 | | 689,250 | 689,250 | 8,863,715 | $ (1,180,970) |
| 2012 | | 689,250 | 689,250 | 10,375,733 | | 689,250 | 689,250 | 9,194,764 | $ (1,180,970) |
| 2013 | | 689,250 | 689,250 | 10,677,785 | | 689,250 | 689,250 | 9,496,816 | $ (1,180,970) |
| 2014 | | 689,250 | 689,250 | 10,953,380 | | 689,250 | 689,250 | 9,772,411 | $ (1,180,970) |
| 2015 | | 689,250 | 689,250 | 11,204,836 | | 689,250 | 689,250 | 10,023,866 | $ (1,180,970) |
| 2016 | | 689,250 | 689,250 | 11,434,266 | | 689,250 | 689,250 | 10,253,296 | $ (1,180,970) |
| 2017 | | 689,250 | 689,250 | 11,643,599 | | 689,250 | 689,250 | 10,462,630 | $ (1,180,970) |
| 2018 | | 689,250 | 689,250 | 11,834,598 | | 689,250 | 689,250 | 10,653,628 | $ (1,180,970) |
| 2019 | | 689,250 | 689,250 | 12,008,866 | | 689,250 | 689,250 | 10,827,896 | $ (1,180,970) |

Notes:

1. Summary of Capital Costs for Switch Replacement:

2004 The cost of switch replacement was calculated based on the 1997 estimate of $1,269,200. Using an average inflation rate of 2.16% per year, the cost of switch replacement was estimated at $1,444,842 in 2004.

2007-2008 The useful life of the existing system would be extended by 5 years with the replacement of the central switch. A new system would still need to be installed and operational in 2008. The cost of completely replacing the existing system was estimated using the Trunked Radio System estimate, assuming an average inflation rate of 2.18%.

2009 It is estimated that the central switch would have a salvageable value of $103,322 (using a declining balance depreciation calculation at 30% per year).

2. Summary of O&M Costs for Switch Replacement

2004-2008 Due to the increasing age of the current system, the O&M costs were assumed to be the same as the Conventional Radio System in the first year and then increasing 15% per year for each subsequent year that the system is in service.

# VHF Mobile Radio Replacement
## Swith Replacement in 2004 (Option 2)

Study Discount Rate: 9.60%

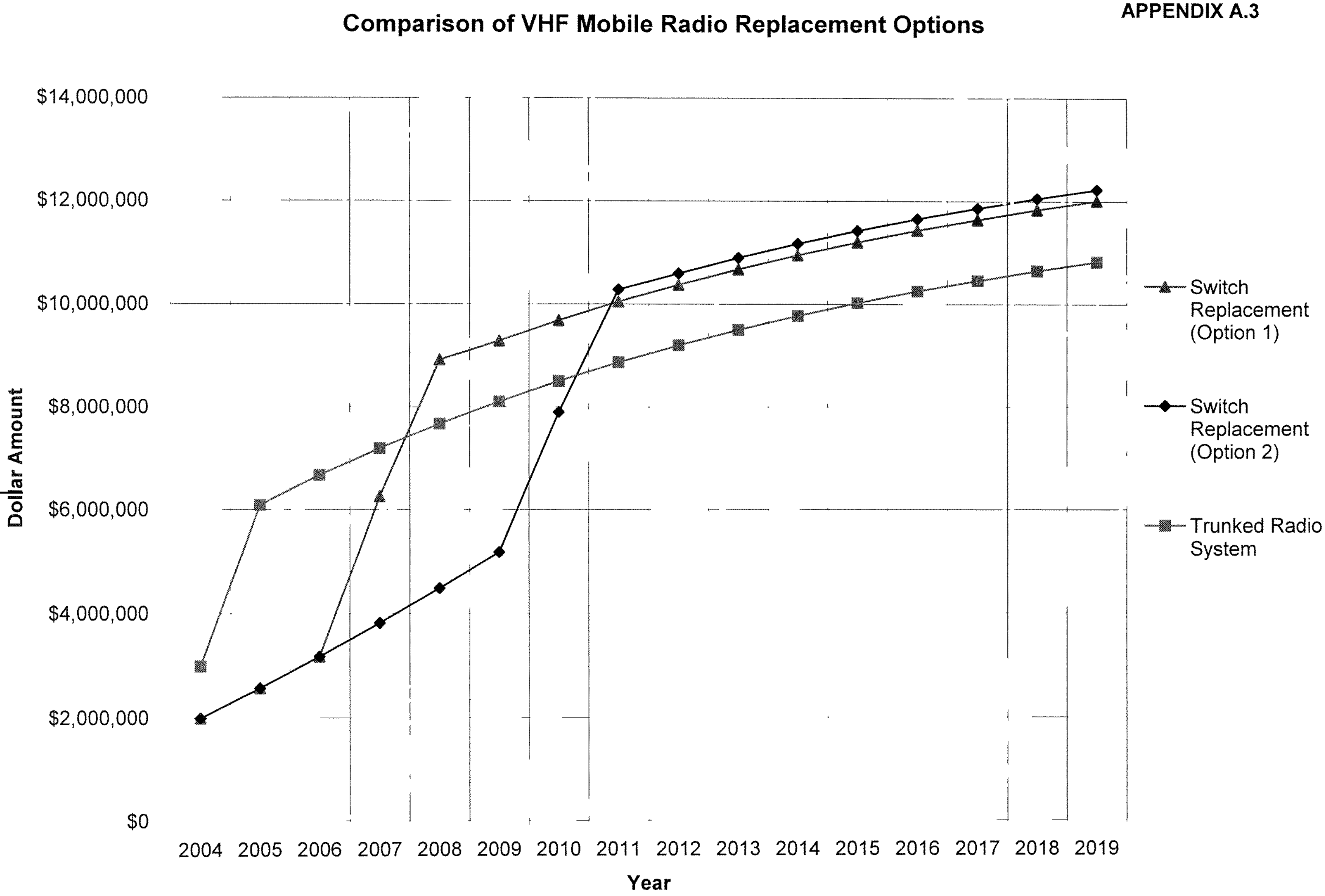
| | Switch Replacement | | | | Trunked Radio System | | | | NPV Comparison (Alt. 2 - Alt. 1) |
|---|---|---|---|---|---|---|---|---|---|
| Year | Capital Costs | O&M Costs | Total | CPW to 2004 | Capital Costs | O&M Costs | Total | CPW to 2004 | CPW to 2004 |
| 2004 | 1,444,842 | 551,250 | 1,996,092 | 1,996,092 | 3,000,000 | | 3,000,000 | 3,000,000 | $ 1,003,908 |
| 2005 | | 633,938 | 633,938 | 2,574,502 | 2,700,000 | 689,250 | 3,389,250 | 6,092,381 | $ 3,517,880 |
| 2006 | | 729,028 | 729,028 | 3,181,410 | | 689,250 | 689,250 | 6,666,175 | $ 3,484,765 |
| 2007 | | 838,382 | 838,382 | 3,818,221 | | 689,250 | 689,250 | 7,189,709 | $ 3,371,488 |
| 2008 | | 964,140 | 964,140 | 4,486,408 | | 689,250 | 689,250 | 7,667,386 | $ 3,180,979 |
| 2009 | | 1,108,761 | 1,108,761 | 5,187,516 | | 689,250 | 689,250 | 8,103,223 | $ 2,915,708 |
| 2010 | 3,414,418 | 1,275,075 | 4,689,492 | 7,893,109 | | 689,250 | 689,250 | 8,500,885 | $ 607,776 |
| 2011 | 3,072,976 | 1,466,336 | 4,539,312 | 10,282,659 | | 689,250 | 689,250 | 8,863,715 | $ (1,418,945) |
| 2012 | (35,439) | 689,250 | 653,811 | 10,596,687 | | 689,250 | 689,250 | 9,194,764 | $ (1,401,923) |
| 2013 | | 689,250 | 689,250 | 10,898,739 | | 689,250 | 689,250 | 9,496,816 | $ (1,401,923) |
| 2014 | | 689,250 | 689,250 | 11,174,333 | | 689,250 | 689,250 | 9,772,411 | $ (1,401,923) |
| 2015 | | 689,250 | 689,250 | 11,425,789 | | 689,250 | 689,250 | 10,023,866 | $ (1,401,923) |
| 2016 | | 689,250 | 689,250 | 11,655,219 | | 689,250 | 689,250 | 10,253,296 | $ (1,401,923) |
| 2017 | | 689,250 | 689,250 | 11,864,553 | | 689,250 | 689,250 | 10,462,630 | $ (1,401,923) |
| 2018 | | 689,250 | 689,250 | 12,055,551 | | 689,250 | 689,250 | 10,653,628 | $ (1,401,923) |
| 2019 | | 689,250 | 689,250 | 12,229,819 | | 689,250 | 689,250 | 10,827,896 | $ (1,401,923) |

Notes:

1. Summary of Capital Costs for Switch Replacement:
   - 2004 — The cost of switch replacement was calculated based on the 1997 estimate of $1,269,200. Using an average inflation rate of 2.16% per year, the cost of switch replacement was estimated at $1,444,842 in 2004.
   - 2010-2011 — The useful life of the existing system would be extended by 8 years with the replacement of the central switch. A new system would still need to be installed and operational in 2011. The cost of completely replacing the existing system was estimated using the Trunked Radio System estimate, assuming an average inflation rate of 2.18%.
   - 2012 — It is estimated that the central switch would have a salvageable value of $35,439 (using a declining balance depreciation calculation at 30% per year).

2. Summary of O&M Costs for Switch Replacement
   - 2004-2011 — Due to the increasing age of the current system, the O&M costs were assumed to be the same as the Conventional Radio System in the first year and then increasing 15% per year for each subsequent year that the system is in service.

APPENDIX A.3



Comparison of VHF Mobile Radio Replacement Options
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
Dollar Amount
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year
Switch Replacement (Option 1)
Switch Replacement (Option 2)
Trunked Radio System

# VHF Mobile Radio Replacement (Hydro Sole User)

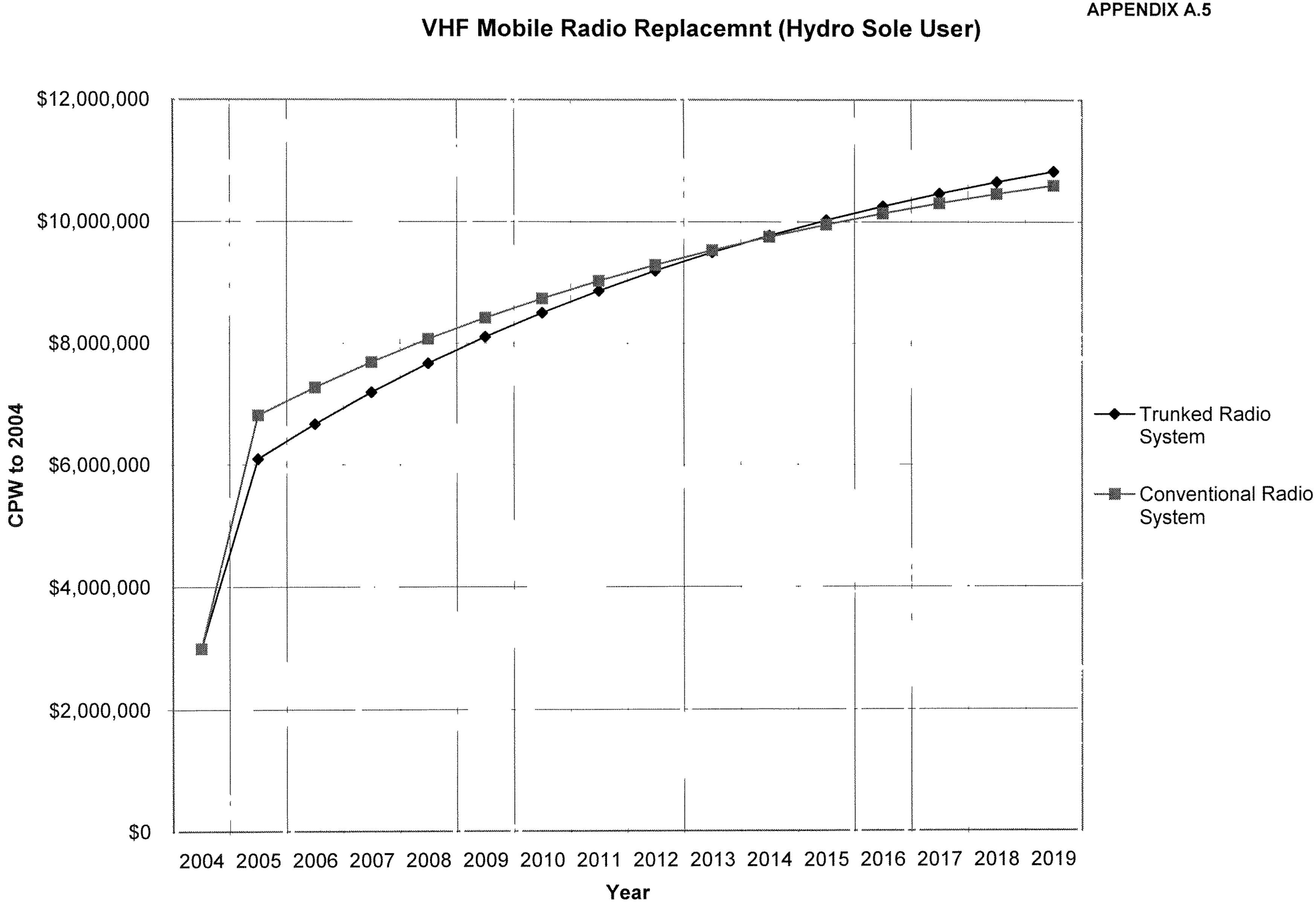
Study Discount Rate: 9.60%

| | Trunked Radio System | | | | Conventional Radio System | | | | NPV Comparison (Alt. 2 - Alt. 1) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Capital Costs | O&M Costs | Total | CPW to 2004 | Capital Costs | O&M Costs | Total | CPW to 2004 | | CPW to 2004 |
| 2004 | 3,000,000 | | 3,000,000 | 3,000,000 | 3,000,000 | | 3,000,000 | 3,000,000 | $ | - |
| 2005 | 2,700,000 | 689,250 | 3,389,250 | 6,092,381 | 3,625,000 | 551,250 | 4,176,250 | 6,810,447 | $ | 718,066 |
| 2006 | | 689,250 | 689,250 | 6,666,175 | | 551,250 | 551,250 | 7,269,357 | $ | 603,182 |
| 2007 | | 689,250 | 689,250 | 7,189,709 | | 551,250 | 551,250 | 7,688,071 | $ | 498,361 |
| 2008 | | 689,250 | 689,250 | 7,667,386 | | 551,250 | 551,250 | 8,070,108 | $ | 402,722 |
| 2009 | | 689,250 | 689,250 | 8,103,223 | | 551,250 | 551,250 | 8,418,683 | $ | 315,460 |
| 2010 | | 689,250 | 689,250 | 8,500,885 | | 551,250 | 551,250 | 8,736,726 | $ | 235,841 |
| 2011 | | 689,250 | 689,250 | 8,863,715 | | 551,250 | 551,250 | 9,026,910 | $ | 163,196 |
| 2012 | | 689,250 | 689,250 | 9,194,764 | | 551,250 | 551,250 | 9,291,678 | $ | 96,914 |
| 2013 | | 689,250 | 689,250 | 9,496,816 | | 551,250 | 551,250 | 9,533,254 | $ | 36,438 |
| 2014 | | 689,250 | 689,250 | 9,772,411 | | 551,250 | 551,250 | 9,753,670 | $ | (18,741) |
| 2015 | | 689,250 | 689,250 | 10,023,866 | | 551,250 | 551,250 | 9,954,779 | $ | (69,087) |
| 2016 | | 689,250 | 689,250 | 10,253,296 | | 551,250 | 551,250 | 10,138,273 | $ | (115,023) |
| 2017 | | 689,250 | 689,250 | 10,462,630 | | 551,250 | 551,250 | 10,305,695 | $ | (156,935) |
| 2018 | | 689,250 | 689,250 | 10,653,628 | | 551,250 | 551,250 | 10,458,452 | $ | (195,176) |
| 2019 | | 689,250 | 689,250 | 10,827,896 | | 551,250 | 551,250 | 10,597,828 | $ | (230,068) |

Notes:

1. Trunked Radio System estimate based on figures used in Capital Job cost. Conventional Radio System estimate based on typical costs for a system of this nature.
2. Operations and Maintenance costs are assumed to be fixed for a 15 year contract with a third party supplier.
3. Maintenance costs for both systems are assumed to be identical.
4. 15 year life span of system assumed.
5. It is assumed that Hydro will be the sole user.

APPENDIX A.5


VHF Mobile Radio Replacemnt (Hydro Sole User)
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
CPW to 2004
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Trunked Radio System
Conventional Radio System

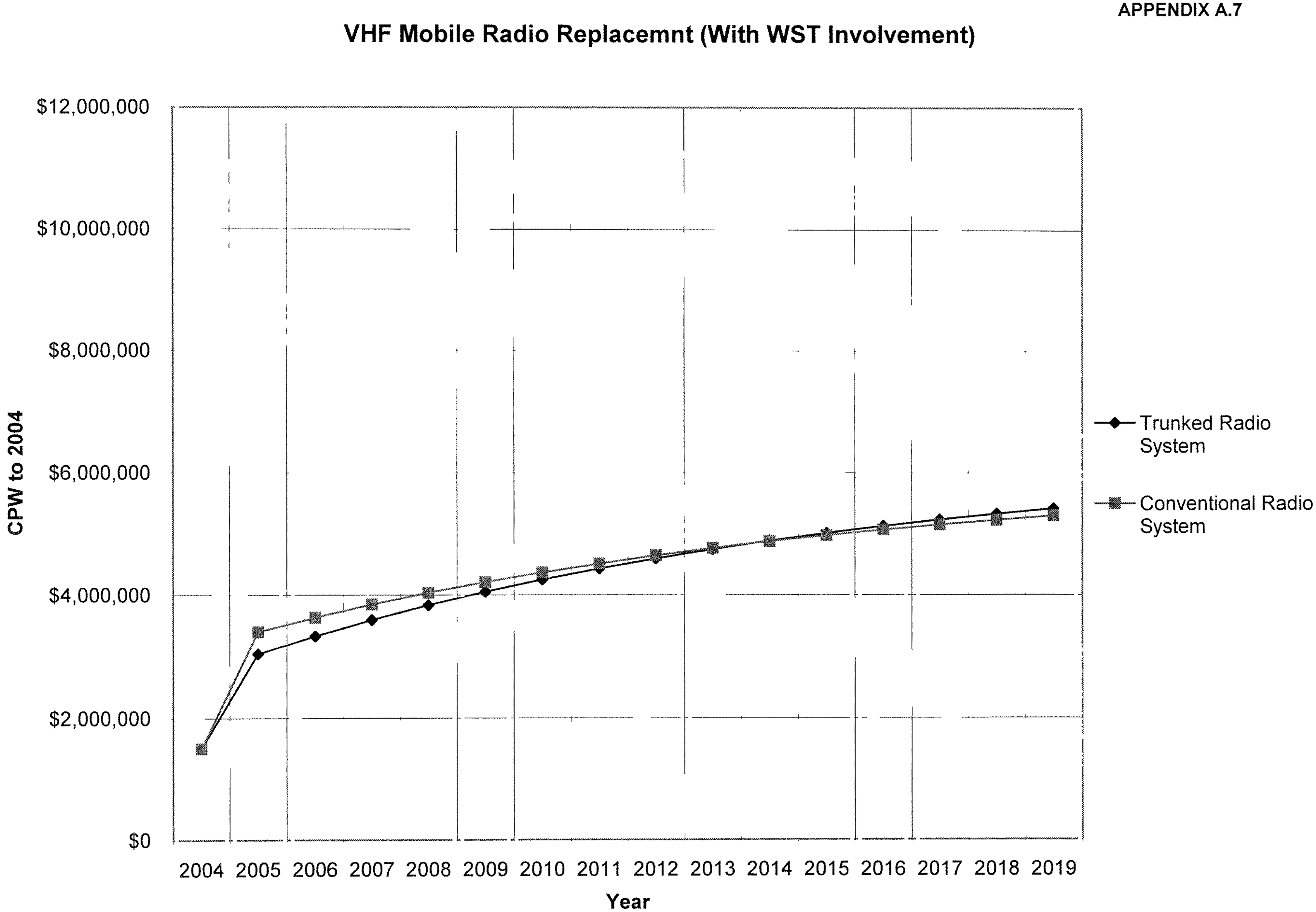
# VHF Mobile Radio Replacement (With WST Involvement)

Study Discount Rate: 9.60%

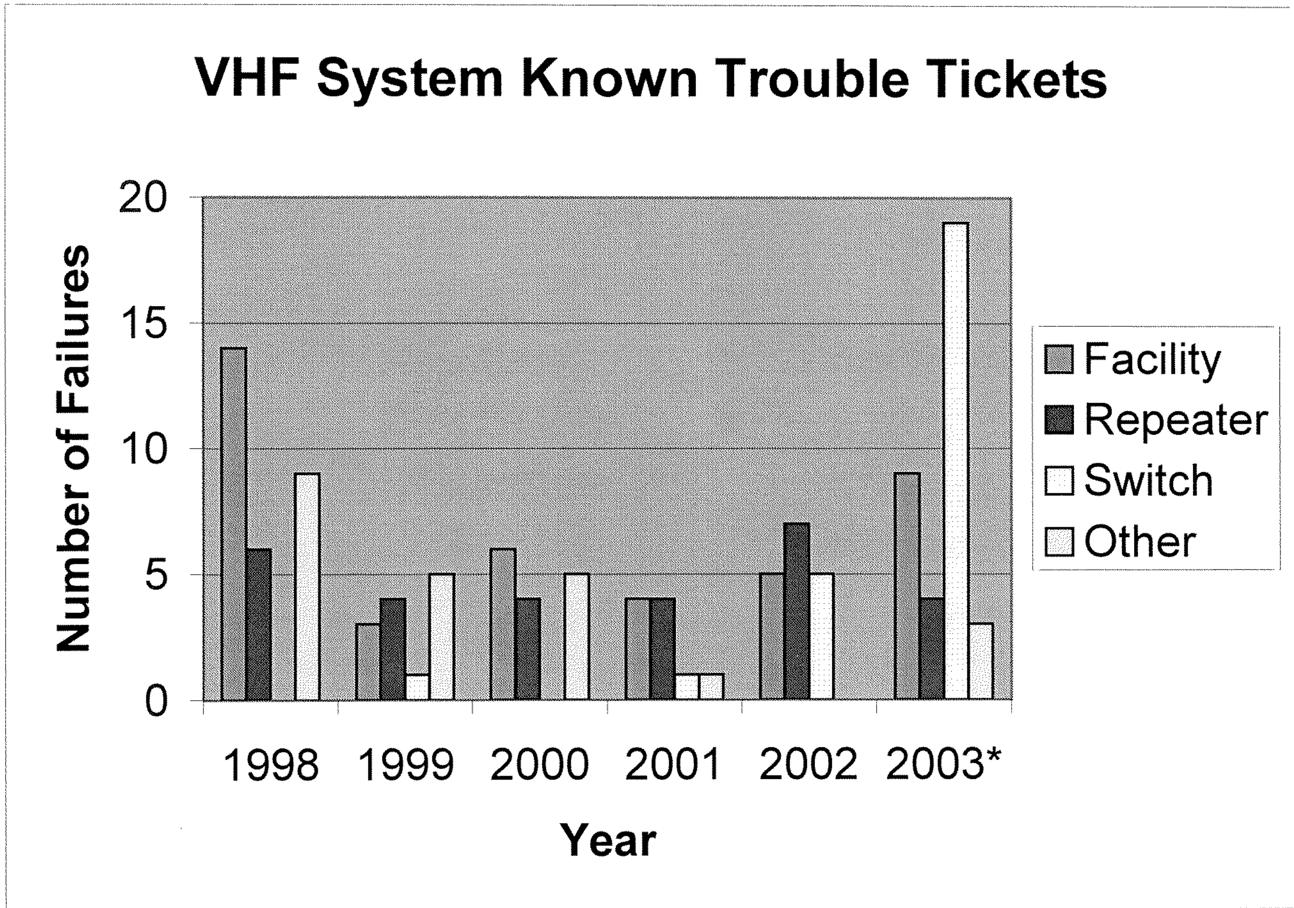
| | Trunked Radio System | | | | Conventional Radio System | | | | NPV Comparison (Alt. 2 - Alt. 1) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Capital Costs | O&M Costs | Total | CPW to 2004 | Capital Costs | O&M Costs | Total | CPW to 2004 | | CPW to 2004 |
| 2004 | 1,500,000 | | 1,500,000 | 1,500,000 | 1,500,000 | | 1,500,000 | 1,500,000 | $ | - |
| 2005 | 1,350,000 | 344,625 | 1,694,625 | 3,046,191 | 1,812,500 | 275,625 | 2,088,125 | 3,405,224 | $ | 359,033 |
| 2006 | | 344,625 | 344,625 | 3,333,087 | | 275,625 | 275,625 | 3,634,679 | $ | 301,591 |
| 2007 | | 344,625 | 344,625 | 3,594,855 | | 275,625 | 275,625 | 3,844,035 | $ | 249,181 |
| 2008 | | 344,625 | 344,625 | 3,833,693 | | 275,625 | 275,625 | 4,035,054 | $ | 201,361 |
| 2009 | | 344,625 | 344,625 | 4,051,612 | | 275,625 | 275,625 | 4,209,342 | $ | 157,730 |
| 2010 | | 344,625 | 344,625 | 4,250,442 | | 275,625 | 275,625 | 4,368,363 | $ | 117,920 |
| 2011 | | 344,625 | 344,625 | 4,431,857 | | 275,625 | 275,625 | 4,513,455 | $ | 81,598 |
| 2012 | | 344,625 | 344,625 | 4,597,382 | | 275,625 | 275,625 | 4,645,839 | $ | 48,457 |
| 2013 | | 344,625 | 344,625 | 4,748,408 | | 275,625 | 275,625 | 4,766,627 | $ | 18,219 |
| 2014 | | 344,625 | 344,625 | 4,886,205 | | 275,625 | 275,625 | 4,876,835 | $ | (9,371) |
| 2015 | | 344,625 | 344,625 | 5,011,933 | | 275,625 | 275,625 | 4,977,390 | $ | (34,543) |
| 2016 | | 344,625 | 344,625 | 5,126,648 | | 275,625 | 275,625 | 5,069,137 | $ | (57,511) |
| 2017 | | 344,625 | 344,625 | 5,231,315 | | 275,625 | 275,625 | 5,152,847 | $ | (78,468) |
| 2018 | | 344,625 | 344,625 | 5,326,814 | | 275,625 | 275,625 | 5,229,226 | $ | (97,588) |
| 2019 | | 344,625 | 344,625 | 5,413,948 | | 275,625 | 275,625 | 5,298,914 | $ | (115,034) |

Notes:
1. Trunked Radio System estimate based on figures used in Capital Job cost. Conventional Radio System estimate based on typical costs for a system of this nature.
2. Operations and Maintenance costs are assumed to be fixed for a 15 year contract with a third party supplier.
3. Maintenance costs for both systems are assumed to be identical.
4. 15 year life span of system assumed.
5. It is assumed that the Provincial Department of Works, Services, and Transportation (WST) contributes 50% of the costs of the system.

APPENDIX A.7


VHF Mobile Radio Replacemnt (With WST Involvement)
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
CPW to 2004
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Trunked Radio System
Conventional Radio System

* 2003 represents two months (January and February)



# APPENDIX B

| MOBILE RADIO SURVEY - DECEMBER 2001 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA | | BC Hydro | Atco Elec. | Trans Alta | Sask Power | Manitob a Hydro | Hydro One | Hydro Quebec | NB Power | NS Power | Nfld. Hydro |
| Private System | 1 | Yes | Yes | Yes | Leased | Yes | Yes | Yes | Yes | Yes | Yes |
| Technology | 2 | Conv. | LTR | LTR | TRK | Conv. | Conv. | TRK/Con | NR | Conv. | Conv. |
| Frequency | 3 | VHF/UHF | VHF | VHF | 800 | VHF | VHF | VHF/800 | VHF | VHF | VHF |
| Data | 4 | No | No | Yes | No | No | No | No | No | No | No |
| Cellular/Satellite | 5 | No | No | No | Yes (2) | Yes (2) | Yes (2) | No | Yes (2) | Yes (2) | Yes (2) |
| Consider Leased | 6 | Maybe | Note 1 | No | Yes | No | Yes | No | Yes | Yes | No |
| Evaluation | 7 | Yes | No | No | No | Yes | No | No | In progress | In progress | No |

**NR - No Response**

## Questions:

1. Do you presently own and maintain a private mobile radio system?
2. Is the system best described as:
   (a) Conventional (b) Trunked (c) LTR - Logical Trunked Radio (d) Other
3. Is the system:
   (a) VHF (b) UHF (c) 800 MHz (d) Other
4. Is the system used to carry data? If yes, please describe the applications.
5. Does your utility use Cellular or Satellite phones for mission critical functions such a power switching, system restoral, etc?
6. Would your utility consider the use of a leased solution as the prime mobile radio system for mission critical functions?
7. Has your utility prepared an evaluation of the use of lease system versus a private system for mobile communications?

## Notes:

1. Only if we (ATCO) had priority (last off, first on) and the service could be shown as reliable and economic as our own, and the right penalty clauses were in place.
2. All utilities using cellular or satellite phone do so to complement the coverage of the Mobile Radio System.

# APPENDIX C

**Technical Report**
**on the**
**Newfoundland & Labrador Hydro**
**Mobile & Radio Paging System Replacement**
**2001 February 26**

***The Reader is advised that pricing, included in this Report have been provided by suppliers on the understanding that information is treated as CONFIDENTIAL. Co-OPERATION of equipment suppliers, in providing accurate information, enables this Report to provide best estimate accuracies; it is, therefore, necessary for Readers to keep the pricing, contained herein, CONFIDENTIAL.***

*CONFIDENTIAL*

Prepared for: Newfoundland & Labrador Hydro
Information Systems & Telecommunications

Prepared by: Norman Cook, P.Eng.

Date: 2001 February 26

File:NLHMORPT.COVER

## TABLE of CONTENTS
## FINAL REPORT



## ATTACHMENTS

# 1 INTRODUCTION

The most important requirement of a mobile radio system is **Access. Access** is determined by two factors:

1. Geographical area coverage.
2. Adequate channel capacity to handle traffic.

This Report is prepared to summarize a study of the Newfoundland & Labrador Hydro ( "NLH") Radio System (the "System"), in accordance with the **Tasks and Responsibilites - Section 2**, below, and to recommend the best method, based on available technology, to meet the existing, and future, operational needs of NLH.

The Writer is aware that discussions have been held with NewTel Mobility, to determine if there are any plans to implement a Province-wide mobile radio system, as exists in the other 3 Atlantic Provinces. With the Newfoundland & Labrador RCMP implementation of their own hybrid trunked mobile radio system, and with the RNC as the joint user, it is unlikely that NewTel will have enough anchor tenants to justify the infrastructure costs of a Province-wide trunked mobile system infrastructure. In all other Atlantic Provinces, the RCMP comprises a significant portion of anchor tenants.

The following **Sections 2 and 3** discuss the Tasks, Responsibilities, and Methodology used in the Study. **Section 4, 5, and 6**, the pros, and cons, of the various frequency bands, radio coverage, and existing peak site traffic, **Section 7**, the current and future operational requirements of the System, including supplementary coverage requirements, and **in Section 8** the alternatives, and associated costs of upgrades, meeting NLH requirements, are reviewed.

With the alternatives identified, estimates for these alternatives are prepared, comparing these alternatives in **Section 9.** Finally, **Sections 10,11, & 12**, summarize the results of the Study, and provide recommendations for subsequent decisions, and implementation.

A **List of References - Attachment 3**, is used throughout this Report, and referred to as a listed item number shown in square "[ ]", brackets following the related text.

Prior to the preparation of this Report, NLH had met with the Writer and identified the following current assessment:

> The existing mobile switch, manufactured by ATI, was placed in service in 1989, and with only a few in operation, spares are very difficult, if not, impossible, to

obtain.

Of the existing mobile and portable radios in inventory, most are in excess of their anticipated service life of 8-10 years.

In addition to selection of new sites in areas of coverage shortfall, the following coverage areas require particular attention:

The Great Northern Peninsula including the adjacent Labrador Coastline.

Happy Valley - Goose Bay area, if feasible to integrate with the Island portion.

The current joint operation of NLH, and WST, works well since seasonal peaks of each Agencies' activity occur at different times which, effectively, reduces repeater traffic conflicts - refer to **Traffic Data - Attachment 4**. The Great Northern Peninsula, however, has occasionally become somewhat congested, with NLH & WST joint usage.

Where possible, the needs of the existing co-user, Works, Services, & Transportation (WST), shall be integrated with replacement, if feasible; however, the priority is for NLH year 2002 implementation, with, or without, joint users.

Mobile radio network issues to be reviewed are as follows:

Review radio paging requirements and recommend a solution(s).

Review/identify mobile data requirements, for issuing switching and field orders, direct to mobile data terminal, MDT, operators via the current NLH AS400 Network (MDTs, which are ruggedized notebook computers, with floor mounted pedestals). This Report identifies network integration with the assistance of NLH Information Systems and Telecommunications ("IS&T").

Automatic Vehicle Location (AVL), which uses Geostationary Positioning Satellites for time/date stamping vehicular location data, to be available to the IS&T network users.

NLH indicated that a mobile repeater, to cover areas which may be too remote for normal mobile repeaters to service, would be a valuable asset for remote construction, and repair, operations.

## 2. TASKS & RESPONSIBILITIES

### 2.1 General

The Scope of this Study is contained in this Section, and summarized, in the form of task responsibilities, as follows

### 2.2 NLH Responsibilities:

2.2.1 Compile Mobile traffic data from existing sites.

2.2.2 Identify existing NLH & third party sites used for existing coverage.

2.2.3 Identify existing sites which may be feasible for supplementary coverage to NLH owned sites, replacement for third party sites, or for areas where coverage does not exist. Sites shall be identified for access & hydro power status.

2.2.4 NLH shall arrange separate meetings with Works, Services, and transportation, and Newfoundland Power, to determine if there are advantages to share the new mobile network, especially with co-use of potential Newfoundland Power radio sites.

### 2.3 Writer Responsibilities:

2.3.1 Review availability of radio bands for a 10 year study life replacement NLH mobile radio system, including bandwidth availability in user equipment.

2.3.2 Review paging requirements and options, utilizing the mobile network if feasible.

2.3.3 Review NLH mobile data requirements, and GPS automatic vehicle location options for the NLH system.

2.3.4 Review NLH mobile radio system alternatives suitable for replacement of existing system.

2.3.5 Prepare cost estimates of alternatives in 2.3.4, and include site costs, in accordance with coverage requirements identified in 2.2, above.

2.3.6 Present recommendations for the replacement mobile network.

# 3 METHODOLOGY

## 3.0 General

3.0.1 A preliminary meeting with the IS&T team provided the terms of reference, as described in **Section 2 - Tasks and Responsibilities**, above.

3.0.2 The first task is to define NLH coverage requirements, with the initial requirements determined from NLH in-house coverage maps prepared several years ago. The maps were reviewed within NLH to obtain a comfort level for the computer generated accuracy of the maps, based on the field experience of knowledgeable radio users, thereby providing the Writer with a more accurate assessment of existing coverage. Hence, with a better appreciation of actual coverage, additional sites were specified, and cost estimates of alternative technologies were completed to determine the preferred mobile replacement technology, and for the estimated number of existing & supplementary sites determined.

3.0.3 The various radio bands were assessed, within the terms of reference of mobile voice, data, growth, coverage capability, and for new, and future, equipment availability, and service life. Meetings with Industry Canada's Spectrum Management Section were held to assess which band is preferred, based on year 2000 NLH traffic measurements, and projected requirements.

3.0.4 Traffic data was reviewed to determine the number of repeaters which are needed at each site to serve the traffic activity of various mobile zones of operation. The quantity of repeaters are significant in the overall costs of alternative mobile technologies, since different technologies utilize different site equipment configurations.

3.0.5 Mobile data rate was determined based on the identified applications to be implemented over the 10 year study life. Data rate is an important consideration since each alternative mobile technology offers different data rate capability. A review of existing voice/data mobile networks was completed to determine if data was typically operated as a separate radio system, or could operate, in harmony with mobile voice.

3.0.6 An assessment of available, and NLH preferred paging technology, was then completed to define the preferred solution.

# 4 INDUSTRY CANADA FREQUENCY BANDS & POLICY

## 4.1 General

There are 3 frequency bands allocated by Industry Canada, for mobile radio use, including trunked radio systems, as follows:

1. VHF 150 MHZ - Existing System
2. UHF 450 MHZ
3. UHF 850 MHZ

**Table A**, below, lists a summary of advantages, and disadvantages, of the frequency bands', 150, 450, & 850 MHz parameters.

**Table A.**

| **Freq. Band** | **Coverage** | **Radio Cost** | **Dispatch** | **Expansion** | **Software** | **Replacement** |
|---|---|---|---|---|---|---|
| 150 conv. | Best area & range from repeater | Not expensive | Not expensive | Urban channels unavailable | Minimum need, if any | Multi supplier availability |
| 450 conv. | Less area/range than VHF | Approx VHF +10% | Same as VHF | Urban channels available | Same as VHF | Same as VHF. TETRA radios are in this band. |
| LTR 150 or 450 | *Same as above* | Not expensive | *Same as above.* | *Same as above.* | Dispatch, mobiles, and repeaters | Multi supplier availability. |
| 850 trunk | Same line of site mobile coverage as 450 but improved portable coverage in malls, & metal clad buildings with small windows | Expensive | Expensive | Additional channel availability virtually unlimited | Regular upgrades required | Current sole source supplier, except for LTR which has multi source radio availability |

## 4.2 Industry Canada Policy

In a January 2001 meeting with Industry Canada, the mobile replacement plan was discussed to determine any licensing policy issues which might affect selection of the preferred band, radio bandwidth, or policies relating to joint use of, not only the mobile radio network, but the microwave backhaul facility, since microwave is an integral part of mobile radio services. Industry Canada was requested to respond advising of any issues to be considered, for NLH joint use expansion plans.

Another important consideration for continued use of the 150 MHZ band, in the Avalon area, near St. John's, is that future growth in VHF channel capacity may not be possible, due to the saturation of this band's use. Growth of channels in the greater St. John's area is critical to the decision to operate in VHF mode, even though the benefit of VHF band Province-wide operation is significant due to provisioning of 30 % more sites in the 450 MHz & 850 MHz bands (the 450 MHz and 850 MHz bands exhibit essentially the same coverage area) - refer to **Attachment 1 - Radio Coverage comparison**.

Another issue, discussed with Industry Canada, for retention of the VHF band is the progress of narrow band equipment from 25 kHZ to 12.5 kHz, and further reduction to 7.5 Khz; however, mobile data rates for the narrow band radios would be reduced as well, for a given modulation scheme. Selection of minimum mobile data rate within NLH for the next 10 years is, therefore, critical.

# 5 RADIO COVERAGE

## 5.1 General

Discussion, in this Section, applies whether the radio is conventional, or trunked, except that, as a rule of thumb, trunked radios operating in the digital mode, exhibits reduced coverage from that of trunked systems operating in analogue mode. Initial discussions indicate that NLH does not require voice privacy, which avoids problems of varying coverage (from 0.5 to 5km range) when a radio is switched from analogue to digital.

The existing 150 MHZ band is the best for radio coverage exhibiting about a 30% increase in coverage area compared with 450 MHz & 850 MHz, and requiring less sites to cover a specific area - refer to **Attachment 1 - Radio Coverage Comparison**.

The 850 MHZ band has only about 1/3 the simplex range of a 150 MHz, or 450 MHz radios in dense forested areas, primarily die to clutter loss, and licensed output power, of this band. The 850 MHZ band exhibits superior portable repeater reception (talkout) performance because of an empirically observed lower body loss, and also exhibits better penetration into buildings which are of metal construction having small windows, which are common characteristics of warehouses, and places such as malls which have several embedded corridors, and storage areas. Whichever band is chosen for urban use, rf amplifiers are generally used to improve coverage in urban structures, such as malls.

The ability of a trunked radio to switch sites ('handoff automatically') to adjacent base/repeater provides a 'virtual' better coverage to an inexperienced, or infrequent, radio user, who is not familiar with the geographical channel switching points for adjacent sites.

It is important for the reader to be aware that no frequency band provides 100% radio coverage, rather, systems are generally designed for 90% area coverage, for 90% of the time, and 90% of location (both time & location being randomly selected) **[2]**. The objectives for public safety are 95% of time and location, however these objectives are seldom met in the Atlantic Provinces due to availability of infrastructure funding to achieve 95% area coverage.

## 5.2 Coverage Criteria

### 5.2.1 Paging

5.2.1.1 Digital (Alpha-numeric) Paging

The technical criteria for alpha-numeric paging coverage, is the range at which the Bit Error Rate (BER) does not exceed a specified value. For example, the MTT pager, Motorola Advisor Gold requires field strength of 5uV/m (512bps) to 10uV/m (2400bps); the PerComm Model PA8002, requires an analogue field strength level of 5 uV/m (512 bps), to 7 uV/m (1200 bps). Hence, for maximum range, the data rate should be reduced. Body loss is a significant factor for 150 MHz & 450 MHz band paging.

5.2.1.2 Analogue (Tone & Voice) Paging

Same criteria as analogue mobile, see 5.2.2, below.

### 5.2.2 Analogue Mobile Criteria

In public safety mobile radio systems, the acceptable coverage range, or boundary, is defined [2], where voice quality is subjectively described as follows:

***"Speech understandable with repetition only rarely required. Some Noise/Distortion"*** This is technically referred to as Delivered Audio Quality (DAQ) of 3.4, which is a figure of merit used in the industry.

In practice, the above is too costly to achieve, and the following subjective description criteria is accepted as suitable:

*"Speech is understandable with slight effort. Occasional repetition required due to Noise/Distortion"* This is technically referred to as DAQ of 3.

#### 5.2.3 Path Variations

Because of the larger mobile antenna, and greater mobile transmit power; the repeater talk-out signal exhibits greater range of transmission than the mobile transmitter talk-back range to the repeater. The excess repeater talk-out power (125w ERP max allowed for 150 MHz) is required to activate reception of the belt mounted portable which experiences an additional 17 dB of (body) attenuation for VHF radio frequencies, and less body attenuation as the frequency band increases; once the portable is raised to head level for talk-back response to the repeater, the body loss attenuation reduces to a lessor level (head attenuation) hence increasing the talk-back range of the portable. This demonstrates the elusive user concept of coverage.

### 5.3 Radio Design Criteria

As in the Introduction, **Access** is the single most important objective, regardless of which features are added.

Radio coverage is usually reviewed by a well established computer prediction model, which has proven industry accuracy in the telecommunications industry for about 20 years. The computer prediction model provides for radio coverage changes based on seasonal weather activity, and facilitates plotting of coverage areas on standard topographic, or other scaled, maps. The prediction model is suitable for remote wide area predictions, unfortunately there is no model available for predicting coverage inside complex structures in an urban area, or areas such as inside the Holyrood Thermal Generating Plant, since steel and concrete structures play havoc with computer modeling variables. Urban coverage must be dealt with on a case by case basis, and after the basic system is installed.

This Report is permitted neither the time, nor the scope, to prepare coverage predictions of existing, or alternate sites. Data previously completed within NLH is used, and supplemented with best guesstimates, in order to provide the basic system configuration, required to prepare estimates for the quantity of sites estimated.

The channel capacity of a radio system is critical when a local 'incident specific' situation which is serviced by a single site, becomes heavily accessed by radios, for example, the situation on the Great Northern Peninsula, where there are times when NLH as well as WST are trying to access the limited repeater resource, will be addressed in this Report's configuration, and cost estimates. This could also occur if a large construction project is being completed adjacent to a site used for daily operational radio traffic.

The amount of voice traffic anticipated under the specific incident will determine whether a single radio voice channel, or multiple channels are required at a remote site. The existing system, for the most part, has operated successfully, in the past while being shared with the Dept. Of Works, Services, & Transportation. Any expansion to other users will inevitably, if not initially, require additional repeaters at high traffic sites, therefore necessitating the provisioning of a suitable sized switch to handle additional repeaters. For purposes of this Draft report, the new microwave system is anticipated adequate to handle the backhaul capacity of future growth.

Secondary, other operationally important issues are also addressed as part of technology review, include the following:

1. Ease of radio use - physical, and technical.
2. Durability of radios for work environment (i.e. US MIL Spec. Standards).
3. Initial, and ongoing equipment costs.
4. System user training needs.
5. System maintenance service provider minimum requirements.
6. Planned obsolescence of selected technology through support.

### 5.4 Simplex (talkaround) Operation in the 850 MHz Band

The latest Motorola Mobile Trunking System is called **SmartZone$^{SM}$** (SZ) in this System the trunking control channel cannot be used for voice - initially, all remote sites, in **SZ** will provide a minimum of 1 control, and 2 voice channels. If simplex channel mode is provided for to reduce traffic on a repeater, and keeping in mind that an 800 MHZ simplex radio, has only about 1/3 the line of site range as VHF, **making the 850 MHz equipment undesirable for local site communications beyond an approximate distance of 2 km (less in highly treed areas).**

# 6 EXISTING RADIO SYSTEM & ALTERNATIVES

## 6.1 Paging System Description

6.1.1 NLH utilizes an analogue tone & voice system having transmitters independent from the mobile system.

6.1.2 Two types of paging systems are available, as follows:

6.1.2.1 Tone & Voice analogue paging (same as NLH existing).

Tone & Voice pagers are becoming obsolete; however, they have the advantage of encoders which use mobile repeaters, as paging transmitters. Many T & V users find that they can use the pager as monitors for the repeaters transmitted mobile voice signal as well. Some agencies do not condone this use of pagers as a simple form of 'scanner', i.e. as in the volunteer organizations. NLH's existing paging system is independent of the mobile system, thereby having a backup communications system, albeit one-way.

6.1.3.2 Alpha-numeric digital paging.

Alpha-numeric paging requires 'digital ready' transmitters, or transmitters which have either FSK or have a true FM modulator (response down to DC), and with minimum rise time of 250 us for reliable POCSAG code operation. There are adapter kits which claim to adapt analogue transmitters for digital paging, however this is not recommended unless more investigation to assess known operating systems using this approach.

Digital (alpha-numeric) pagers are approximately 1/3 the cost of T & V pagers.

## 6.2 Paging System Selection

6.2.1 Selection of a paging transmitter to carry alphanumeric format paging is more critical than for analogue tone & voice due to the requirement for fast transmitter rise times (i.e. wider bandwidth) for the digital signals.

6.2.2 The Writer is aware of one manufacturer, **Multitone**, who provides a multi- format paging system which can be configured for most paging formats required.
Outputs of this particular model can be zoned with different paging formats based on groups of transmitters, or coverage areas.

6.2.3 Highlight Comparisons of Paging Systems, are summarized in **Table B,** following:

**Table B**

| Feature | Encoder | | Transmitter, Unit $ | | Pager, Qty $ | |
|---|---|---|---|---|---|---|
| Pager Type | T & V | Alpha-Numeric | T & V | Alpha-N | T & V | Alpha-N |
| Message | Tone Sequence Voice | Digital | Standard | Digital Ready | Audio | Display 1 - 4 Lines |
| Message Storage | NA | NA | NA | NA | Some | Many |
| Time/Date Stamp | NA | NA | NA | NA | No | Yes |
| Cost | Attach 5 | Attach 5 | $ 5,000 | $ 40,000 | $ 450 | $ 150 |
| Package Media | Desktop, EIA Rack | Desktop, EIA Rack | Stand alone, EIA | Stand alone, EIA | Audio | Small Characters |
| Size | NA | NA | NA | NA | Med. | Small |

## 6.3 Mobile Radio

6.3.1 Review of the existing NLH Multi Department Mobile Radio System Description [1], indicates that it is trunking system, with the exception that a single repeater is employed at each site. Although this defeats the concept of trunking, the system has the necessary features to operate with a central switch (the Gander ATI Switch), and to perform the necessary telephone interface functions which are available on all the trunked systems being considered as alternatives.

The alternative trunked radio networks to be compared, and considered for replacement, are briefly, as follows.

6.3.2 The TETRA digital trunked radio network, an open standard, multi mobile supplier European Digital System. Beginning introduction in Canada, with the nearest supplier in Halifax, NS.

6.3.3 The ComNet Ericsson's EDACS analogue/digital trunked radio proprietary network. Province-wide systems exist in Canada, and having locally supported equipment.

6.3.4 The Motorola SmartZone analogue/digital trunked radio proprietary network. Province-wide systems exist in Canada, and having locally supported equipment.

6.3.5 The E.F. Johnson LTR radio system is also an open system for which several vendors can supply radio equipment. Several systems exist in North America, having local service support. In Newfoundland & Labrador, a supplier, or NLH, would require technical training on the LTR Network.

## 6.4 Current User Equipment Quantities

### 6.4.1 General

Existing radio system assessment is provided in **Attachment 2 - Radio Equipment List**, to complete user equipment quantities in order to select the suitable model radio/pager, and to assign appropriate cost estimates, which are model dependent. For example, an model equipped with a data port, and automatic vehicle location features will be more costly than a basic model which is best for many user tasks.

### 6.4.2 Pagers

Existing pagers are analogue T&V type, with an independent infrastructure, which includes dedicated transmitters. Quantities are shown with mobile equipment quantities in **Attachment 2 - Radio Distribution List**.

### 6.4.3 Mobile

The **Attachment 4 - Radio Distribution List**, is supplied from current records, and is the starting point for radio equipment replacement estimates

The generally accepted mobile telecommunications equipment service lives are considered as follows, and provided that manufacturer continues product support:

| | | |
|---|---|---|
| Fixed Equipment | 12-15 years | |
| Mobile Radios | 10 years | |
| Portable Radios | 8 years | (batteries 2-4 years for 8 hr. shifts 5-5-90 duty cycle) |

The above equipment lives apply to conventional radio equipment; in the final economic analysis it may be necessary to reduce the lives of programmable equipment, such as trunked radios, because of the rapid changes technology undergoes. User equipment service life is critical to economic analysis since replacement capital injection may be required sooner, or more frequent, in the economic model, compared with conventional equipment replacement. Care must be taken in planning for trunked radio service lives with the rapid change in technology. Trunked systems require mandatory software upgrades, in most cases, are required to keep manufacturer warranties effective. The best protection to avoid obsolescence during our 10 year service life is to define, and to specify, in detail, the manufacturer/supplier conditions up front, in the Specifications/Contracts.

# 7 EXISTING AND FUTURE OPERATIONAL REQUIREMENTS

This Section discusses existing, and future, operational requirements of NLH.

**Since radio access, which includes coverage and voice channel loading, is the most important requirement of any radio system, these requirements are discussed, in this Section, before the other issues.**

## 7.1 Existing Requirements

### 7.1.1 Radio coverage.

7.1.1.1 Existing coverage requirements do not meet the area encompassed by NLH [9], and in malls where VHF coverage has been a problem. Since paging is the limiting factor in achieving good wireless coverage (due to the lack of good antenna and hip location on the body, resulting in reduced effective receiver sensitivity); if paging coverage is met by selection of a specific site, then portable coverage should be adequate. Review of NLH paging coverage identifies sites adequate for NLH's mobile/portable radio coverage.

### 7.1.2 Radio Access

7.1.2.1 Existing traffic data, and NLH feedback indicates that previous repeater access problems with W,S, & T have been resolved, with the exception of the Great Northern Peninsula, GNP, where some improvements could be made to augment the needs on the GNP.

The Labrador south shore shall be included as an area to augment coverage on the GNP.

## 7.2 Future Requirements

### 7.2.0 Site Traffic Capacity

A review of the existing traffic on peak usage sites is found in **Attachment 4-Traffic Data**. Results show the complimentary seasonal site activity of NLH and

W,S, & T radio usage. Unless other user(s) are considered for joint system usage, there should not be a need for expansion of repeaters other than site additions required for radio coverage. A few sites could improve call queue time for access improvement, fortunately, Kenmount Hill traffic peaks at only 50% of the traffic of some of the network's busier sites; this is critical since Kenmount would be the most difficult site to obtain approval for an additional VHF frequency pair license.

### 7.2.1 Physical Size of User Equipment

Recent technology has reduced physical size, and weight of pagers and portable radios; it will be necessary, prior to going to Tender, for Department operations personnel to have a 'hands on' exposure to various models to determine if the smaller physical radio sizes do not cause a problem for the radio user, especially while using heavy gloves, or having other apparel, required by the radio user tasks. Some recent field trials have reported difficulty of some pager users to read the small 4 line text displays.

### 7.2.2 Mobile Data

Physically, an RS232 port is found on LTR, EDACS, and TETRA, mobile radio, with TETRA having an equivalent port on its portable radios. The port is duplicated at the dispatch end, or some suitable terminating PC on the Mobile data networks, require a processor which operates independently of the voice trunked switch, and somewhat like a router (Data Controller) - refer to **Attachment 12 - Dedicated Data System Block Diagram**. The Data Controller is an option on TETRA, and EDACS, which assigns an IP address to each mobile. The Data Controller would provide the necessary interface with the NLH AS400 Network. EDACS currently offers the data 'router' in only TCP/IP protocol.

The future major application of mobile data is anticipated to be email access, with field orders being attached as in normal email applications. It is anticipated that this application would find that the mobile user requiring higher speed data rates approaching those available to home computers, these data rates are only becoming available on such European Trunked Radio Networks such as TETRA, which is beginning to appear in North America now (data rates typically 28.8 kbps = 19.2 kbps throughput) approx 30 % throughput reduction results from the integrity of forward error correction code - FEC, and protocol bits ). The Writer feels that 2 kbps throughput is sufficient for brief text based email services, as for filling of form masks in MDTs (provided, of course, that the system is not misused, as experienced initially for voice communications, when operators were not made aware of the limited time resource available for unnecessary wireless voice communication!). Mobile data connection, limited to the NLH AS400 Server, would limit use to work related text activity. NLH may want to limit mobile data to Corporate use only, and not extend use to W,S, & T, unless the feature was proven to reduce access time resources.

For operational requirements, such as issuance of field orders, the data transfer can be greatly reduced by having any common form resident on the MDT, and just transmitting the data required to 'fill in the blanks', requiring mobile software data development.

If transmission of graphics is required, it will be necessary to select the higher speed mobile data systems initially, to avoid future 'growing pains' and associated expenses.

Some public safety first responder agencies use a redundant mobile data on the Cellular Digital Packet Data (CDPD) network for redundancy. CDPD operates at a 19.2 kbps (throughput approx 12 kbps) and is currently found to be an expensive service.

### 7.2.3 GPS Automatic Vehicle Location (AVL)

Geostationary Positioning Satellite data is an application of low speed mobile data, requiring a GPS receiver added to the radio data port. This option is available from radio suppliers, or may be third party units. One supplier adds the option for about $1000 for each mobile. GPS data is usually superimposed on applications software, such as topographic, and municipal maps, on a desktop PC, for Computer Aided Dispatch operations.

### 7.2.4 Portable Repeater

The EDACS alternative suppliers a mobile repeater option. In addition, third party mobile repeaters are currently being developed for trunking systems requiring trunked system access to conventional systems. RF repeaters are also used to improve coverage in urban areas such as malls.

# 8 RADIO SYSTEM ALTERNATIVES

## 8.1 Paging

The older Tone and Voice (T&V) Pager is becoming replaced with Alpha-numeric digital pagers. An advantage of T&V pagers is that they can use any existing mobile transmitter and can be used to monitor voice on the repeater talkout channel, however the T&V pager is expensive ( $450.00/ea. In large quantities compared with $150/ea. for alpha-numeric pagers ).

A disadvantage users find with Alpha-numeric pagers is the size of the display, some pagers offer a zoom feature to overcome this problem.

This Report focuses on the application of the alpha numeric pager since they have features that include the following:

8.1.1 Avoids the problem of missed voice syllables, or need to repeat voice messages.

8.1.2 Information remains in the pager until cleared by the user, avoiding missed messages, or enabling recall of messages.

8.1.3 Permits use of vibrating alert, avoiding the need for user to turn it off under certain private meetings, or appointments, for etiquette reasons.

8.1.4 Features Time/date stamping of incoming information.

8.1.5 Memory backup prevents loss of messages if battery fails.

8.1.6 Backlit displays for reading recalled messages at night.

8.1.7 Messages can contain more instructions due to memory capacity of pager; messages can also be stacked until cleared by user.

Paging allows maximum user access for the dollar spent. A disadvantage with one-way paging is that the dispatcher does not have confirmation that the page had been received. Paging coverage is less than portable coverage due to the body loss observed with the pager's reduced receive signal, and typical belt mount location on the body.

## 8.2 Mobile Radio

This Section briefly describes the configuration of the following 4 alternatives:

.1 TETRA - European Digital Trunked Open Standard Radio System.

.2 Motorola SmartZone$^{SM}$ Trunked Radio System.

.2 ComNet Ericsson EDACS$^{SM}$ Trunked Radio System.

.3 LTR$^{SM}$ Trunked Radio System.

Estimates are prepared, and economically compared in the next **Section 9 - Cost Estimates of Alternatives & Assumptions.**

LTR$^{SM}$ is an open system trunking standard, originally introduced by Transcrypt (formerly E.F. Johnson). Many radio suppliers make compatible user equipment.

The remainder of this Report will analyze the latter factors towards recommending the diligent choice of technology for NLH.

The above alternative radio system configurations, available to meet the radio requirements of NLH, are now discussed in more detail.

## 8.3 Generic Trunked Mobile Radio System

### 8.3.1 General

During Report preparation of the **Attachments 6 through 10**, which are Block Diagrams of the Existing, and Trunked Mobile Radio System (TMRS) Alternatives being considered as replacements can be represented by a generic trunked radio network since they function similarly.

The existing NLH mobile radio system is a TMRS, except that there is only one repeater at each site, thereby not meeting the basic requirement for a TMRS. All TMRSs have the capability to interface with either a Private Branch Exchange

(PBX), or the existing Public Switched Telephone Network (PSTN). The ATI switch, is simply the 'Redundant Switch, or Controller" shown in all the alternative Trunked Mobile Radio (TMR) Networks. Features contained in the existing TMRS allow interconnection with a PBX, or the PSTN.

Its interesting to note that the existing TMRS is also data capable, except that the MDMRS Console Workstation Operator (CWS) must set up the mode manually, unlike the new replacement alternatives discussed in this Report.

All trunked radio systems can be hybridized with conventional radio systems. A proprietary system, such as Motorola SmartNet$^{SM}$, SmartZone$^{SM}$, or ComNet Ericsson EDACS, and TETRA interfaces with conventional through a console patch; the conventional channel is represented by an icon on the console PC display, and is simply 'affiliated', by dispatch operator software, with the trunked system talkgroup which is also a display icon. A more sophisticated, and expensive, infrastructure, is required for proprietary trunked systems.

The Hybrid Conventional/Trunked Mobile Radio System provides for an easy transition to Logic Trunked Radio ( LTR), which is an economical trunked radio system. LTR has the necessary features, and multi supplier sources, to enable competitive tendering of equipment throughout the service life (Section 6, above). The LTR also has low speed data port with selected mobile radio models. LTR & EDACS trunked systems utilizes a control channel which can also be used for voice communications.

Configuring the conventional system to an LTR radio system requires simply the addition of a controller at the repeater site, acquisition of the necessary number of repeaters for voice/data traffic expansion needs, acquisition of LTR compatible mobiles and portables, acquisition of a compatible LTR dispatch computer software, and programming of the system to function as a trunked radio system, complete with talkgroups.

There are 2 major trunked radio systems currently operating in Canada, and the United States, as follows:

.1 Motorola SmartNet$^{SM}$/SmartZone$^{SM}$ System
- used in Nova Scotia Province-wide by NLH & the Province, NLH, respectively; also Manitoba.

.2 ComNet Ericsson EDACS System

- used in British Columbia, Saskatchewan, Ottawa-Carlton, Newfoundland Province-wide by RCMP & RNC

Both systems above are proprietary, the ComNet Ericsson utilizes their radios only. Motorola SmartZone$^{SM}$ Radios can be second sourced, but user capability may be limited unless negotiated prior to final contract signing, and may be non-negotiable if the user want to add specific features, including software upgrades, later in the radio service Contract.

The decision for selection of the desired configuration is based on the relative operational features, and cost of acquisition and maintenance. Both Motorola SmartZone$^{SM}$, and ComNet Ericsson EDACS$^{SM}$ utilize expensive central trunking switches, both systems have features generic to trunked radio systems. Both systems utilize a control channel at each site. The Motorola control channel is dedicated for site control, a minimum of 2 additional voice channels are usually provided at each site; EDACS$^{SM}$ can utilize the control channel as a voice channel. The EDACS$^{SM}$ dual use of the control channel permits remote, low usage sites, to be trunking configured, with features such as roaming, while only requiring a single channel.

Because of the high cost of a central switch for each proprietary trunked radio system, application of these systems is usually confined to province, or city, -wide usage with more than one user group sharing the cost of the infrastructure.

There are 2 major European trunked radio systems beginning to make inroads to the North American market, but introduction is slow, and support is sparsely located across North America. These systems are known as MPT 1327 (a mature analogue system of about 12 years), and TETRA ( a major digital trunking system, plans for penetration in Canada/US end 2001); both of these European systems are open architecture configured with closely monitored evolution by an independent agency, resulting in multi suppliers, hence, more competition, and less cost of user equipment.

The MPT 1327 has not been considered in this Report, primarily due to the lack of support services in Atlantic Canada.

# 9 Cost Estimates of Alternatives & Assumptions

## 9.1 Radio Paging

This Section lists the configuration, and associated costs - refer to **Attachment 5 - Cost Estimates**, showing the paging alternatives considered, as follows:

9.1.1 Tone & Voice Paging - refer to **Attachment 11.**

9.1.2 Alpha Numeric (POCSAG) Paging - refer to **Attachment 11**.

During the writing of this Report a dual function paging system, developed in the UK and currently used in Canada, was reviewed. The advantage of this Multitone Access 3000 system is that it offers T & V, as well as alphanumeric paging utilizing standard transmitters in a proprietary format. The encoder can also provide standard T & V paging, as well as the standard POCSAG alphanumeric paging. This dual function paging system is included for the paging cost estimates in Attachment 5.

## 9.2 Mobile Radio

This Section lists the configuration, and associated costs - refer to **Attachment 5** showing trunked mobile radio alternatives considered, as follows:

9.2.1 TETRA$^{SM}$ Digital Trunked System - refer to **Attachment** 7.

9.2.2 Logic Trunked Radio LTR$^{SM}$ - refer to **Attachment 8.**

9.2.3 Motorola SmartZone$^{SM}$ Trunked Radio System - refer to **Attachment 9.**

9.2.1 ComNet Ericsson EDACS$^{SM}$ - refer to **Attachment 10.**

### 9.3 Assumptions

9.3.1 The following assumptions are used in the completion of cost estimates for the above alternatives:

9.3.1.1 Terrestrial links (backhaul) shall be considered as having adequate capacity at NLH owned sites. Where NLH must use third party sites, either rented lines, or radio links shall be provided by NLH to the nearest interface point to NLH's microwave network, including the new Eastern portion. Costs for all backhaul facilities are not included in this Report.

9.3.1.2 The system design shall provide for alarm circuits to each radio site to report any major, and minor alarms to a 7/24 monitored alarm center. The existing NLH 7/24 center would be the logical location for having all mobile radio network alarms to appear. In general, trunking systems have ports available for network alarms, which may be in standard SNMP protocol format, or operating on standard MicroSoft Windows NT; alternately the local microwave alarm system can be utilized for available mobile equipment major & minor alarms. Central alarm equipment is considered NLH supplied.

9.3.1.3 Existing & new NLH primary radio sites, required for necessary mobile coverage, and third party supplementary coverage sites, can facilitate the following mobile radio infrastructure requirements:

- Adequate floor space for mobile/paging equipment, and associated equipment, such as space for equipment links to third party adjacent sites.
- Adequate power from the primary power source, and necessary backup time in supplementary power sources.
- Towers sufficient to meet CSA S37 tower loading requirements, and provisioning to ensure that third party towers are capable of meeting the same requirements.
- Provisioning for the necessary site access of NLH, and third party sites, to meet the standby power requirements

for extended prime power outages.

– Coverage areas, on which the number of repeater sites are determined for cost estimates is based on maps which are not fully confirmed in the field. These maps are assumed for estimate preparation for this Study.

– The middle cost radio model (tier) is used in estimate preparation. Features of trunking radios are very dependent upon the model used, with significant pricing variations.

9.3.1.4 It is unlikely that the future addition of Labrador sites will require an addition to the central mobile switch, since Labrador requires special mountain top repeater configurations which are design to work with the low availability of power available at these sites.

Labrador mobile solutions require a separate design philosophy than the Island portion found in **Attachment 5 - Cost Estimates**.

## 10 Conclusions

### Paging

#### 10.1 General

This Section discusses the most cost effective alternative for **paging**, and with consideration to the relative merits, and demerits, of the features.

10.1.1 NLH must determine the user/operations preferred method of paging; this can be achieved with a local evaluation field trial on an existing digital paging network, and using a 4 line digital pager, preferably with a display zoom feature. The zoom feature is required for many users who have difficulty reading small font messages, on the typical small pager packaging size.

10.1.2 The costs of alphanumeric pagers are 1/3 that of T&V pagers, and many features are desirable operationally, such as time/date message stamping (POCSAG standard). The down side is that digital paging transmitters are more expensive, including a requirement for more antenna filtering at sites shared with other analogue radios (i.e. mobile). **Attachment 5, Sheet 2.** Use of a third party Province-wide paging network, and digital pagers is the most cost effective way to proceed.

10.1.3 It is apparent that the cost of existing, or new, infrastructure required to operate the relatively small number of paging receivers (Qty = 47), used within NLH, is not justified. It would be more beneficial to provision an additional mobile radio transmitter for each site, replacing the paging transmitter, and providing a portable radio in place of pagers for each existing paging system user. The latter configuration provides the site equipment redundancy presently achieved by the existing separate paging transmitter existing at each site now.

**Mobile**

10.2 General

10.2.1 **Detailed Cost Estimates - Attachment 5,** were prepared for each of the 4 available trunked radio systems.

10.2.1 Tendering generally drops the costs used for preparing estimates; a reduction of 25 % can be expected in the normal tendering process; however there are unknown factors, arising from assumptions which dictate leaving the estimates as they are for alternative selection purposes.

10.2.3 Forthcoming negotiations, following a Memorandum of Understanding that the Dept. Of Works, Services, & Transportation (W,S, &T) plan to continue with a modified joint use arrangement with NLH, with some coverage expansion, means that the VHF band is preferred, unless significant future traffic increases are identified. W,S, & T has indicated that they may add an approximately 100, currently simplex, radios to the NLH network. NLH must review the areas in which these additional radios are located, to assess the repeater traffic loading impact.

10.2.4 Further to 10.2.3 above, if future join users are considered by NLH, especially in core, or high radio traffic areas, any new service equipment may be isolated from NLH by placement on any frequency band; while this option does not grow the core NLH/WST Network in an optimized trunking manner, it does provide for NLH revenue, utilizing the infrastructure, since the infrastructure is frequency independent, with the exception of requiring the repeaters to be the band of the user equipment (i.e. mobiles, portables).

10.2.5 Implementation with the LTR open system trunked radio system, will permit reuse of existing transmitters, utilizing the Zetron Model 452/459 repeater controller. This will provide for the most cost effective solution, while maintaining a solution which is supported by a multi-supplier user equipment source of radios which operate in both the narrow band 12.5 kHz, and existing band 25 kHz VHF frequencies. Repeaters which meet the new narrow band requirements can be installed, and integrated operationally, with existing repeaters using the Zetron Models 452/459 controllers. For the busier sites, found in ATTACHMENT 4 - Traffic Summary 2000, a second channel LTR can be added, enabling dual channel & dual mode conventional radios, and LTR radios to share site repeater facilities.

# 11 Recommendations

## 11.1 General - Paging

This Section recommends the rollout of the paging network with consideration to the fact that mobile upgrade/replacement will be implemented simultaneously.

The following recommendations are offered for consideration by NLH IS&T:

11.1.1 The infrastructure required to support the 47 existing pagers is not justified. Third party Province-wide PSTN dial-up paging systems should be utilized where coverage permits. Where third party coverage does not meet NLH operations, the current NLH pager user should be given a portable radio on the new Network.

## 11.2 General - Mobile

## 11.3 Mobile System Recommendations

11.3.1 A specification be prepared for tendering Request for Proposals. Generic function definitions of radio models, and associated price breakdown requested based on quantity range. **While this Report offers the best estimates at this stage, the Writer is aware of planning, and corporate affiliations which could cause a change in technology, and costs, overnight, which is consistent with the rapid growth, and aggressive competition in the trunked radio market.**

11.3.2 The Specification should provide for mandatory requirements, but also identify options which are not covered in immediate implementation. This will facilitate the decision making process for implementing the final network within approved budgets, and budgeting for what is necessary. Any options, not initially approved by IS&T, are therefore identified for future annual budgeting, with vendor cost commitments 'up front'.

11.3.3 The preferred frequency band for the 10 year study life is VHF.

11.3.4 The preferred mobile radio system is LTR.

11.3.5 Quantities of specific mobile radio models must be decided for NLH users, with attention paid to future applications/needs (i.e. data, Automatic Vehicle Location -AVL, using GPS), since costs are more sensitive to variations, compared with existing conventional mobile radio.

11.3.6 Continued shared use with W,S, & T, since growth should not change, except fo the addition of approximately 100 radios currently used for simplex operation only (as identified by WS&T in a Meeting with NLH dated 2001 02 15, and to be confirmed with a follow-up Letter to the Meeting) .

11.3.7 Industry Canada Policy for join use must be considered both for mobile and microwave joint use, since, depending who is jointly using the network(s), mandatory, unlimited use may be enforced by Industry Canada - refer to Industry Canada's Policy letter - **Attachment 14 - Industry Canada's Policy Letter**.

Further discussion shall be completed with Industry Canada, in the event Newfoundland Power wishes to become a joint owner of the NLH mobile radio system. Newfoundland Power would be required to pool their VHF frequencies for implemetation of a shared mobile radio system upgrade. Consideration to phase in 12.5 kHz radios is required for future expansion, with consideration to required data throughput.

11.3.8 Since the radios are data pipes only, it will be necessary to identify NLH data requirements from a data infrastructure (IT) requirement. If a complete current mobile data assessment of needs/applications is not fully identified now, particularly for bandwidth requirements, a separate radio system may be required, or added later, since data rates are alternative dependent.

11.3.9 The requirement for status messaging is significant in the long term mobile system. These requirements should be obtained from radio users, and included in the Specification, and as add-on options in the long term implementation, as costs are dependent upon the user equipment model provisioned, and dispatch configuration.

11.3.10 Radio coverage prediction should be completed prior to preparation of the Specification, especially prior to preparation of costing, to add Newfoundland Power, since redundant sites have been determined in preliminary technical discussions with Newfoundland Power ( i.e. Meeting 2001, February 23).

11.3.11 Radio coverage measurements shall be completed as part of final commissioning, and compared with predictions, for future reference of coverage variations.

11.3.12 An Implementation Plan, including supplementary coverage site work, for radio paging & mobile system be completed as the next step following a decision of IS&T to proceed. The schedule for the Final Implementation Plan be completed following acceptance of the preferred mobile radio proposal.

# 12 Implementation

## 12.1 General

12.1.1 Supplement coverage areas with portables, for existing pager users.

12.1.2 Identify all supplementary sites required to complete total radio coverage needs, and provide for infrastructure work to be completed. This work must be scheduled to match installation times for adjacent backbone trunked radio installations. This is required to entertain the addition of Newfoundland Power as a joint owner, since many sites have been found redundant with NLH. Further discussions are required with Newfoundland Power.

12.1.3 Low bandwidth radio links to third party supplementary sites shall be required to fulfill coverage objectives. Licensing applications for fixed links shall be completed and submitted to improve authorization lead time.

12.1.4 Once approval is obtained from IS&T to proceed, an Implementation Schedule shall be completed for the tendering process, supplier delivery, and shall include prioritization of sites (coverage areas) to be installed. Newfoundland Power traffic requirements must be determined for the areas within their operational areas.

12.1.5 The process to prepare mobile specifications, tender, review proposals, award the tender, manufacture the equipment, and begin implementation will take an estimated 12 - 18 months.

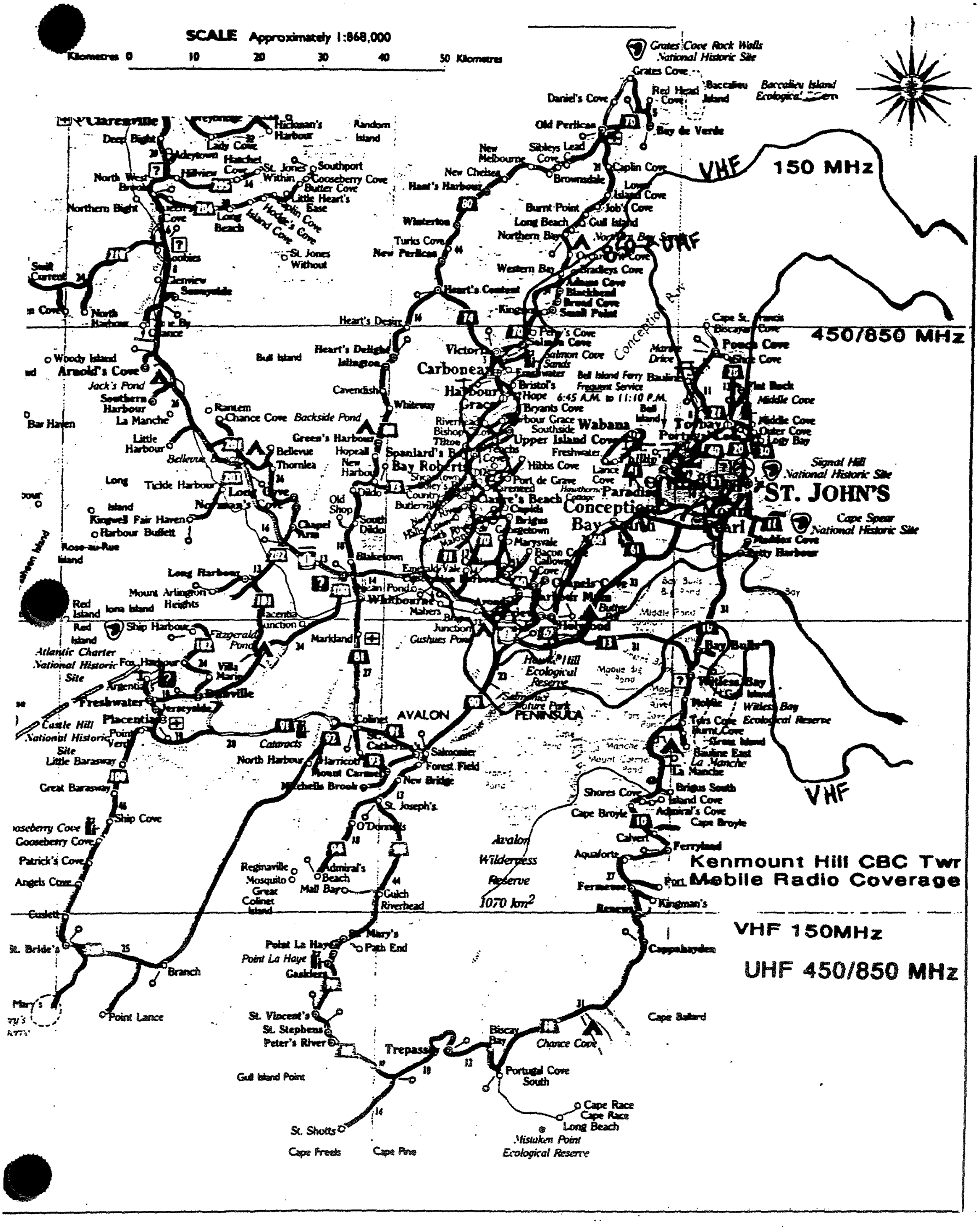
12.1.6 Completion of site work, including third party tower analysis of third party & supplementary sites, and necessary reinforcement, should be completed first; budgets for tower upgrade can be allocated and this work can be completed while the mobile radio system is being manufactured. Site space & power upgrade can be installed in supplementary coverage sites, in readiness for the mobile radio installation and commissioning.

12.1.7 Microwave links should be equipped with the necessary mux cards, and associated end-to-end paging & mobile circuits commissioned.

12.1.8 A decision for the location of the trunking switch should be made, and building readiness can be planned to merge with the overall schedule.

12.1.9 The overall Schedule can be finalized, with milestones and critical paths, when firm deliver dates are provided in the tender evaluation process.

ATTACHMENT #1



**ATTACHMENT 2**

## Radio Distribution List

| Area Offices | Pagers | Mobiles | Portables | Base Stations |
|---|---|---|---|---|
| St. John's - ECC | 19 | 39 | 10 | 4 |
| Bay D'Espoir | 12 | 25 | 21 | 2 |
| Bishop's Falls | 2 | 90 | 15 | 5 |
| Churchill Falls | | | | |
| Happy Valley | | 17 | 4 | 4 |
| Holyrood | 2 | | 3 | 2 |
| Port Saunder's | 5 | 21 | 8 | 3 |
| St. Anthony | 3 | 20 | 13 | 1 |
| Stephenville | 2 | 16 | 6 | 4 |
| Wabush | | 6 | 2 | 2 |
| Whitbourne | 2 | 15 | 3 | 6 |
| | | | | |
| **Totals** | 47 | 249 | 85 | 33 |

**ATTACHMENT # 8**

**List of References**


1. NLH (MDMRS) System Description, Issue 3A, Aug. 7, 1990.

2. EIA/TIA TSB88 -1, Wireless Communications Systems - Performance in Noise and Interference Limited Situations - Recommended Methods for Technology-Independent Modeling, Simulation, and Verification (including Addendum 1), December 1998.

3. User Group (Site Traffic) Comparison for NLH, Year 2000.

**ATTACHMENT # 4**

ATTACHMENT #
Sheet 1 of 3.

Newfoundland & Labrador Hydro - Mobile Traffic Summary, Year 2000
Peak Usage Shown

| 2000 Month | Site(s) | W,S, &T PEG | W,S, &T Usage,min. | | N&LH PEG | N&LH Usage,min. | | TOTAL PEG | TOTAL Usage,min. |
|---|---|---|---|---|---|---|---|---|---|
| Jan | Bay D'Espoir Hill | 566 | 727 | | 959 | 847 | | 1525 | 1574 |
| | Bonne Bay | 2261 | 2271 | | 114 | 105 | | 2375 | 2376 |
| | Clarenville | 2701 | 2636 | | 48 | 36 | | 2749 | 2672 |
| | Corner Bk. | 2626 | 2309 | | 30 | 29 | | 2656 | 2338 |
| | Mt. Margaret | 2886 | 3497 | | 322 | 360 | | 3208 | 3857 |
| | Red Cliff | 2873 | 3744 | | 524 | 506 | | 3397 | 4250 |
| | **All Sites Totals** | **28029** | **30795** | | **4831** | **4590** | | **32860** | **35385** |
| | | | | | | | | | |
| Feb | Bay D'Espoir Hill | 232 | 301 | | | | | 232 | 301 |
| | Bonne Bay | 1813 | 1703 | | 77 | 75 | | 1890 | 1778 |
| | Clarenville | 2198 | 1924 | | 20 | 17 | | 2218 | 1941 |
| | Corner Bk. | 2370 | 2143 | | 37 | 32 | | 2407 | 2175 |
| | Mt. Margaret | 3013 | 3929 | | 338 | 391 | | 3351 | 4320 |
| | Red Cliff | 1366 | 1678 | | 342 | 277 | | 1708 | 1955 |
| | St. Anthony | 1662 | 1753 | | 325 | 282 | | 1987 | 2035 |
| | **All Sites Totals** | **20357** | **21842** | | **4353** | **3983** | | **24710** | **25825** |
| | | | | | | | | | |
| Mar. | Bay D'Espoir Hill | 310 | 411 | | 1055 | 950 | | 1365 | 1361 |
| | Bonne Bay | 1002 | 919 | | 154 | 161 | | 1156 | 1080 |
| | Clarenville | 2356 | 2127 | | 26 | 26 | | 2382 | 2153 |
| | Corner Bk. | 1330 | 1189 | | 62 | 63 | | 1392 | 1252 |
| | Mt. Margaret | 2192 | 2561 | | 468 | 502 | | 2660 | 3063 |
| | Red Cliff | 1719 | 2267 | | 640 | 538 | | 2359 | 2805 |
| | St. Anthony | 1437 | 1264 | | 1222 | 1327 | | 2659 | 2591 |
| | **All Sites Totals** | **17226** | **18081** | | **6996** | **6681** | | **24222** | **24762** |
| | | | | | | | | | |
| April | Bay D'Espoir Hill | 140 | 181 | | 1062 | 1003 | | 1202 | 1184 |
| | Bonne Bay | 385 | 374 | | 393 | 416 | | 778 | 790 |
| | Clarenville | 1088 | 995 | | 37 | 25 | | 1125 | 1020 |
| | Corner Bk. | 723 | 576 | | 13 | 12 | | 736 | 588 |
| | Kenmount Hill | 1062 | 816 | | 260 | 181 | | 1322 | 997 |
| | Mt. Margaret | 900 | 980 | | 541 | 630 | | 1441 | 1610 |
| | Red Cliff | 484 | 519 | | 509 | 493 | | 993 | 1012 |
| | St. Anthony | 400 | 327 | | 356 | 374 | | 756 | 701 |
| | **All Sites Totals** | **7665** | **7372** | | **5688** | **5497** | | **13353** | **12869** |
| | | | | | | | | | |
| May | Bay D'Espoir Hill | 74 | 89 | | 836 | 641 | | 910 | 730 |
| | Bonne Bay | 406 | 360 | | 371 | 465 | | 777 | 825 |
| | Clarenville | 887 | 735 | | 51 | 28 | | 938 | 763 |
| | Corner Bk. | 842 | 663 | | 39 | 37 | | 881 | 700 |
| | Kenmount Hill | 1084 | 873 | | 122 | 65 | | 1206 | 938 |
| | Mt. Margaret | 705 | 842 | | 402 | 460 | | 1107 | 1302 |
| | Red Cliff | 683 | 758 | | 605 | 528 | | 1288 | 1286 |
| | St. Anthony | 301 | 253 | | 289 | 270 | | 590 | 523 |
| | **All Sites Totals** | **7041** | **6536** | | **5160** | **4736** | | **12201** | **11272** |

**ATTACHMENT # 4**



| 2000 Month | Site(s) | W,S, &T PEG | W,S, &T Usage,min. | N&LH PEG | N&LH Usage,min. | TOTAL PEG | TOTAL Usage,min. |
|---|---|---|---|---|---|---|---|
| June | Bay D'Espoir Hill | 44 | 49 | 937 | 770 | 981 | 819 |
| | Bonne Bay | 363 | 242 | 327 | 321 | 690 | 563 |
| | Clarenville | 809 | 610 | 129 | 98 | 938 | 708 |
| | Corner Bk. | 832 | 729 | 132 | 123 | 964 | 852 |
| | Kenmount Hill | 1333 | 1125 | 195 | 121 | 1528 | 1246 |
| | Mt. Margaret | 448 | 433 | 595 | 616 | 1043 | 1049 |
| | Red Cliff | 690 | 637 | 680 | 601 | 1370 | 1238 |
| | St. Anthony | 136 | 108 | 395 | 410 | 531 | 518 |
| | **All Sites Totals** | **6391** | **5453** | **6829** | **6224** | **13220** | **11677** |
| | | | | | | | |
| July | Bay D'Espoir Hill | 88 | 102 | 1596 | 1377 | 1684 | 1479 |
| | Bonne Bay | 237 | 171 | 229 | 227 | 466 | 398 |
| | Clarenville | 851 | 672 | 38 | 27 | 889 | 699 |
| | Corner Bk. | 605 | 451 | 73 | 78 | 678 | 529 |
| | Kenmount Hill | 959 | 841 | 105 | 67 | 1064 | 908 |
| | Mt. Margaret | 436 | 382 | 567 | 716 | 1003 | 1098 |
| | Red Cliff | 457 | 419 | 573 | 557 | 1030 | 976 |
| | St. Anthony | 216 | 180 | 377 | 373 | 593 | 553 |
| | **All Sites Totals** | **5083** | **4230** | **6840** | **6948** | **11923** | **11178** |
| | | | | | | | |
| July | Bay D'Espoir Hill | 88 | 102 | 1596 | 1377 | 1684 | 1479 |
| | Bonne Bay | 237 | 171 | 229 | 227 | 466 | 398 |
| | Clarenville | 851 | 672 | 38 | 27 | 889 | 699 |
| | Corner Bk. | 605 | 451 | 73 | 78 | 678 | 529 |
| | Kenmount Hill | 959 | 841 | 105 | 67 | 1064 | 908 |
| | Mt. Margaret | 436 | 382 | 567 | 718 | 1003 | 1100 |
| | Red Cliff | 457 | 419 | 573 | 557 | 1030 | 976 |
| | St. Anthony | 216 | 180 | 377 | 373 | 593 | 553 |
| | **All Sites Totals** | **5083** | **4230** | **6840** | **6948** | **11923** | **11178** |
| | | | | | | | |
| Aug. | Bay D'Espoir Hill | 78 | 99 | 1038 | 811 | 1116 | 910 |
| | Bonne Bay | 201 | 129 | 144 | 149 | 345 | 278 |
| | Clarenville | 937 | 766 | 30 | 22 | 967 | 788 |
| | Corner Bk. | 551 | 508 | 231 | 306 | 782 | 814 |
| | Kenmount Hill | 932 | 748 | 62 | 35 | 994 | 783 |
| | Mt. Margaret | 211 | 212 | 447 | 569 | 658 | 781 |
| | Red Cliff | 686 | 663 | 566 | 551 | 1252 | 1214 |
| | St. Anthony | 82 | 60 | 545 | 607 | 627 | 667 |
| | **All Sites Totals** | **5528** | **4694** | **6879** | **7035** | **12407** | **11729** |

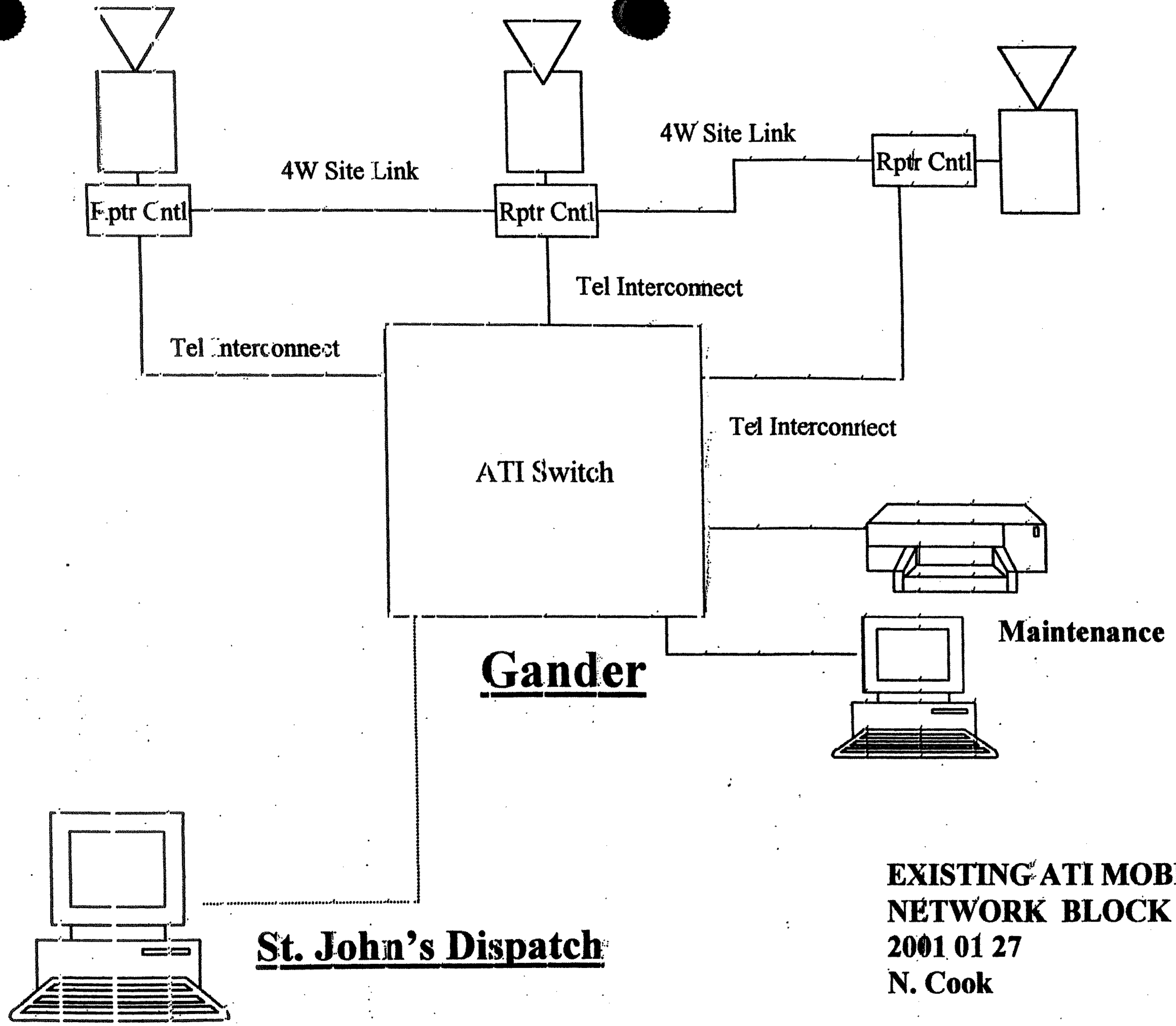
ATTACHMENT # 4

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sheet 3 of 3. | |
| 2000 | | | | | | | | |
| Month | Site(s) | W.S. &T | | | N&LH | | TOTAL | |
| | | PEG | Usage,min. | | PEG | Usage,min. | PEG | Usage,min. |
| Sept. | Bay D'Espoir Hill | 112 | 127 | | 1151 | 991 | 1116 | 910 |
| | Bonne Bay | 150 | 103 | | 202 | 197 | 345 | 278 |
| | Clarenville | 1143 | 950 | | 61 | 44 | 967 | 788 |
| | Corner Bk. | 633 | 508 | | 115 | 111 | 782 | 814 |
| | Kenmount Hill | 2976 | 2610 | | 68 | 41 | 994 | 783 |
| | Mt. Margaret | 241 | 235 | | 369 | 394 | 658 | 781 |
| | Red Cliff | 759 | 761 | | 644 | 623 | 1252 | 1214 |
| | St. Anthony | 123 | 86 | | 525 | 502 | 627 | 667 |
| | **All Sites Totals** | **7547** | **6609** | | **7083** | **6682** | **12407** | **11729** |
| | | | | | | | | |
| Oct. | Bay D'Espoir Hill | 96 | 139 | | 1229 | 1219 | 1263 | 1118 |
| | Bonne Bay | 264 | 174 | | 281 | 280 | 352 | 300 |
| | Clarenville | 784 | 668 | | 70 | 42 | 1204 | 994 |
| | Corner Bk. | 806 | 634 | | 78 | 84 | 748 | 619 |
| | Kenmount Hill | 902 | 759 | | 52 | 34 | 3044 | 2651 |
| | Mt. Margaret | 482 | 572 | | 589 | 653 | 610 | 629 |
| | Red Cliff | 822 | 819 | | 485 | 452 | 1403 | 1384 |
| | St. Anthony | 207 | 142 | | 421 | 425 | 648 | 588 |
| | **All Sites Totals** | **6245** | **5691** | | **6823** | **6804** | **14630** | **13291** |
| | | | | | | | | |
| Nov. | Bay D'Espoir Hill | 175 | 206 | | 1042 | 907 | 1325 | 1358 |
| | Bonne Bay | 557 | 418 | | 316 | 293 | 545 | 454 |
| | Clarenville | 1368 | 1087 | | 29 | 17 | 854 | 710 |
| | Corner Bk. | 1449 | 1175 | | 215 | 223 | 884 | 718 |
| | Kenmount Hill | 860 | 655 | | 99 | 57 | 954 | 793 |
| | Mt. Margaret | 321 | 288 | | 521 | 564 | 1071 | 1225 |
| | Red Cliff | 896 | 941 | | 577 | 552 | 1307 | 1271 |
| | St. Anthony | 260 | 224 | | 398 | 376 | 628 | 567 |
| | **All Sites Totals** | **9313** | **8230** | | **6344** | **5951** | **13068** | **12495** |
| | | | | | | | | |
| Dec. | Bay D'Espoir Hill | 166 | 214 | | 264 | 242 | 1217 | 1113 |
| | Bonne Bay | 1025 | 905 | | 24 | 25 | 873 | 711 |
| | Clarenville | 1403 | 1352 | | 19 | 20 | 1397 | 1104 |
| | Corner Bk. | 1322 | 1257 | | 21 | 15 | 1664 | 1398 |
| | Kenmount Hill | 188 | 128 | | 31 | 20 | 959 | 712 |
| | Mt. Margaret | 1024 | 1328 | | 196 | 205 | 842 | 852 |
| | Red Cliff | 1150 | 1517 | | 137 | 155 | 1473 | 1493 |
| | St. Anthony | 607 | 598 | | 108 | 105 | 658 | 600 |
| | **All Sites Totals** | **11296** | **12264** | | **1747** | **1688** | **15657** | **14181** |

| | A | B | C | E | G | I | K |
|---|---|---|---|---|---|---|---|
| | CUSTOM | | | | | | File:\NLH\MobSys.Esti |
| 2 | SYSTEMS | | | Newfoundland & Labrador Hydro | | | |
| 3 | ELECTRONICS LIMITED | | | Mobile System Alternatives Estimates | | | Sheet 1 of 2. |
| 4 | | | | | | | |
| 5 | | | | Transcrypt | Motorola | CNEricsson | NOTES |
| 6 | **Mobile System:** | **Qty** | **TETRA** | **LTR** | **SmartZone** | **EDACS** | Rev 01 03 05 -00 |
| 7 | **General:** | | | | | | |
| 8 | Architecture >>>>>> | | Open | Open | Proprietary | Proprietary | |
| 9 | Frequency Band, MHZ | | 450 | 150/450/850 | 150/450/850 | 150/450/850 | |
| 10 | Mode | | Digital | Analogue | Analogue | Digital | |
| 11 | **Description:** | | | | | | |
| 12 | **Redundant Central Switch** | 1 | $550,000 | $500,000 | $1,400,000 | $3,600,000 | |
| 13 | **Site Equipment (Rptr/Contl,Ant** | 35 | 2,625,000 | 2,100,000 | 2,625,000 | 3,150,000 | Single Ch Site. |
| 14 | - add mobile data capacity 1 rptr/site | 35 | 1,750,000 | 875,000 | 1,750,000 | 1,750,000 | LTR use Zetron 42/459 |
| 15 | **Mobile Radios - avg. model** | 50 | 202,500 | 112,500 | 262,500 | 212,500 | |
| 16 | -80% w.data,reference Attach # 2 | 200 | 810,000 | 450,000 | 2,050,000 | 1,050,000 | |
| 17 | add GPS AVL to data | 200 | 200,000 | 200,000 | 200,000 | 200,000 | |
| 18 | **Portable Radios -avg. model** | 85 | 272,000 | 85,000 | 425,000 | 340,000 | Transcrypt User |
| 19 | -reference Attachment 2 | | | | | | Equipt. is Less Cost. |
| 20 | **Base Stations- mob w. PSupp.** | 33 | 231,000 | 156,750 | 247,500 | 231,000 | |
| 21 | **Sub Total** | | **6,640,500** | **4,479,250** | **8,960,000** | **10,533,500** | |
| 22 | **Features - incremental $ shown:** | | | | | | |
| 23 | - Encryption (per mob/port/base) | | 600 | | | | |
| 24 | - Data | | UE incl'd | UE incl'd | 1200 incl'd | UE incl'd | UE= User Equipment |
| 25 | Nominal Rate | | 28.8kbps | 1.2/2.4kbps | 1.2kbps | 9.6kbps | Data Infrastructure |
| 26 | Throughput Rate | | 19kbps | | | 7.2kbps | needs OS,Appl's Soft. |
| 27 | - Mobile Network CPU/Router | 1 | 150,000 | 150,000 | 150,000 | 250,000 | EDACS = 8 Ports |
| 28 | - Status Messaging | | | | | | |
| 29 | - GPS AVL (per mobile) | | 1,000 | 1,000 | | | |
| 30 | **Miscellaneous:** | | | | | | |
| 31 | - Add Tower Contingency(3) | | 450,000 | 450,000 | 450,000 | 450,000 | |
| 32 | - Extended Cover Link Facilities | | 400,000 | 400,000 | 400,000 | 400,000 | |
| 33 | - Engineering Ext. | | 60,000 | 60,000 | 60,000 | 60,000 | |
| 34 | - Drafting/Documentation | | 25,000 | 25,000 | 25,000 | 25,000 | |
| 35 | - Commissioning/Fact. Test | | 75,000 | 75,000 | 75,000 | 75,000 | |
| 36 | - Radio Coverage Equipment | | 25,000 | 25,000 | 25,000 | 25,000 | |
| 37 | - Demolition | | 105,000 | 105,000 | 105,000 | 105,000 | |
| 38 | - Training | | 100,000 | 100,000 | 100,000 | 100,000 | |
| 39 | **TOTAL less HST** | | **$7,880,500** | **$5,719,250** | **$10,200,000** | **$11,773,500** | |

ATTACHMENT 5

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | Sheet 2 of 2. | |
| 42 | CUSTOM | | | | Newfoundland & Labrador Hydro | | | | | | |
| 43 | SYSTEMS | | | | Mobile System Alternatives Estimates | | | | | | |
| 44 | ELECTRONICS LIMITED | | | | | | | | | Rev 01 03 05 -00 | |
| 45 | | | | | | | | | | | |
| 46 | | | | | | | | | | | |
| 47 | **Paging System:** | | **Typical** | | | | **Independent Mobile Data System:** | | | | |
| 48 | | | | | | | (req'd for SmartZone for usable data throughput.) | | | | |
| 49 | Encoder - Redundant | 2 | 60,000 | | | | Data Controlr: | 1 | 150,000 | | |
| 50 | - dual Analogue/Digital | | | | | | | | | | |
| 51 | | | | | | | Appl. Server: | 1 | 150,000 | | |
| 52 | Site Equipment: | | see Options below | | | | | | | | |
| 53 | | | | | | | Base Stas | 35 | 1,750,000 | | |
| 54 | **Option 1** | | | | | | | | | | |
| 55 | - Analogue Txs | 35 | 1,575,000 | | | | Engineering | | 250,000 | or use existing | |
| 56 | - Off Air Confirm at Site | 35 | 105,000 | | | | | | | paging Txs | |
| 57 | - Paging Receivers | 50 | 22,500 | | | | Installation | | 110,000 | | |
| 58 | (Dual T&V + Alphanumeric) | | | | | | | | | | |
| 59 | **Sub T. Opt1** | | **1,762,500** | | | | **Sub Total Data** | | **2,410,000** | | |
| 60 | **Option 2** | | | | | | | | | | |
| 61 | - Digital Txs | 35 | 2,100,000 | | | | **GPS Rx** | 1 | 1,500 | | |
| 62 | - Off Air Confirm at Site | 35 | 105,000 | | | | | | | | |
| 63 | - Paging Receivers | 50 | 7,500 | | | | **ADD: Software Development Costs** | | | | |
| 64 | (Digital) | | | | | | **or Applications Service Provider Costs** | | | | |
| 65 | **Sub T. Opt2** | | **2,272,500** | | | | | | | | |
| 66 | | | | | | | | | | | |
| 67 | **Preferred Option LTR - COST SUMMARY:** | | | | | | | | | | |
| 68 | | Cell R | Description | | | | | | | | |
| 69 | | E22 | Basic System | | $4,479,250 | | | | | | |
| 70 | | I59 | Data Router | | 660,000 | | | | | | |
| 71 | | E32-3 | Miscellaneous | | 1,240,000 | | | | | | |
| 72 | | C49 | Paging Encoder | | 60,000 | | | | | | |
| 73 | | C57 | Pagers | | 22,500 | | | | | | |
| 74 | | C62 | Off Air Page Conf | | 105,000 | | | | | | |
| 75 | | | | | | | | | | | |
| 76 | | | **TOTAL SYSTEM** | | **$6,566,750** | | | | | | |
| 77 | | | | | | | | | | | |

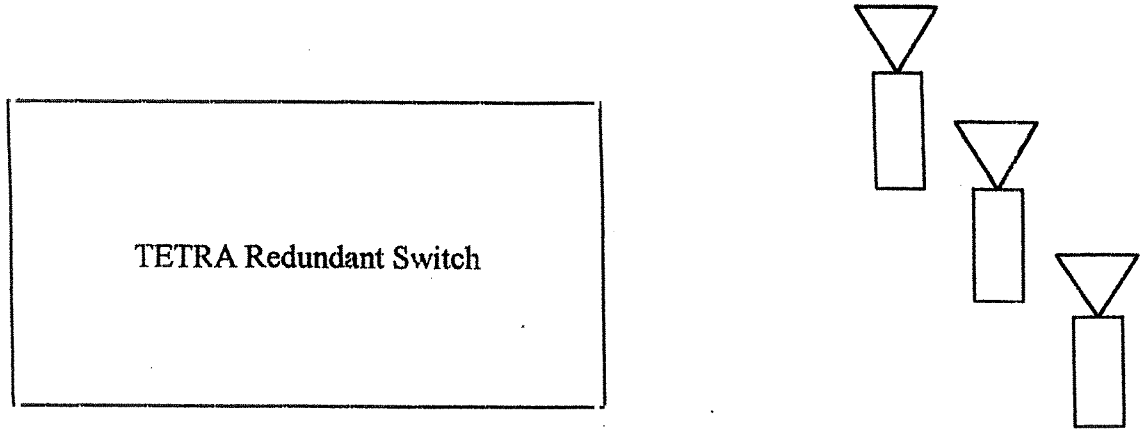



**EXISTING ATI MOBILE NETWORK BLOCK DIAGRAM**
**2001 01 27**
**N. Cook**

**ATTACHMENT # 6**

ATTACHMENT 7

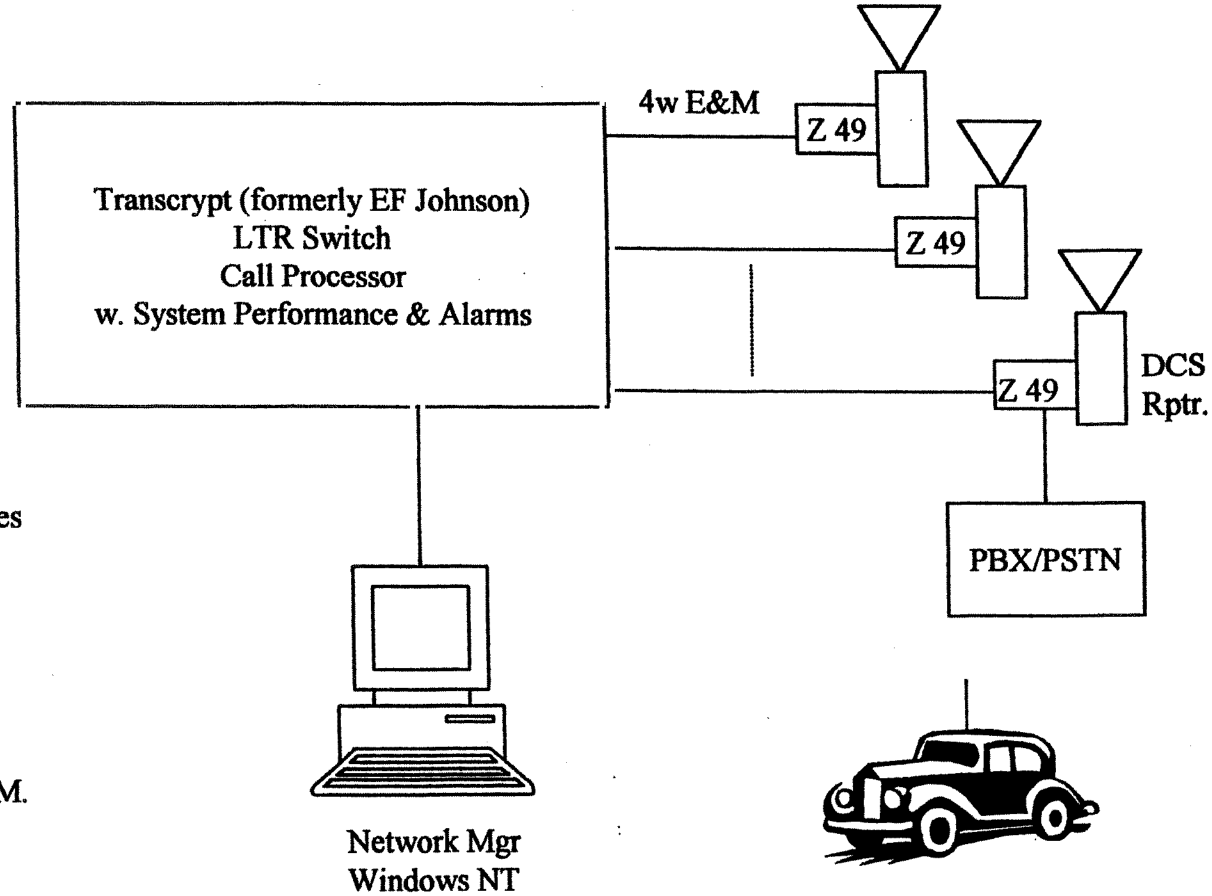
TO BE COMPLETED




TETRA Features
-TDMA
-Mobile Data 28.8kbps (19.2kbps throughput))
-Redundant w. triple mission critical processors
-Inique Open Standard MOU–ETSI 1995
-Many Radio Manufacturers
-Few Systems in North America
-Central or Distributed Processing
-450 MHz Band (Europe)

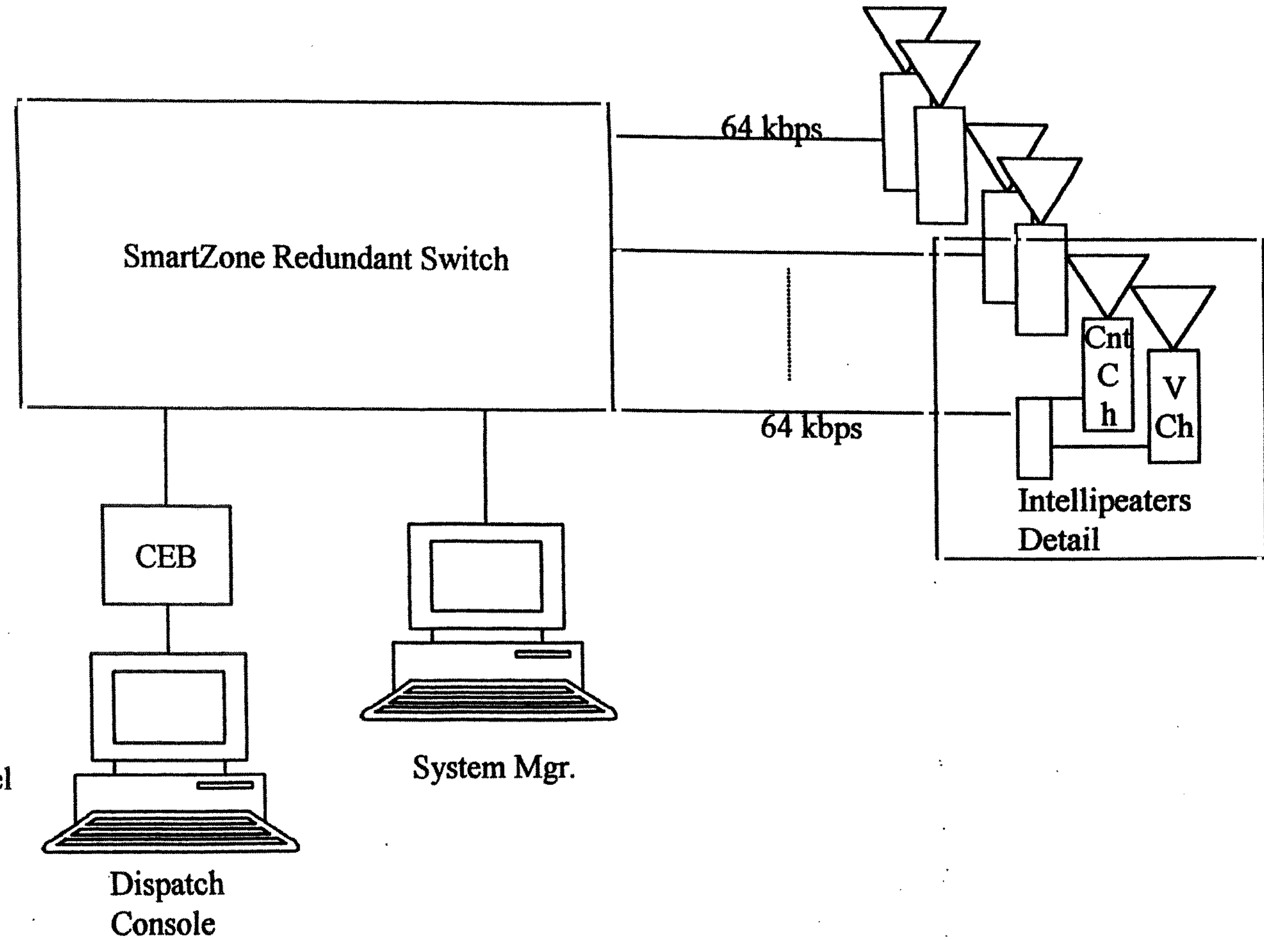
TETRA
Block Diagram NLH IST
2001 01 24
N. Cook

Logic Ttrunked Radio LTR Features
-Analogue
-FDMA
-Mobile Data 1.4 kbps/2.4 kbps
-Redundant ???
-Open Standard E.F Johnson
-Local Service
-Zetron 49 Site Cntt I/F Tel,4wE&M.
- & Site Stats.
-Inexpensive Radios
-Many Radio Manufacturers
-Radios 12.5/25 MHz BW Program
-Central or Distributed Processing
-150/450/850 MHz Band
-Subscriber Manager Activity Logger




LTR Mobile Radio
Block Diagram NLH IS&T
2001 01 24
N. Cook

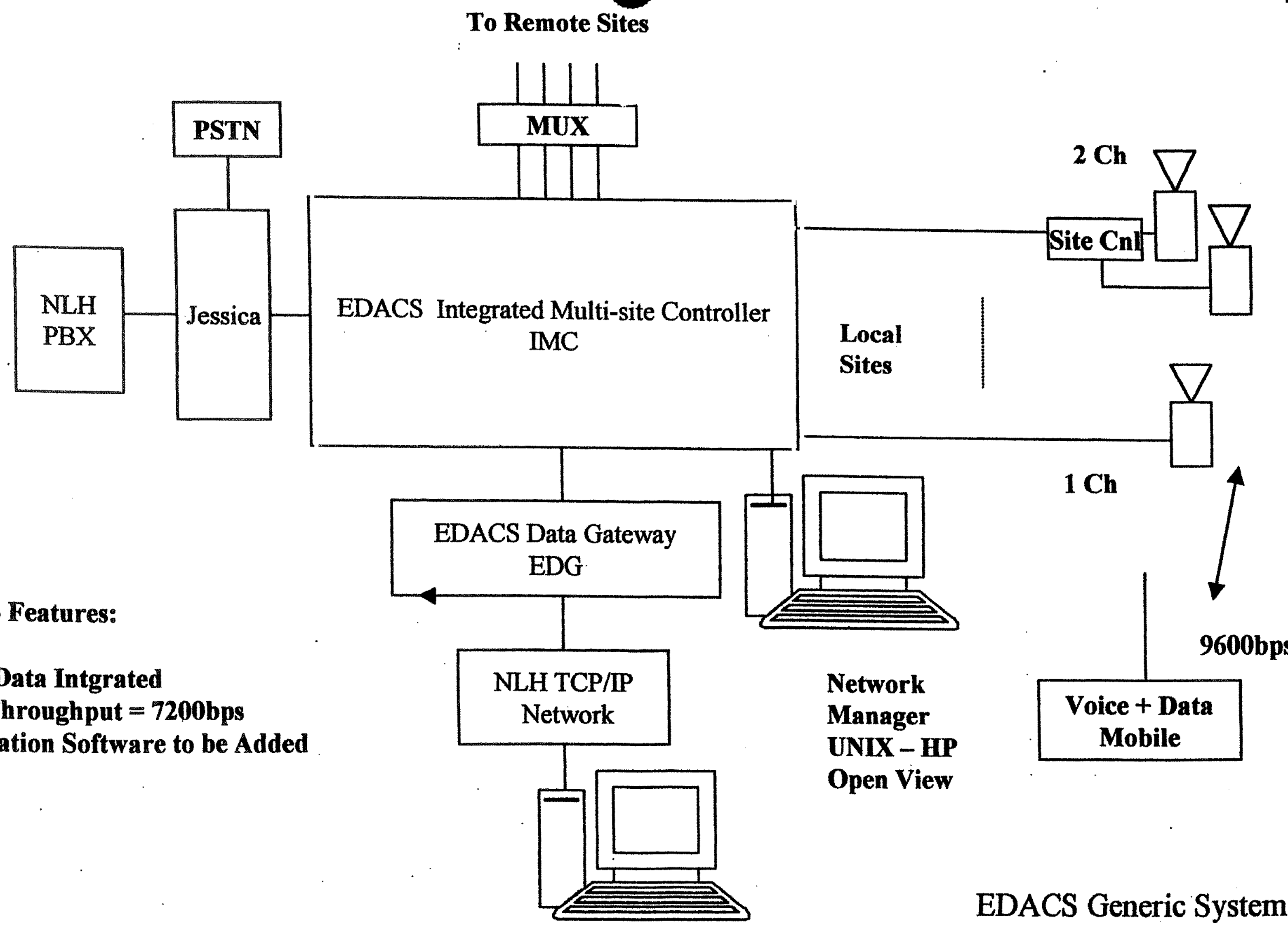
ATTACHMENT 8




SmartZone Features
-FDMA
- Msoft NT Network Protocol
-Mobile Data 2kbpson Cntl Channel
-Dedicated Control Channel
-Minimum 2 Chs per Site
-Proprietary Network
-Many Systems in North America
-Central Processing, fault tolerant
-150/450/850 MHz Band

SmartZone Network
Block Diagram NLH IST
2001 01 24
N. Cook

ATTACHMENT # 9

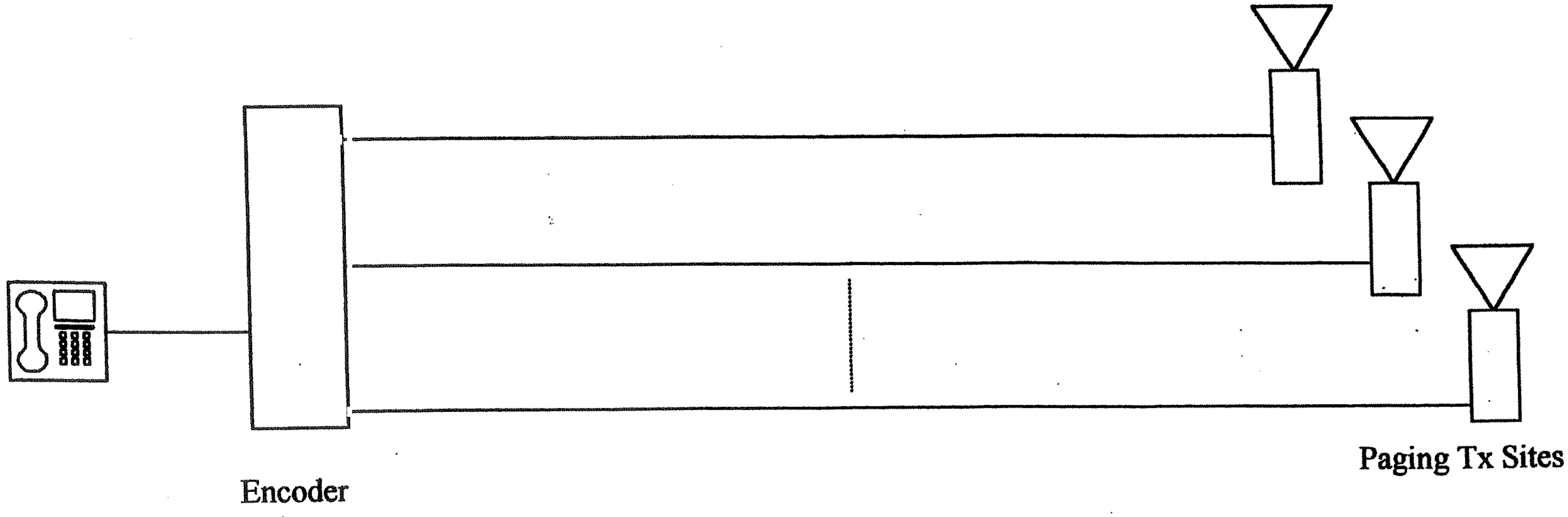



**EDACS Features:**

-Voice/Data Intgrated
-Data Throughput = 7200bps
-Application Software to be Added

EDACS Generic System
Block Diagram NLH IST
2001 01 24
N. Cook

**ATTACHMENT # 10**




## Paging Features:

-Tone &Voice (NLH)
- Limited voice storage.
- Redundant/separate to Mobile System

-Disadvantage – no confirmation
-Many Radio Manufacturers

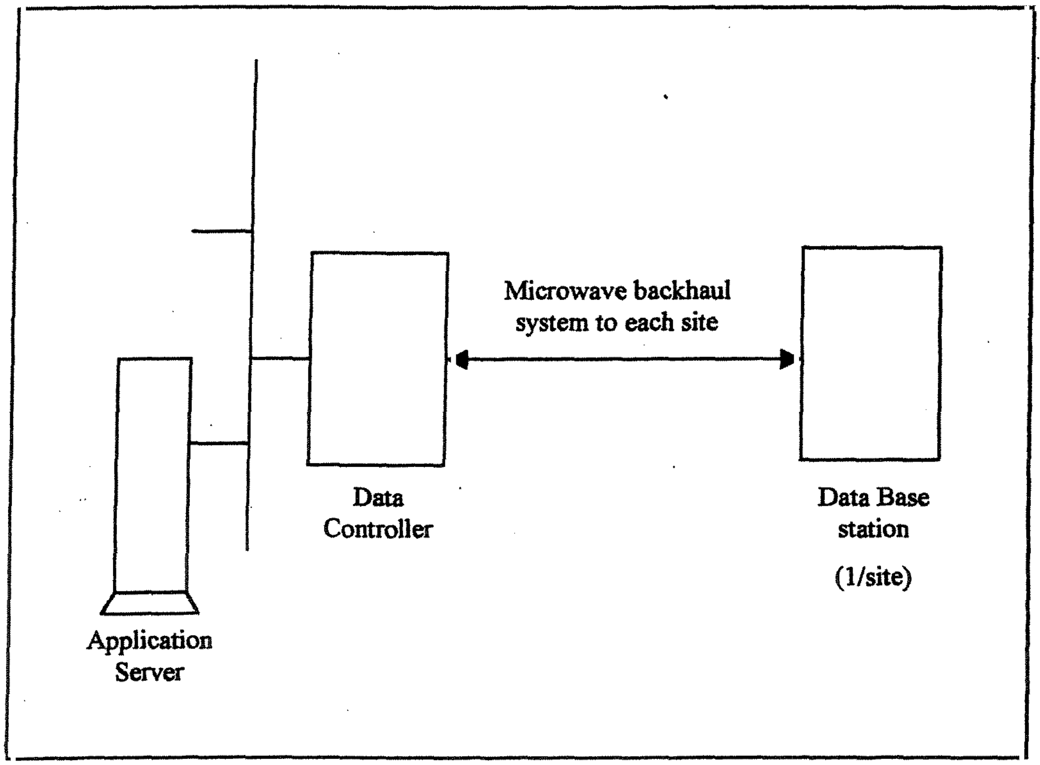
-Existing is VHF (max coverage)
-Pagers are expensive

**DIGITAL OPTION**
POCSAG (Alpha Numeric)
- Many message storage capability
- Pagers store many messages
- Time/Date Stamp
- Disadvantage – no confirmation
- Displays difficult to read exc. zoom
- Many Radio Manufacturers.
- Digital Ready Transmitters Req'd.
- Pagers 1/3 cost of T&V

**Paging Network**
Block Diagram NLH IST
2001 01 24
N. Cook

**ATTACHMENT # 11**

**ATTACHMENT # 12**




Dedicated Data System Block Diagram

**ATTACHMENT # 13**



[illegible] Lab Hydro Existing Repeater Sites

| Site Name | Latitude (N) | Longitude (W) | Elevation (m AMSL) | Owner | Tower Ht. (m) | ERP (W) | TX Freq | RX Freq | Notes |
|---|---|---|---|---|---|---|---|---|---|
| Annieopsquotch | 48 15 05 | 57 43 26 | 558 | RCMP? | 50 | 12 | 162.63 | 170.19 | Twr. ht. Incorrect? |
| Bay d'Espoir Hill | 47 59 42 | 55 46 5 | 262 | NLH | 54 | 77.6 | 164.22 | 170.28 | |
| Bay l'Argent | 47 32 11 | 54 51 34 | 244 | NTM | 40 | 102 | 162.63 | 170.19 | |
| Blue Grass Hill | 49 03 31 | 57 11 13 | 434 | NLH | 48 | 95.5 | 163.08 | 172.29 | |
| Blue Mountain | 51 29 31 | 55 45 58 | unknown | NLH | 15 | 126 | 164.79 | 170.52 | |
| Bonne Bay | 49 22 10 | 57 44 16 | 480 | NTM | 40 | 105 | 163.86 | 170.22 | Three Tom |
| Brent's Cove | 49 54 37 | 55 40 23 | 198 | NTM | 50 | 102 | 164.22 | 170.28 | |
| Carmanville | 49 25 13 | 54 17 27 | 89 | NTM | 45 | 105 | 163.23 | 170.49 | |
| Clarenville | 48 11 21 | 54 02 17 | 290 | NTM | 88 | 93.3 | 162.75 | 170.34 | Shoal Hr. |
| Codroy | 48 03 31 | 58 51 27 | 389 | NTM | 31 | 110 | 163.08 | 172.29 | |
| Corner Brook | 48 55 11 | 57 58 15 | 381 | NTM | 71 | 60.3 | 172.53 | 167.43 | |
| Gambo | 48 49 49 | 54 22 04 | 207 | NTM | 43 | 102 | 163.08 | 172.29 | |
| Godaleich Hill | 48 15 28 | 56 10 00 | 350 | NLH | 48 | 15 | 163.23 | 170.49 | |
| Hawke Hills | 47 19 19 | 53 07 32 | 290 | NTM | 29 | 102 | 163.08 | 172.29 | Four Mile |
| Hermitage | 47 33 32 | 55 56 21 | 274 | NTM | 25 | 112 | 163.86 | 170.22 | |
| Jackson's Arm | 49 52 57 | 56 47 06 | 290 | NTM | 13 | 117 | 163.62 | 170.01 | |
| Kenmount | 47 32 01 | 52 47 27 | 255 | NTM | 20 | 74.1 | 172.53 | 167.43 | Ht. Approx |
| Millertown | 48 48 36 | 56 31 45 | 232 | NTM | 96 | 87.1 | 163.86 | 170.22 | |
| Mount Margaret | 51 01 05 | 56 48 47 | 279 | NTM | 60 | 105 | 162.75 | 170.34 | |
| P[illegible]aunders | 50 38 58 | 57 17 51 | 79 | NTM | 124 | 102 | 162.63 | 170.19 | |
| [illegible]nd Creek | 50 08 41 | 57 37 39 | 172 | NTM | 20 | 115 | 164.79 | 170.52 | |
| Red Cliff | 48 57 13 | 55 47 43 | 199 | NTM | 137 | 70.8 | 164.79 | 170.52 | |
| Red Rocks | 47 40 35 | 59 18 10 | 197 | NTM | 71 | 95.5 | 163.62 | 170.01 | |
| Rocky Ridge | 47 51 20 | 57 39 08 | 488 | NTM | 21 | 29.5 | 163.62 | 170.01 | |
| Serrated Hills | 47 40 26 | 53 51 48 | 213 | NTM | 46 | 10 | 163.62 | 170.01 | |
| Sheffield | 49 21 42 | 56 33 24 | 468 | NTM | 94 | 89.1 | 162.75 | 170.34 | |
| Southwest Brook | 51 01 14 | 56 08 47 | 92 | NTM | 65 | 95.5 | 163.62 | 170.01 | |
| St. Anthony | 51 20 56 | 55 36 36 | 132 | NTM | 46 | 112 | 163.86 | 170.22 | |
| Stephenville | 48 31 38 | 58 29 13 | 130 | NTM | 36 | 105 | 164.79 | 170.52 | |

**ATTACHMENT 13**



& Lab Hydro Owned Potential New Repeater Sites

| Site Name | Latitude (N) | Longitude (W) | Elevation (m AMSL) | Tower Ht. (m) | Year Avail. | Potential Site Replacing | Notes |
|---|---|---|---|---|---|---|---|
| Gull Pond Hill | 48 17 29 | 55 28 31 | 285 | 82 | Immed | None | |
| Sandy Brook Hill | 48 52 36 | 55 47 24 | 283 | 93 | Immed | Red Rocks | |
| Mary March | 48 49 12 | 56 43 15 | 335 | 115 | Immed | Millertown | |
| Deer Lake | 49 10 38 | 57 24 21 | 59.5 | 20 | Immed | Bonne Bay | |
| Petty Harbour | 47 30 53 | 52 44 22 | 160 | 40 | 2002 | Kenmount | |
| Four Mile | 47 19 42 | 53 07 30 | 290 | 82 | 2002 | Hawke Hill | |
| Chapel Arm | 47 30 38 | 53 43 22 | 224 | 82 | 2002 | Serrated Hill | |
| Bull Arm | 47 49 45 | 53 56 19 | 145 | 90 | 2002 | Clarenville/Serrated | |
| Granite Canal | 48 11 51 | 56 49 18 | 332 | 30 | 2003 | Annieopsquotch | Tower ht. TBD |
| Burnt Dam | 48 9 46 | 57 20 20 | 321 | 30 | 2003 | Annieopsquotch | Tower ht. TBD |
| Grandy Brook | 47 46 59 | 57 39 32 | 318 | TBD | 2002 | Rocky Ridge | New Site |
| Shoal Harbour | 48 11 21 | 54 2 17 | 263 | 40 | 2003 | Clarenville | Tower ht. TBD |
| Glovertown | 48 40 34 | 54 4 40 | 191 | 40 | 2003 | | Tower ht. TBD |
| Johnathan's Pond | 49 3 53 | 54 30 21 | 126 | 40 | 2003 | | Tower ht. TBD |
| Southwest Brook | 49 10 43 | 55 2 42 | 73 | 60 | 2003 | | Tower ht. TBD |

**ATTACHMENT # 14**

# Industry Canada's Joint Use Policy Summary Letter

**ATTACHMENT #14**

**m Cook, P.Eng.**

**From:** <Guerrette.Rene@ic.gc.ca>
**To:** <CSEL@CSEL.nf.ca>
**Sent:** Tuesday, February 06, 2001 1:53 PM
**Subject:** FW: Microwave Licensing Policies

Norm,,
Hope this helps

René

> -----Original Message-----
> From: Guerrette, Rene: STJ
> Sent: Monday, February 05, 2001 12:36 PM
> To: Cook Norman (E-mail)
> Cc: Richard, Roland: MCN; Leblanc, Mike: MCN
> Subject: Microwave Licensing Policies
>
>
> Norm,
>
s per our discussions, I looked a little further into the policies
nvolved in Nfld.. Hydro changing it's status from a microwave user to a
> microwave carrier. We also discussed the possibility of NFLD Hydro
> becoming a full fledged service provider. The policies with regards to
> becoming a service provider on the mobile side of the operations are
> separate and even less restrictive. We can discuss this aspect of the
> requirements if and when you are ready. For the purpose of furthering your
> inquiry into the possibilities offered under the microwave, please refer
> to the following policies; RP 015, RP 017, RP 018, RP 022. Radio
> communications Act(RA), Telecommunications Act(TA) and the Broadcasting
> Act(BA). I mention the BA only since the RP 022 asks for comments on
> combining the 3 policies into the one in an attempt to further liberalize
> the policy on microwave licensing.
>
> The other 2 acts, TA and RA provide the requirements from an ownership
> control perspective for Canadian companies wishing to operate as common
> carriers. As a CC, companies fall under the regulatory aspect of the CRTC.
> A visit to their web site may provide more info on the implications of
> being regulated under the TA. As well, there may be provincial PUB issues
> that could affect the carriers of telecommunications.
>
> Feel free to call me if you have any further questions.
>
gards,
>
> René
>