SECTION G

Plan of Projected Operating

Maintenance Expenditures

2006 - 2015

For Holyrood Generating Station

Newfoundland & Labrador Hydro

July 2005

TABLE OF CONTENTS

PAGE

INTRODUCTION

In the Decision and Order No. P. U.14 (2004) of the Board of Commissioners of Public Utilities ("the Board"), dated May 4,2004, (the 'Order) Newfoundland and Labrador Hydro ("Hydro") is required to **"file a ten year plan of maintenance expenditures for the Holyrood Generating Station with its annual capital budget application, until otherwise directed by the Board**" (p. 64 and Paragraph 12, p. 166 of the Order).

This requirement is specifically related to system equipment maintenance costs; therefore, capital expenditures have not been included in the following report. Capital expenditures for Holyrood are submitted annually to the Board with other Hydro capital proposals as part of annual capital budget applications, and vary from year to year.

This report addresses the identified and expected maintenance expenditures for the years 2006 to 2015 inclusive. With respect to these expenditures it must be noted that Unit No's. 1 and 2, as well as two of the main fuel storage tanks and other associated ancillary equipment, are in excess of thirty (30) years old. Unit No. 3 is in excess of twenty (20) years old, along with its associated equipment, including the other two main fuel storage tanks. While many components of this equipment have been replaced and additional items added through the maintenance and capital program over the years, numerous pieces of equipment and components are original.

An accurate ten (10) year plan of system equipment maintenance is difficult to complete given the harsh operating environment, varied production requirements and the age of the units. This report, however, outlines for the next ten (10) years, maintenance items that are anticipated at this time. This plan, of course, will change as time progresses. The operating condition of the equipment will be continuously reviewed and, undoubtedly, events will occur that are not foreseen at this time, which will require changes in the currently anticipated annual

maintenance. As can be seen from this report, there must be variation in annual operating costs for the Holyrood Thermal plant. It is not possible to “levelize” the cost of maintaining a plant such as Holyrood where there are numerous components and systems integrated together to form a fossil fired thermal electric generating system.

MAINTENANCE PHILOSOPHY

The Board, in its Order as related to the Holyrood Thermal Plant, noted at p. 64 that **"The Board will require NLH's10 year plan of maintenance expenditures for the Holyrood Generating Station to be updated annually to reflect changing operating circumstances."**

It would be useful to first review the three main types or categories of maintenance undertaken at Holyrood.

1) Preventive Maintenance

While it is true that any plant will incur greater maintenance costs as it ages, Holyrood has used, and continues to use, up-to-date maintenance techniques and practices to maintain plant efficiency, availability and reliability. These include preventive, predictive and condition-based maintenance techniques, which are usually referred to by the overall term of "Preventive Maintenance". The basic principle underlying this approach to maintenance is timely intervention to prevent imminent or catastrophic failure, which may cause a substantial safety exposure, an increase in cost or an extended unavailability of the unit or system.

Preventive maintenance, in its specific sense, comprises routine inspections, checks and component replacement at specific time intervals, to prevent failures known, or reasonably expected, to occur within a definable time or operating hour interval during the life of the equipment, e.g. generator brush wear, air and oil filter replacements, etc. This also includes discarding equipment or components rather than repairing them when it is less expensive to do so.

Predictive maintenance involves routine testing of equipment to determine deterioration rates and initiating and carrying out repairs in a timely manner before a failure occurs, e.g. ultrasonic thickness checks on fluid

lines to monitor erosion wear rates, non-destructive testing of boiler and turbine components to determine fatigue, wear or corrosion rates and remaining life. Predictive maintenance items include such things as boiler and auxiliary equipment annual overhaul, among other items, wherein an assessment is made of components or subsystems that are only accessible during these overhauls.

There is also regular or continual monitoring of equipment operating parameters with a comparison of the results with optimum conditions to determine the most economic time to intervene and perform remedial work that is intended to return the equipment to optimum performance levels, e.g. air heater washes, generator winding insulation condition, oil sampling and testing, etc.

Turbine major and minor overhauls are, effectively, long-term predictive and preventive maintenance activities. A turbine major overhaul is a major disassembly, inspection and repair of the whole turbine. Since this is a very expensive and time consuming activity, the time between these overhauls is extended to minimize the recurring cost and maximize the equipment operating time, and thus useful life of the internal wearing components. Prior to 1988, these major overhauls were carried out at four-year intervals; a subsequent assessment of the risk and cost savings resulted in extending these overhauls to six-year intervals.

In 2003, a study was undertaken by Hartford Steam Boiler Insurance Company, using their proprietary program called Turbine Overhaul Optimization Program (TOOP). This assesses the causes of failure, the risk of failure and the maintenance history of the Turbines, and then proposes the optimum frequency between major overhauls. This assessment concluded that the Turbine major overhaul interval could be extended to 9 years from the major overhaul of Unit #1 in 2003, the major overhaul of Unit #2 in 2005 and the major overhaul of Unit #3 in 2007,

providing that certain upgrades of internal components are made. These recommendations have been accepted and provision for the required upgrades have been incorporated into this updated 10 year plan, see Appendix 4, 2007, Unit 3 TOOP Project.

Turbine valve overhauls are carried out at three-year intervals, between major overhauls. This has been found necessary, due to the critical nature of the safety and reliability aspects of these valves to the turbine operation and integrity, and will continue to be maintained on this three-year interval between major overhauls.

2) Corrective Maintenance

In addition to the predictive maintenance tactics outlined above, there are also corrective maintenance requirements. These include repairs to equipment as it fails or reaches the point where preventive maintenance has identified that the equipment is approaching the end of its useful service life. E.g. wear and tear on pumps, pipes and valves in the main and auxiliary systems, motor rewinds due to failed or deteriorated winding insulation, or as a result of adverse conditions (humidity, salt laden atmosphere, etc), replacement of corroded piping equipment and boiler tube failure repairs etc. In 2003, Unit #2 suffered 3 Superheater Tube failures and their analysis indicated a common tube failure problem had developed. However, at this stage, no provision had been made for additional tube failure repairs, but future capital refurbishment, has been incorporated in the 2006 Capital Budget.

3) Projects

Operating projects are those major cost repairs and inspections that are required to return structures and equipment to their original or near original condition to maintain structural integrity, possibly extend plant life, improve efficiency, improve availability and prevent or reduce

environmental risks. Such projects include repairs to building structural steel, roof repairs/replacement, fuel oil tank and pipeline inspection and coating, replacement of equipment or components no longer supported by the original manufacturer. A major Asbestos Abatement program commenced in 2005 and will be completed over a three-year period. Due to the significant cost (approaching $9M), Hydro was given approval to treat this as an extraordinary repair, which will mean an annual cost will be recovered over an additional five years, bringing the total cash flow period to eight years, 2005 to 2012.

COST VARIABILITY

Preventive maintenance costs are generally incurred annually at a constant level and do not fluctuate significantly. This does not apply to corrective maintenance costs, which are unavoidable and somewhat unpredictable due to the changing energy production demands on the units from year to year. These changing demands give rise to changes in wear rates, the majority of which cannot be monitored closely enough for reasonably accurate prediction, without incurring excessive inspection costs. Excessive inspection may in itself introduce increased risk of failure and thus additional cost, so all must be considered in balancing the most appropriate amount of inspection with accepted levels of failure. These costs however, generally balance from one year to another.

The turbine and valve overhaul costs are cyclic in nature. With three units in the plant on a nine-year major Turbine overhaul cycle interspersed with a three-year valve overhaul, this component of the system equipment maintenance cost is one of the significant reasons for the observed annual fluctuations that make normalizing annual maintenance costs difficult.

Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
No. 1	Minor			Minor			Major			Minor
No. 2			Minor			Minor			Major	
No. 3		Major			Minor			Minor		
General Cost	↓	↑	↓				↑	↓	↑	↓

Similarly, major operating projects, because of their extended maintenance intervals (years) or non-repeatability also add to the annual fluctuations of the system equipment maintenance costs.

Maintenance projects for the Holyrood Thermal plant are planned on a five-year basis, but as with any plan, it is not 'fixed' or definitive, as other events can cause a shift in the prioritization of such projects. This five-year maintenance plan is regularly updated by Hydro as time progresses.

DETAILED ANALYSIS

Attached are Appendices 1 to 9, which set out the ten-year maintenance plan for the Holyrood Thermal plant, as requested by the Board. Appendix 1 is a summary and indicates the expected expenditures in each of the major equipment groupings containing system equipment maintenance (SEM) costs for the years 2006 to 2015. Appendices 2 to 9, inclusive, show the expected SEM costs categorized according to Preventive, Corrective, Overhauls and Major Operating Projects for each of the major equipment groupings containing SEM costs.

This plan was prepared using the 2006 preventive, corrective and overhaul data and the current 2006 to 2010 operating project lists from Hydro's five-year plan for the Holyrood Thermal Plant as the base data. Considerable judgment of plant personnel had to be used to prepare a ten-year plan.

Hydro does not normally use any escalation in its five-year operating plan at the Plant or regional level. This five-year plan is primarily used for internal purposes and generation of work plans rather than detailed financial planning. However, in the attached ten-year plan, an escalation factor has been used, consistent with the series used for capital project estimates. A single escalation rate was used in this exercise and assumed a 50% weighting of Labour escalation and 50% of Material escalation, and is as follows:-

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
%	2.0	2.0	2.2	2.2	2.2	2.2	2.3	2.2	2.1

Appendices 2 to 9 list the categories of SEM costs for the years 2006 to 2015 in each of the major equipment groupings containing SEM. The categories listed are:

Preventive – Annual	Routine preventive maintenance activities carried out every year
Corrective	Typical but unknown breakdown/ emergency repairs carried out during the year
Turbine – Major	Major overhauls now planned every nine (9) years
Turbine – Minor	Major valve overhauls currently carried out every three (3) years, between major overhauls.
Boiler – Annual	Boiler overhauls carried out annually
Operating Projects	Non-capitalized projects, justified on the basis of Reliability, Safety, Environment or Cost Benefit Analyses.

Appendices 2, 3 and 4 (for Unit No's. 1, 2 and 3 respectively) use all of the foregoing categories. Appendices 5 to 9 are for the remaining equipment groupings of Common Equipment, Building and Grounds, Water Treatment Plant, Waste Water Treatment Plant & Environmental Monitoring and use only Preventive, Corrective and Major Operating Projects.

It must be noted that the Appendices do not itemize preventive and corrective items. The preventive maintenance program consists of approximately 1000 PM's performed on plant equipment annually. Corrective items include a large number of low cost jobs, the majority of which are largely unknown until they happen; thus, it is not practical to provide a breakout of the costs. Projects included in the headings of Operating Projects, Turbine - Major and Turbine - Minor work have been itemized in the year that the work is planned for execution.

Hydro's normal five-year plan identifies specific projects up to 2010. For the period 2011 to 2015, Hydro used an average per unit of the project budgets for

the three units over the years 2006 to 2010 with escalation. This approach was taken, as it is not practical or possible to determine specific work items, which are essentially unknown for the period of 2011 to 2015.

SUMMARY

This Plan presents the best available information at this time for a ten-year forecast of the maintenance projects for the Holyrood Plant and is based on the 2006 system equipment maintenance budget. As with any forecast, it is subject to change depending on the operating demands of the plant, the results of inspections and assessments of changing equipment conditions.

The Plan takes into account up-to-date maintenance tactics and known restoration and inspection work. As can be seen from the Plans, fluctuations in the annual cost cannot be eliminated due to the 9-year Turbine Overhauls and 3-year Valve Overhauls, as well as the large but infrequent Major Operating projects, such as Fuel Oil Storage Tank painting and inspection.

APPENDIX 1

TOTAL HOLYROOD SEM[1] 10 YEAR MAINTENANCE EXPENDITURES ESCALATED (K)

	($000)										
	Base Year 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
UNIT #1 Total SEM	1,956	1,265	1,332	1,671	1,348	1,555	3,121	1,626	1,661	2,097	
UNIT #2 Total SEM	1,248	1,428	1,947	1,319	1,348	1,923	1,589	1,626	3,263	1,696	
UNIT #3 Total SEM	1,260	4,065	1,602	1,319	1,707	1,555	1,589	2,010	1,661	1,696	
Common Equipment Total SEM	2,404	2,260	2,579	4,284	4,081	1,642	1,678	1,716	1,754	1,791	
Buildings and Grounds Total SEM	894	692	581	615	498	687	702	718	734	750	
WT Plant Total SEM	241	161	164	240	297	231	237	242	247	253	
WWT Plant Total SEM	18	5	43	19	6	19	19	19	20	20	
Environmental Monitoring Total SEM	171	175	178	182	186	180	184	188	192	196	
Total Holyrood SEM	8,192	10,051	8,426	9,648	9,469	7,791	9,119	8,145	9,534	8,499	
Total Operating Projects	2,806	3,517	2,822	3,920	3,615	1,809	1,848	1,891	1,933	1,973	

[1] *SEM – System Equipment Maintenance*

APPENDIX 2

HOLYROOD 10 YEAR MAINTENANCE PLAN

	($000)										
Unit No. 1	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	150	153	156	159	163	167	170	174	178	182	
Corrective	290	296	302	308	315	322	329	337	344	351	
Turbine Major Overhaul							1,532				
Turbine Valve Overhaul	331			352						401	
Boiler Annual Overhaul	800	816	832	851	869	888	908	929	949	969	
Auxiliary Equipment Annual Overhaul											
Operating Projects											
Air Heater Cold End Repairs	160										
Breeching Floor Refractory	40										
Breeching Pant Leg Roof	35										
Upgrade #1 Turbine Emerg. Trip Device	150										
Boiler Feed Pump East			42								
Projects – Lump Sum for Future Years						178	182	186	190	194	
Total - Unit No. 1	**1,956**	**1,265**	**1,332**	**1,671**	**1,348**	**1,555**	**3,121**	**1,626**	**1,661**	**2,097**	
Total Operating Projects Unit 1	385		42			178	182	186	190	194	

(1) 178 - Average Project Cost Per Unit 2006 to 2010 (plus escalation)

APPENDIX 3											
	($000)										
Unit No. 2	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	150	153	156	160	163	167	170	174	178	182	
Corrective	290	296	302	308	315	322	329	337	344	351	
Turbine Major Overhaul									1,602		
Turbine Valve Overhaul			344			368					
Boiler Annual Overhaul	800	816	832	851	869	888	908	929	949	969	
Auxiliary Equipment Annual Overhaul											
Operating Projects											
Unit 2 Vacuum Pump South	8										
Air Heater Cold End Repairs		163									
Replace Unit 2 Main Boiler Stop Valve			156								
Upgrade Turbine Emerg Trip Device			156								
Projects - Lump Sum for Future Years						178	182	186	190	194	
Total - Unit No. 2	**1,248**	**1,428**	**1,947**	**1,319**	**1,348**	**1,923**	**1,589**	**1,626**	**3,263**	**1,696**	
Total Operating Projects Unit 2	8	163	312			178	182	186	190	194	

[(1)] 178 - Average Project Cost Per Unit 2006 to2010 plus escalation)

APPENDIX 4											
	($000)										
Unit No. 3	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	150	153	156	160	163	167	170	174	178	182	
Corrective	290	296	302	308	315	322	329	337	344	351	
Turbine Major Overhaul		1,377									
Turbine Valve Overhaul					360			384			
Boiler Annual Overhaul	800	816	832	851	869	888	908	929	949	969	
Auxiliary Equipment Annual Overhaul											
Operating Projects											
7th Stage Bucket Replacement	1										
HP,IP & N1,2,3 Pkg Ring Replacement	1										
Replacement of UPS Batteries	12										
Sootblower System	2										
Cold Water Line	5										
TOOP Recommendations		255									
7th Stage Bucket Replacement		408									
7th Stage Diaphragm – Major Repairs		255									
Boiler Feed Pump East		41									
HP,IP & N1,2,3 Pkg Ring Replacement		51									
HP/IP Diaphragm Spill Strip Repairs		102									
Nozzle Block Repairs		102									
Inspect/Replace Lower Valve Snout Rings		163									
East Circulating Water (CW)Motor Rewind		46									
Replace Unit 2 Major Boiler Stop Valve			156								
Turbine Emergency Trip Device			156								
Projects – Lump Sums for Future Years						178	182	186	190	194	
Total - Unit No. 3	**1,260**	**4,065**	**1,602**	**1,319**	**1,707**	**1,555**	**1,589**	**2,010**	**1,661**	**1,696**	
Total Operating Projects Unit 3	20	1,423	312			178	182	186	190	194	
Total SEM for all Three Units	**4,464**	**6,758**	**4,881**	**4,308**	**4,402**	**5,032**	**6,300**	**5,261**	**6,586**	**5,490**	
Total Project Work for Three Units	413	1,586	666			533	545	557	569	581	

(1) 178 - Average Project Cost Per Unit 2006 to 2010 (plus escalation)

APPENDIX 5											
	($000)										
Common Equipment	2006	2007	2008	2009	2010	2011	2012	2013	2014		
Preventive – Yearly	225	229	234	239	244	250	255	261	267	272	
Corrective	468	478	487	498	509	520	531	544	556	567	
Operating Projects											
Asbestos Abatement	909	1,487	1,806	1,846	1,589						
FO Storage Tank #2 Inspection & Repair	500										
Ground Fault Protection	20										
Inspection of Seal Pits & Piping	5										
Painting Mechanical Equipment	50										
Pipe Surveillance	50										
Plant Color Coding	15										
Replacement of UPS #4 Batteries	12										
Stack Repairs	150										
Pipe Surveillance		51	52								
Plant Color Coding		15									
Fuel Oil Storage Inspection & Repair				1,701	1,739						
Projects – Lump Sum for Future Years						872	891	912	932	951	
Total Common Equipment	**2,404**	**2,260**	**2,579**	**4,284**	**4,081**	**1,642**	**1,678**	**1,716**	**1,754**	**1,791**	
Total Operating Projects Common Equipment	1,711	1,553	1,858	3,547	3,327	872	891	912	932	951	

(1) 872- Average Project Cost 2006 to 2010 (less Asbestos Removal, plus escalation)

APPENDIX 6

	($000)										
Buildings Grounds	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	230	235	239	245	250	255	261	267	273	279	
Corrective	228	233	237	242	248	253	259	265	271	276	
Operating Projects											
Coat Interior Liner Panels	100	102	104								
Coat Powerhouse/warehouse Floors	66										
Luminaire Replacement	20										
Repair & Repaint Structural Steel	70	92									
Roof Replacement & Restoration	180										
Marine Terminal Fender Repairs		31									
Coat Int. Liner Panels, Pwhse/CW Pumphouse				128							
Projects - Lump Sum for Future Years						178	182	187	191	195	
Total – Buildings and Grounds	**894**	**692**	**581**	**615**	**498**	**687**	**702**	**718**	**734**	**750**	
Total Operating Projects Buildings and Grounds	436	224	104	128		178	182	187	191	195	

(1) 178 - Average Project Cost 2006 to 2010 (plus escalation)

APPENDIX 7											
	($000)										
WT Plant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	53	54	55	56	57	59	60	61	63	64	
Corrective	105	107	110	112	114	117	119	122	125	128	
Operating Projects											
Replace Acid Lines on Skids	18										
Unit #2 Condensate Polisher Resin	65										
Unit #1 Condensate Polisher Resin				72							
Unit #3 Condensate Polisher Resin					75						
Water Treatment Plant “A” Train Resin					50						
Projects - Lump Sum for Future Years						56	57	59	60	61	
Total WT Plant and Environmental	**241**	**161**	**164**	**240**	**297**	**231**	**237**	**242**	**247**	**253**	
Total Operating Projects WT Plant	83			72	125	56	57	59	60	61	

(1) 56 - Average Project Cost 2006 to 2010 (plus escalation)

APPENDIX 8											
	($000)										
Waste Water Treatment Plant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly	1	1	1	1	1	1	1	1	1	1	
Corrective	4	4	4	4	4	4	5	5	5	5	
Operating Projects											
WWTP Periodic Basin Cleaning & Inspection	13		14	14							
110V AC Power Supply to Landfill			18								
Filter Fabric Replacement-Plat Press			6								
Projects - Lump Sum for Future Years						13	13	13	14	14	
Total WWT Plant	**18**	**5**	**43**	**19**	**6**	**19**	**19**	**19**	**20**	**20**	
Total Operating Projects WWT Plant	13		37	14		13	13	13	14	14	

(1) 13 - Average Project Cost 2006 to 2010 (plus escalation)

APPENDIX 9											
	($000)										
Environmental Monitoring	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preventive – Yearly											
Corrective	21	21	22	22	23	23	24	24	25	25	
Operating Projects											
Emissions Monitoring	150	153	156	159	163						
Projects - Lump Sum for Future Years						156	160	163	167	171	
Total Environmental Monitoring	**171**	**175**	**178**	**182**	**186**	**180**	**184**	**188**	**192**	**196**	
Total Operating Projects Env. Monitoring	150	153	156	159	163	156	160	163	167	171	

(1) 156 - Average Project Cost 2006 to 2010 (plus escalation)