Q. Please provide a copy of Hydro's five year capital and operating project plans for its Bay d'Espoir, Exploits, and Holyrood production assets for 2018.

A. For the capital and operating project plans for the Hydraulic Production Assets please refer to PUB-NLH-008, Attachments 1 to 4, current as of the fourth quarter of 2018.

- PUB-NLH-008, Attachment 1: Hydraulic Generation 5-year Capital Plan;
- PUB-NLH-008, Attachment 2: Hydraulic Generation 5-year Operating Plan;
- PUB-NLH-008, Attachment 3: Exploits Generation 5-year Capital Plan; and
- PUB-NLH-008, Attachment 4: Exploits Generation 5-year Operating Plan.

For the capital project plans for the Holyrood Thermal Generating Station Assets please refer to PUB-NLH-008, Attachment 5, current as of the fourth quarter of 2018.

- PUB-NLH-008, Attachment 5: "Newfoundland and Labrador Hydro Holyrood Thermal Generating Station Long Term Asset Planning – Master List."

Please refer to PUB-NLH-008, Attachment 6 for Hydro's operating plans for Holyrood, as filed in the 2019 Capital Budget Application.

- PUB-NLH-008, Attachment 6: "Plan of Projected Operating Maintenance Expenditures – 2019 – 2028 – For Holyrood Generating Station"

The plans are developed by the generation facilities Long-Term Asset Planning team.

NEWFOUNDLAND AND LABRADOR HYDRO
HYDRO GENERATION CAPITAL LONG-TERM ASSET PLANNING
MASTER LIST

PROJECT DESCRIPTION

GENERATION	
A. HYDRAULIC PLANTS	**1293, 1290, 1284, 1281**

2020

Hydraulic Generation Refurbishment and Modernization (2019-20)
Refurbish Hydraulic Structures - BDE (2019-20)
Replace Units 1-6 Generator Bearing Cover Seals - BDE
Replace T/G Cooling Water Pump and Strainer - HLK
Replace Drainage Pumps - HLK, PRV
Refurbish Generator Rotor - HLK
Stand Alone
Replace Exciter Controls Units 1 to 6 - BDE

Hydraulic Generation Refurbishment and Modernization
Upgrade Public Safety Around Dams and Waterways - BDE
Overhaul Unit 2 - CAT
Refurbish Hydraulic Structures - Various (2020-21)
Refurbish / Replace Sump Pumps - USL
Upgrade Sump Level System - Various
Install Partial Discharge Continuous Monitors - HLK, CAT, GCL
Refurbish Access Road to Ebbegunbaeg - BDE
Rewind Unit 5 Generator Rotors and Stators - BDE
Replace Diesel Generator 2 at Victoria Control Structure - BDE
Install Remote Seepage Monitoring System - BDE
Replace Condition Monitoring Equipment (Year 3 of 3) - BDE
Replace Control Cable PH1 - BDE (2020)
Upgrade Bear Brook Crosssing - BDE
Install Frazil Ice Forecasting System - USL
Replace Turbine Generator Control and Vibration Monitoring Systems - PRV
Stand Alone
Hydraulic Inservice Failures (2020)
Penstock Level II Condition Assessment - CAT

2021

Hydraulic Generation Refurbishment and Modernization
Upgrade Public Safety Around Dams and Waterways - BDE
Overhaul Unit 5 - BDE
Overhaul Unit - PRV
Refurbish Hydraulic Structures - Various (2021-22)
Upgrade Generator Bearings - BDE (2021)
Rewind Unit 6 Generator Rotors and Stators - BDE
Replace Network Switches for ABB RTU's - GCL
Install Trashrake System at Intake/Control Structure - HLK
Replace Sump Pump #3 - HLK
Replace Diesel Fuel Tank #2 and #3 at Burnt Dam - BDE
Replace Underground Oily Water Separator - BDE
Replace Control Cable in PH2 - BDE
Refurbish Station Service Transformer - CAT
Refurbish Draft Tube Deck (Phase 2) - BDE
Resurface All On Site Roads - BDE
Refurbish Turbine - BDE (2021)
Replace Control Cable PH1 - BDE (2021)
Replace Monorail Beams & Associated Mounts SRS - BDE
Replace Unit Controller (Phase 2) - GCL (NEW)
Penstock Life Extension (Phase 1) - BDE
Stand Alone
Hydraulic Inservice Failures (2021)

2022

Hydraulic Generation Refurbishment and Modernization
Upgrade Public Safety Around Dams and Waterways - BDE
Overhaul Unit 7 - BDE
Overhaul Unit 6 - BDE
Refurbish Hydraulic Structures - Various (2022-23)
Upgrade Generator Bearings - BDE (2022)
Install Domestic Water Filtration System - USL
Replace Annunciators - BDE
Purchase and Install Trashrake System at Intake - CAT
Refurbish Mechanical Governers - BDE (2022-28)
Refurbish Rip Rap Material on Main Dam - HLK
Replace Emergency Diesel Generator - USL
Refurbish Draft Tube Deck (Phase 3) - BDE
Replace Rotary Strainer - USL

NEWFOUNDLAND AND LABRADOR HYDRO
HYDRO GENERATION CAPITAL LONG-TERM ASSET PLANNING
MASTER LIST

PROJECT DESCRIPTION

Refurbish Draft Tube Structure and Decking, Unit 7 - BDE
Resurface Access Road and Intake - PRV
Install Dynamic Air Gap Monitoring System - USL, HLK (part 2)
Replace Units 5-7 Flow Measuring Devices - BDE
Refurbish Turbine - BDE (2022)
Stabilize Powerhouse Slope (Phase 2) - CAT
Replace Control Cable PH1 - BDE (2022)
Replace PH1 Control Room Air Conditioner - BDE
Stand Alone
Hydraulic Inservice Failures (2022)

2023

Hydraulic Generation Refurbishment and Modernization
Upgrade Public Safety Around Dams and Waterways - BDE
Overhaul Unit 3 - BDE
Overhaul Unit 4 - BDE
Overhaul Unit 1 - CAT
Refurbish Hydraulic Structures - Various (2023-24)
Replace Condition Monitoring Equipment - PRV
Replace PH2 HP Air Compressor #1 - BDE
Replace Cooling Water Piping - HLK
Replace Firewater Pumps 1 and 2 - HLK
Stabilize Powerhouse Slope - HLK
Resurface Crest of Power Canal - HLK
Replace EBBE Disel Genset #1 - BDE
Install Burnt Spillway Gatehouse Buidling - BDE
Replace Burnt Dam Septic System - BDE
Replace Cooling Water Pumps - USL
Replace Exciter Unit 7 - BDE
Refurbish Unit 7 Control Board/Panel and Replace Unit Control Cables - BDE
Refurbish Unit 1 Needle Valve Assembly and Purchase Spare Needle - CAT
Refurbish Unit 1 Electronic Governor System, and Auxiliaries - CAT
Replace Surface Air Coolers for Both Units - CAT
Replace Oil Level System - GCL
Refurbish Governor Hydraulic System, Piping, Pumps, and Controls - USL
Replace Campsite Water Storage Tank - BDE
Replace Governor Control Systems - USL & GCL
Replace Firewater Pumps Unit 1 - CAT
Stand Alone
Hydraulic Inservice Failures (2023)

2024

Hydraulic Generation Refurbishment and Modernization
Upgrade Public Safety Around Dams and Waterways - BDE
Hydraulic Generating Unit Overhauls - BDE Unit 2, USL & GCL
Refurbish Hydraulic Structures - Various (2024-25)
Replace PH2 HP Air Compressor #2 - BDE
Replace Office Roof PH1 - BDE
Purchase Six Thrust Brg Coolers Unit 1 to 6 - BDE
Purchase Six Turbine Brg Coolers Unit 1 to 6 - BDE
Replace Powerhouse 1 Control Room A/C Unit - BDE
Rehabilitate Access Roads (ditching, culverts, surface) - HLK
Refurbish EBBE Gatehouse Building - BDE
Install Frazil Ice Detection System at Intake1 - BDE
Refurbish Rip Rap Material on VD-3 (Victoria Dam) - BDE
Replace PH Septic System - USL
~~Replace Firewater Pumps - PRV (CANCEL)~~
Replace Generator Field Breaker Unit 7 - BDE
Refurbish Unit Control Panel/Monitoring System - GCL
Replace/Refurnish PH Station Service Panel - USL
Replace Station Cooling Water Piping/Valves/Controls - USL
Replace Thrust Bearing Segments - USL
Replace Guide Bearing Segments - USL
Construct Office Complex for Powerhouse Staff Year (1 of 3) - BDE
Refurbish Governor Controls and Hydraulics - USL
Stand Alone
Hydraulic Inservice Failures (2024)

Hydro Generation Operating Project Plan (Regulated)
2019
Dam Safety Review Program (USL exceot SD2, GCL, Goodyear, MDBC)
DSR Recommendations
Eclipse Dam - Dam Break Study, including flood inundation maps
Pudops Dam - Dam Break Study, including flood inundation maps
BDE - Vegetation Control Program
BDE - Road maintenance
BDE - SAC Retubing
BDE - P1-3 Internal Inspection
GCL - Unit Controller Condition Assessment
BDE - Bear Brook Bridge Restoration
Burnt Dam - Attendance Analysis (Phase 2)
Operating Total
2020
Dam Safety Review Program (Cat Arm, Snooks Main Dam)
DSR Recommendations
Dam Break Study - Various
Overhead Crane Recommendations
Dismantle Victoria Spillway superstructure
Data Acquisition
Vegetation Control Program - Hydro Generation
BDE Road maintenance
Bridge Inspections PM9 - GCL, CAT
HLK replace compressed air controls
Assessment of CAT, HLK, USL and GCL Rotary Strainer
Evaluation of all bridges on Hydro Generation Access Roads
Operating Total
2021
Dam Safety Review Program (Cat Arm, Snooks Main Dam)
DSR Recommendations
Dam Break Study - Various
Overhead Crane Recommendations
Data Acquisition
Vegetation Control Program - Hydro Generation
BDE Road maintenance
HLK Cooling Water Piping Assessment
HLK PH Slope Stabolization Assessment
HLK Power Canal Crest condition Assessment
BDE - Burnt Dam septic system condition assessment
USL Powerhouse Alkali-Silica-Reativity (ASR) Study
Operating Total

2022
Dam Safety Review Program (Cat Arm, Snooks Main Dam)
DSR Recommendations
Dam Break Study - Various
Overhead Crane Recommendations
GCL Exciter condition assessment
BDE Mechanical Governor Condition Assessment
Vegetation Control Program - Hydro Generation
BDE Road maintenance
Operating Total
2023
Dam Safety Review Program (Cat Arm, Snooks Main Dam)
DSR Recommendations
Dam Break Study - Various
Overhead Crane Recommendations
Vegetation Control Program - Hydro Generation
BDE Road maintenance

Activity ID	Project Description
2017 PROJECT CARRY-OVERS	
	BF Dam Public Safety Enhancements
	Goodyears Dam Replacement - Engineering
2018 PROJECT CARRY-OVERS	
Grand Falls	
GF4	
A1451	GF4 Switchgear and Cell Replacement - Year 2 of 2
GF5-8	
A1071	GF5-8 Building Crane Civil Enhancements Phase 2
GF Dams	
A1420	GF Fishway Flume System Rebuild & Automation
Comm	
A1320	GF Gen Station Standby Diesel/13.8 kV Backup Station Service - Year 2 of 2 (Construction)
A1480	GF Automation Equipment (PLC) Upgrades - Converter Building Year 2 of 2 (Construction)
Bishop Falls	
BF 1-7	
A1520	BF Switchgear Replacement - Year 2 of 2 (Construction)
BF Common	
NEW	BF Cooling water piping replacement
BF Dams	
A1720	BF Spillway Gates Assessment (Engineering)
Millertown Dam	
A1330	Dam Public Safety Review (Millertown, Buchans, NT & ST)

2019 Capital Plan	
Grand Falls	
GF5-8	
A1240	GF5-8 Basement Upgrade - Year 1 of 2 (Engineering)
A3050	GF5-8 Tailrace Upgrade - Year 1 of 2 (Engineering)
NEW	GF5-8 Penstock Repairs and Concrete Rehab. - Year 2 of 2 (Construction)
GF9 (Beeton)	
A1640	Intake Gate Hoist Rebuild & Hoist Cover Repair - Year 2 of 2 (Construction)
Dams	
A1470	GF Public Safety Measures - Year 1 of 2
A2100	GF Inside & Outside Spill Gate Rebuild and Concrete Repairs - Year 1 of 3 (Design and Fabricate Stoplogs)
Comm	
A1250	GF Gen Room Automation (PLC) Upgrade - Year 2 of 2 (Construction)
NEW	GF Fire Detection System - Upgrade
Bishop Falls	
BF 1-7	
A1152	BF Unit 1-7 Generator Control PLCs - Year 1 (Engineering)
Comm	
A1141	BF Turbine Chamber Emergency Closure Gates (Engineering)
NEW	BF Spillway Gantry Crane Refurbishment - Year 1 of 2 (Engineering)
Dams	
NEW	BF Wing Dam - Reinstate Rip Rap on Upstream Slope
Millertown	
A1550	Dam Public Safety Upgrade (Millertown, Buchans, NT & ST) - Year 1 of 2
A1950	Spillgate Refurbishment - Year 1 of 3 (Engineering + Stoplogs)
2020 Capital Plan	
Grand Falls	
Dams	
A1470	GF Public Safety Measures - Year 2 of 2
A1680	GF Inside & Outside Spill Gate Rebuild and Concrete Repairs - Year 2 of 3 (Detailed inspection of existing & eng.)
Comm	
A3210	GF Intake #2 and #4 Improvements - Year 1 of 2 (Engineering)
Bishop Falls	
Comm	
NEW	BF Spillway Gantry Crane Refurbishment - Year 2 of 2 (Construction)
Millertown	
A2180	Spillgate Refurbishment - Year 2 of 3 (Construction)
A3320	Public Safety Upgrade (Millertown, Buchans, NT & ST) - Year 2 of 2

2021	
Grand Falls	
Comm	
A2960	GF Inside & Outside Spill Gate Rebuild and Concrete Repairs - Year 3 of 3 (Construction)
A3340	GF Intake #2 and #4 Improvements - Year 2 of 2 (Construction)
NEW	GF Converter Building - Reconfiguration of breakers and refurbishment - Year 1 of 2 (Engineering)
NEW	Fleet Management - Vehicle Replacement
A3290	GFP Replace Fireline Piping
NEW	Fleet Management - Vehicle Replacement
Bishop Falls	
BF 1-7	
NEW	BF1-7 Exciter Replacement - Year 1 of 2 (Engineering)
BF 1-7	
A3230	BF Units 1-7 Generator Control PLCs - Year 2 (Construction)
Comm	
A3130	BF Spillway Gate Refurbishment - Year 1 of 3 (Construction)
NEW	BFP Powerhouse Concrete Repairs and waterproofing
NEW	BFP - Upgrades to plant unwatering and oil seperator system
A1380	BF Forebay Inlet Gates Coatings, Repairs and Dogging System - Year 1 of 2 (Engineering)
Millertown	
A3010	Millertown Dam - Condition Assessment of Submerged Gates
A3020	Spillgate Refurbishment - Year 3 of 3 (Construction)
Goodyear's Dam	
A3140	Goodyear's Dam Replacement - Year 1 of 2 (Construction)
2022	
Grand Falls	
GF4	
NEW	GF4 Penstock Coating - Year 1 of 2 (Engineering)
Comm	
NEW	GF Converter Building - Reconfig. of breakers and refurbishment - Year 2 of 2 (Construction)
Bishop Falls	
BF 1-7	
NEW	BF1-7 Exciter Replacement - Year 2 of 2 (Construction)
Comm	
A3360	BF Spillway Gate Refurbishment - Year 2 of 3
A1380	BF Forebay Inlet Gates Coatings, Repairs and Dogging System - Year 2 of 2 (Construction)
Millertown	
NEW	Electrical Distribution & Control Upgrade - Year 1 of 2 (Engineering & Procurement)
NEW	Millertown Dam - Submerged Gates Refurbishment - Year 1 of 2 (Engineering)
North Twin Lake Dam	
A2900	Dam Refurbishment (to accommodate IDF) - Year 1 of 2 (Eng)
South Twin Lake Dam	
A2800	Dam Refurbishment (to accommodate IDF) - Year 1 of 2 (Eng)
Goodyear's Dam	
A3140	Goodyear's Dam Replacement - Year 2 of 2 (Construction)

2023	
Grand Falls	
GF5-8	
A1440	GF5-8 Tailrace Upgrade - Year 2 of 2 (Construction)
A3120	GF5-8 Basement Upgrade - Year 2 of 2 (Construction)
Comm	
A2670	Old Forebay Concrete Gravity Section, Gates, and Power Canal Embankment - Major refurbishment/replacement - Engineering (Dewatering of Power Canal required)
NEW	GFP - Plant dewatering and oil seperation improvements - Engineering Study
Bishop Falls	
Comm	
A1143	BF Turbine Chamber Emergency Closure Gates Year 2 of 5
A3360	BF Spillway Gate Refurbishment - Year 3 of 3
A2770	SCADA Improvements - Year 1 of 2 (Engineering)
Millertown	
NEW	Electrical Distribution & Control Upgrade - Year 2 of 2 (Construction)
2024	
Grand Falls	
GF4	
A2600	GF4 - Inspect Penstock and Draft Tube
GF9	
NEW	GF9 - Perform Capital Level Condition Assessment - Unit, Penstock, Drafttube
GF9 (Beeton)	
A2920	GF9 - Stator Pit Access
A2930	GF9 - Improve Ventilation Lower Levels
GF5-8	
A2610	GF5-8 Inspect Penstock
Bishop Falls	
Comm	
A1143	BF Turbine Chamber Emergency Closure Gates Year 3 of 5
A2710	Forebay Intake Concrete Gravity Section - Major refurbishment - Engineering
Millertown	
NEW	Millertown Accomodations - renovation and plumbing upgrades
NEW	Millertown Dam - Submerged Gates Refurbishment - Year 2 of 2 (Construction)
North Twin Lake Dam	
A2900	Dam Refurbishment (to accommodate IDF) - Year 2 of 2 (Construction)
South Twin Lake Dam	
A2800	Dam Refurbishment (to accommodate IDF) - Year 2 of 2 (Construction)

Listing of Potential Operating Projects

Project #	Title
Project Year - 2019	
1	Block Bin Demolition - Year 1
2	GF9 - Install PD Couplers
3	DSR and stability analysis for Millertown and BF
4	GFP Intake improvements - Conceptual Design and Cost Estimate.
5	Painting Program
6	Exploits Vegetation Program
7	GFP - PI Data Monitoring
8	BFP - Chamber Concrete repairs
9	EMS Systems / Contaminated Sites Management Program
Project Year - 2020	
1	Block Bin Demolition - Year 2
2	Painting Program
3	Exploits Vegetation Program
4	BFP - Chamber Concrete repairs
5	EMS Systems / Contaminated Sites Management Program
Project Year - 2021	
1	Block Bin Demolition - Year 2
2	Painting Program
3	Exploits Vegetation Program
4	BFP - Chamber Concrete repairs
5	EMS Systems / Contaminated Sites Management Program
Project Year - 2023	
1	Millertown DSR
Project Year - 2024	
1	Grand Falls and Goodyear's Dam DSR

NEWFOUNDLAND AND LABRADOR HYDRO
HOLYROOD THERMAL GENERATING STATION
LONG TERM ASSET PLANNING - MASTER LIST

PROJECT DESCRIPTION

GENERATION

B. THERMAL PLANTS 1296, 1297

2020

Rewind Unit 3 Stator - HRD
Upgrade UPS 1 & 2 - HRD
Upgrade UPS 3 & 4 - HRD
Thermal In-Service Failures (2020)

2021

Replace One of North or South Instrument Air Receiver System Unit 3 - HRD
Replace One of North or South Service Air Receivers Unit 3 - HRD
Upgrade Property Fencing - HRD
Replace Stage II Electrical Distribution Equipment - HRD
Upgrade Waste Water Basin Building - HRD
Thermal In-Service Failures (2021)

2022

Upgrade On Site Roads - HRD
Upgrade Fire System - HRD
Inspect and Upgrade Light Oil System - HRD
Upgrade Bio-Green/Sewage Treatment System - HRD
Replace Unit 3 Generator (slip rings, bushings, bearings, etc.) - HRD
Replace Unit 3 Protective Relaying - HRD
Overhaul Unit 3 Generator - HRD
Replace Stage 1 4160V AC Breakers - HRD
Install New Lube Oil / Seal Oil Systems Unit 3 - HRD
Replace High Bay Lighting with LED - HRD (NEW)
Thermal In-Service Failures (2022)

2023

Upgrade Holyrood Training Centre - HRD
Refurbish Stage 2 Cooling Water Pumphouse - HRD
Upgrade Cooling Water Sys. Wet Well Stop Log Unit 3 - HRD
Thermal In-Service Failures (2023)

2024

Upgrade Water Treatment Plant - HRD (if required for H2 electrolyzer)
Thermal In-Service Failures (2024)

Plan of Projected Operating Maintenance Expenditures

2019 – 2028

For Holyrood Generating Station

July 2018

newfoundland labrador hydro
a nalcor energy company

Table of Contents

Appendices

1.0 Introduction

In Order No. P. U. 14(2004), the Board of Commissioners of Public Utilities (the Board), directed Newfoundland and Labrador Hydro (Hydro) to **"**file a ten year plan of maintenance expenditures for the Holyrood Generating Station (Holyrood) with its annual capital budget application, until otherwise directed by the Board."[1] As this requirement is specifically related to system equipment maintenance (SEM) costs, non-maintenance SEM costs and capital expenditures have not been included in the following report. Capital expenditures for the Holyrood plant are submitted annually to the Board with other Hydro capital proposals as part of the annual capital budget application, as well as in the Holyrood Overview.

This report addresses the identified and expected maintenance expenditures for the years 2019 to 2028 inclusive. With respect to these expenditures, it should be noted that Units 1 and 2, as well as two of the main fuel storage tanks and other associated ancillary equipment, have been in service for 48 years and that Unit 3 and its associated equipment have been in service for 38 years. While many components of this equipment have been replaced and additional items added through the maintenance and capital program over the years, numerous pieces of equipment and components are original.

An accurate, uniform ten-year plan of SEM is difficult to complete. The harsh operating environment, evolving production requirements, and the age of units may trigger revision of the maintenance plan to address unforeseen events. Even though expenses for major overhauls are included in capital, some variability in the annual budget will remain as a result of the complexity of numerous components and integrated systems that form a fossil fuel fired thermal electric generating system. This report will endeavor to identify the regular variations in the annual operating costs for Holyrood.

[1] Board Order No. P.U. 14(2004), at page 166.

2.0 Maintenance Philosophy

In Order No. P. U. 14(2004), the Board stated that "The Board will require NLH's ten-year plan of maintenance expenditures for the Holyrood Generating Station to be updated annually to reflect changing operating circumstances."[2]

Maintenance efforts aim to prevent functional failure and extend the operational life of assets, helping to minimize total asset life cycle cost. The type and amount of maintenance applied is dependent on the criticality of the asset and the impact of failure on service delivery. Hydro seeks to balance the cost of maintenance against the cost of failure and the impact on safe, reliable service when applying maintenance strategies and tactics. There are four main types or categories of maintenance undertaken at Holyrood, including: preventive maintenance; corrective maintenance; boiler overhauls; and operating projects.

2.1 Preventive Maintenance

Holyrood 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 that may cause a substantial safety exposure, an extended unavailability of the unit or system, or an increase in cost.

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

[2] Board Order No. P.U. 14(2004), at page 64.

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 and 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 overhauls, 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).

Since 2008, the Preventive Maintenance Program has been enhanced to include the extra costs associated with plant cleaning in areas where asbestos and heavy metals have been identified as potential health hazards.

2.2 Corrective Maintenance

In addition to the preventive maintenance techniques outlined above, there are also corrective maintenance requirements. This includes work performed to identify, isolate and restore equipment, machines or systems to a level in which it can be operated safely and used for its intended purpose. The requirement of corrective maintenance may arise for various reasons including failure, wear and tear, and harsh environments such as humid or salt laden air. Examples of corrective maintenance include wear and tear on pumps, pipes, and valves in the main and auxiliary systems.

2.3 Boiler Overhauls

Boiler overhauls consist of the maintenance and refurbishment work required to ensure reliable boiler operation for the upcoming season. Overhauls include packages of standard work, defined work, and as-found work. Standard work covers activities that are predictable and required on an annual basis due to normal operation, wear and tear. Defined work represents planned, specific activities that do not normally occur on an annual basis and addresses issues identified from prior condition inspections and trending. As-found work covers unforeseen issues identified during an ongoing overhaul. In some cases the nature of defined work meets criteria for capitalization, and in such cases is not included in SEM.

2.4 Operating Projects

Operating projects are low cost repairs and annual inspections that are required to return structures and equipment to their original or near original operability, to maintain structural integrity, improve efficiency, improve availability, and prevent or reduce environmental risks. Such projects include emissions monitoring and testing, and periodic basin cleaning in the Waste Water Treatment Plant.

3.0 Cost Variability

Preventive maintenance costs are generally incurred annually at a constant level and do not fluctuate significantly. This principle does not apply to corrective maintenance costs, which are unavoidable and unpredictable due to the changing energy production demands on the units from year to year. Due to accounting methodology changes approved in Order P.U. 13(2012), major overhauls and inspections with a frequency of greater than one year are capitalized, reducing the fluctuation in maintenance expenditures that were experienced in prior periods. Projects for Holyrood 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. The five-year maintenance plan is updated on a regular basis to reflect any shifts in priority.

4.0 Detailed Analysis

Appendices A through D set out the ten-year maintenance plan for Holyrood. Appendix A is a summary that outlines the expected expenditures in each of the major equipment groupings containing SEM costs for the years 2019 to 2028. Appendices B through D, inclusive, show the expected SEM costs categorized according to Preventive, Corrective, Annual Overhauls, and Operating Projects for each of the major equipment groupings containing SEM costs.

Appendix B lists the categories of SEM costs for generating units for the years 2019 to 2028 in each of the major equipment groupings. The categories listed are:

- **Preventive**: Routine preventive maintenance activities carried out every year.
- **Corrective**: Typical but unknown breakdown/emergency repairs carried out during the year.
- **Boiler**: Boiler overhauls carried out annually with one unit per year overhauled on a reduced scope as a result of better fuel quality. For 2020 and 2021, all boiler overhauls are expected to be on a reduced scope. No boiler overhauls are expected beyond 2021.
- **Operating Projects**: Non-capitalized projects justified on the basis of safety, environment, reliability, or cost benefit analysis.

Appendices C and D provide a listing of the remaining equipment groupings, including Common Equipment, Building and Grounds, Water Treatment Plant, Waste Water Treatment Plant and Environmental Monitoring and use only Preventive, Corrective, and Operating Projects.

It should be noted that this ten-year plan spans the period during which the role of Holyrood will change as a result of the interconnection between Labrador and the Island. These events significantly impact cost and activity levels for Holyrood for the standby period and for the synchronous condenser period, as reflected in this plan. Generation from the Holyrood Thermal Generation Plant has already started to reduce as a result of the availability of the Labrador Island Transmission Link and the Maritime Link. The units at Holyrood will start to be placed in standby mode as these systems are fully proven to be ready for reliable service, and units at

Muskrat Falls are brought on-line. The timing of the final shut down and repurposing of the Holyrood plant will be made once commissioning of the infrastructure related to the Muskrat Falls Project is complete in 2020 and reliable service has been demonstrated over the following winter period. This is anticipated to occur in the 2020/2021 timeframe. For the purposes of projecting operating costs in this report, a placeholder assumption has been made that the standby phase begins in 2018 and continues into 2021. Delivery of power and energy via the Labrador Island Transmission Link started in 2018, but remains limited to available recall power from Churchill Falls as the Muskrat Falls powerhouse is not yet in service.

Hydro does not normally use any escalation in its five-year operating plan at the Plant or regional level as the five-year plan is primarily used for internal purposes and generation of work plans rather than detailed financial planning. However, in the attached ten-year plan, a single escalation factor of 2.5% per year has been used for 2019 to 2028 based on an average rate from Hydro's current corporate assumptions.

It should be noted that the appendices do not itemize preventive and corrective items. The preventive maintenance program consists of approximately 1,500 preventive maintenance work orders performed on plant equipment annually. Corrective items include a large number of low cost projects, the majority of which are largely unknown until they happen; thus, it is not practical to provide a breakout of the costs.

5.0 Summary

This Plan is based on the 2019 budget for system equipment and adjusted for future years using the best available information including up to date maintenance tactics and known restoration and inspection work to establish a ten-year forecast of the maintenance projects for the Holyrood Plant. As with any forecast, it is subject to change depending on the operating demands of the plant, the results of inspections and assessments of changing equipment conditions.

Appendix A

Total Holyrood 10 Year SEM Expenditures ($000s)

	Base Year 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Unit 1 Total SEM	$1,871	$996	$258	$0	$0	$0	$0	$0	$0	$0
Unit 2 Total SEM	$1,420	$1,092	$258	$0	$0	$0	$0	$0	$0	$0
Unit 3 Total SEM	$1,880	$1,003	$262	$268	$275	$282	$289	$296	$303	$311
Common Equipment Total SEM	$1,820	$1,399	$673	$690	$707	$725	$743	$762	$781	$800
Buildings & Grounds Total SEM	$282	$289	$297	$304	$312	$319	$327	$336	$344	$353
WT Plant Total SEM	$57	$58	$20	$21	$21	$22	$22	$23	$23	$24
WWT Plant Total SEM	$10	$8	$8	$8	$8	$8	$9	$9	$9	$9
Environmental Monitoring Total SEM	$112	$115	$115	$118	$121	$124	$127	$130	$133	$137
Total Operating Projects	$241	$118	$61	$0	$33	$150	$35	$0	$37	$0
Total Holyrood SEM	**$7,694**	**$5,079**	**$1,952**	**$1,408**	**$1,477**	**$1,630**	**$1,551**	**$1,555**	**$1,630**	**$1,633**

Appendix B

10 Year SEM Expenditures for Generating Units ($000s)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Unit No. 1										
Preventive	385	296	138	0	0	0	0	0	0	0
Corrective	335	258	120	0	0	0	0	0	0	0
Boiler O/H	1,151	442	0	0	0	0	0	0	0	0
Subtotal	1,871	996	258	0	0	0	0	0	0	0
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 1	0	0	0	0	0	0	0	0	0	0
Total - Unit No. 1	**1,871**	**996**	**258**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Unit No. 2										
Preventive	385	296	138	0	0	0	0	0	0	0
Corrective	335	258	120	0	0	0	0	0	0	0
Boiler O/H	700	538	0	0	0	0	0	0	0	0
Subtotal	**1,420**	**1,092**	**258**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 2	0	0	0	0	0	0	0	0	0	0
Total - Unit No. 2	**1,420**	**1,092**	**258**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Unit No. 3										
Preventive	390	300	140	143	147	150	154	158	162	166
Corrective	339	261	122	125	128	131	135	138	141	145
Boiler O/H	1,151	442	0	0	0	0	0	0	0	0
Subtotal	**1,880**	**1,003**	**262**	**268**	**275**	**282**	**289**	**296**	**303**	**311**
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 3	0	0	0	0	0	0	0	0	0	0
Total - Unit No. 3	**1,880**	**1,003**	**262**	**268**	**275**	**282**	**289**	**296**	**303**	**311**

Appendix C

10 Year SEM Expenditures for Ancillary Units ($000s)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Common Equipment										
Preventive	1,635	1,257	597	608	623	639	655	671	688	705
Corrective	185	142	76	82	84	86	88	91	93	95
Subtotal	**1,820**	**1,399**	**673**	**690**	**707**	**725**	**743**	**762**	**781**	**800**
Operating Projects										
Total Op Projects - Common	0	0	0	0	0	0	0	0	0	0
Total - Common Equipment	**1,820**	**1,399**	**673**	**690**	**707**	**725**	**743**	**762**	**781**	**800**
Buildings & Grounds										
Preventive	260	267	273	280	287	294	302	309	317	325
Corrective	22	23	23	24	24	25	26	26	27	28
Subtotal	**282**	**289**	**297**	**304**	**312**	**319**	**327**	**336**	**344**	**353**
Operating Projects										
Total Op Projects - Bldgs & Grounds	0	0	0	0	0	0	0	0	0	0
Total - Bldgs & Grounds	**282**	**289**	**297**	**304**	**312**	**319**	**327**	**336**	**344**	**353**
Water Treatment Plant										
Preventive	32	33	11	11	12	12	12	12	13	13
Corrective	25	26	9	9	9	10	10	10	10	11
Subtotal	**57**	**58**	**20**	**21**	**21**	**22**	**22**	**23**	**23**	**24**
Operating Projects										
Resin Replacement	82	63	29	0	0	0	0	0	0	0
Total Op Projects - WTP	82	63	29	0	0	0	0	0	0	0
Total - Water Treatment Plant	**139**	**121**	**49**	**21**	**21**	**22**	**22**	**23**	**23**	**24**

Appendix D

10 Year SEM Expenditures for Ancillary Units ($000s)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Environmental Monitoring										
Preventive	16.00	16.40	16.40	16.81	17.23	17.66	18.10	18.56	19.02	19.49
Corrective	96.26	98.66	98.66	101.13	103.66	106.25	108.90	111.63	114.42	117.28
Subtotal	**112.26**	**115.06**	**115.06**	**117.94**	**120.89**	**123.91**	**127.01**	**130.18**	**133.44**	**136.77**
Operating Projects										
Thermal Plant	54.00	55.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GT and Diesel Plant	30.00		31.52		33.11		34.79		36.55	
Total Op Projects - Environment	84.00	55.35	31.52	0.00	33.11	0.00	34.79	0.00	36.55	0.00
Total - Environmental Monitoring	**196.26**	**170.41**	**146.58**	**117.94**	**154.00**	**123.91**	**161.80**	**130.18**	**169.99**	**136.77**
Waste Water Treatment Plant										
Preventive	5.04	3.88	4.00	4.00	4.10	4.20	4.31	4.42	4.53	4.64
Corrective	5.04	3.88	4.00	4.00	4.10	4.20	4.31	4.42	4.53	4.64
Subtotal	**10.09**	**7.75**	**8.00**	**8.00**	**8.20**	**8.41**	**8.62**	**8.83**	**9.05**	**9.28**
Operating Projects										
WWTP Periodic Basin Cleaning						150.00				
WWTP Continuous Basin Clean-Out	75.00									
Total Op Projects - WWTP	75.00	0.00	0.00	0.00	0.00	150.00	0.00	0.00	0.00	0.00
Total - Waste Water Treatment	**85.09**	**7.75**	**8.00**	**8.00**	**8.20**	**158.41**	**8.62**	**8.83**	**9.05**	**9.28**