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June 16, 2014

The Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, Newfoundland & Labrador
A1A 5B2

Attention: Ms. Cheryl Blundon
Director Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: The Board's Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnection System

In accordance with the Board's Interim Report dated May 15, 2014, wherein the Board required the filing of reports on today's date with respect to the above noted matter, please find enclosed the original plus 12 copies of Hydro's:

- Hydro Place Emergency Power Report;
- Protection and Control Systems Report;
- Terminal Station and P&C Resource Requirements Report;
- Terminal Station Transformers Report; and
- Generation Availability Report.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Geoffrey P. Young
Senior Legal Counsel

GPY/cp

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Sheryl Nisenbaum – Praxair Canada Inc.
Roberta Frampton Benefiel – Grand Riverkeeper Labrador
Thomas Johnson – Consumer Advocate
Thomas O' Reilly – Cox & Palmer
Danny Dumaresque

Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System

REPORT TO THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES RELATED TO GENERATION AVAILABILITY

Newfoundland and Labrador Hydro

June 16, 2014

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Appendices:

1 BACKGROUND AND INTRODUCTION

Unplanned reductions in the availability of energy from Hydro's island generation sources during the latter part of December, 2013 and into early January, 2014 were a significant factor in the supply disruptions and power outages which occurred on the island interconnected system in January, 2014. The most significant of these occurred at the Holyrood Thermal Generating Station and with Hydro's combustion turbines located in Hardwoods and in Stephenville.

Hydro's internal review and investigation identified a number of actions to be taken to address the factors which caused the unavailability of these units, and to ensure maximum reliability of its system before the next winter season in 2014/15. Several of these recommendations were identified as key priority actions, and work has been ongoing to ensure that all necessary maintenance and other work is completed in 2014.

In their review on behalf of the Board of Commissioners of Public Utilities (PUB), Liberty Consulting (Liberty) made a number of recommendations with a view to improving generation availability at Hydro. Several of these were similar to or the same as those identified by Hydro, and in any event all Liberty recommendations were adopted by Hydro and integrated into the Company's Integrated Outage Action Plan.

In its Interim Report of May 15, 2014, the PUB reinforced a number of key actions it felt should be taken to ensure generation reliability and winter readiness. This Report is in response to a request by the PUB in its Interim Report that Hydro should file a report by June 16, 2014 in relation to each of the following issues addressing schedule, estimated costs, the resources required, and how these requirements will be met:

a) A generation master plan for winter preparation, including a plan to implement an availability improvement program on all generating assets and its maintenance program for the Holyrood Thermal Generating Station;

b) A plan in relation to critical spares for the Holyrood Thermal Generating Station and the Hardwoods and Stephenville gas turbines; and

c) A plan in relation to securing economically available interruptible loads.

2 GENERATION AVAILABILITY AND WINTER READINESS

2.1 Winter Readiness Assessment

A Winter Readiness Self-Assessment package has been developed to aid in improving winter readiness programs. It will be used to identify the strengths and weaknesses of the existing plans and then used to improve the plans.

Planned activities in the area of winter readiness include:

a) Complete and document Winter Readiness Self-Assessment – July 30, 2014.
b) Prepare winter readiness action plan and complete activities identified prior to November 30, 2014.

2.2 Availability Improvement: Gas Turbines – Stephenville and Hardwoods

The availability improvement program for the two gas turbines, Stephenville and Hardwoods, includes a focus on maintenance, spare parts, repeat failures, fuel storage, and winter readiness. Additionally, planned inspection and life extension activities at the Stephenville Gas Turbine will continue in 2014, 2015 and 2016. The availability of service agreements with major vendors and service providers for dedicated response will also be investigated to improve response times during times of urgency.

2.2.1 Maintenance

Typically, maintenance work priorities start with preventative maintenance (PM) work undertaken on a scheduled basis then critical corrective and scheduled outage/ overhaul/project work. The scope and schedule for PM work has been updated through a structured Asset Maintenance Review Project completed in 2011. It looked externally at leading practices in the utility industry across North America and compared those to Hydro's own practices, adopting or adjusting as appropriate for Hydro's unique operational and environmental context with evaluation performed by roundtable panels of internal experts and frontline maintainers and operators.

Testing, inspection and routine ongoing equipment condition assessment is a key element of identifying potential for developing difficulties. Generally, Hydro utilizes industry standard testing protocols and frequencies. In 2014, Hydro has established a plan to complete identified testing. Improvements in preventative and corrective maintenance (CM) execution will be implemented as part of the 2014 integrated work planning process.

Preparation of the 2014 maintenance execution plan for the gas turbines is ongoing. The annual maintenance plan for 2014 includes planned maintenance and inspection in accordance with the existing maintenance strategy for the gas turbines as well as any outstanding PM and CM work. Additionally, all additional maintenance activities identified through this year's maintenance review process will be completed. All maintenance activities are being planned with required resources identified for completion prior to November 30, 2014.

Planned activities related to maintenance of the gas turbines are:

a) Complete all planned maintenance and inspections on each of the gas turbines (PMs) prior to November 30, 2014.
b) Complete all overdue maintenance on each of the gas turbines (PMs, CMs) prior to November 30, 2014.
c) Complete any additional CMs identified as a result of planned inspections and testing on each of the gas turbines prior to November 30, 2014.
d) Review current maintenance practices and revise as necessary, with changes implemented prior to November 30, 2014.

2.2.2 Capital Execution and Planning

Condition assessment is a key tool in the development of Hydro's asset management plans, using methods such as those developed by the Electric Power Research Institute (EPRI). Hydro has actively been undertaking priority condition assessments to better refine maintenance, refurbishment and replacement requirements and reflect those in long and short term work plans. A condition assessment and life cycle cost analysis of the Hardwoods and Stephenville gas turbines was carried out by Stantec in 2007, and this has been the basis for the planned refurbishment of these facilities.

A refurbishment/life extension project was completed at Hardwoods Gas Turbine through 2010 and 2013. A similar project is being completed at the Stephenville Gas Turbine beginning in 2014. In addition to the planned refurbishment projects, major projects have been completed at both sites as a result of an in-service failure of the alternator at the Stephenville site. The rewind of the Stephenville alternator was completed in June 2013, while the replacement of the alternator at the Hardwoods site was completed in December, 2013. During the extended outages required to complete this work at both sites, additional inspection, testing and maintenance work was carried out. Further to the work already completed, the following activities are planned:

a) Complete 2014 planned capital work – inspection, refurbishment and life extension activities.
b) Plan additional capital work identified through inspection and maintenance.
c) Review and adjust the long term capital plan for gas turbines as necessary based on results of inspection, testing, and refurbishment work completed to date.

2.2.3 Repeat Failures Review

Historically, the gas turbines have suffered from repeat failed starts and trips at both sites as a result of sporadic, small mechanical and electrical equipment issues in balance of plant systems such as the fuel forwarding, compressed air, and glycol cooling systems. The nature of these sporadic operational issues is such that any one issue might result in a failed start or trip on a particular start up but not on the next. The following activities are planned related to repeat failures:

a) Review repeat failures being experienced and identify root causes – August 31, 2014
b) Implement identified solutions - October 31, 2014
c) Continue to monitor on an ongoing basis and address root causes.

2.2.4 Fuel Storage Capacity Review and Fuel Management Procedures

Liquid fuel availability became an issue throughout the island of Newfoundland during the 2013/2014 holiday period and the system event due to the nature of the fuel delivery contracting practices. However, this did not have an incremental impact on gas turbine availability. Hydro has a priority delivery contract, but also manages its requirements so as not to impact other liquid fuel deliveries. Hydro undertook special efforts due to the provincial short supply to secure 80,000 litres from the Canadian Coast Guard.

The recent gas turbine fuel storage practice has been to maintain levels of 60% of tank capacity to increase fuel turnover rates and ensure room for fuel thermal expansion between seasons as a means to minimize risk of spillage. Analysis shows that 80 to 90% storage volume could have been employed which would have allowed for longer operation without a delivery, but would decrease fuel inventory turnover rates under normal circumstances and would need to be carefully monitored in periods of large ambient temperature swings.

The planned activities related to fuel storage capacity review and fuel management procedures are:

a) Review fuel storage requirements, processes and procedures for each gas turbine plant – June 30, 2014; and
b) Review fuel management procedures as required to ensure appropriate fuel storage and availability through the 2014/2015 winter period – July 31, 2014.

2.2.5 Test starts and runs

Since the January 2014 events, Hydro has implemented a protocol for performing test starts of the gas turbines in Stephenville and Hardwoods in advance of all forecasted significant weather events. This is in addition to the monthly test starts which were standard practice prior to January. While Hydro plans to continue these test starts, an assessment of the impacts of increasing the frequency of starting and running the gas turbines prior to severe weather to allow time to identify and correct issues is also planned. This assessment will include the following:

a) Evaluate the frequency, protocol and procedure for test starts to determine the most effective approach to ensure gas turbine availability when called upon – September 30, 2014.

b) Implement and verify the effectiveness of the modified frequency, procedure and protocol for test runs to ensure desired outcomes – October 31, 2014.

2.2.6 Emergency Preparedness and Response

Building on analysis of the events of January 2013 and 2014, Hydro has introduced initiatives to confirm the availability of the gas turbines prior to forecast significant weather events. These initiatives cover the areas of resource availability, equipment readiness checks, test starts, and maintaining site access.

2.2.7 Critical Spares Procurement

Hydro maintains critical spares for all its facilities based on vendor recommendations, as well as operational experience, failure history and equipment condition assessments. Hydro has developed a strategy, framework and process that are consistent with good industry practice for its facilities.

The critical spares plan as it relates to the gas turbines involves the completion of a critical spares review, an assessment of current spares inventory to identify additional spares required, and procurement of necessary critical spares prior to the 2014/2015 winter season, including means to monitor and control inventory levels. Details of the critical spares plan for the gas turbines are presented in Section 3.2.

2.2.8 Vendor Service Agreements

Hydro will be investigating entering into service agreements with gas turbine service and equipment vendors to provide improvements in personnel and parts availability during holidays, weekends and after normal business hours. These agreements would provide for minimum response times for parts and equipment, service calls, and the provision of on-site technical assistance.

2.3 Availability Improvement: Holyrood Thermal Generating Station

The Holyrood Thermal Generating Station is undertaking the following availability improvements with completion planned before November 30, 2014:

1. **Emergency Preparedness** - Initiatives have been introduced based on an analysis of the January, 2014 outage events. These cover the areas of resource availability, critical planned maintenance checks, review of black start procedures, and transportation of critical personnel to site.

2. **Breaker Maintenance** – A 600 Volt and 4160 Volt breaker maintenance refresher course has already been provided to plant electricians. This was followed by a review of the plant outage plan to ensure time was permitted to execute the maintenance tactics consistent with this training. In addition, an outside service provider has been contacted to offer additional technical direction with respect to equipment condition.

3. **Forced Draft (FD) Fan Motors** – Maintenance of these large 4160 Volt motors will be increased. A comprehensive inspection and repair, through a third party service provider, is underway for a minimum of one motor per generating unit prior to November 30 (there are two motors per unit for three units for a total of six). This maintenance work will coincide with the 2014 capital project to install variable speed drives (VSD) on the forced fan (FD) fans of each generating unit.

4. **Unit 2 Turbine Valve (Control Valves/Spindles)** - During the major overhaul of its Unit #2 turbine generator, Hydro will apply a focused level of rigor and inspection to all control valve spindles, upon disassembly. Damaged control valve spindles will be

replaced with the upgraded incolloy material and the feasibility of upgrading all valves will be evaluated.

5. **Critical Spares** – In addition to the updating, identification and procurement of critical spares, which is ongoing (see Section 3.1 for details), there will be the purchase of spare 4160 volt motors as noted below in Section 3.1.

6. **Turbine Generator Lube Oil Systems** – Based on learnings from the Unit No.1 (January 11th, 2013) failure, several corrective actions have been implemented. These include: enhanced operating and maintenance procedures; equipment modification including upgraded start coils for low voltage performance; signage; purchase of a spare DC lube oil pump motor; battery testing; improved on-line system functional checks; and an enhanced repair specification for the motor service contract.

7. **Inspection Test Program (ITP)** – A rigorous inspection test program is maintained to ensure inspection, maintenance and repairs of high pressure components, particularly through the operating season. With aging assets, this program has been expanded to include increased testing of higher risk areas, in addition to the standard program, which will involve condition assessment based on EPRI Guidelines - Level 2 inspections. A consultant has been engaged for risk assessment and work scope identification, and any equipment indications found through the inspections will be addressed.

2.4 Availability Improvement: Hydro Generation

The key focus areas for Hydroelectric Generation facilities are:

a) Critical Spares Strategy;
b) Improved Planning, Scheduling and Work Execution Process; and
c) Vibration Issue at Granite Canal Plant.

2.4.1 Critical Spares

A complete review of asset criticality for the hydroelectric plants was completed early in 2014. The target to complete an analysis of the top 25 percent of critical assets in 2014 is currently on schedule. Additional information is provided in Section 3.3 of this report.

2.4.2 Planning/Scheduling and Work Execution

This is an area of continual improvement for the hydroelectric facilities. The initiatives undertaken by Hydro Generation have included the following:

a) breaking down the annual work plan into monthly plans, and discussing/ adjusting as required;
b) locking down schedules at least two weeks in advance of project start date;
c) establishing plans and complete work as packages (i.e.: dam maintenance, unit maintenance, property, etc.);
d) transferring responsibility of one of the Planners to that of a dedicated Scheduler;
e) improved front end integration and discussion with System Operations and Project Execution and Technical Services departments to develop integrated schedules and work scopes;
f) changing work order processes to provide more flexibility in the field to expedite execution of work; and
g) conducting "project review and close-out meetings" following the completion of any major work to ensure that all required work was completed as scheduled.

2.4.3 Granite Canal Vibration Issue

An analysis of high vibration incidents in the generating unit at the Granite Canal plant has identified a common factor of very cold ambient temperatures. Ice accumulation on the turbine blades is the identified causal factor. An internal investigation is pointing toward an issue with the air admission chamber on the unit. This issue will be investigated during the annual shutdown for inspection and maintenance in August and addressed as required.

3 CRITICAL SPARES PLAN

3.1 Holyrood Thermal Generating Station (HTGS)

To complete the critical spares review, a Consultant has been engaged to provide expertise and the additional resources required. The review will be executed in three phases with Phase 1 (defined as items 1-6 below) currently underway by a project team comprised of consultants and assigned HTGS personnel.

The Critical Spares Review Plan is as follows:

1. Review the existing critical spares review done by the 2011 Condition Assessment Consultants, AMEC, and procure any identified spares which have not been procured to date. This review has started and procurement plans have been initiated.
2. Engage a medium voltage motor manufacturer to provide spare 4 kV motors for forced draft fans, boiler feed pumps, condensate extraction pumps and circulating water pumps. Motors are planned to be in stock at Holyrood by November 30, 2014.
3. Update the HTGS report “Asset Criticality Rankings” (Fall 2013), and revise as necessary in reference to the criteria requiring all three generating units at the HTGS to be fully available to the transmission system at all times for the period December 1 through March 31. A sample extract of these criticality rankings is shown in Appendix A.
4. For each major asset listed in the “Asset Criticality Rankings” report, expand to include a more comprehensive list of assets to be reviewed. For asset criticality and critical spares, an asset is defined as a piece of equipment for which spare parts could be inventoried while a major asset consists of multiple smaller assets. The following is an example of a Major Asset versus an Asset.

   An LP Heater is a Major Asset which consists of Level Controls, Tube Bundles, Safety Valves and Non-Return Valve Assets. A Level Control Asset consists of parts: probes, transmitters, controllers, etc.
5. HTGS personnel will review the preliminary list to confirm progress to date and verify the inclusion of all assets. The list will then be updated as required.

6. For each major asset, on an asset-by-asset basis, review and analyze all assets with respect to generation availability, and score each asset's criticality. The criticality scoring consists of ten factors which are defined in Appendix B, Criticality Definitions.
7. For each critical asset, define all parts into a parts spreadsheet.
8. HTGS personnel will review the parts spreadsheet to confirm progress to date and verify the inclusion of all parts. The list will then be updated as required.
9. For each Asset, on a part-by-part basis, review and analyze all parts to determine spare part criticality. Determine the criticality ranking in accordance to the Critical Spare Decision Diagram, shown in Appendix C, and tabulate the criticality in such a manner that the asset number, name, description and specification can be extracted to form a Bill of Materials (BoM) of all spares.
10. With the finalized critical spares list, review the inventory of stock against the spare parts, presently in stock, and prepare an itemized list of parts which must be procured.
11. Based on the itemized list of critical spares noted above carry out a market investigation to compile a list of potential suppliers of required critical spares. Invite price and delivery estimates from the suppliers to provide the critical spares.

The necessary resources and expertise required to complete the critical spares review may vary over the extent of the work described above. As such, the scope of work has been divided into three phases, with Phase 1 including items 1-6 above, Phase 2 including items 7-9, and Phase 3 including items 10-11.

Table 3.1 below outlines Hydro's schedule for completing Phase 1 of the critical spares review.

Table 3.1 – Schedule for Phase 1 of Critical Spares Review at HTGS	
Activity	**Completion Date**
Purchase Order Issued	May 8, 2014
Kick Off Meeting	May 14, 2014
Draft Report of Spares to be Stocked	August 7, 2014
Presentation of Report	August 28, 2014
Finalized Report of Critical Spares to be Stocked	September 11, 2014
Finalized Critical Spares Listing Including: a) Bill of Materials; b) estimated lead times; and c) cost estimates	November 30, 2014

3.2 Gas Turbines – Stephenville and Hardwoods

The critical spares plan as it relates to the gas turbines involves the completion of an asset criticality review, critical spares review, preparation of a critical spares list, review of the current spares inventory to identify additional spares required, and procurement of necessary spares prior to the 2014/2015 winter season. The procurement of spares already identified through lessons learned is ongoing, and spares are being procured as identified and sourced. For example, spare fuel control valves have been procured for the Hardwoods gas turbine. A consultant is being engaged to provide the expertise and resources to work with Hydro personnel to complete the critical spares review.

The following activities comprise the critical spares plan as it applies to the gas turbines.

1. The asset criticality work is not as advanced for the gas turbines as it is for other generating plants. Thus, an asset criticality review of the Hardwoods and Stephenville gas turbine facilities will be completed as part of the plan.
2. Based on the asset criticality review, a list of major assets will be prepared and then expanded to create a more detailed list of assets to be reviewed.
3. A review of previous work completed related to the two gas turbine facilities will be undertaken and a preliminary list of critical spare parts will be prepared.
4. Hydro and the consultant will then review the preliminary critical spares list and confirm the inclusion of all assets and spare parts.
5. The list of critical spare parts will then be finalized.

6. The final list of critical spare parts will be reviewed against spares in inventory and additional spares requirements identified.
7. Procurement of required critical spares will be undertaken.

The planned schedule for this critical spares review is shown in Table 3.2 below.

Table 3.2 – Schedule for Critical Spares Review, Gas Turbines

Activity	Completion Date
Project start	June 18, 2014
Kick off meeting	June 20, 2014
Preliminary spares list complete	August 8, 2014
Draft report submitted	August 29, 2014
Final report submitted	September 12, 2014
Completed procurement of critical items	November 15, 2014

3.3 Hydro Generation

Hydro Generation has ranked its assets based on criticality. The 25 percent most critical assets were selected and used to populate a critical spares assessment spreadsheet. The target for critical spares assessment in 2014 is to complete the assessment for the top 25 percent most critical assets. These assets will then be sorted by area to allow for a more detailed assessment. Currently, each asset is being assessed to identify the equipment and then the critical equipment and its components. When this has been completed, each piece of critical equipment and component will be assessed. The critical spares list from the review will be cross referenced with the existing critical spares listing to identify gaps and procure critical spares for inventory where required.

On average, a full day per week for the hydroelectric long term asset department is dedicated to the critical spares assessment process, resulting in a 25 percent time commitment (based on four 10 hr/day work days per week) to year end. Progress is monitored monthly and, if required, the percentage of time dedicated to critical spares will be adjusted to ensure the target is met by year end.

The schedule for the review of critical spares at Hydro Generation is shown in Table 3.3 below.

Table 3.3 – Schedule for Critical Spares Review, Hydro Generation	
Activity	**Completion Date**
Identify equipment and critical equipment/components	July 31, 2014
Assess critical spares for critical equipment/components	September 30, 2014
Cross reference assessed spares with existing critical spares list	October 31, 2014
Order critical spares that are not already set-up in inventory	November 30, 2014

4 SECURING ECONOMICALLY AVAILABLE INTERRUPTIBLE LOADS

In its interim report filed with the PUB on March 24, 2014 Hydro recommended continued discussions with large industrial customers for interruptible arrangements. This action was echoed in Liberty's interim report, released April 2014, when they recommended that Hydro continue discussions with industrial customers with a goal of securing economically available interruptible loads.

Hydro's workplan sets a framework for the actions necessary for Hydro to engage its industrial customers who could potentially make a material contribution to interruptible load. According to Hydro's Schedule of Rates, Rules and Regulations, an industrial customer is defined as "any person purchasing power, other than a retailer, supplied from the Interconnected Island bulk transmission grid at voltages of 66 kV or greater on the primary side of any transformation equipment directly supplying the person and who has entered into a contract with Hydro for the purchase of firm power and energy." There are currently five customers who meet the criteria for classification as an industrial customer on the island interconnected system:

1. Praxair;
2. Vale (Nickel refinery);
3. North Atlantic Refining;
4. Kruger (Corner Brook Pulp and Paper); and
5. Teck Resources (Duck Pond Mine).

Hydro has also initiated discussions with Newfoundland Power regarding its potential to make arrangements for interruptible load with its large customers. Newfoundland Power and its customers fall outside of the scope of this work plan, which strictly addresses interruptible load options from Hydro's industrial customers.

The objective of Hydro's this workplan is to identify the industrial customers who have the potential to make a material contribution to interruptible load and engage those customers with the ultimate goal of securing economically available interruptible load or other capacity assistance arrangements.

Table 4.1 below identifies the resources required and the related assignments for this project.

Table 4.1 – Resource Requirements and Assignments

Required Resource	**Assignment**
Accountable	Vice President, Newfoundland and Labrador Hydro
Project Lead	Vice President, Strategic Planning & Business Development
Legal	Senior Legal Counsel
Rates & Regulatory	Manager, Rates & Regulation
System Operations	Vice President, System Operations & Planning Manager, System Operations & Integration Support System Operations Engineering Manager
Commercial	General Manager, Energy Marketing
Research/Administration	Electricity Policy Analyst
External consultant	As required

Table 4.2 below indicates the current status of the key activities in Hydro's workplan for securing available interruptible loads.

Table 4.2 – Status of Workplan for Securing Interruptible Load		
Activity	**Planned Activities Description**	**Status**
A. Preliminary Research		
1.	Research interruptible loads and capacity assistance in other Canadian jurisdictions	In progress
2.	Review Hydro's previous interruptible power and capacity assistance contracts to inform discussion with customers	In progress
3.	Complete analysis of costs expected to be incurred by potential customers for the provision of interruptible load	In progress
4.	Complete analysis of Hydro's cost of providing additional capacity for incorporation into developing pricing considerations for interruptible load	Pending
B. Legal Considerations		
5.	Complete legal review of any potential issues associated with obtaining interruptible power and/or capacity assistance	In progress
C. Regulatory Considerations		
6.	Determine regulatory process to follow with respect to obtaining interruptible power and/or capacity assistance arrangements	In progress
D. System Considerations		
7.	Assess most appropriate means of incorporating interruptible power and/or capacity assistance arrangements into Hydro's isolated island system	Pending
E. Commercial Considerations		
8.	Assess appropriate commercial terms (including rate structure) to be incorporated into potential agreements	In progress
F. Engagement of Customers		
9.	Make contact with industrial customers inquiring as to their ability to curtail or provide capacity assistance	In progress
10.	Meet with industrial customers as necessary	In progress
11.	Determine optimal combination of interruptible and/or capacity assistance contracts moving forward	Pending
12.	Obtain alignment/agreement with applicable industrial customers on terms & conditions/commercial arrangements	Pending
G. Approval and Execution of Commercial Arrangements/Terms & Conditions		
13.	Put forward for final PUB approval and execute arrangements as required	Pending

5 SCHEDULE, RESOURCES AND COSTS

5.1 Holyrood Thermal Generating Station

5.1.1 Schedule

Holyrood's formalized Maintenance Plan for the 2014 outage season contained in Appendix D is integrated into the Hydro System-Wide Integrated Outage Plan. The Holyrood plan provided shows an overview, and it is further broken down to work orders at the detailed working level. The Holyrood plan shows all three generating units available for service on November 7, 2014 and includes the following:

1. A listing of all key activities planned for each unit;
2. Separate critical path diagrams – critical path diagrams are included in the plan's Gantt Charts. These are typically dictated by a combination of larger outage windows required for primary asset maintenance, higher level capital projects and unit availability, which is approved in consultation with System Operations. System Operations coordinates an overall generation outage master plan and outages outside of the Hoyrood Generating Station directly impacting the duration, timing, sequencing and order of unit outages within Holyrood.
3. As noted, the sequencing of individual generating unit outages (at Holyrood) varies from year to year and is dictated in part by System Operations requirements and with a view to winter availability targets and environmental operating criteria. Referring to the plan in Appendix D, there were three main factors that determined the sequencing of unit maintenance within the overall outage window.
    a) There had to be one generating unit available for generation during the entire maintenance season.
    b) Unit 2 needed a major turbine/generator overhaul that had to be started reasonably early in the schedule.
    c) There had to be an outage overlap between Units 1 and 2, i.e. a stage 1 outage, to facilitate completion of capital projects involving common assets, namely MCC upgrades and 129 V DC breakers.

Based on these three factors, once the Unit 2 overhaul early date was fixed, it was decided to complete Unit 3 first, since it had the shortest outage window, and Unit 1 last, thereby facilitating the stage 1 outage.

4. Bulk production curves - maintenance activities for each unit by individual work order can be viewed through the expanded version of the overall Maintenance Plan (Appendix D) which is available from the plant. These include resource estimates by work order which provide totals for annual work plan resource requirements. Bulk production of electricity from Holyrood is integrated into production planning by System Operations with the interface presented as the system-wide Integrated Outage Plan.

5.1.2 Resources

Resources for the availability improvements for Holyrood as listed in Section 2.2 are managed through various processes. Hydro uses its Materials Management System (MMS), including on-site inventory, to procure the materials, parts and equipment required for execution of the annual work plan. In the case of the capital program, materials and labour are provided through third party contractors to complete the majority of work, with final tie-in and commissioning completed by plant forces.

With respect to people/labour, the remaining types of work (CM, PM, non-maintenance work, and operating project work) are planned and executed through four mechanisms:

1. Plant Labour - The annual work plan is viewed month by month at the beginning of the maintenance season to identify resource (people) short-falls, with respect to the execution of work at the shop floor levels. Historically, temporary employees have been hired to close any gaps to ensure optimal execution of the plan.
2. Major Asset Contracts - the execution of the annual work for major plant assets (turbine/generator and boiler) is completed through publicly tendered, and relatively large service contracts. The contracts (primarily labour) are pre-qualified and awarded to recognized service providers in the respective areas. Currently, the major service providers at Holyrood are Alstom Power (turbine/generator) and Babcock and Wilcox

(boiler). These contracts provide for a full range of maintenance services, except for specific parts drawn from Hydro inventory, and generally rely heavily on the expertise of the service provider for technical guidance and work execution.

3. Minor Asset Service Agreements – the Holyrood site tenders and manages in excess of 20 service agreements to provide a wide range of site service and labour considered to be outside the core activities of the Plant. These include contracts for non-destructive testing (NDE), insulation and abatement, motor repair, safety valve services, crane maintenance and snow clearing;
4. Consultants - In the areas of Long Term Asset Planning (LTAP) and Health, Safety & Environment (HSE), consultants have been hired to provide a wide range of professional services such as studies, technical direction, equipment assessment and project management. An example of this is the use of a consultant for the plant Inspection Test Program (see Section 2.2 above).

For the initiatives listed, incremental resource needs will be addressed as follows:

a) Emergency Preparedness – temporary employees, overtime and service agreements.
b) Breaker Maintenance – temporary employees, overtime, external services consulting;
c) Forced Draft (FD) Fan Motor Maintenance – temporary employees, overtime and minor asset service agreement.
d) Unit 2 Turbine Valve (Control Valve Spindles) – capital program – major asset contract, minor asset service agreement.
e) Critical Spares – plant labour, consulting services.
f) Turbine Generator Lube Oil System Enhancements – temporary employees, minor asset service agreement.
g) Inspection Test Program – capital program – consulting services, major asset contract.

5.1.3 Incremental Costs

All of the four mechanisms mentioned above are managed within plant Operating and Maintenance budgets. Overtime labour budgets are used to manage short term labour requirements within a given year.

Incremental costs related to relatively large unforeseen needs typically require specific Board approval for either emergency capital expenditure or deferred amortized operating expense.

The capital program costs are managed through the Project Execution and Technical Services (PETS) Department.

The following preliminary estimates have been compiled to detail the incremental costs associated with the winter availability initiatives listed in Section 2.2.

Table 5.1 – Incremental 2014 Costs, Holyrood		
Item	**Includes**	**Estimated Cost**
Emergency Preparedness	▪ Vehicle rentals ▪ Additional equipment testing ▪ Stand-by ▪ Snow-clearing	$35,000
Breaker Maintenance	▪ Labour ▪ Training courses ▪ Consultant contract ▪ Replacement components	$430,000
Forced Draft (FD) Fan Motors Maintenance	▪ Remove, ship, overhaul, return, reinstall	$150,000 (3 motors)
Control Valve Spindles	▪ Repair/inspection ▪ Replace all remaining	$40,000 (Capital)
Critical Spares	▪ Consultant review ▪ Critical spares purchase	$2,000,000
Turbine Generator Lube Oil System Enhancements	▪ Labour ▪ Contract services	$25,000
Inspection Test Program (EPRI Level 2)	▪ Consultant ▪ Inspection and testing ▪ Remedial work	$1,500,000 (2014 Capital Program)

The following is the total preliminary estimated costs for generation availability initiatives:

1. Operating - $2,640,000; and
2. Capital - $1,540,000.

5.2 Gas Turbines – Stephenville and Hardwoods

5.2.1 Schedule

The maintenance plan for the gas turbines for the 2014 season is integrated into the Hydro System-Wide Integrated Outage Plan. The Hardwoods and Stephenville plans consist of maintenance and project work and are broken down by individual work order at the detailed working level. The plans show all work complete for both generating units by November 30,

2014. A major refurbishment project is ongoing at the Stephenville plant which requires extended outages of each end and the entire unit to allow for inspection and overhaul activities. While there are no significant outages planned for Hardwoods, some shorter duration outages will be required to complete PM and CM activities.

Similar to Holyrood, the detailed plans for each gas turbine include:

a) A listing of all key PM and CM activities planned for each unit.
b) A listing of all major project related activities for each unit.
c) Critical path diagrams in the plan's Gantt charts. These are typically dictated by a combination of larger outage windows required for primary asset maintenance, capital projects and, unit availability which is approved in consultation with System Operations. System Operations coordinates an overall generation outage master plan and outages outside of the gas turbines directly impacts the duration, timing, sequencing and order of the gas turbines outages.
d) The duration and sequencing of the individual generating unit outages is dependent on the work being performed and is dictated in part by System Operation requirements.

5.2.2 Resources

Similar to Holyrood, resources for the availability improvements for the gas turbines are managed generally through the following means.

1. Hydro uses its Materials Management System (MMS), including on-site inventory, to procure the materials, parts and equipment required for execution of the annual work plan.
2. In the case of the capital program, materials and labour are provided through third party contractors to complete the majority of work, with final commissioning completed by Hydro forces.
3. The PM and CM requirements are generally executed through four (4) mechanisms:
    a) Hydro Labour - The annual work plan is viewed month by month at the beginning of the maintenance season to identify resource (people) short-falls, with respect

to the execution of work at the shop floor levels. Historically, hiring of temporary employees and overtime has been used to ensure execution of the plan.

b) Contract labour related to capital project activities, such as equipment condition assessments, equipment overhauls, and replacement and modification of major equipment.

c) Service Agreements – these include minor contracts for non-destructive testing (NDE), insulation and abatement, fire system and crane maintenance, and snow clearing.

d) Consultants, contractors and OEMs – Consultants, contractors, and original equipment manufacturers are used to provide a wide range of professional services such as studies, technical direction, equipment condition assessment and project management.

For the reliability initiatives listed, incremental resource needs will be addressed as follows:

a) Emergency Preparedness – Hydro labour, overtime and service agreements.
b) Critical Spares Review – Hydro labour, consulting services.
c) Equipment upgrades, modifications – Hydro labour, consulting and contract services.

5.2.3 Incremental Costs

To date, estimated incremental costs associated with the improved availability initiatives identified for the gas turbines includes only the use of a consultant for the completion of the critical spares review, at $75,000. The costs related to procurement of spares, additional CM, and implementation of repeat failure causes have not yet been identified.

5.3 Generation Master Plan

Hydro's planned outages to its hydroelectric, thermal and combustion turbine generating units and Non-Utility Generators on the Island Interconnected System occur during periods outside of the winter peaking season. In its planning process, Hydro uses two main criteria to determine what generating capacity can be released from operation and placed on a planned outage: System contingency reserve and Avalon transmission support requirements.

5.3.1 System Contingency Reserve

Hydro manages generation resource availability on the Island Interconnected System and schedules generating units out of service for planned maintenance in order to meet a (n-1) system contingency reserve criterion. In this manner, sufficient reserves are planned to be available to meet the Island Interconnected System load under a contingency of the largest (MW rating) available generating unit. Hydro does not rely on capacity from wind and other non-dispatchable[1] resources to provide reserve. However, if these resources are in production they can further increase the reserves available. Following the (n-1) criterion in developing the plan results in no extended planned maintenance scheduled during the winter period. However, if the short-term load forecast permits, Hydro may take the opportunity to schedule a short duration generating unit outage to address any known urgent buy not emergency running or CM issues.

5.3.2 Avalon Transmission Support Requirements

Hydro also manages its generation resources on the Avalon Peninsula to support the transmission system into the region and to enable efficient operation of the HTGS. To maintain power system reliability, the HTGS units are scheduled in accordance with the expected Avalon load[2] as per the following thresholds:

Avalon Load	Number of HTGS Units
> 330 MW	One
> 495 MW	Two
> 630 MW	Three

[1]Non-dispatchable generation is generation which the power system operator cannot control and thereby set the level of output to meet the customer demand.
[2] The Avalon load is the electrical load east of Come-by-Chance.

These thresholds assume that all transmission and standby generation serving the Avalon Peninsula are available[3]. Otherwise, HTGS units may have to be operated at lower levels of Avalon load[4].

5.3.3 2014 Planned Generation Outage Schedule

The following chart indicates Hydro's Planned Generation Outage Schedule for June 1 to December 31, 2014. The reserve is calculated for each week, based on the available generation capacity under a contingency of the loss of the largest generating unit (n-1) and the load forecast. In all weeks, there are sufficient reserves planned to be available to meet Hydro's reliability criterion. As well, the planned HTGS unit outage schedule aligns with the requirements to meet the Avalon load.

One HTGS unit will be available for the remainder of the year. This will permit one unit operation at HTGS during the summer period should it be required for Avalon reliability and allow for flexibility in maintaining this outage schedule should other generating units be changed or delayed to address unforeseen issues. In performing a sensitivity of a 50% delay (of the original outage duration) to all hydroelectric and standby units, contingency reserves can still be met. As well, the master plan incorporates a four week delay for each of the HTGS units. Finally, a total plant outage to the HTGS of two weeks, though not in the master plan, is sometimes required to address common assets and may be permitted in August if the Avalon loading permits.

All of Hydro's generating units and Non-Utility Generators are scheduled to be available prior to December 1.

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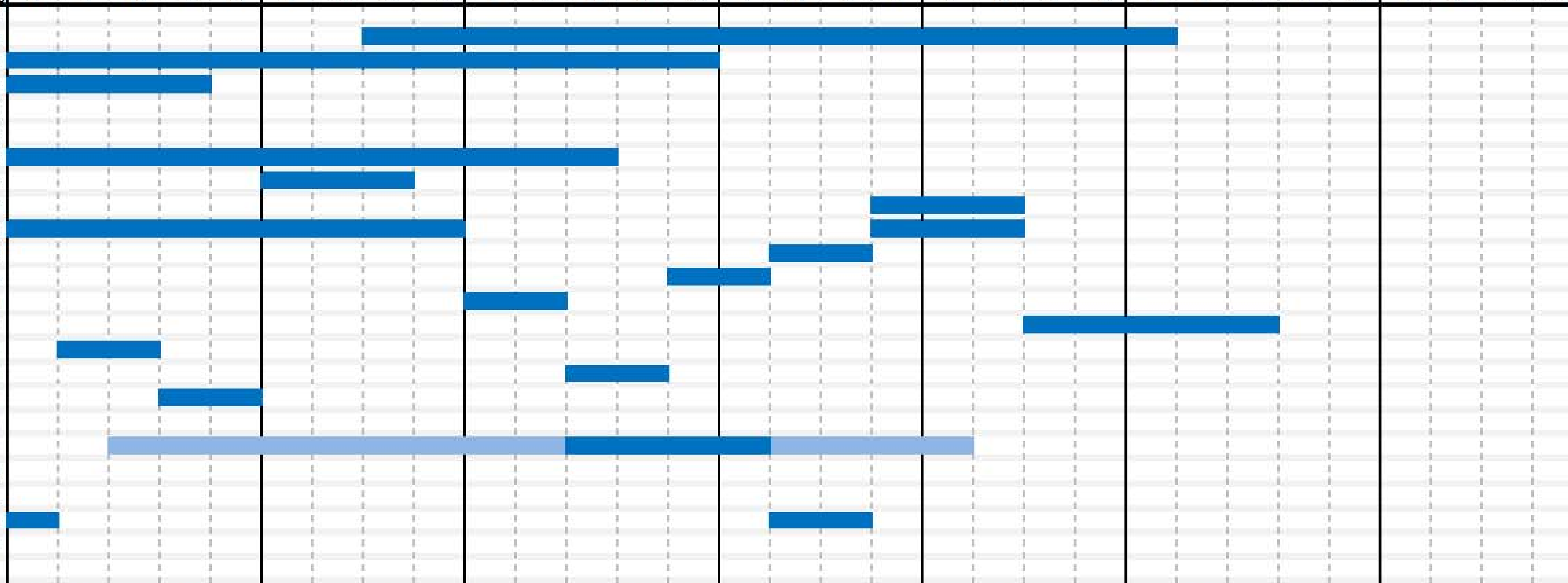
[3] The Avalon thresholds noted in the table do not include the impact of the new 100 MW (nominal) Holyrood Combustion Turbine.

[4] The HTGS units cannot be quickly turned on and off like gas turbine units to respond to a system problem. Therefore, to provide the same response as a gas turbine, a HTGS unit must be placed on line and operated at its minimum output level of 70 MW in order to be available to quickly respond to a problem. As problems are unpredictable, this would result in the HTGS unit being on for many days consuming large amounts of fuel when there would otherwise be no requirement for them to operate.

2014 Planned Generation Outage Schedule



Month		June					July				August					September				October				November					December			
Week Starting		1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28
Unit	*MW*																															
Holyrood - G1	170																															
Holyrood - G2	170																															
Holyrood - G3	150																															
Bay D'Espoir - G1	76.5																															
Bay D'Espoir - G2	76.5																															
Bay D'Espoir - G3	76.5																															
Bay D'Espoir - G4	76.5																															
Bay D'Espoir - G5	76.5																															
Bay D'Espoir - G6	76.5																															
Bay D'Espoir - G7	154																															
Upper Salmon	84																															
Granite Canal	40																															
Hinds Lake	75																															
Cat Arm - G1	67																															
Cat Arm - G2	67																															
Paradise River	8																															
Hardwoods GT	50																															
Stephenville GT	50																															
Holyrood CT [Note 1]	100																															
HBY / STA Diesels	14																															
Star Lake	18																															
Exploits	63																															
CoGen	8																															
Available Capacity	1,747	1,156	1,107	1,082	1,141	1,291	1,223	1,223	1,053	1,129	1,166	1,166	1,114	1,190	1,173	1,343	1,280	1,280	1,299	1,299	1,324	1,402	1,402	1,402	1,572	1,572	1,647	1,647	1,747	1,747	1,747	1,747
Forecasted Gross Peak Load		855	825	796	766	737	707	707	708	708	708	708	708	708	708	724	739	755	770	828	885	951	1,009	1,041	1,074	1,106	1,139	1,171	1,523	1,523	1,523	1,523
Total Reserves		301	282	286	375	554	516	515	345	421	458	458	406	482	465	620	541	526	529	471	439	451	393	361	498	466	508	476	224	224	224	224
Largest Operating Unit		170	170	170	170	154	154	154	154	154	154	154	154	154	154	154	150	150	154	154	154	170	170	170	170	170	170	170	170	170	170	170
n-1 Reserve		131	112	116	205	400	362	361	191	267	304	304	252	328	311	466	391	376	375	317	285	281	223	191	328	296	338	306	54	54	54	54
Avalon Load		449	433	418	402	387	371	371	371	372	372	372	372	372	372	380	388	396	404	435	465	499	530	547	564	581	598	615	799	799	799	799
HTGS Units Required		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3

Legend	
White	Unit Available
Light Blue	Unit De-Rated 50%
Dark Blue	Unit Unavailable

Note 1 The new Holyrood CT is planned to be available on December 1, 2014

APPENDIX A

Sample Asset Criticality Rankings - Holyrood

Asset Criticality

			Health & Safety	Output	Quality	Utilization	Alternatives	Environment	Time to Effect	Equipment Score	MTBF	Cost	Efficiency	Additional Score	Criticality
L.P. Feedwater System	Surface Condenser		4	8	8	5	6	2	5	76800	2	3	3	18	1382400
L.P. Feedwater System	Surface Condenser	Hot Well	4	8	8	5	6	2	5	76800	1	3	3	9	691200
L.P. Feedwater System	Surface Condenser	Hot Well Flash Tank	4	3	1	5	6	1	4	1440	1	4	2	8	11520
L.P. Feedwater System	Surface Condenser	Salt Water Cooling	4	8	8	5	6	2	5	76800	2	3	3	18	1382400
L.P. Feedwater System	Surface Condenser	Makeup Water	1	4	1	5	6	2	4	960	1	3	3	9	8640
L.P. Feedwater System	Condensate Extraction Pumps		1	8	8	5	3	1	5	4800	2	3	1	6	28800
L.P. Feedwater System	Condensate Extraction Check Valves		1	3	1	5	1	1	4	60	2	3	2	12	720
L.P. Feedwater System	Polisher Bypass Valve		1	4	8	5	2	1	5	1600	1	2	2	4	6400
L.P. Feedwater System	Gland Seal Condenser		1	1	1	5	2	1	4	40	1	3	2	6	240
L.P. Feedwater System	Gland Seal Condenser	Exhausters	1	1	1	5	1	1	1	5	3	3	1	9	45
L.P. Feedwater System	L.P. Heaters		2	1	1	5	2	1	5	100	4	3	2	24	2400
L.P. Feedwater System	L.P. Heaters	Safety Valves Steam	4	1	1	5	2	1	4	160	2	2	2	8	1280
L.P. Feedwater System	L.P. Heaters	Safety Valves Water (Relief Valve)	4	2	1	5	2	1	5	400	2	2	2	8	3200
L.P. Feedwater System	L.P. Heaters	NRV Valves	10	2	1	5	6	1	5	3000	2	3	2	12	36000
L.P. Feedwater System	L.P. Heaters	Tube Bundles	2	2	1	5	2	1	2	80	2	3	2	12	960
L.P. Feedwater System	L.P. Heaters	Controls (Level)	2	2	1	5	4	1	5	400	3	3	2	18	7200
L.P. Feedwater System	L.P. Heaters	Manual Isolation Valves	2	1	1	1	2	1	1	4	1	1	2	2	8
L.P. Feedwater System	L.P. Heaters	Purge Vents	2	1	1	1	2	1	2	8	1	1	1	1	8
L.P. Feedwater System	L.P. Heaters	Continuous Vents	2	1	1	5	2	1	2	40	2	1	2	4	160
L.P. Feedwater System	L.P. Heater Controls (Water Induction Protection)		6	8	8	5	6	1	5	57600	1	3	2	6	345600
L.P. Feedwater System	L.P. Heater Controls (Water Induction Protection)	Solenoid Valves	2	2	1	5	6	1	5	600	1	1	2	2	1200
L.P. Feedwater System	L.P. Heater Controls (Water Induction Protection)	Level Probe & Module	2	2	1	5	6	1	5	600	1	2	2	4	2400
L.P. Feedwater System	Cortrol System		4	2	1	5	6	4	3	2880	4	2	1	8	23040
L.P. Feedwater System	Cortrol System	Pumps	2	2	1	5	1	2	4	160	4	2	1	8	1280
L.P. Feedwater System	Cortrol System	Suction Tote Tank	2	2	1	5	2	2	2	160	2	3	1	6	960
L.P. Feedwater System	Cortrol System	Controls	1	2	1	5	6	1	3	180	3	2	1	6	1080
L.P. Feedwater System	Ammonia System		6	2	1	5	6	4	3	4320	4	2	1	8	34560
L.P. Feedwater System	Ammonia System	Pumps	2	2	1	5	1	2	3	120	4	2	1	8	960
L.P. Feedwater System	Ammonia System	Suction Tote Tank	2	2	1	5	2	2	2	160	2	3	1	6	960
L.P. Feedwater System	Ammonia System	Controls	1	2	1	5	6	1	3	180	3	2	1	6	1080
L.P. Feedwater System	Deaerator System	Deaerator	6	8	3	5	6	1	5	21600	1	3	2	6	129600
L.P. Feedwater System	Deaerator System	Deaerator Storage Tank	6	3	1	5	6	1	3	1620	1	3	1	3	4860
L.P. Feedwater System	Deaerator System	NRV Valves (2)	10	2	1	5	6	1	5	3000	2	2	1	4	12000
L.P. Feedwater System	Deaerator System	Heating Coil	2	1	1	5	3	1	5	150	1	2	2	4	600
L.P. Feedwater System	Deaerator System	Pegging Steam	2	1	1	5	3	1	5	150	1	2	2	4	600
L.P. Feedwater System	Deaerator System	Safety Valves	6	3	1	5	6	1	5	2700	4	2	2	16	43200
L.P. Feedwater System	Deaerator System	DA Vent	2	1	1	5	3	1	5	150	1	2	2	4	600
L.P. Feedwater System	Deaerator System	Level Control	2	4	8	5	4	1	5	6400	1	3	1	3	19200

APPENDIX B

Criticality Definitions

CRITICALITY DEFINITIONS

Equipment Factors

FACTOR 1 - Health and Safety

Level	Definition	Score
1	Minor	1
2	A medical treatment incident or minor damage to plant is foreseeable less than 2 hours D/T	2
3	A lost time incident or serious damage to plant is foreseeable 2 hours to 8 hours D/T	4
4	A disability or catastrophic damage to plant more than 8 hours D/T	6
5	Loss of life or plant incident that is reportable to Department of Labour more than 8 hr D/T	10

Explanation :- Covers both maintenance and operation. Can cover both people and plant.

FACTOR 2 - Output (Unit Capacity derating / outage - time and impact)

Level	Definition	Score
1	No effect	1
2	Reduced rate minor effect	2
3	Reduced rate serious effect or off between 10 mins and 2 hours	3
4	Off 2 hours to 8 hours	4
5	Off for more than 8 hours	8

Explanation :- Based on 100% unit availability requirement at all times.

FACTOR 3 - Quality Of Desired Output

Level	Definition	Score
1	No effect or Planned Shutdown	1
3	Controlled Shutdown	3
4	Trip/Under Frequency Load Shed	8

Explanation :- Do not chose the worst case but one that is reasonably foreseeable.

FACTOR 4 - Utilization

Level	Definition	Score
1	Used less than 33% of the time	1
2	Used between 33% and 66% of the time	2
3	Used more than 66% of the time	3
4	Used 100% of time	5

Explanation :- The percentage time when its functionality is required for continuous plant operation.

FACTOR 5 - Alternatives (Same as Loss Mitigation)

Level	Definition	Score
1	Standby or alternative route readily available	1
2	Standby or alternative route available but with minor difficulty	2
3	Standby or alternative route available with difficulty OR loss of unit capacity	3
4	No standby or alternative route available without extreme difficulty	4
5	No alternative	6

CRITICALITY DEFINITIONS

FACTOR	**6 - Environment**	
Level	Definition	Score
1	No effect	1
2	Minor local effect - can be contained on site eg noise/smell	2
3	More serious local / minor off-plant - liable to result in discharge to atmosphere or water course eg ammonia/fumes/oil	4
4	Reportable or exceeds consents - has potential for prosecution	6
5	More serious off-plant or off-site effect which involves outside services	10
Explanation: - Use reasonably foreseeable effects rather than worse case. Include dust, noise,		

FACTOR	**7 - Time to Effect**	
Level	Definition	Score
1	Negligible effect	1
2	More than 24 hours	2
3	Between 2 hours and 24 hours	3
4	Between 30 mins and 2 hours	4
5	Immediate	5
Explanation:- Sometime the effect of a breakdown is not felt immediately because buffer storage is provided.		

Additional Factors

FACTOR	**8 - Mean Time Between Failures (MTBF)**	
Level	Definition	Score
1	More than 5 yrs MTBF	1
2	Between 3 and 5 years MTBF	2
3	Between 1 and 3 years MTBF	3
4	Between 6 months and 1 year MTBF	4
5	Less than 6 months MTBF	5
Failure defined - unable to function at the required level.		
Explanation:- Use typical times not worst case.		

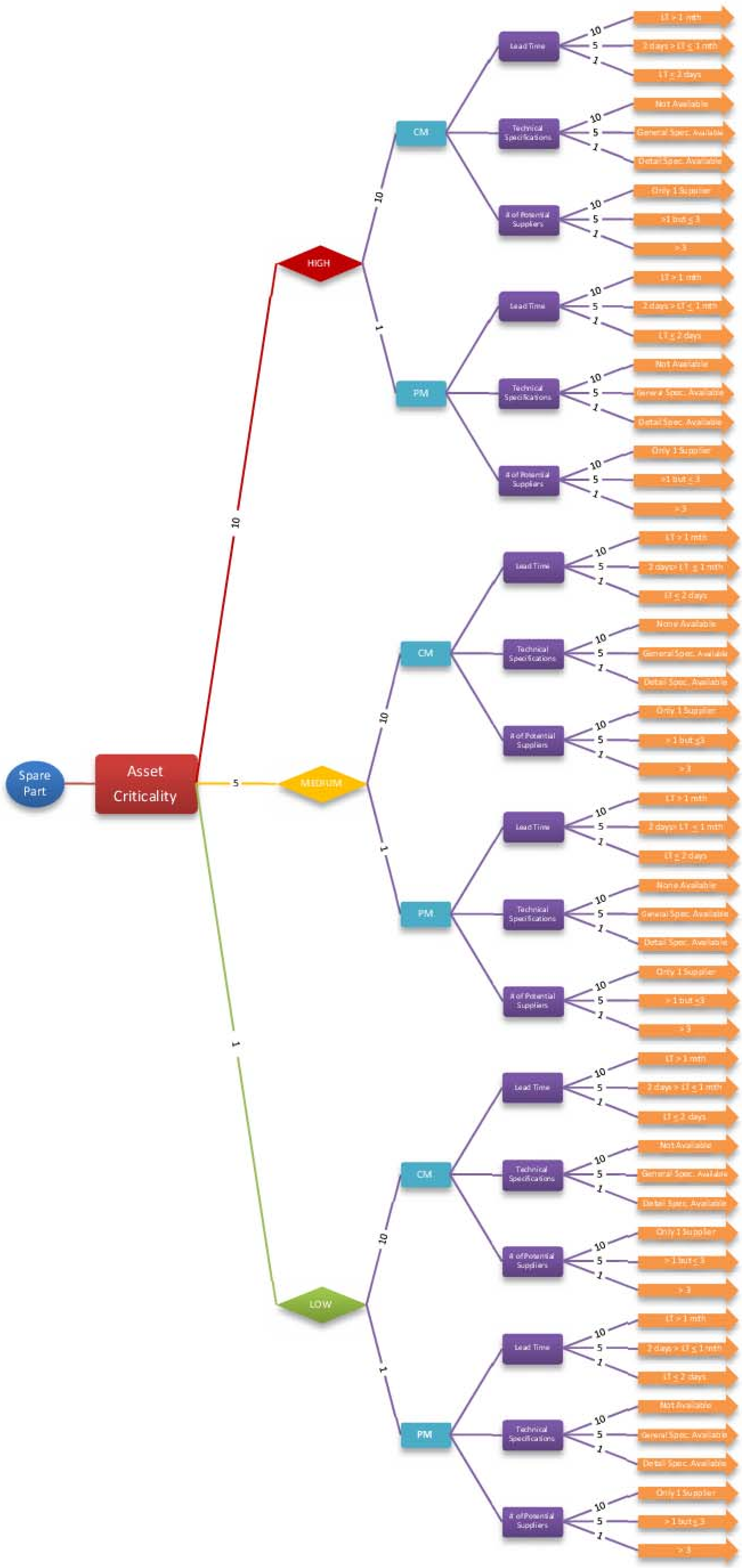
FACTOR	**9 - Engineering Cost Breakdown**	
Level	Definition	Score
1	Less than $500	1
2	Between $500 and $5000	2
3	Between $5000 and $ 50,000	3
4	Between $50000 and $500,000	4
5	More than $500,000	5
Explanation:- Includes labour materials and contractors, but not production costs. Includes cost of		

FACTOR	**10 - Effect of Waste or Energy Loss (Efficiency)**	
Level	Definition	Score
1	No energy loss	1
2	Minor energy loss	2
3	Moderate energy loss	3
4	Major energy loss	4
Explanation:- Better control, fewer interruptions, steadier optimum running will improve this.		

APPENDIX C

Critical Spares Decision Diagram

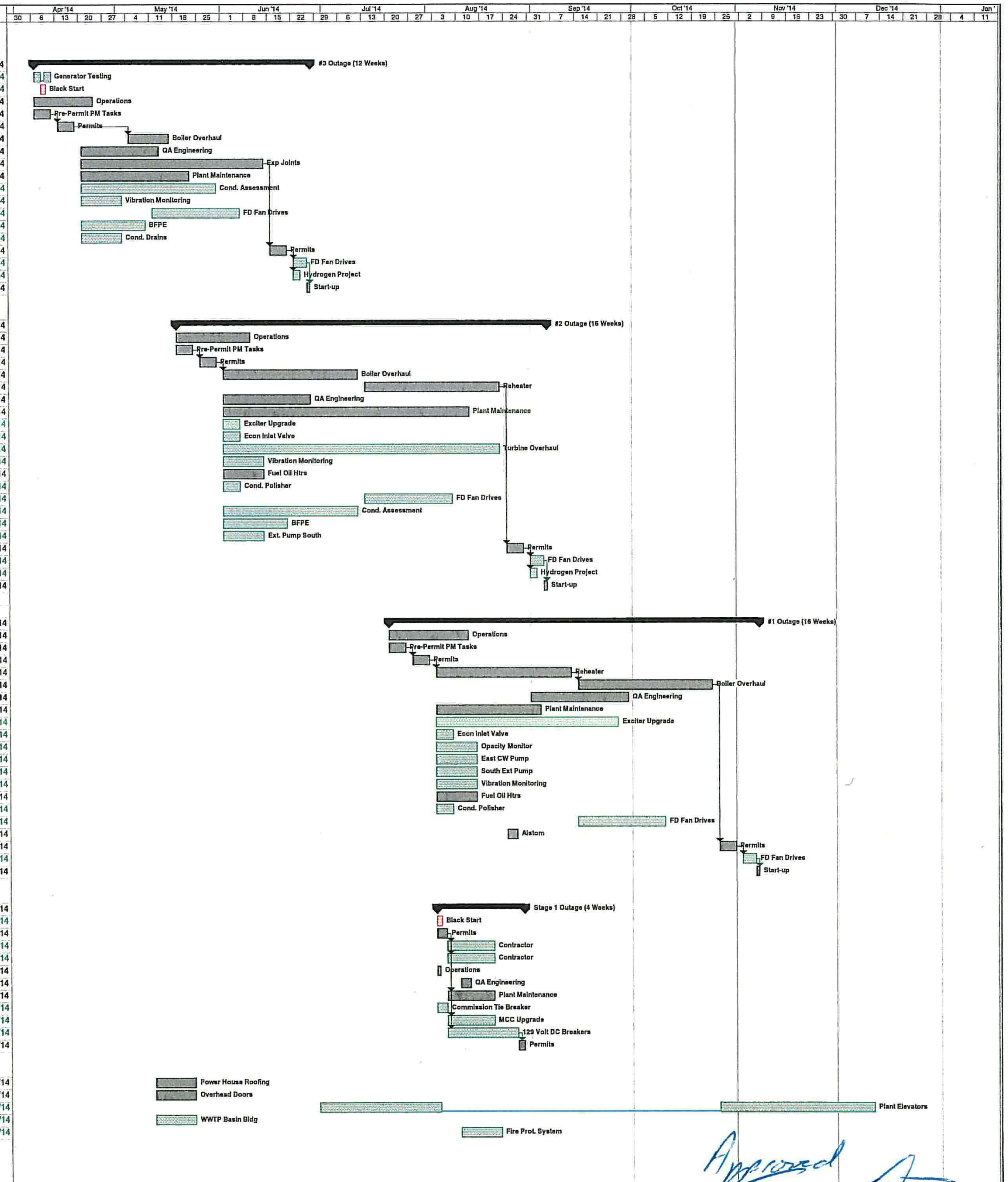
Critical Spare Decision Diagram



APPENDIX D - OUTAGE SCHEDULE

Master Outage Schedule – Holyrood Thermal Generating Station

ID	% Compl	Task Name	Permit Block	Dept	Work Order	W/O T	Comments/Constraints	Duration	Resource Names	Start	Finish
1		2014 HRD COORDINATED MAINTENANCE SCHEDULE									
2											
3		#3 Planned Minor Repairs & Capital Work									
4	0%	Unit #3 Outage					84 days total	60 days	#3 Outage (12 Weeks)	Mon 4/7/14	Fri 6/27/14
5	0%	Generator Testing (Dynamic RSO Testing - windings)					Alstom	4 days	Generator Testing	Mon 4/7/14	Fri 4/11/14
6	0%	Black Start Testing - Stage 2		17106			Start BFP	12 hrs	Black Start	Wed 4/9/14	Thu 4/10/14
7	0%	Operations Tasks					Operations	13.5 days	Operations	Mon 4/7/14	Thu 4/24/14
35	0%	Pre-Permit						5 days	Pre-Permit PM Tasks	Mon 4/7/14	Fri 4/11/14
70	0%	Install Work Protection Permits for Outage		17106	1037587			1 wk	Permits	Mon 4/14/14	Fri 4/18/14
71	0%	Boiler Overhaul (Minor)					B&W	10 days	Boiler Overhaul	Mon 5/5/14	Fri 5/16/14
95	0%	Engineering Tasks					Quality Assurance	17 days	QA Engineering	Mon 4/21/14	Tue 5/13/14
130	0%	Replace Expansion Joints					B&W	8 wks	Exp Joints	Mon 4/21/14	Fri 6/13/14
131	0%	Preventative & Corrective Maintenance Tasks						24 days	Plant Maintenance	Mon 4/21/14	Thu 5/22/14
250	0%	Complete Condition Assessment, Phase 3			1031717			6 wks	Cond. Assessment	Mon 4/21/14	Fri 5/30/14
251	0%	Upgrade Vibration Monitoring System			1031699		Bently Nevada	2 wks	Vibration Monitoring	Mon 4/21/14	Fri 5/2/14
252	0%	Install Variable Speed Drives on FD Fans			1001117			4 wks	FD Fan Drives	Mon 5/12/14	Fri 6/6/14
253	0%	Boiler Feed Pump East Overhaul						3 wks	BFPE	Mon 4/21/14	Fri 5/9/14
254	0%	CR Condensate Drains & HP Heater trip level			1032224		Yr 1 of 2 (Eng)	2 wks	Cond. Drains	Mon 4/21/14	Fri 5/2/14
255	0%	Remove Work Protection Permits						1 wk	Permits	Mon 6/16/14	Fri 6/20/14
256	0%	Commission Variable Speed Drives on FD Fans			1001123		Commissioning	4 days	FD Fan Drives	Mon 6/23/14	Thu 6/26/14
257	0%	Hydrogen Upgrade - Commission Auto Vent Valves			888741		Commissioning	2 days	Hydrogen Project	Mon 6/23/14	Tue 6/24/14
258	0%	Start-Up						1 day	Start-up	Fri 6/27/14	Fri 6/27/14
264											
265		#2 Planned Major Repairs & Capital Work									
266	0%	Unit #2 Outage					112 days total	80 days	#2 Outage (16 Weeks)	Mon 5/19/14	Fri 9/5/14
267	0%	Operations Tasks		17106			Operations	16 days	Operations	Mon 5/19/14	Mon 6/9/14
300	0%	Pre-Permit						5 days	Pre-Permit PM Tasks	Mon 5/19/14	Fri 5/23/14
345	0%	Install Work Protection Permits		17106	1037587			1 wk	Permits	Mon 5/26/14	Fri 5/30/14
346	0%	Boiler Overhaul (Major)		81616			6 weeks	30 days	Boiler Overhaul	Mon 6/2/14	Fri 7/11/14
390	0%	Reheater Major Repairs					Contractor	6 wks	Reheater	Mon 7/14/14	Fri 8/22/14
391	0%	Engineering Tasks		17107			Quality Assurance	20 days	QA Engineering	Mon 6/2/14	Fri 6/27/14
412	0%	Preventative & Corrective Maintenance Tasks						53 days	Plant Maintenance	Mon 6/2/14	Wed 8/13/14
500	0%	Upgrade Excitation System (Unitrol "P")					Engineering	1 wk	Exciter Upgrade	Mon 6/2/14	Fri 6/6/14
501	0%	Replace Economizer Inlet Valve			1032231		Yr 1 of 2 (Eng)	1 wk	Econ Inlet Valve	Mon 6/2/14	Fri 6/6/14
502	0%	Overhaul Steam Turbine Generator					12 Weeks	60 days	Turbine Overhaul	Mon 6/2/14	Fri 8/22/14
523	0%	Upgrade Vibration Monitoring System			1031699		Bently Nevada	2 wks	Vibration Monitoring	Mon 6/2/14	Fri 6/13/14
524	0%	Replace Fuel Oil Heaters					If Required	2 wks	Fuel Oil Htrs	Mon 6/2/14	Fri 6/13/14
525	0%	Replace Condensate Polisher Annunicator Panels			976178			1 wk	Cond. Polisher	Mon 6/2/14	Fri 6/6/14
526	0%	Install Variable Speed Drives on FD Fans			1001117		Contingent on U3	4 wks	FD Fan Drives	Mon 7/14/14	Fri 8/8/14
527	0%	Complete Condition Assessment, Phase 3			1031717			6 wks	Cond. Assessment	Mon 6/2/14	Fri 7/11/14
528	0%	Boiler Feedpump East Overhaul			906945		Carry-over from 2013	3 wks	BFPE	Mon 6/2/14	Fri 6/20/14
529	0%	Extraction Pump South Overhaul			1025058		Remove prior to outage	2 wks	Ext. Pump South	Mon 6/2/14	Fri 6/13/14
530	0%	Remove Work Protection Permitry						1 wk	Permits	Mon 8/25/14	Fri 8/29/14
531	0%	Commission Variable Speed Drives on FD Fans			1001123		Commissioning	4 days	FD Fan Drives	Mon 9/1/14	Thu 9/4/14
532	0%	Hydrogen Upgrade - Commission Auto Vent Valves			888741		Commissioning	2 days	Hydrogen Project	Mon 9/1/14	Tue 9/2/14
533	0%	Start-Up						1 day	Start-up	Fri 9/5/14	Fri 9/5/14
539											
540		#1 Planned Major Repairs & Capital Work									
541	0%	Unit #1 Outage					112 days total	80 days	#1 Outage (16 Weeks)	Mon 7/21/14	Fri 11/7/14
542	0%	Operations Tasks		17106			Operations	17.5 days	Operations	Mon 7/21/14	Wed 8/13/14
578	0%	Pre-Permit						5 days	Pre-Permit PM Tasks	Mon 7/21/14	Fri 7/25/14
610	0%	Install Work Protection Permits		17106	1037587			1 wk	Permits	Mon 7/28/14	Fri 8/1/14
611	0%	Reheater Major Repairs					Contractor	6 wks	Reheater	Mon 8/4/14	Fri 9/12/14
612	0%	Boiler Overhaul (Major)		81616			6 Weeks	30 days	Boiler Overhaul	Mon 9/15/14	Fri 10/24/14
632	0%	Engineering Tasks		17107			Quality Assurance	21 days	QA Engineering	Mon 9/1/14	Mon 9/29/14
654	0%	Preventative & Corrective Maintenance Tasks						23 days	Plant Maintenance	Mon 8/4/14	Wed 9/3/14
729	0%	Upgrade Excitation System (Unitrol "P")					ABB	8 wks	Exciter Upgrade	Mon 8/4/14	Fri 9/26/14
730	0%	Replace Economizer Inlet Valve			1032231		Yr 1 of 2 (Eng)	1 wk	Econ Inlet Valve	Mon 8/4/14	Fri 8/8/14
731	0%	Upgrade Continuous Opacity Monitor			1032219			2 wks	Opacity Monitor	Mon 8/4/14	Fri 8/15/14
732	0%	East CW Pump Overhaul			1025958			2 wks	East CW Pump	Mon 8/4/14	Fri 8/15/14
733	0%	South Extraction Pump Overhaul			1025962		Remove prior to outage	2 wks	South Ext Pump	Mon 8/4/14	Fri 8/15/14
734	0%	Upgrade Vibration Monitoring System			1031699		Bently Nevada	2 wks	Vibration Monitoring	Mon 8/4/14	Fri 8/15/14
735	0%	Replace Fuel Oil Heaters					If Required	2 wks	Fuel Oil Htrs	Mon 8/4/14	Fri 8/15/14
736	0%	Replace Condensate Polisher Annunicator Panels			976178		Carry-over from 2013	1 wk	Cond. Polisher	Mon 8/4/14	Fri 8/8/14
737	0%	Install Variable Speed Drives on FD Fans			1001117			4 wks	FD Fan Drives	Mon 9/15/14	Fri 10/10/14
738	0%	Install Balance Weight on Turbine	Sep Permit	81617			Turbine balancing	24 hrs	Alstom	Mon 8/25/14	Wed 8/27/14
739	0%	Remove Work Protection Permitry						1 wk	Permits	Mon 10/27/14	Fri 10/31/14
740	0%	Commission Variable Speed Drives on FD Fans			1001123			4 days	FD Fan Drives	Mon 11/3/14	Thu 11/6/14
741	0%	Start-Up						1 day	Start-up	Fri 11/7/14	Fri 11/7/14
746											
747		Stage 1 Outage Major Repairs & Capital Work									
748	0%	Stage 1 Outage					28 days total	20 days	Stage 1 Outage (4 Weeks)	Mon 8/4/14	Fri 8/29/14
749	0%	Black Start Testing - Stage 1		17106			Start BFP	12 hrs	Black Start	Mon 8/4/14	Tue 8/5/14
750	0%	Install Work Protection Permits		17106	1037587			3 days	Permits	Mon 8/4/14	Wed 8/6/14
751	0%	Condition Assessment - High Energy Piping Testing			1031717		Contractor	2 wks	Contractor	Thu 8/7/14	Wed 8/20/14
752	0%	Condition Assessment - Pipe Hanger Inspections			1031717		Contractor	2 wks	Contractor	Thu 8/7/14	Wed 8/20/14
753	0%	Operations Tasks		17106			Operations	1 day	Operations	Mon 8/4/14	Mon 8/4/14
755	0%	Engineering Tasks		17107			Quality Assurance	3 days	QA Engineering	Mon 8/11/14	Wed 8/13/14
759	0%	Preventative Maintenance & Corrective Work Orders					Plant Resources	10 days	Plant Maintenance	Thu 8/7/14	Wed 8/20/14
764	0%	Stage 1 Pumphouse MCC - Commission Tie Breaker					MCC Upgrade	3 days	Commission Tie Breaker	Mon 8/4/14	Wed 8/6/14
765	0%	Upgrade Electrical Equipment (MCC C1 & E1 Replacement)			855202			2 wks	MCC Upgrade	Thu 8/7/14	Wed 8/20/14
766	0%	Replace 129VDC and 258VDC Distriubution Panels & Breakers			1031704		Stage 1	3 wks	129 Volt DC Breakers	Thu 8/7/14	Wed 8/27/14
767	0%	Remove Work Protection Permitry						2 days	Permits	Thu 8/28/14	Fri 8/29/14
768											
769		Common Area Major Repairs & Capital Work					Non-Outage Dependant				
770	0%	Upgrade Powerhouse Roofing					Engineering	2 wks	Power House Roofing	Mon 5/12/14	Fri 5/23/14
771	0%	Replace Powerhouse Overhead Doors					Engineering	2 wks	Overhead Doors	Mon 5/12/14	Fri 5/23/14
772	0%	Upgrade Plant Elevators			1031695			12 wks	Plant Elevators	Mon 6/30/14	Thu 12/11/14
773	0%	Upgrade Waste Water Basin Building					Engineering	2 wks	WWTP Basin Bldg	Mon 5/12/14	Fri 5/23/14
774	0%	Install Fire Protection Upgrades (Valve Operator)			1031710		Engineering	2 wks	Fire Prot. System	Mon 8/11/14	Fri 8/22/14
775											
776		Black - Permits Tasks & Regular Plant Maintenance Activities									
777		Lime Green - Capital Work Submissions Pending Approval for 2014									
778		Green - Approved Capital Work for 2014									



Approved
[illegible signature]
March 12, 2014

Project: 2014 HRD Coordinated Maintenance Schedule
Date: Wed 3/12/14
Rev.:8

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline