newfoundland labrador
hydro
a nalcor energy company

Hydro Place. 500 Columbus Drive.
P.O. Box 12400. St. John's. NL
Canada A1B 4K7
t. 709.737.1400 f. 709.737.1800
www.nlh.nl.ca

June 2, 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 with respect to the above noted matter please find enclosed the original plus 12 copies of Hydro's:

- Updated Integrated Action Plan;
- June 2 report in relation to the work required to be done in 2014 with regard to terminal station transformers; and
- June 2 report in relation to the work required to be done in 2014 with regard to air blast circuit breakers.

With respect to the updated Integrated Action Plan, Hydro has incorporated the actions recommended by Liberty Consulting. These items have been given appropriate priority ranking and have been scheduled in accordance with the dates set out by the Board in its Interim Report. Hydro will align resources to ensure completion of the various items set out in the updated Integrated Action Plan in accordance with the priority and completion dates scheduled for these items.

Hydro will continue to update the Integrated Action Plan to reflect any further findings of Hydro's internal investigation and/or further findings arising from the Board's review.

The reports on terminal station transformers and air blast circuit breakers set out in detail the specific information requested by the Board.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Geoffrey P. Young
Senior Legal Counsel

GPY/jc

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 REGARDING WORK TO BE PERFORMED ON AIR BLAST CIRCUIT BREAKERS

Newfoundland and Labrador Hydro

June 2, 2014

newfoundland labrador hydro
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1 INTRODUCTION

On May 15, 2014, the Newfoundland and Labrador Board of Commissioners of Public Utilities ("Board") issued its Interim Report in the matter of an investigation and hearing into supply issues and power outages on the Island Interconnected System ("Interim Report"). Pursuant to the Interim Report, Newfoundland and Labrador Hydro ("Hydro") was to file by June 2, 2014, a report in relation to the work required to be done in 2014 with regard to its air blast circuit breakers, addressing schedule, estimated costs, the resources required, and how these requirements will be met, setting out:

1. A plan for the proper exercise, preferably in cold weather, of all air blast circuit breakers annually beginning in 2014;
2. A list of critical air blast circuit breakers and an explanation as to how this determination was made;
3. A plan to complete 2014 and overdue testing and maintenance on critical air blast circuit breakers in 2014;
4. A plan to complete 2014 and overdue testing and maintenance on the remaining air blast circuit breakers;
5. A plan to periodically operate air blast circuit breakers from protective relays;
6. A plan to conduct an in-depth analysis of the DC system for B1L03 to determine if any high impedance paths exist that may affect its operation;
7. A plan to conduct a review of the annual air system leak check preventative maintenance to ensure that it is adequate in both scope and timing of execution to accurately identify leaks at the Sunnyside Terminal Station; and
8. A plan to review the current approach to air blast circuit breaker re-lubrication, addressing why the DOW 55 grease was not removed during the 2007 re-lubrication.

This report constitutes Hydro's response to the foregoing Board direction.

Hydro's internal investigation and analysis of the supply issues and power outages which occurred in January, 2014 identified many recommendations for action. The review by Liberty Consulting made further recommendations which incorporated many of Hydro's recommendations. These have all been consolidated into an integrated action plan which Hydro is managing and tracking to ensure successful completion.

A significant component of Hydro's internal review action plan is the requirement to address issues with reliable operation of air blast circuit breakers. As part of Hydro's asset management strategy, Hydro has an established 20-year capital plan for all of its assets. In this plan Hydro has identified and established a schedule for the replacement of air blast breakers. Hydro is accelerating this plan as outlined in this report.

Hydro identified, as part of a maintenance review in 2010, the need to improve the completion rate on its preventative maintenance routines for air blast breakers. Hydro established a six year plan for doing this, and since that time some of the preventative maintenance has been reprioritized due to other priority work, resulting in it being rescheduled. Hydro will complete this plan by ensuring that the preventative maintenance on all critical air blast breakers is completed in 2014, and that all remaining breakers are completed in 2015.

Following the power outage incidents in January 2013 and January 2014, Hydro identified the need to address specific issues with air blast breakers. Actions were initiated in the 2013 review for additional breaker testing and a review of maintenance tactics. Hydro's March, 2014 internal review report also highlighted breakers as a priority area of focus.

Since the end of the 2013/14 peak winter demand season, Hydro has begun executing its annual maintenance program and progress on the breakers is provided in this report. The level of maintenance activity is increasing over the summer and into the fall of 2014. Hydro will be actively monitoring and tracking compliance to the breaker maintenance plan to

ensure the power system is ready for sustained reliable performance in the winter of 2014/2015 and beyond.

2 PLAN FOR ANNUAL EXERCISE OF AIR BLAST CIRCUIT BREAKERS

In 2013, as a result of Hydro's review of the January 11, 2013 system disturbance, Hydro developed a plan to exercise (i.e., triggered to open and triggered to close) annually its 230 kV breakers both remotely from the Energy Control Centre ("ECC") and locally from the station. (See PUB-NLH-159 Attachment 1 for an example of a preventative maintenance ("PM") model work order set up to exercise breakers at Holyrood Terminal Station.) The intent of this plan is to ensure that every circuit breaker is exercised on a yearly basis to confirm operations no matter the type. An annual, time based PM program was set up in Hydro's maintenance management system in 2013. The exercising of the 230 kV breakers has been occurring in accordance with that plan. All breakers which had operating issues during the January 4, 2014 event were exercised and had operated successfully prior to the event. This plan has now been expanded to include all circuit breakers installed in the Island Interconnected System.

Throughout the remainder of 2014 and in subsequent years, all circuit breakers are scheduled to be exercised. All 230 kV circuit breakers are planned and scheduled to be completed on or before October 31, 2014, while the balance will be exercised no later than November 30, 2014. All circuit breakers will be exercised in accordance with Hydro's PM procedure documented on the work order. The plan takes into consideration the criticality, voltage class, type, outage schedule, equipment outages and the time of year.

The PM tactic for exercising breakers includes verification of breaker status both locally and remotely. The action of exercising a breaker will operate the mechanisms inside the breaker, promote lubrication movement in the heads, highlight air leaks and clean auxiliary contacts. All of this will improve the reliability of breaker operation when called upon during faults or protection operation in any season.

Hydro is currently reviewing the temperature range in which breaker exercising should occur to ensure winter readiness and that breakers will reliably operate in cold temperatures.

Breaker exercising will be conducted under a controlled environment to achieve its intent and to avoid any unnecessary outages. System Operations will approve outages on all breakers and will be planned and executed to minimize customer impact.

As of May 30, 2014, Hydro has exercised 34 circuit breakers, which includes 21 air blast circuit breakers (15 - 230 kV and six - 138 kV) and 13 other breakers.

The schedule for executing the remaining PM work in 2014 is found in Appendix A.

The 2014 incremental costs associated with this PM work are found in Section 9.

The 2014 incremental administrative and supervisory resource requirements for this PM work are found in Section 10.

3 CRITICAL AIR BLAST CIRCUIT BREAKERS

Appendix B (Sheet A) lists air blast circuit breakers greater than 66 kV on the Island Interconnected System, and their respective criticality ranking. The asset criticality for air blast circuit breakers was determined using an asset criticality ranking tool[1] which considered 12 different factors as outlined in Appendix B (Sheet B). Each factor was considered separately for each air blast circuit breaker and a score was applied based upon the factors definitions to arrive at an overall criticality score. The criticality score was then ranked by highest to lowest to determine an overall ranking. A review was then completed on the scores to arrive at criticality groups.

The highest criticality for Group A is mainly driven by the fact they are generator breakers without an alternate route to get power to the grid. Group B, the next highest criticality, is mainly driven by the fact they are generator breakers with an alternate route to get power to the grid, as well as 230 kV line breakers, mainly on the East Coast of the Province. Group C breakers are mainly 230 kV line breakers (Central and West) or transformer breakers, while Group D are 138 kV line breakers. For the purposes of this report, the critical breakers are defined as breakers in Group A and Group B. Overdue maintenance associated with Group A and Group B breakers is planned in 2014 as a priority and overdue maintenance associated with Group C and Group D breakers will be started in 2014 and completed in 2015.

[1] The asset criticality ranking tool was developed internally and leverages internal knowledge and experience, as well as externally validated practices and support.

These criticality groupings were developed by an internal Hydro team with representatives from Long Term Asset Planning[2], Work Execution[3] and System Operations[4] and will be reviewed and updated on an ongoing basis.

[2] This role leads long term asset planning and critical spares management activities. It is accountable for developing and refreshing the 20+ year asset plan addressing asset rehabilitation/overhaul, renewal and replacement. It drives the development of annual asset work plan and provides oversight and input into effectiveness of asset maintenance activities including preventative & predictive maintenance.

[3] This role leads the planning and execution of maintenance work in the annual work plan in a safe, environmentally friendly and effective manner.

[4] This is the power system operations group which is responsible for the safe, reliable, environmentally responsible and effective operation of the Island Interconnected System.

4 PLAN FOR TESTING OF CRITICAL AND REMAINING AIR BLAST CIRCUIT BREAKERS

Hydro has 63 PMs to complete on air blast circuit breakers on a six-year frequency. In 2010, Hydro reviewed its completion rate of PMs on its air blast circuit breakers and recognized it was tracking behind the desired six-year cycle of completing the PMs. In 2010, Hydro established a plan to have all PMs back on the six-year cycle by the end of 2015. Up to the beginning of 2014 (four years into the six-year cycle), Hydro has completed 23 PMs on air blast circuit breakers.

In 2014, Hydro has further developed the plan to complete overdue testing and maintenance on all air blast circuit breakers by the end of 2015. There are 40 air blast breaker PMs to be completed by the end of 2015, 18 of which are overdue. In 2014, 23 air blast breaker PMs (14 planned, nine overdue) will be completed. The remaining 17 air blast circuit breaker PMs (eight planned, nine overdue) will be completed in 2015. In 2016 and beyond, the annual number of air blast breaker PMs will return to nine or ten per year and will decrease over time as air blast circuit breakers are replaced[5]. The 2014 plan focuses on completing the most overdue PMs with the priority being critical air blast circuit breakers as shown in Section 2, two of which, B1L03 at Sunnyside and B1L17 at Holyrood, are completed. During PM work outages, corrective maintenance ("CM") work will be performed before the equipment is returned to service.

With the additional PM and CM work to be completed by December 1, 2014, additional resources will be required. The resources will be a combination of temporary employees and external contractors to supplement the existing resource levels in Transmission and Rural Operations ("TRO").

[5] As per Liberty Consulting recommendation Hydro is reviewing the frequency of the air blast breaker PMs to determine whether more frequent air blast breaker PMs are necessary due to age and condition of the breakers. In addition, Hydro is replacing its air blast circuit breakers, which will change the number of air blast PMs required each year and which will result in new PMs for a different type of breaker.

As of May 30, 2014, Hydro has completed four circuit breaker PMs, which includes two critical air blast circuit breakers and two other air blast circuit breakers.

A schedule to execute this remaining additional PM and CM work is shown in Appendix C.

The incremental cost beyond base budgets for 2014 associated with these additional PMs is found in Section 9. The cost shown in the table includes all air blast circuit blasters.

Incremental administrative and supervisory resource requirement for this PM is found in Section 10.

5 PLAN FOR OPERATING AIR BLAST CIRCUIT BREAKERS FROM PROTECTIVE RELAYS

Hydro will implement an addition to its Air Blast Circuit Breaker PM program to include a test to trip air blast circuit breakers from protective relays located in the protection panels. This change will be carefully implemented to prevent any unintentional operations of breakers which could result in customer interruptions.

In 2014, it is planned to complete the air blast circuit breaker PMs outlined in Section 3. In June and July, the PM checksheets and work orders will be updated in Hydro's Computerized Maintenance Management System to reflect the steps and checks to be followed by the technicians to trip from the protective relays.

Circuit breaker tripping tests via protective relays will begin in August, 2014.

6 PLAN TO CONDUCT AN IN-DEPTH ANALYSIS OF THE DC SYSTEM FOR SUNNYSIDE B1L03

Following the events of January 2 to 8, 2014, Hydro completed an overhaul and function testing on breaker B1L03 at the Sunnyside Terminal Station ("Sunnyside") in January. As well, additional testing was carried out, which involved initiating a trip on breaker B1L03 from the transformer lockout relay 86T1 and measuring the voltage drop across the individual phase trip coils. This testing verified that the breaker trip relay, the individual phase trip coils and associated wiring/connections functioned as required.

To alleviate concerns of possible high impedance paths in the DC trip circuit that may affect breaker operation, Hydro plans a complete checkout and re-commissioning of the breaker DC circuit with breaker B1L03 isolated from the electrical system. The procedure will include:

1. A visual inspection of all devices associated with breaker B1L03 protection and control;
2. Verifying tightness of all connections;
3. Where practical, inspection of all cabling between breaker B1L03 and associated protection and control panels, to look for damaged insulation;
4. Measuring and recording resistance and insulation resistance (megger) of all conductors in cabling between breaker B1L03 and associated protection and control panels;
5. Where possible, removing/disconnecting relays and measure contact resistance;
6. Performing continuity checks on all DC panel wiring associated with breaker B1L03;
7. Measuring resistance of trip coils to verify that coil resistances are within manufacturers' specifications;
8. Measuring and recording DC protection circuit voltage prior to and during all tests;

9. With a recorder connected across breaker trip coils, operating trip (T) relay and measure and record voltage;
10. Function testing three phase and single phase trips from all protective devices which operate into the breaker B1L03 protection circuitry. For three phase trip tests, monitoring voltage drop across the trip relay (T) coil. Investigating any sources of high path resistance that lead to lower than expected coil voltage on the trip (T) relay; and
11. Performing breaker timing tests on breaker B1L03 to verify timing is within manufacturers' tolerances.

An outage to perform this testing is scheduled for June 2014. Any deficiencies found during testing will be documented and corrected prior to releasing the breaker for service.

7 PLAN TO CONDUCT A REVIEW OF THE ANNUAL AIR SYSTEM LEAK CHECK PREVENTATIVE MAINTENANCE

Hydro will review its current annual air system leak check PM by September 30, 2014. The purpose of this review is to ensure that it is adequate in scope and timing of execution to accurately identify leaks at Sunnyside. The review will be led by a Hydro Asset Specialist and will include:

1. Interviews with maintenance staff and supervisors within Hydro to:
    a) Review existing maintenance tactics and checksheets and determine if updates or modifications are required for improvements; and
    b) Discuss whether changes in training are required.
2. Contacting other utilities in Canada who use air blast circuit breakers to determine their maintenance tactics and frequency for air systems supplying air blast circuit breakers; and
3. Contacting the breaker manufacturer to determine if Hydro's current air system maintenance tactic and frequency are in accordance with their recommendations.

The findings of the above will be utilized to establish an updated best practice for both Sunnyside Terminal Station and other stations that contain compressed air systems to help improve leak detection and minimize air leaks in all terminal stations with similar technology. This review will also consider the performance of compressed air systems in cold temperatures to assist with the development of the standard temperature range for breaker exercising. A summary report of the findings with action items identified will be prepared.

8 PLAN TO REVIEW THE CURRENT APPROACH TO AIR BLAST CIRCUIT BREAKER RE-LUBRICATION

Hydro will review the current approach to air blast circuit breaker re-lubrication by September 30, 2014. The purpose of this review is to review current practices and any opportunities for improvement related to the application and removal of breaker lubrication. This review will be lead by a Hydro Asset Specialist and will include:

1. Interviews with maintenance staff who worked on the re-lubrication in 2007 to get a better understanding of how the re-lubrication was completed, such as the lubrication used and the application locations and method;
2. Interviews with other maintenance staff and supervisors who perform breaker overhauls currently to:
    a) Gauge understanding of greasing techniques and the procedure for re-lubrication; and
    b) Assess any issues with completing lubrication in the field as opposed to the shop.
3. Contacting other utilities in Canada who use air blast circuit breakers to determine the types of lubrication used and methods for application;
4. Contacting the breaker manufacturer (OEM) to determine the types of greases used for various parts of the breaker and the recommended procedure to follow for lubrication; and
5. Contacting another supplier of non-OEM air blast breaker parts to discuss types of greases used with parts they are supplying and the recommended procedure to follow for lubrication.

The findings of the above will be utilized to establish an updated best practice for lubrication of air blast circuit breakers within Hydro. The review will also consider performance of lubrication systems in cold temperatures to assist with the development of

the standard temperature range for breaker exercising. A summary report of the findings will be prepared with action items identified.

9 ESTIMATED COST

Table 9.1 – Air Blast Circuit Breaker Additional 2014 and 2015 Work Cost Summary

Estimated Total Cost to Execute Additional Work for Air Blast Circuit Breakers	
Estimate to Exercise Air Blast Circuit Breakers	**$48,596**
Estimate Additional PMs for 2014 (Critical Overdue)	**$239,443**
Estimate Additional CMs for 2014 (Critical Overdue)	**$168,860**
Estimate Additional PMs for 2015 (Remaining Overdue)	**$239,443**
Estimate Additional CMs for 2015 (Remaining Overdue)	**$168,860**
TOTAL ESTIMATE	**$865,201**

Table 9.2 – Air Blast Circuit Breaker Exercising 2014 Estimate

Estimated Costs to Exercise Air Blast Circuit Breakers			
Number of Breakers to be Exercised	**63**		
TOTAL LABOUR ESTIMATE			**$23,535**
Internal Labour Execution (Regular Schedule)	42	$14,729	
Internal Labour Execution (O/T Schedule)	21	$8,807	
RENTALS			**$18,000**
Light Vehicles (Van/Truck)		$18,000	
ADMINISTRATION & DELAYS			**$7,061**
Delays/Re-schedule (weather and system conditions) (20% Labour)		$4,707	
Administration (10% Labour)		$2,354	
TOTAL ESTIMATE			**$48,596**

Table 9.3 – Air Blast Circuit Breaker PM 2014 Estimate

Estimated Costs to Execute Additional PMs for Air Blast Circuit Breakers for 2014			
Number of additional Air Blast Circuit Breaker PMs	**9**		
TOTAL LABOR ESTIMATE			**$122,648**
Internal Labour Execution (Regular Schedule)	2	$20,424	
Internal Labour Execution (O/T Schedule)	1	$12,019	
Internal Labour & Contractor Execution	6	$90,205	
RENTALS			**$80,000**
Bucket Truck (six months)		$30,000	
Material Handler (six months)		$30,000	
Light Vehicles (Vans/Truck)		$20,000	
ADMINISTRATION & DELAYS			**$36,795**
Delays/Re-schedule (weather and system conditions) (20% Labour)		$24,530	
Administration (10% Labour)		$12,265	
TOTAL ESTIMATE			**$239,443**

Table 9.4 – Air Blast Circuit Breaker CM 2014 Estimate

Estimated Costs to Execute Additional CMs for Air Blast Circuit Breakers for 2014			
Number of overdue Air Blast Circuit Breakers to Complete	**9**		
TOTAL LABOR ESTIMATE			**$68,354**
Internal Labour Execution (Regular Schedule)	2	$10,701	
Internal Labour Execution (O/T Schedule)	1	$5,907	
Internal Labour & Contractor Execution	6	$51,746	
RENTALS			**$80,000**
Bucket Truck (six months)		$30,000	
Material Handler (six months)		$30,000	
Light Vehicles (Vans/Truck)		$20,000	
ADMINISTRATION & DELAYS			**$20,506**
Delays/Re-schedule (weather and system conditions) (20% Labour)		$13,671	
Administration (10% Labour)		$6,835	
TOTAL ESTIMATE			**$168,860**

Table 9.5 – Air Blast Circuit Breaker PM 2015 Estimate

Estimated Costs to Execute Additional PMs for Air Blast Circuit Breakers for 2015			
Number of additional Air Blast Circuit Breaker PMs	**9**		
TOTAL LABOR ESTIMATE			**$122,648**
Internal Labour Execution (Regular Schedule)	2	$20,424	
Internal Labour Execution (O/T Schedule)	1	$12,019	
Internal Labour & Contractor Execution	6	$90,205	
RENTALS			**$80,000**
Bucket Truck (six months)		$30,000	
Material Handler (six months)		$30,000	
Light Vehicles (Vans/Truck)		$20,000	
ADMINISTRATION & DELAYS			**$36,795**
Delays/Re-schedule (weather and system conditions) (20% Labour)		$24,530	
Administration (10% Labour)		$12,265	
TOTAL ESTIMATE			**$239,443**

Table 9.6 – Air Blast Circuit Breaker CM 2015 Estimate

Estimated Costs to Execute Additional CMs for Air Blast Circuit Breakers for 2015			
Number of overdue Air Blast Circuit Breakers to Complete	**9**		
TOTAL LABOR ESTIMATE			**$68,354**
Internal Labour Execution (Regular Schedule)	2	$10,701	
Internal Labour Execution (O/T Schedule)	1	$5,907	
Internal Labour & Contractor Execution	6	$51,746	
RENTALS			**$80,000**
Bucket Truck (six months)		$30,000	
Material Handler (six months)		$30,000	
Light Vehicles (Vans/Truck)		$20,000	
ADMINISTRATION & DELAYS			**$20,506**
Delays/Re-schedule (weather and system conditions) (20% Labour)		$13,671	
Administration (10% Labour)		$6,835	
TOTAL ESTIMATE			**$168,860**

10 RESOURCE REQUIREMENTS

The incremental administrative and supervisory resource requirements for breaker exercising and air blast circuit breaker PM and CM and the transformers PM and CM completions are shown in the table below. These are in addition to the contractor and trades workers shown in Section 6.

Some resources listed here will be shared between the air blast circuit breaker PM execution and the critical transformer PM execution. Resources shown in this report coincide with resources shown in the transformer PM report, however costs will not be duplicated.

Table 10.1 – Additional Resources – PM and CM Recovery Plan

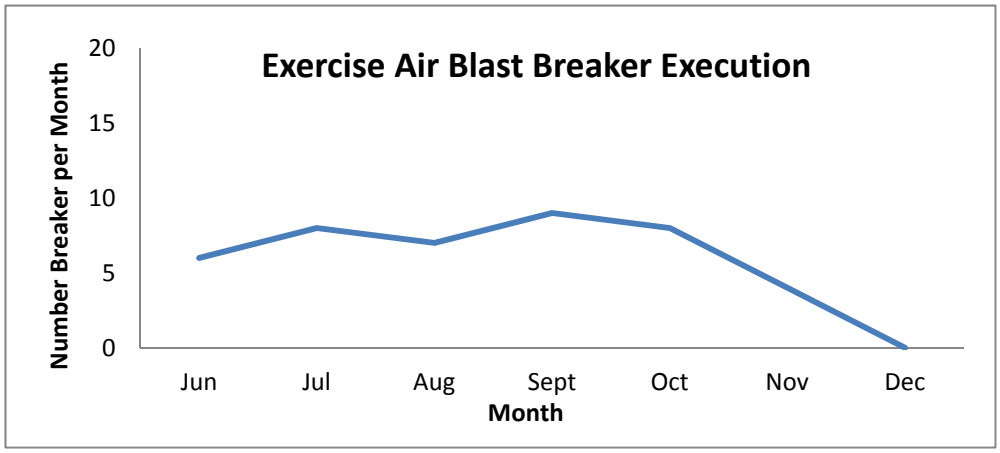
2014			
Classification	**FTE**	**Total**	**Dates**
Maintenance Planner	0.5	$33,525	July-Dec
Equipment Engineer LTAP	0.5	$40,000	July-Dec
Electrical/Mechanical Supervisor	0.5	$33,525	July-Dec
Superintendent G&T	0.5	$50,125	July-Dec
Asset Specialists	0.5	$50,125	July-Dec
Total FTE	**2.5**	**$207,300**	
2015			
Classification	**FTE**	**Total**	**Dates**
Maintenance Planner	1.0	$67,050	Jan-Dec
Equipment Engineer LTAP	1.0	$80,000	Jan-Dec
Electrical/Mechanical Supervisor	0.5	$33,525	Jan-Dec
Superintendent G&T	1.0	$100,250	Jan-Dec
Asset Specialists	0.5	$50,125	Jan-Dec
Total FTE	**4.0**	**$330,950**	

Field Resource estimates are shown in the estimates to complete the PMs and CMs in Section 9 of this report. These resources include such trades as Electrical Maintenance A, Mechanical Maintenance A and Protection and Control Technicians.

APPENDIX A

BREAKER EXERCISING SCHEDULE

Breaker Exercising Schedule									
	Number Breakers per Month								
		2014							
Breaker Type	Completed	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Quantity
Air Blast Breakers	**21**	**6**	**8**	**7**	**9**	**8**	**4**	**0**	**42**



APPENDIX B

SHEET A: ISLAND INTERCONNECTED BREAKER ASSET CRITICALITY

Location	Equipment Number	Type	Criticality Score/ 1000	Criticality Category
BDE TS1	B1T2	Air Blast	9600.0	A
BDE TS1	B3T5	Air Blast	9600.0	A
BDE TS1	B3T6	Air Blast	9600.0	A
BDE TS1	B2T3	Air Blast	9600.0	A
BDE TS1	B1T1	Air Blast	9600.0	A
BDE TS1	B2T4	Air Blast	9600.0	A
HRD TS	B2L42	Air Blast	672.0	B
HRD TS	B3L18	Air Blast	672.0	B
HRD TS	B1B11	Air Blast	672.0	B
HRD TS	B2B11	Air Blast	672.0	B
BDE TS1	B1B10	Air Blast	672.0	B
HRD TS	B3B13	Air Blast	672.0	B
HRD TS	B1L17	Air Blast	672.0	B
BDE TS1	B1B2	Air Blast	480.0	B
BDE TS1	B2B3	Air Blast	480.0	B
BDE TS1	B3B4	Air Blast	480.0	B
BDE TS1	B4B5	Air Blast	480.0	B
WAV TS	B1L08	Air Blast	216.0	B
HWD TS	B1L01	Air Blast	216.0	B
OPD TS	B1L18	Air Blast	216.0	B
OPD TS	B1L36	Air Blast	216.0	B
SSD TS	B1L03	Air Blast	96.0	B
SSD TS	L02L07	Air Blast	96.0	B
SSD TS	B1L02	Air Blast	96.0	B
SSD TS	L06L07	Air Blast	96.0	B
WAV TS	L01L03	Air Blast	96.0	B
HRD TS	B12L17	Air Blast	96.0	B
WAV TS	B1B3	Air Blast	96.0	B
HRD TS	B12L42	Air Blast	96.0	B
HRD TS	B12B15	Air Blast	96.0	B
WAV TS	B1L37	Air Blast	96.0	B
BDE TS1	B5B6	Air Blast	96.0	B
BDE TS1	B6B10	Air Blast	96.0	B
WAV TS	L03L17	Air Blast	96.0	B
WAV TS	B1L17	Air Blast	96.0	B
SSD TS	B2T1	Air Blast	43.2	C
STB TS	B3T1	Air Blast	43.2	C

Location	Equipment Number	Type	Criticality Score/ 1000	Criticality Category
SSD TS	B3T4	Air Blast	43.2	C
SSD TS	L109T4	Air Blast	43.2	C
STB TS	B3T2	Air Blast	43.2	C
STB TS	L05L31	Air Blast	14.4	C
BBK TS	B1L09	Air Blast	14.4	C
BBK TS	B1L11	Air Blast	14.4	C
BUC TS	L28L32	Air Blast	14.4	C
BUC TS	B1L05	Air Blast	14.4	C
BBK TS	L09L33	Air Blast	14.4	C
BBK TS	L11L33	Air Blast	14.4	C
MDR TS	B1L28	Air Blast	14.4	C
STB TS	B1L31	Air Blast	14.4	C
STB TS	L05L35	Air Blast	14.4	C
STB TS	B1L35	Air Blast	14.4	C
STB TS	B2L04	Air Blast	14.4	C
BUC TS	B1L28	Air Blast	14.4	C
MDR TS	B5L11	Air Blast	14.4	C
STB TS	B1L32	Air Blast	14.4	C
BUC TS	L05L33	Air Blast	14.4	C
SSD TS	B2L12	Air Blast	10.8	D
SSD TS	L19L100	Air Blast	10.8	D
STB TS	B3L22	Air Blast	10.8	D
SSD TS	L100L109	Air Blast	10.8	D
STB TS	B3L133	Air Blast	10.8	D
STB TS	B3L10	Air Blast	10.8	D
STB TS	B3L130	Air Blast	10.8	D

SHEET B: BREAKER CRITICALITY ANALYSIS FACTORS BREAKERS

Equipment Factors		
FACTOR 1 - Health and Safety		
Level	Definition	Score
1	Minor	1
2	A medical treatment	2
3	A lost time incident	4
4	A disability	6
5	Loss of life	10
Explanation: Judge based upon asset risk to both people and plant.		

FACTOR 2 - Output (Capacity De-rating/Outage Time to Repair)- System		
Level	Definition	Score
1	No effect	1
2	Reduced rate minor effect	2
3	Reduced rate serious effect	3
4	Off two hours to eight hours	4
5	Off for more than eight hours	8
Explanation: Estimated time to repair.		

FACTOR 3 - Quality Of Desired Output (Voltage/Frequency)		
Level	Definition	Score
1	No effect	1
2	Minor effect to system without downgrade	2
3	Downgrade to system	3
4	Dump (Under frequency Load Shed)	4
Explanation: Do not choose 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: Estimate percentage of scheduled production hours.		

Equipment Factors

FACTOR 5 - Alternatives

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	3
4	No standby or alternative route available without extreme difficulty	4
5	No alternative	5

FACTOR 6 - Environment

Level	Definition	Score
1	No effect	1
2	Minor local effect - can be contained on site, e.g. noise/smell	2
3	More serious local / minor off-plant - liable to result in discharge to atmosphere or water course, e.g. 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: Consider oil in Oil Circuit Breakers and SF6 gas in SF6 Breakers.		

FACTOR 7 - Time to Affect (Time of failure to take affect)

Level	Definition	Score
1	Negligible effect	1
2	More than 24 hours	2
3	Between two hours and 24 hours	3
4	Between 30 mins and two hours	4
5	Immediate	5
Explanation: Judgment on time failure will take effect to system.		

FACTOR 8 - Customer Impacts

Level	Definition	Score
1	Distribution $\leq$ 25 kV	1
2	Sub Transmission 46-69 kV	2
3	Transmission 138 kV	3
4	Transmission 230 kV	4
Explanation: This will depend upon the voltage class of system impacted.		

Equipment Factors		
FACTOR 9 - Loss Type		
Level	Definition	Score
1	Equipment	1
2	Facility (Station or Line)	3
3	Production (Affect generation output)	5
Explanation: Need to select the most probable loss type.		

Breaker Additional Factors		
FACTOR 10 - Breaker Type		
Level	Definition	Score
1	SF6	1
2	Oil Circuit Breaker	2
3	Air Blast	5
Explanation: Input score for breaker type.		

FACTOR 11 - Direct Impact on Generation Capacity to Grid		
Level	Definition	Score
1	< 5 MW/MVar	1
2	> 5 MW/MVar	2
3	$\geq$ 40 MW/MVar	3
4	$\geq$ 70 MW/MVar	5
5	> 150 MW/MVar	7
Explanation: Indicate impact of failure on getting generation capacity onto grid.		

FACTOR 12 - Transformer Breaker		
Level	Definition	Score
1	No	1
2	Yes	4
Explanation: Breaker failure could result in transformer being offline.		

APPENDIX C

SCHEDULE TO COMPLETE OVERDUE AIR BLAST CIRCUIT BREAKER PMs

Overdue PMs - 2014	
Air Blast Circuit Breaker	**Criticality**
BDETS1,B3T6	**A**
BDETS1,B1T1	**A**
WAVTS,B1L37	**B**
BDETS1,B6B10	**B**
BDETS1,B3B4	**B**
BDETS1,B2B3	**B**
BDETS1,B5B6	**B**
HRDTS,B12L42	**B**
HRDTS,B12B15	**B**

Air Blast Circuit Breaker PM Schedule								
	Number Breaker per Month							
	2014							
Breaker Type	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Quantity**
230 kV AB	1	2	2	2	1	1	0	9