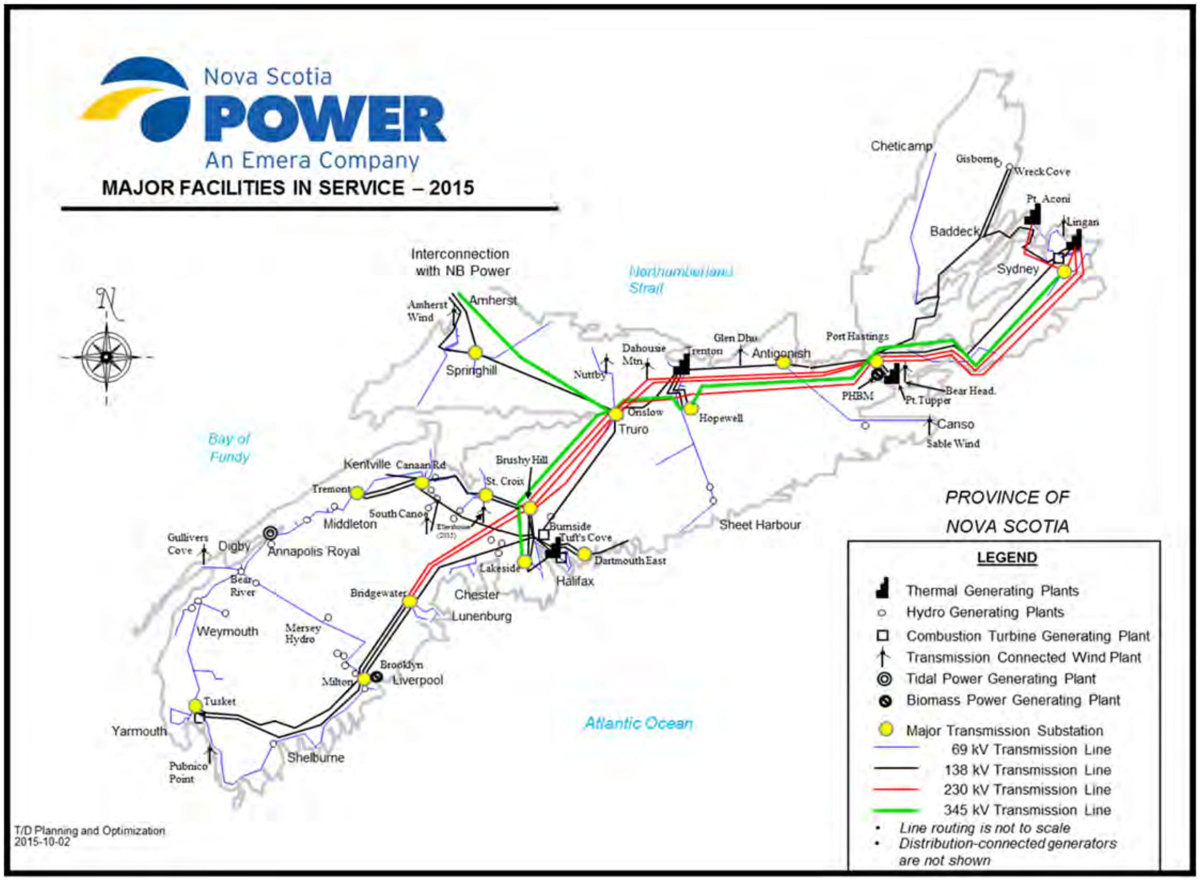
Nova Scotia Power

2016 Annual Capital Expenditure Plan



Date Filed: November 12, 2015

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Executive Summary

Nova Scotia Power is making every effort to reduce upward pressure on future electricity rates while providing safe, reliable service and abiding by all environmental and regulatory obligations. Our customers and stakeholders have consistently told us through recent regulatory proceedings, including prior General Rate Applications (GRA) and Annual Capital Expenditure (ACE) Plan proceedings, and through direct conversations with customers, that this is what they expect of Nova Scotia Power. Our ACE Plans, including the 2016 ACE Plan, are developed to meet our customers' expectations.

The 2016 ACE Plan filing is an important part of NS Power's capital program, providing the Nova Scotia Utility and Review Board (Board, UARB), stakeholders and NS Power's customers with our outlook on capital spending for the year ahead. The 2016 capital budget is $279.9 million, of which NS Power seeks approval of $174.4 million of capital spending made up of 73 capital work orders plus the capital routine program. Proposed capital expenditures for 2016 are compared to prior years in the table below.

Year	2011 Actual	2012 Actual	2013 Actual	2014 Actual	2015 ACE Plan	2015 Q3 F	2016 ACE Plan
Generation	$85.4	$88.7	$68.4	$66.0	$99.8	$103.0	$105.0
New Renewables	66.2	53.2	15.2	82.8	12.1	17.5	-
Transmission	58.4	45.4	31.0	51.0	68.0	49.7	$56.1
Distribution	62.4	68.7	62.9	52.8	64.1	59.6	$74.8
General Plant	42.5	28.5	29.9	21.7	29.0	28.5	$44.0
Total	**$315.0**	**$284.5**	**$207.4**	**$274.3**	**$273.0**	**$258.3**	**$279.9**

*Above figures include non-rate base spending on South Canoe and Maritime Link related transmission.

The majority of capital work orders submitted for approval are less than $1 million each: 26 projects are forecast between $250,000 and $500,000; 19 are forecast between $500,000 and $1 million, and 28 exceed $1 million. Most of these work orders reflect sustaining and compliance capital work on our system. Representative projects include rebuilding or refurbishing aging and deteriorated plant and equipment, or investment in our assets in order to comply with regulations.

NS Power's focus on sustaining capital projects is made possible, in part, by the evolution of NS Power's asset management program, which includes NS Power's revised project ranking methodology as described in the Capital Expenditure Justification Criteria (CEJC). In fact, NS Power's Asset Management Program has been recently recognized by Uptime Magazine, which serves over 50,000 maintenance Reliability Leaders and Asset Management Professionals throughout industry. Uptime Magazine has selected NS Power for the "Best Asset Management" award. This award will be presented at this year's International Maintenance Conference in December. Over 40 countries and 1,000 people participate in this conference annually.

Beyond the focus on sustainable capital and associated projects, NS Power continues to adjust to an evolving power system, driven in part by the adoption of increasing amounts of variable renewable energy and the introduction of smart grid technologies. Future strategic capital investments include the Metro Transmission Upgrades, Automated Metering Infrastructure (AMI), and large hydro infrastructure investment forecast to begin in 2018.

NS Power continues its transformation to more renewable sources of generation as we make tough and informed choices to ensure we comply with the most ambitious renewable energy requirements and emissions reductions in Canada. Those choices mean NS Power has made significant progress to reduce the use of fossil fuels and adopt renewable sources of generation. In 2014, NS Power achieved a 30 percent reduction in CO_2 emissions from 2005 levels. In 2016, the installed wind generation on the NS Power system is expected to exceed 600MW. When considered as a percentage of the power system peak of approximately 2,000MW, this places NS Power amongst the leaders in wind integration in North America.

Against this backdrop of transformation, NS Power must continue to deliver reliable service. This introduces challenges related to the changing role for much of NS Power's steam generation fleet, and efforts to extract the value from these assets, while counting on them for dependable firm generation capacity when renewable generation is unavailable.

Over the last several years, NS Power has been actively engaged with stakeholders regarding continual improvements to the ACE Plan. In furtherance of this effort, in 2015 NS Power engaged with consultants for the Small Business Advocate and the Consumer Advocate pursuant to the Board's 2015 ACE Plan Decision and Order. A report regarding these discussions was submitted to the UARB on June 30, 2015, along with a revised Detailed and Summary CEJC for the Board's information and approval respectively. These engagements have been a positive influence on the ACE Plan proceedings, and NS Power will continue to engage stakeholders going forward.

NS Power's ACE Plan continues to be an important part of reducing upward pressure on rates through timely investments to strengthen system reliability and preserve our existing assets.[1]

NS Power respectfully requests Board approval of the following:

- 73 Capital Items with 2016 budget spending of $59,589,833 and total project spending of $92,452,908. (Please refer to Section 2.2.)

- Capital routine programs with 2016 budget spending of $81,990,925. (Please refer to Section 7.1.)

- 2016 AFUDC Rate of 7.23% for capital. (Please refer to Section 1.3.)

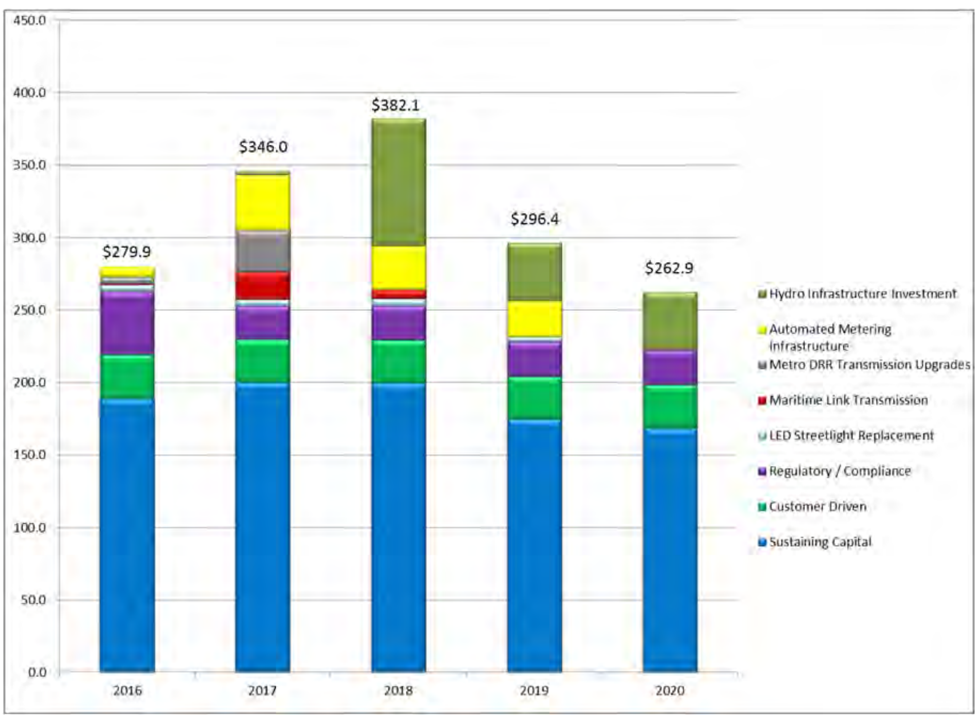
[1] Please refer to Section 8.1.1.

1 Introduction

1.1 Sustaining Capital Program

NS Power's 2016 ACE Plan was developed to meet our customers' expectations for safe, reliable service, and less reliance on fossil fuel generation. It continues to be a largely sustaining capital program representing cost-effective investments to maintain system performance for our customers. The emphasis continues to be on making the best use of our existing assets, making timely investments based on equipment condition and criticality, and managing the significant transformation to renewable energy underway on the NS Power system. In this way, NS Power is continuing to address the affordability of investments and reducing upward pressure on rates.

As shown in the figure below, the investments on sustaining our assets, customer driven investments, and investments required by regulatory or environmental standards are forecasted to be reasonably stable. Strategic capital investments, such as hydro infrastructure re-investment, Metro Transmission Upgrades, and Automated Metering Infrastructure may create larger capital investments in future years.



Investment Type	2016	2017	2018	2019	2020
Sustaining Capital	188.9	200.0	199.5	174.6	168.5
Customer Growth	30.6	29.7	29.8	29.9	30.0
Regulatory / Compliance	43.3	23.0	23.5	23.9	24.4
LED Streetlight Replacement	4.7	4.9	5.0	3.0	0.0
Maritime Link Transmission	0.8	18.5	6.3	0.0	0.0
Metro Transmission Upgrades	4.7	28.9	0.0	0.0	0.0
Automated Metering Infrastructure	7.0	38.0	30.0	25.0	0.0
Hydro Infrastructure Investment	0.0	3.0	88.0	40.0	40.0
	279.9	**346.0**	**382.1**	**296.4**	**262.9**

*Totals may be off slightly due to rounding. Figures are noted in $millions.

The Sustaining, Customer Driven, and Regulatory/Compliance Capital portion of the annual forecast is more certain than the large scale strategic capital profile. The Sustaining Capital estimates are built up from well-established asset management and replacement programs, while Strategic Capital reflects projections of spending in later years that may not be fully scoped at this time, and are high level estimates subject to change as project scope becomes better defined. Hydro Infrastructure Investment, which includes re-development of the Mersey Hydro System and a major overhaul of our Wreck Cove Hydro generating station, is an example of investment that is not fully scoped at this time, and the primary reason for the increased forecast spend in 2018.

1.2 2015 Stakeholder Engagement

Consistent with prior years, NS Power engaged in stakeholder discussions regarding a number of capital related matters. A report regarding the outcome of these discussions, along with a revised CEJC, was submitted to the UARB on June 30, 2015. Highlights of those discussions and the report are provided below.

1.2.1 Revenue Requirement & Affordability

NS Power has continued to work with stakeholders and their consultants on the issue of the revenue requirement directive (Section 8.1.1) and affordability. On February 18, 2015, NS Power submitted the 2015 ACE Plan Terms of Consensus. The Terms of Consensus provided:

In the 2016 ACE Plan, NS Power will continue to include fixed cost recoveries in

> the revenue requirement directive as an offsetting effect along with the effect of depreciation. However, NS Power will more clearly delineate these items so that the before and after revenue requirement can be easily ascertained. NS Power will provide draft versions of this directive to interested stakeholders for their review and comment. This stakeholder consultation process will begin within 30 days of the Board issuing its decision in this matter.[2]

In its 2015 ACE Plan Decision, the UARB provided:

> The Board finds that the increased complexity of the revenue requirement model comes at the cost of understanding its purpose. The model, in itself, should not be seen as a prediction of accurate future rates; rather, it should only be seen as indicating the cost pressures that capital expenditures have on future rates.
>
> NSPI should continue its consultations with stakeholders on how to simplify the goal, and calculation, of the revenue requirement model, using a five-year projection.[3]

NS Power discussed the revenue requirement directive with consultants for the Small Business Advocate (SBA) and Consumer Advocate (CA) in 2015. In NS Power's report on stakeholder consultations submitted to the UARB on June 30, 2015, NS Power reaffirmed its commitment to clearly delineate fixed cost recoveries and depreciation in the overall revenue requirement table in future ACE Plans, and provided corresponding mock-ups of that table.

Treatment of Administrative Overhead (AO) and depreciation in the overall calculation was also discussed with stakeholders. NS Power was unable to reach agreement with stakeholders on the treatment of AO and depreciation. However, to address this issue, NS Power committed to and provides herein a detailed electronic version of the overall revenue requirement table.

NS Power continues to provide other detailed information regarding the revenue requirement impact of certain classes of expenditures. For example, Section 8.1.1 also provides the revenue requirement impact of economically justified and work support facility projects. Moreover,

[2] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, page 3.
[3] NS Power 2015 ACE Plan, Decision, M06514/P-128.15, May 5, 2015, pages 22-23.

Section 8.1.4 - Annual Ranking/Prioritization of Capital Projects provides NS Power's rationale and rankings of projects.

1.2.2 Sustaining Capital – Alignment with the Integrated Resource Plan

The 2015 ACE Plan Terms of Consensus included commitments regarding alignment with the Integrated Resource Plan (IRP). Specifically, Section 8 of the Terms of Consensus provided the following:

> (8) NS Power will also engage with interested stakeholders on the issue of NS Power including information in future ACE Plans to show how its long-term planning assumptions regarding projections of sustaining capital investment in existing thermal plants presented in the IRP and future ACE Plans are consistent. This stakeholder consultation process will begin within 30 days of the Board issuing its decision in this matter.[4]

During stakeholder consultations, NS Power discussed the issue of including information in future ACE Plans to show how its long-term planning assumptions regarding projections of sustaining capital investment in existing thermal plants presented in the IRP and future ACE Plans are consistent. A mock-up of this commitment was provided and agreed upon by stakeholders pursuant to NS Power's report to the Board dated June 30, 2015. The final version of this information can be found in Section 8.1.2.

1.2.3 Economic Analysis Model

The 2015 ACE Plan Terms of Consensus included a commitment with respect to NS Power's Economic Analysis Model (EAM). Specifically, Section 7 of the Terms of Consensus provided the following:

> (7) In future ACE Plans, NS Power will update the EAMs to provide a five (5) year forecast of unit capacity factors and replacement energy costs. In addition, NS Power will also engage with interested stakeholders on the appropriateness and method(s) of forecasting or extrapolating replacement energy costs for the time period past five (5) years for

[4] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, pages 2-3.

> projects with EAMs that have payback periods of more than five (5) years. This stakeholder consultation process will begin within 30 days of the Board issuing its decision in this matter.[5]

During stakeholder consultations, NS Power reaffirmed its commitment to provide five year avoided cost forecasts in its EAMs – an increase from the two years previously used. NS Power and stakeholders also agreed that for years six onward an escalator calculated at inflation would be used provided that each year NS Power compared the inflation escalator to fuel forecasts. These commitments have been included in section 6.7.1 and 9.1.1 of the revised Detailed CEJC, and section 6.3.1 of the revised Summary CEJC. The EAMs provided in the 2016 ACE Plan conform to this agreed upon methodology.

1.2.4 Reliability Directive

The 2015 ACE Plan Terms of Consensus included commitments regarding the ACE Plan Reliability Directive. Specifically, Sections 4 and 5 of the Terms of Consensus provided the following:

> (4) As part of the reliability directive in future ACE Plans, NS Power will provide additional information regarding its plans for replacement of aging transmission and distribution equipment in accordance with the following recommendation on this matter made by the SBA's consultant, Mary Neal, at page 12 of her evidence in this proceeding dated January 16, 2015:
>
> > "I recommend NSPI provide more information regarding its plans for replacement of aging transmission and distribution equipment to better show how it justified the target investments. This should include (where possible):
> >
> > - Descriptions of assets to be replaced and their ages,

[5] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, page 2.

- Goals for strategic replacement programs, such as targets for age profiles of different asset classes,
- Expected improvements in asset age profiles due to each ACE Plan project involving replacement of transmission and distribution equipment considered at end-of-life,
- More detailed descriptions of how NSPI targets specific assets every year, whether based on age, performance degradation, or other factors, and
- Any recent, relevant inspection data."

(5) As part of the reliability directive in future ACE Plans, NS Power will provide an update on its storm performance and related capital investment strategies to improve storm performance.[6]

During stakeholder consultations, NS Power reaffirmed its commitment to include, where applicable, more detailed information regarding NS Power's reliability investment strategy, as well as updates on storm performance and related capital investments, in the ACE Plan reliability directive. A mock-up of a revised reliability directive was provided to stakeholders. Feedback was received, and included the suggestion to provide descriptions and data, where available, for all asset classes, and how that data informed NS Power's approach to each. The mock-up version was agreed upon by NS Power and stakeholders. The final version of this information can be found in Section 8.1.7.

1.2.5 Electronic Database

The 2015 ACE Plan Terms of Consensus included commitments regarding the ACE Plan electronic database. Specifically, Section 3 of the Terms of Consensus provided the following:

(3) In future ACE Plans, NS Power will provide the most recent quarterly capital report, updated with ACE Plan data, in place of the electronic database provided in 2015 ACE Plan.[7]

[6] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, page 2.
[7] Ibid.

The 2015 ACE Plan UARB Decision directed NS Power to:

> …continue the provision of the electronic database in future ACE Plan filings.[8]

Upon further consideration, NS Power concluded that providing both the ACE Plan database and the Q3 quarterly capital report updated with ACE Plan projects was the simplest and most complete approach. This was discussed with and agreed upon by stakeholders. Feedback from stakeholders resulted in two minor revisions, including a new acronym list and clarifying that the actual spend column in the quarterly capital report indicates actual spend at quarter end. A final revised mock-up of the database was provided to stakeholders, reviewed and agreed upon. The ACE Plan electronic database and updated Q3 Capital Report have been provided along with the 2016 ACE Plan submission.

1.2.6 Capital Expenditure Justification Criteria

During stakeholder consultations, multiple revisions to the CEJC were proposed by NS Power and submitted to stakeholders for review. Feedback was received by stakeholders and incorporated into the CEJC. The substantive revisions include the following:

- Generation, Transmission and Distribution Ranking Methodology update – incorporation of NS Power's current ranking matrix and supporting language.

- Revenue Requirement Directive – language incorporated noting NS Power's commitment to delineate fixed cost recoveries and depreciation in the overall revenue requirement table.

- Economic Analysis Model – language incorporated noting NS Power's commitment to use five year forecasts for avoided costs, the adoption of an inflation escalator for years 6 onward, and the commitment to compare the inflation escalator to fuel forecasts on an annual basis.

- Cost thresholds for Routine ATO submissions – language incorporated providing thresholds for routine ATO submissions identical to the Board approved thresholds for individual capital item FIN submissions.

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[8] NS Power 2015 ACE Plan, Decision, M06514, May 5, 2015, page 27, line 108.

- Approval of annual AFUDC rates – language incorporated establishing the ACE Plan process for the approval of annual AFUDC rates for capital.

The changes to the CEJC were reviewed by stakeholders. A revised summary and detailed CEJC were submitted to the UARB for approval and information respectively on June 30, 2015. The UARB provided several IRs to which NS Power responded on August 10, 2015. By letter dated October 8, 2015, the UARB directed NS Power to incorporate three revisions to the Summary and Detailed CEJC. NS Power resubmitted the revised Summary and Detailed CEJC, with the Board's revisions incorporated, on October 29, 2015.

1.3 2016 AFUDC Rate

In the Board's 2013 ACE Plan Decision, the UARB provided the following directive:

> The Board directs NSPI to adjust the rate used for AFUDC purposes to match that approved in the most recent GRA.[9]

In accordance with the Board's direction, NS Power used the 2013 GRA approved 2014 AFUDC rate of 7.78 percent as noted in the 2014 ACE Plan. However, the 2013 GRA applied only to 2013 and 2014. As such, in the 2015 ACE Plan, NS Power requested and was granted approval of a 2015 AFUDC rate for capital expenditures.

Consistent with NS Power's request in the 2015 ACE Plan, NS Power requests approval of the 2016 AFUDC rate at 7.23 percent for capital expenditures, as supported by the following table.

[9] NS Power 2013 ACE Plan, Decision, M05339, May 27, 2013, page 23.

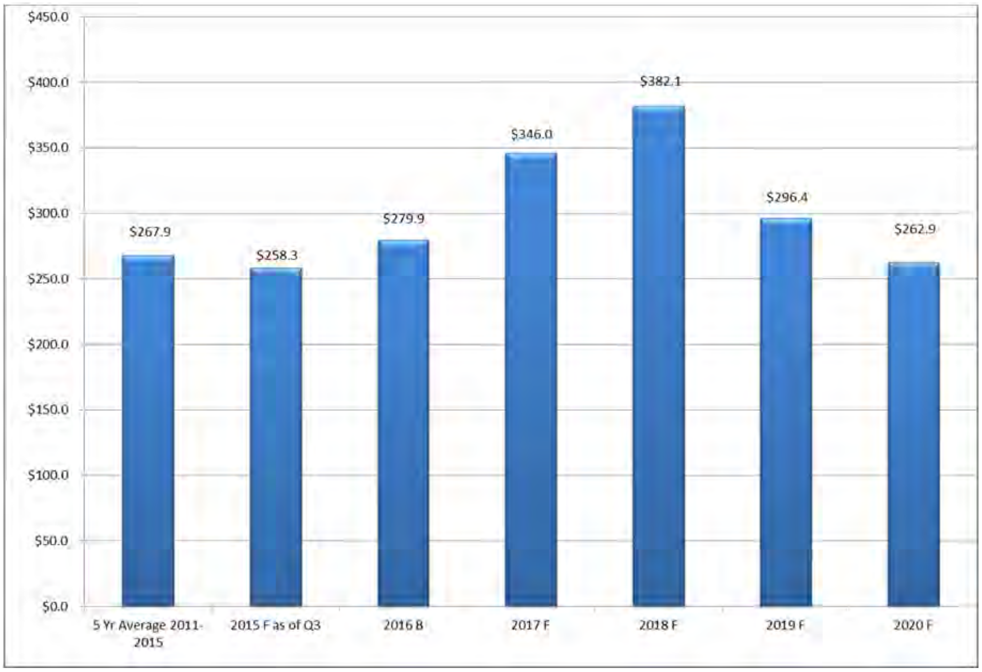
Nova Scotia Power Inc.
<u>Estimated Average Capital and Cost of Capital</u>
Year Ended December 31st 2016
Millions of Dollars

	Opening	Closing	Average Capital	Capital Ratio	Cost Pre-tax Factor	Cost After-tax Factor	Weighted Pre-tax Cost	Weighted After-tax Cost
Estimated Cost of Capital								
Short-term debt	$77.2	$106.3	$91.7	2.4%	2.56%	1.77%	0.06%	0.04%
Long-term debt	2,210.6	2,209.9	2,210.3	58.1%	6.22%	4.32%	3.61%	2.51%
Total debt	$2,287.7	$2,316.2	$2,302.0	60.5%	8.78%	6.09%	3.67%	2.55%
Common equity	1,498.3	1,510.0	1,504.1	39.5%	9.00%	9.00%	3.56%	3.56%
Total	**$3,786.0**	**$3,826.2**	**$3,806.1**	**100.0%**			**7.23%**	**6.11%**

Notes:
1) Figures presented may include $0.1M in rounding differences on some line items.
2) Pre-tax equity cost excludes the income tax gross-up factor.
3) Average capital reflects average of year-end balances.

1.4 Capital Spending History and Forecast Overview

Historical, Budget and Forecast
(Millions of Dollars)



F = Forecast, B=Budget in above figure

Total Annual Capital Expenditures by Function

(Millions of Dollars)

	Actuals						ACE Plan	Forecast			
Year	**2011**	**2012**	**2013**	**2014**	**2015 Q3 F**	**2015 ACE Budget**	**2016**	**2017**	**2018**	**2019**	**2020**
Generation	$85.4	$88.7	$68.4	$66.0	$103.0	$99.8	$105.0	$87.3	$169.0	$115.1	$115.7
New Renewables	66.2	53.2	15.2	82.8	17.5	12.1	-	-	-	-	-
Transmission	58.4	45.4	31.0	51.0	49.7	68.0	$56.1	110.5	71.5	52.3	53.4
Distribution	62.4	68.7	62.9	52.8	59.6	64.1	$74.8	105.0	98.3	89.5	62.7
General Plant	42.5	28.5	29.9	21.7	28.5	29.0	$44.0	43.2	43.3	39.4	31.1
Total	**$315.0**	**$284.5**	**$207.4**	**$274.3**	**$258.3**	**$273.0**	**$279.9**	**$346.0**	**$382.1**	**$296.4**	**$262.9**

NOTE: Figures presented may include $0.1M in rounding differences on some line items.

1.5 2015 ACE Capital Items Deferred/Cancelled

NS Power's list of deferred and cancelled capital work orders relative to the 2015 ACE Plan are noted in the following table.

Of the 27 projects listed, two projects were included in the 2015 ACE Plan for approval. 12 of these projects were listed in the 2015 ACE Plan to be filed separately as individual capital items. The remaining 13 projects were listed in the 2015 ACE Plan as projects under $250,000.

These 27 projects were originally included in the 2015 ACE Plan with a forecasted spend of $8.4 million in 2015.

2015 ACE Items – Deferred or Cancelled

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
Generation							
45116	CT - BGT1 GG4C-1D Engine Refurbishment *Engine condition continues to be closely monitored. These condition assessments have determined this project can be safely deferred to 2017.*	1,168,167	Deferred	2017	ACE 2015	Request Approval	
44775	CT - TUC#4 LM6000 Generator Rotor Re-wedge *Further assessment / scoping was required to determine the requirements of this project. Now scheduled for early 2016 execution.*	803,594	Deferred	2016		Subsequent Approval	Subsequent Approval

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
44536	LIN3 HP Rows 1&2 Replacement *Upon inspection, which can only occur when the turbine covers are removed, the blades were found to be in an acceptable condition where they can reliably remain in-service until the next planned major outage in 8-10 years.*	706,791	Cancelled			Subsequent Approval	
46352	TRE5 Air Heater Refurbishments *Assessment of the air heater baskets indicated the condition would allow for operation until 2016 when an outage of sufficient length is available to complete this work.*	527,994	Deferred	2016	ACE 2015	Request Approval	Request Approval
46483	CT - Tusket Control System Upgrade *Additional engineering was required in 2015 to clearly define the scope and select the new control system. Assessment has shown this can be safely deferred until 2017.*	441,816	Deferred	2017		Subsequent Approval	
46466	TUC2 - Rotary Airheater Refurbishment *Further inspection showed that ongoing maintenance / monitoring can allow this project to be deferred to 2017.*	439,946	Deferred	2017		Subsequent Approval	
46655	ICP Mile 10.1 Bridge Repairs *A railway inspection consultant determined that the bridge can function safely in its current state and investment can be deferred to 2018.*	377,279	Deferred	2018		Subsequent Approval	
44752	BGT1 - Generator Rotor Retaining Ring Replacement *Further assessment indicated that this work can safely be completed in 2017.*	357,869	Deferred	2017		Subsequent Approval	

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
29065	CT - BGT Replace Halon Fire Protection System *Further assessment has shown that the equipment that is currently installed still provides adequate safety protection and can be safely deferred to 2016.*	356,682	Deferred	2016		Subsequent Approval	Less than 250k
45117	BGT1 - PLC and Field Device Control Upgrade *This work can safely be deferred to 2017 when the engine refurbishment of Burnside Unit 1 will be completed.*	253,768	Deferred	2017		Subsequent Approval	
45176	ICP - Pier Belting *Further assessment showed the condition of these belts allowed for them to operate reliably in 2015, thus deferring the investment to 2016.*	231,227	Deferred	2016		Less than 250K	Less than 250k
42937	TUC-LMs East Gas Compressor Overhaul *Upon further assessment, it was found that the compressor cylinder wall wear is not to the point where cylinder replacement is necessary as of yet. Project will continue to be monitored to determine necessary timing.*	154,319	Deferred	2017		Less than 250K	
43420	CTs - BGT Air Dryer System Upgrade *After further investigation, the condition of the air dryer systems does not warrant investment at this time.*	125,947	Deferred	2017		Less than 250K	

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
28249	POT Structural Steel Refurbishment *Further assessment showed that this project can be safely deferred to 2016, which allowed higher priority work to be completed during the planned outage. Ongoing assessments will be completed to ensure personnel safety.*	123,921	Deferred	2016		Less than 250K	Less than 250k
46495	TUC3 - DCS Upgrade *Further assessment showed the risk of this project could be properly managed in 2015 in order to allow for deferral to 2016.*	95,475	Deferred	2016		Less than 250K	Less than 250k
42944	TUC3 - Boiler Drum North PSV Replacement *Further assessment showed the components condition allowed for reliable operation throughout 2015. This project will now be executed in 2016.*	70,524	Deferred	2016		Less than 250K	Less than 250k
45118	BGT1 - Addition of Flux Probe & Partial Discharge *This work can safely be deferred to 2017 when the engine refurbishment of Burnside Unit 1 will be completed.*	65,650	Deferred	2017		Less than 250K	
43146	CTs - VJ Air Dryer System Upgrade *After further investigation, the condition of the air dryer systems does not warrant investment at this time.*	64,441	Deferred	2017		Less than 250K	
46596	POT - Precipitator Refurbishment *Further assessment completed in 2015 determined this project could be operated in a reliable manner without capital investment until 2017.*	51,935	Deferred	2017		Less than 250K	

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
45122	BGT3 - Clutch Switch Improvement *This project was based on issues that occurred on Burnside Unit #1. These issues are not currently as prevalent on Unit 3 which has allowed for this project to be deferred to 2017.*	28,981	Deferred	2017		Less than 250K	
45121	BGT2 - Clutch Switch improvement *This project was based on issues that occurred on Burnside Unit #1. These issues are not currently as prevalent on Unit 3 which has allowed for this project to be deferred to 2017.*	28,637	Deferred	2017		Less than 250K	
46502	TUC - Silica Analyzer *This project was completed and charged to operating expense as it did not meet capitalization materiality limits.*	25,000	Cancelled			Less than 250K	
Transmission							
41519	Harbour East 138 kV Transmission Line *This project is required to meet expected load growth requirements in Dartmouth, Cole Harbour and Eastern Passage. This need has been continuously monitored to determine when this upgrade is required to meet these requirements. Current load projections indicate construction did not need to begin in 2015.*	8,793,272	Deferred	2016		Subsequent Approval	Subsequent Approval

CI	Project Title	2015 ACE Project Total	Cancelled/ Deferred	Deferred To	Prior Approval	Prior ACE Plan Reference	2016 ACE Plan Reference
45053	69Kv Structure Replacements West *At the time of ACE 2015, this was planned for construction in 2016. Further evaluation showed this project could be safely deferred to 2017. Engineering / Assessment will be completed in 2016 with the project being executed in 2017.*	4,495,729	Deferred	2017		Subsequent Approval	
Distribution							
44749	Tiverton Tower Refurbishment *Further engineering and design was required and will be completed in late 2015. Execution will occur in 2016 once final design is completed.*	1,281,771	Deferred	2016		Subsequent Approval	Subsequent Approval
43218	88W-323HA Tusket Islands Phase 3 *Further engineering was required to understand the full scope of the project. Execution now scheduled for 2017, with engineering being completed in 2016.*	286,911	Deferred	2017		Subsequent Approval	
General Plant							
41442	IT - Advanced Laptop Security *This project has been cancelled and will be completed as part of CI 47477 IT – Security Enhancements.*	85,056	Cancelled			Less than 250K	

1

2 2016 Annual Capital Expenditure Plan

2.1 Summary of Expenditures

The following table provides the proposed capital investment by approval category for NS Power's 2016 ACE Plan filing. This Application seeks UARB approval of the 2016 routine capital and other 2016 projects, which total $141.9 million of forecast spending in 2016. Certain items do not require UARB approval, but are included in NS Power's annual capital plan for transparency and stakeholders' information. The 2016 ACE Plan budget also includes spending on multi-year projects that were previously approved by the UARB.

2016 ACE Plan Spend	**2016 UARB Approval Request ($M)**	**UARB Approval Not Required ($M)**	**Capital Items Forecast for Later Filing in 2015/2016 ($M)**	**Previously Approved Capital Projects with 2016 Carryover ($M)**	**2016 ACE Plan ($M)**
Capital Item Approval Sought through the 2016 ACE Process (Including Routine Capital Projects*)	141.6				**141.6**
Capital Items Forecast for Later Filing in 2015/2016			56.3		**56.3**
Carryover Projects				56.7	**56.7**
Capital Items Less Than $250K		15.3			**15.3**
Point Aconi Capital Spend		10.0			**10.0**
2016 ACE Plan	**$141.6**	**$25.3**	**$56.3**	**$56.7**	**$279.9**

** NS Power is seeking approval of $82.0 million of Routine spending in 2016.*

NOTE: Figures presented in the ACE Plan document reflect rounding which may cause $0.1 million in rounding differences on some line items.

2.2 2016 ACE Plan Capital Items Submitted for Approval

This table provides the list of new Capital Items for which NS Power seeks UARB approval by this Application, totaling $59.6 million of spend in 2016, with a total forecast spend of $92.5 million.

Tab #	CI#	Project Title	2016 Budget ($)	Project Total ($)
Hydro				
G01	46298	HYD Five Mile Lake Dam Refurbishment	1,793,260	2,209,018
G02	47397	HYD Gisborne Dam D4 and Spillway S4 Refurbishment	1,669,320	2,050,519
G03	47396	HYD Nictaux Powerhouse Dam Refurbishment	1,437,731	1,792,968
G04	47172	HYD Tidewater 1 Overhaul	962,136	1,418,532
G05	47332	HYD Methals Overhaul	1,216,083	1,392,927
G06	47432	HYD Ridge Overhaul	869,304	869,304
Total New Hydro Spending			**$7,947,834**	**$9,733,269**
Steam Boiler				
G07	47552	TRE5 Boiler Refurbishment 2016	1,204,387	1,204,387
G08	47664	LIN4 Division Wall Replacement	619,243	619,243
G09	47613	PHB - Boiler Refurbishment 2016	604,193	604,193
G10	47666	LIN4 Boiler Refurbishment 2016	571,859	571,859
G11	47663	LIN4 - SH5 Boiler Tube Replacement	538,776	538,776
G12	46352	TRE5 Air Heater Refurbishments	530,139	530,139
G13	47689	LIN4 - Air Heater Refurbishment	521,951	521,951
G14	47761	LIN1 Boiler Refurbishment	506,845	506,845
G15	47690	LIN4 Burner Front Refurbishment	480,349	480,349
Turbine				
G16	47658	LIN4 L-0 Blade Replacement	3,550,915	4,597,152
G17	47755	LIN4 Turbine High Temperature Fasteners Replacement	1,073,877	1,073,877
G18	47911	TUC1 High Temperature Fastener Replacement	828,968	828,968
G19	46465	TUC2 Turbine Valve Refurbishment	651,362	651,362
G20	48018	TUC1 IP Blading Refurbishments	1,137,208	1,137,208
Generator				
G21	47673	LIN4 Generator Rotor Rewind	2,602,159	2,602,159
G22	43170	LIN4 AVR Replacement	418,432	842,207
G23	47657	LIN4 High Voltage Bushing Refurbishment	724,395	822,570
Chemical				
G24	47762	LIN4 Analytical Panel Replacement	401,658	401,658
G25	47961	LIN1 Condenser Tube Coating	333,944	333,944
G26	47704	POT - Replace Polisher Chemical Skid	321,950	321,950
G27	47945	TUC Electrode-ionization (EDI) Unit Replacement	275,154	275,154

Tab #	CI#	Project Title	2016 Budget ($)	Project Total ($)
Balance of Plant				
G28	47611	POT - Demolish Unit 1 Stack	1,732,346	1,732,346
G29	47505	LIN Coal Mill Refurbishment 2016	749,183	749,183
G30	47661	POT - Asbestos Management 2016	721,551	721,551
G31	47869	LIN4 Bottom Ash	616,599	616,599
G32	47554	TRE5 5-1 FD Fan Refurbishment	494,802	494,802
G33	41505	TRE5 - 5F Conveyor Structural Refurbishment	484,801	484,801
G34	47872	LIN E Gallery Structural Steel Protective Coating	481,492	481,492
G35	47555	TRE5 Coal System Upgrades	414,085	469,942
G36	47510	LIN Coal Plant Structural Refurbishment Phase 2	359,425	359,425
G37	47662	POT Coal Mill Overhauls 2016	324,874	324,874
G38	47617	TRE6 Elevator Controls Upgrade	320,704	320,704
G39	47614	PHB - Fuel System Refurbishment 2016	296,556	296,556
G40	47668	POT - Plant Siding 2016	287,926	287,926
G41	47596	TRE6 ID Fan Damper Upgrades	272,239	272,239
G42	47507	LIN CW Pump Rebuild 2016	441,560	441,560
G43	47506	LIN CW Screen Refurbishment 2016	349,743	349,743
Total New Steam Spending			**$26,245,653**	**$27,869,697**
Total New Generation Spending			**$34,193,487**	**$37,602,965**
Transmission				
T01	46591	88S Lingan Replace 230kV GIS	1,351,406	14,249,882
T02	48066	2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program	2,160,890	3,500,427
T03	46587	Metro Voltage Support Add Capacitor	2,960,916	3,373,511
T04	46757	88S Lingan 230kV BPS Upgrades	265,641	3,218,221
T05	46811	2H Armdale Transformer Addition	1,292,601	2,545,596
T06	47950	L5017 Replacements & Upgrades	1,175,785	2,182,142
T07	44981	2C Port Hastings Add 138-25kV Transformer	548,727	2,053,799
T08	47952	L-7001 Replacements (Phase 3 & 4)	1,617,933	1,725,284
T09	48061	New Mobile Substation, 69-25/12-kV, 6MVA	173,005	1,728,234
T10	48114	2016 Steel Tower Life Extension – HRM	503,696	1,477,739
T11	47914	L-6537 Replacements and Upgrades	744,025	1,382,705
T12	47935	L5040 Replacements	668,692	1,241,298
T13	47949	L-5028 Replacements and Upgrades	598,866	1,144,355
T14	47912	L-6552 Replacements and Upgrades	1,054,326	1,054,326
T15	48113	2016 Steel Tower Refurbishment	960,453	1,032,578
T16	48059	2016/2017 Transmission Switch & Breaker Replacements	470,933	980,999
T17	48116	2016 Sacrificial Anode Installation Program	452,034	970,909
T18	48067	2016 Oil Containment Program	245,199	468,963
T19	48063	2016/2017 Capacitor Bank Breaker Replacements	199,159	385,850
T20	48062	2016/2017 Reactor Breaker Replacements	201,038	384,974
Total New Transmission Spending			**$17,645,326**	**$45,101,792**
Distribution				
D01	47721	2016 PCB Phase-out for Pole Top Transformers	2,562,582	4,409,579
D02	48093	2016 Padmount Replacement Program	1,761,336	1,911,470

Tab #	CI#	Project Title	2016 Budget ($)	Project Total ($)
D03	47752	4S-333 Bentinck St. Rebuild	575,357	575,357
D04	48092	2016 Substation Recloser Replacements	529,270	529,270
D05	47765	58C-405 Belle Cote Phase 2	477,154	477,154
D06	47766	70V-302 Centerlea Rebuild	456,314	456,314
D07	47734	1C-411 Highway 4 Reconductor	437,410	437,410
D08	47732	131H-424/137H-412 Hammonds Plains Feeder Tie	337,133	337,133
D09	47754	63V-313 Ward Rd Reconductor	308,994	308,994
Total New Distribution Spending			**$7,445,551**	**$9,442,682**
General Plant				
Outage Performance				
GP01	48072	2016 ADMS Switch Order Management	305,469	305,469
Total New Outage Performance Spending			**305,469**	**305,469**
Total New General Plant Spending			**305,469**	**305,469**
Total New Capital Spending			**$59,589,833**	**$92,452,908**
Total Routine Capital Spending			**$81,990,925**	**$81,990,925**
Total Capital Items for which Approval is Sought			**$141,580,758**	**$174,443,832**

2.3 2016 ACE Plan Capital Items Forecast for Subsequent Approval

The following table identifies 2016 projects that are not yet ready for submission to the UARB, and that NS Power anticipates will be filed for approval throughout 2016. NS Power estimates $56.3 million of spending in 2016 on these projects, which are currently estimated for total spending of $230.6 million. The budget numbers indicated below are estimates as NS Power needs additional time to refine the specific project budget proposals. This section of NS Power's filing is designed to provide an indication of these anticipated 2016 projects, as requested by the Board.

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CI#	Project Title	2016 Budget ($)	Project Total ($)
Hydro			
29807	HYD - Tusket Falls Main Dam *This project includes the refurbishment of the dam and spillway to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines.*	257,292	6,534,233
44595	HYD - Hollow Bridge Canal and Intake Refurbishment *This project includes the refurbishment of the dykes, spillway and spillway channel, and replacement of the canal and intake gate/ hoist assemblies at Hollow Bridge.*	2,907,602	3,137,002
46254	HYD - Mill Lake Surge Tank Refurbishment *This project includes the refurbishment of the Mill Lake Surge Tank on the St. Margaret's Bay Hydro System.*	1,380,899	1,421,366
47167	HYD - Sandy Lake Surge Tank Refurbishment *This project includes the refurbishment of the Sandy Lake Surge Tank on the St. Margaret's Bay Hydro System.*	1,316,587	1,358,796
47551	HYD - SHH Controls Upgrade *This project includes the installation of a new control system and instrumentation on the Sheet Harbour Hydro System.*	524,406	1,092,851
48020	HYD - RUT3 Generator Refurbishment *This project is for the replacement of the stator, rewind of the generator, and replacement components at the Ruth Falls Unit #3 on the Sheet Harbour Hydro System.*	774,422	1,030,940
47163	HYD - Tusket Controls Upgrade *This project includes the installation of a new control system and instrumentation on the Tusket River Hydro System.*	472,153	880,570
	Total New Hydro Spending for Subsequent Approval	**7,633,361**	**15,455,757**
Combustion Turbine			
44775	TUC#4 LM6000 Generator Stator Re-wedge *This project is for the disassembly, rotor re-wedge and re-assembly of the Tuft's Cove #4 LM6000 generator rotor.*	1,586,056	1,722,180
46191	Tusket Fuel System Upgrade *This project includes the upgrade of the diesel fuel storage tanks at the Tusket Combustion Turbine site.*	606,082	892,178
44788	BGT1 Vibration Monitoring & Protection System Upgrade *This project includes the installation of a new vibration monitoring system and a protection system upgrade on Unit #1 at the Burnside Combustion Turbine site.*	252,674	252,674
	Total New Combustion Turbine Spending for Subsequent Approval	**2,444,812**	**$2,867,031**
Steam			
48157	TUC Auxiliary Boiler Purchase *This project includes the procurement and installation of a new auxiliary boiler to be used at the Tuft's Cove Generating Station.*	2,822,565	2,822,565

CI#	Project Title	2016 Budget ($)	Project Total ($)
47870	LIN Cofferdam Outer Cell Refurbishment *This project includes the refurbishment of the cofferdam outer cell steel support structure to maintain integrity of the cooling water inlet cofferdam.*	850,609	850,609
47871	LIN Stack Re-Coating *This project includes the replacement of protective coating on both concrete stacks at Lingan Generating Station.*	707,696	707,696
47953	LIN Rail Car Positioner Upgrade *This project includes an upgrade to the Rail Car Positioner which is original to the plant and is required to deliver coal to the plant.*	507,812	507,812
47687	POT Boiler Chemical Recondition *This project is for the chemical reconditioning of the boiler for the removal of metal oxides from the heat transfer surfaces, which will allow for the base metal to be pacified with an uncontaminated oxide layer.*	855,348	855,348
47893	TUC3 Generator Hydrogen Panel Upgrade *This project includes the upgrade of the Generator Hydrogen Panel on Unit #3 at Tufts Cove Generating Station*	301,806	301,806
	Total New Steam Spending for Subsequent Approval	**$6,045,836**	**$6,045,836**
	Total New Generation Spending for Subsequent Approval	**$16,124,009**	**$24,368,625**

Transmission

48025	L7018 Upgrade to 345kV & Capacitor Bank Addition *This project is part of an investment to increase Onslow South transfer levels, increase reactive power capacity in the Halifax area, address reliability issues in the Halifax area when Tuft's Cove generation is not running and reduce the need for uneconomic dispatch of Tuft's Cove Generating Station for system stability concerns.*	1,982,135	21,495,059
41519	Harbour East 138 kV Transmission Line *This project includes the design and construction of a new 138kV transmission line from the existing Dartmouth East (113h) substation to a new substation required in the Eastern Passage area.*	2,120,250	11,672,021
43678	Separate L8004/L7005 on Canso Crossing Double Circuit Tower(DCT) *This is a network upgrade project required to support the Maritime Link Investment.*	270,900	10,767,280
48022	Spider Lake Substation Addition *This project is part of an investment to increase Onslow South transfer levels, increase reactive power capacity in the Halifax area, address reliability issues in the Halifax area when Tuft's Cove generation is not running and reduce the need for uneconomic dispatch of Tuft's Cove Generating Station for system stability concerns.*	1,093,651	6,348,981

CI#	Project Title	2016 Budget ($)	Project Total ($)
48154	L5527 Reconductor *This project will reconductor L-5527, which is a 57 kilometer 69kV transmission line that connects 4C Lochaber Road, 57C Salmon River Lake, 24C Dickie Brook, 19C1 Canso Wind Farm and 19C Town of Canso.*	297,828	497,606
48024	90H - Sackville: Capacitor Bank Addition & L-6010/L6005 Breaker Upgrades *This project is part of an investment to increase Onslow South transfer levels, increase reactive power capacity in the Halifax area, address reliability issues in the Halifax area when Tuft's Cove generation is not running and reduce the need for uneconomic dispatch of Tuft's Cove Generating Station for system stability concerns.*	794,131	3,852,989
48023	103H - Lakeside: Capacitor Bank Additions & L-6003 Breaker Upgrades *This project is part of an investment to increase Onslow South transfer levels, increase reactive power capacity in the Halifax area, address reliability issues in the Halifax area when Tuft's Cove generation is not running and reduce the need for uneconomic dispatch of Tuft's Cove Generating Station for system stability concerns.*	794,131	3,231,190
43268	9W-B53 Tusket Replace Supporting Structure *The scope of this project is to replace the wood poles and associated wooden crossarms which comprise the support for 69kV bus 9W-B53.*	354,151	354,151
	Total New Transmission Spending for Subsequent Approval	**$7,707,178**	**$58,219,276**

Distribution

CI#	Project Title	2016 Budget ($)	Project Total ($)
47124	Automated Metering Infrastructure *This project includes the implementation of Automated Metering Infrastructure to NS Power customers. 2016 investment will include business case preparation and a possible pilot project to best determine the most beneficial path forward in fully implementing Automated Metering Infrastructure. It is planned to be completed over a 3-4 year window.*	6,997,996	100,000,000
47760	85S-402 Re-Insulate *This project includes replacement of approximately 750 insulators along 85S-402, from Wreck Cove to Jersey Cove, along Hwy 19.*	387,024	1,855,988
47776	111S Prime Brook Feeder Exits & Feeders *The material and work to build four overhead feeder exits and feeders out of the new 111S Prime Brook Substation.*	1,474,738	1,560,144
47787	2H Armdale New Feeders *This Project will address the addition of 4 new feeders at the 2H Armdale substation to address the load growth on the peninsula, St Margaret's Bay and the Herring Cove Road Areas. The 4 new feeders will provide additional capacity to both areas and reduce load on adjacent feeders.*	451,838	1,272,415
44749	Tiverton Tower Refurbishment *This project includes the design and the replacement of the steel distribution tower in Tiverton and replacement of conductor over Petit Passage.*	880,250	1,157,069

CI#	Project Title	2016 Budget ($)	Project Total ($)
47753	24C-442GB Highway 16 Reconductor Phase 2 *This project includes the costs associated with replacing and upgrading approximately 6.6 kms of conductor along a portion of 24C-442GB from Fox Island Road to Dover Road.*	669,565	1,154,302
47784	103H-Lakeside Feeder Reconfiguration *The scope of this project is to reduce loading on two heavily loaded feeders from 103H-Lakeside through an extension of the existing double circuit on St. Margaret's Bay Road.*	579,868	579,868
47792	Distribution Automation Remote Communications *This project includes design and installation of remote communication on targeted down-line reclosers.*	378,666	415,762
48152	20H-Spryfield Voltage Conversion Phase II *The project will continue to reduce the loading on 20H-Spryfield, through conversions from 12kV to 25kV*	375,848	375,848
47403	Load Research Sample Update *This project is to add approximately 400 new interval meters to NS Power's existing Load Research Sample in order to return the sample to an appropriate confidence and precision level.*	286,872	322,387
47786	129H Kearney Lake New Feeder *This project will create a new feeder from 129H-Kearney Lake to meet the load growth in the area, create a feeder tie to 129H-413 and reduce load on 129H-413.*	311,817	311,817
48195	Halifax 4kV Conversion Phase 3 *This project is to convert 4kV distribution plant in peninsular Halifax to 25kV.*	250,336	250,336
	Total New Distribution Plant Spending for Subsequent Approval	**$13,044,818**	**$109,255,935**
General Plant			
44671	IT - Oracle Financials Upgrade *This project is to establish the long term solution for finance, procurement, human resource and related applications and upgrading the current Oracle E-business modules and replacing the employee expense management application InvoiceXpress.*	3,768,231	9,891,170
46075	IT - Maximo Upgrade & GIS Integration *This project will upgrade NS Power's version of Maximo to the current release from the vendor and integrate the Maximo system with the NS Power GIS system, enabling a spatial view of work and assets in Maximo on a platform that is supported by the vendor.*	3,042,932	7,937,644
48232	T&D Scheduling & Dispatch *The NS Power version of the scheduling and dispatch tool used in NS Power's T&D operation is at end of support by the vendor. This project will deliver an upgraded platform that includes vendor support and ensures the continued operation of the scheduling and dispatch function.*	2,012,050	5,306,971
48251	T&D Field Design *The NS Power version of field design tool used by NS Power's T&D field workforce is approaching end of support by the vendor. This project will deliver an upgraded platform that includes vendor support and ensures the continued operation of the field design function.*	2,012,050	4,022,082

CI#	Project Title	2016 Budget ($)	Project Total ($)
47477	IT - Security Enhancements *This project will address new cyber security threats and build prevention and detention capabilities around NS Power's IT infrastructure.*	2,280,000	2,536,182
48236	Customer Experience Self-Serve Development Phase 1 *Focused on two key customer experiences, this project will cover the costs of deploying new self-serve options for customers as well as integration with, and enhancements to, back end systems to allow for an improved end-to-end customer experience.*	1,802,719	1,802,719
46671	NERC CIP Version 5 Implementation *This project is required to meet new NERC standards around cyber security. It includes the adoption of the new version (v5) which includes the implementation of security measures for cyber systems based on the impact rating (high, medium, low) of the Bulk Power System elements they support.*	552,227	1,528,492
48254	IT - Outage Communication Technology Capacity Improvement *This project will improve the capacity for NSPI to test, train and provide disaster recovery services on technology supporting outage communications. It will allow NS Power to conduct testing, including end-to-end load testing, while maintaining the required support and availability for ongoing operations.*	1,500,000	1,500,000
41425	IT - Cognos Upgrade *This project includes the upgrade of the existing Cognos platform, used for large portions of NS Power's financial reporting activities, from Version 7.4 to Version 10.*	190,000	1,431,257
46073	IT - Lotus Notes Applications Replacement *This project is to replace the current versions of Lotus notes and the hardware it is running on with hardware and software applications that are supported.*	415,008	744,698
47751	Dynamic Transmission Limits *This project is for the design and implementation of dynamic transmission limits in the Ragged Lake SCADA/EMS system.*	414,748	552,560
48234	Customer Support System Enhancements *This project encompasses system enhancements to key customer experience support systems to improve the customer experience. These projects will be related to initiatives identified in eight different customer experiences, such as street light repairs, move in / move out processes.*	515,063	515,063
48238	Customer Billing Experience Improvements *This project will provide bill enhancements and additional supporting tools to improve the billing experience for customers.*	515,063	515,063
48155	2016 SCADA Application Upgrade *The 2016 SCADA Application Upgrade is required to keep the NS Power SCADA system within range of the vendor (Open Systems International) supported release.*	426,355	426,355
	Total New General Plant Spending for Subsequent Approval	**$19,446,445**	**$38,710,255**
	Total Capital Items for Subsequent Approval	**$56,322,449**	**$230,554,091**

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2.4 2016 ACE Plan Capital Items with Estimated Total Project Cost of Less Than $250,000

This table includes capital items with a total project cost of less than $250,000. In accordance with Section 35 of the Public Utilities Act, these projects do not require UARB approval but are provided for transparency and stakeholder information.

CI#	Project Title	2016 Budget ($)	Project Total ($)
Hydro			
47166	HYD - McAskill Brook Decommissioning	71,722	110,990
	Total Hydro Items Less Than $250,000	**$71,722**	**$110,990**
Steam			
47894	TUC2 Boiler Nat Gas Ignitors	244,362	244,362
47868	LIN Stack Lighting Replacement	241,895	241,895
47719	POT - Unit 2 Boiler Refurbishment 2016	240,083	240,083
41664	TRE5 Precip Refurbishment	239,816	239,816
47933	LIN4 Turbine Vibration Monitoring Upgrade	238,216	238,216
47874	LIN Ash Scale Replacement	237,241	237,241
47895	TUC3 Lube Oil Purifier Upgrade	234,808	234,808
47867	LIN Bunker Chute Sealing Phase 2	225,956	225,956
47947	TUC6 Condenser Waterbox Coating	225,210	225,210
47692	POT - Fire system upgrades 2016	224,304	224,304
47498	LIN - Crusher & Dumper Building Fire System Refurbishment	222,648	222,648
45176	ICP - Pier Belting	221,043	221,043
47635	TRE Facilities Upgrades	219,301	219,301
47875	LIN PF Line Replacement	214,575	214,575
47896	TUC2 Main Steam Piping Weld Replacement (Creep Damage)	214,384	214,384
47897	TUC 4kV/600V Breaker Replacements	210,845	210,845
47898	TUC Asbestos Abatement	209,234	209,234

CI#	Project Title	2016 Budget ($)	Project Total ($)
47701	POT - Lab upgrades phase 3	207,803	207,803
46358	TRE5 Burner Refurbishments	207,190	207,190
47863	LIN4 Turbine Valves Refurbishment	204,548	204,548
47865	LIN Heavy Oil Suction Line Replacement Phase 1	201,870	201,870
47960	LIN1 Control Valve Rebuild	197,976	197,976
43386	POT - LP dosing automation	195,807	195,807
47593	TRE Sodium Bisulphite Injection System	194,093	194,093
46419	POT - Bay door replacements	193,523	193,523
46371	POT - Refurbish 4160KV motors	183,270	186,020
47892	TUC1 Turbine Valves	184,092	184,092
22410	TRE5 5-1 Condensate Extraction Pump Refurbishment	180,956	180,956
43429	TRE5 Lube Oil Cooler Retube	178,666	178,666
47599	TRE5 5-4 Mill Refurbishments	176,181	176,181
47839	ICP Locomotive Truck Refurbishment 2016	173,116	173,116
47703	POT - Replace DCS servers	172,078	172,078
47899	TUC1 TSE/Data Management Upgrades	171,599	171,599
43239	LIN4 BFP Proportional Recirculation Line Control	158,524	158,524
47676	POT Expansion joint replacements	158,506	158,506
47901	TUC Bailey Control Valves' Replacement	158,479	158,479
47497	LIN - Flyash Transport Air Compressor Replacement	158,439	158,439
47606	TRE5 Soot Blower Controls Replacement	158,399	158,399
47602	TRE Oil Forwarding Pump Area Fire Protection	157,172	157,172
47900	TUC1 MgOH Powder System Upgrade	156,145	156,145
47866	LIN4 Condenser Tube Protective Coating	156,043	156,043
47600	TRE Asbestos Abatement (2016)	154,303	154,303
47688	POT - Refurbish condensate extraction pump	154,069	154,069
47702	POT - Wastewater Treatment Plant chemical system refurbishment	153,313	153,313

CI#	Project Title	2016 Budget ($)	Project Total ($)
47963	LIN Waster Water Stand Pipe Refurbishment	152,065	152,065
47601	TRE Ash Site Management (2016)	145,235	145,235
44357	LIN 3 4 Stack Cap Refurbishment	135,801	135,801
47835	ICP May St. Crossing Signal House Replacement	125,796	125,796
28249	POT Structural Steel Refurbishment on South ID fan and Precipitator ductwork steel	125,179	125,179
47955	LIN4 ID FAN Shaft Refurbishment	124,952	124,952
47832	ICP Rail Center Roof Refurbishment	124,807	124,807
47605	TRE Carbon Sulphur Analyzer Replacement	124,788	124,788
47836	ICP Ranger Belt Conveyor Structural Refurbishment	118,713	118,713
47508	LIN Coal System Guard Upgrade Phase 2	114,493	114,493
47607	TRE5 Common Water Piping Replacements	106,858	106,858
47904	TUC3 Vacuum Pump Refurbishment	105,695	105,695
47674	POT - Circulating Water Pumphouse Motor Control Center Refurbishment	104,836	104,836
47642	TRE6 Feeder Controls Upgrade	104,734	104,734
47864	LIN 4160V and 600V Breaker Refurbishment	104,343	104,343
46426	TRE6 Fly Ash Compressor Replacement	103,868	103,868
47873	LIN Plant Communications Upgrade	102,250	102,250
47504	LIN Facilities Upgrade	100,667	100,667
43407	TRE5 Cable Rooms Fire Protection	99,011	99,011
46495	TUC3 - DCS Upgrade	89,617	89,617
47838	ICP Pier Fire Detection	89,537	89,537
47903	TUC2 Lube Oil Coolers' Inlet/Outlet Waterbox Replacement	87,877	87,877
47645	TRE6 6B Instr Air Compressor Replacement	86,196	86,196
47501	LIN Boiler Fill Pump Suction Line Replacement	84,499	84,499
47707	POT - Replace D belt and refurbish frames and rollers	83,822	83,822
47708	POT - Vacuum cleaning system upgrade	77,847	77,847
42944	TUC3 - Boiler Drum North PSV Replacement	75,132	75,132

CI#	Project Title	2016 Budget ($)	Project Total ($)
47499	LIN Precip Fire Detection Upgrade	60,752	60,752
47710	POT - Replace selected Polisher valves and solenoid panel	57,840	57,840
47709	POT - Replace raw water flow meter	57,117	57,117
48014	TUC DC Battery Bank Replacement	55,524	55,524
47907	TUC6 Vacuum Pumps' Seal Water Cooler Upgrade	55,068	55,068
47909	TUC Nat Gas Valves Refurbishment	54,855	54,855
47905	TUC1 Chimney Access Infrastructure Refurbishment	54,313	54,313
47906	TUC6 Arc Flash Relays	53,881	53,881
47615	PHB - HVAC System Upgrades	52,511	52,511
47503	LIN Propane Skid Steer Tractor Replacement	48,811	48,811
47711	POT - PI interface to DCS	46,863	46,863
47647	TRE5 4kV Switch Gear Room Fire Protection	45,544	45,544
47646	TRE5 Relay Room Fire Protection	44,564	44,564
47837	ICP Rail Center Fire System Water Supply	42,462	42,462
	Total Steam Items Less Than $250,000	**$12,238,800**	**$12,241,550**
Combustion Turbine			
29065	CT - BGT Replace Halon Fire Protection System	229,422	229,422
47812	BGT Fuel Tank 3 Refurbishment	147,059	212,149
47941	TUC4 LM6000 Enclosure Protective Coating	66,126	66,126
47942	TUC5 LM6000 Enclosure Protective Coating	66,126	66,126
47944	TUC4 LM6000 Higgot Kane Crack Repair	33,063	33,063
47939	TUC4 LM6000 Replace all SS Tubing and Fittings	20,000	20,000
47940	TUC5 LM6000 Replace all SS Tubing and Fittings	20,000	20,000
	Total Combustion Turbine Items Less Than $250,000	**$581,796**	**$646,886**

CI#	Project Title	2016 Budget ($)	Project Total ($)
	Total Generation Items Less Than $250,000	**$12,892,318**	**$12,999,426**
Transmission			
48151	2016 Insulator Replacement Program	244,828	244,828
48111	East Switch Upgrades 15S	122,220	122,220
48156	East Switch Upgrades 58C	122,220	122,220
48112	11W King Street Substation Retirement	91,927	91,927
48026	L-6033/L6035 CT Ratio Changes at 1H - Water St.	50,372	50,372
	Total Transmission Items Less Than $250,000	**$631,567**	**$631,567**
Distribution			
47756	36V-303 Reconductor Middle Dyke Rd	226,303	226,303
47775	67C/58C Inverness Transfer Scheme	141,564	141,564
47777	70W-321 Wiles Lake Road	122,264	122,264
47774	546C-311 West Bay Upgrade	81,516	81,516
	Total Distribution Items Less Than $250,000	**$571,646**	**$571,646**
General Plant			
48044	Bentley Nevada Upgrade and Intergaration to Fleet Monitoring	228,862	228,862
47612	IT - U&U Portfolio and Project Management (PPM)	176,773	218,293
48046	Enhanced Fleet Monitoring Instrumentation	179,136	179,136
48117	2H Armdale RTU Replacement	130,975	130,975
48073	2016 NSPI GIS Upgrade	124,915	124,915
48029	Meridium Dashboards	116,984	116,984
47671	PTMT - Cathodic Protection System Refurbishment	90,799	90,799
48070	GIC Study Software	86,804	86,804
48035	DL NERC Module	81,889	81,889

CI#	Project Title	2016 Budget ($)	Project Total ($)
	Total General Plant Items Less Than $250,000	$1,217,137	$1,258,657
	Total Capital Items Less Than $250,000	$15,312,668	$15,461,295

2.5 2015 ACE Plan Capital Items – Point Aconi Generating Station

This table provides the Point Aconi capital projects for 2015. These projects do not require UARB Approval but are provided for transparency and stakeholder information.

CI#	Project Title	2016 Budget ($)	Project Total ($)
47846	POA Ash Cell 4 Stage 3	1,774,305	3,914,220
47847	POA Boiler Refractory Replacement	746,522	746,522
47932	POA SH3 Boiler Tube Replacement Phase 2	513,213	513,213
47851	POA Boiler Refurbishment	424,158	424,158
47843	POA Structural Steel Refurbishment	399,626	399,626
47352	POA Vortex Finder Replacement 2016	209,021	390,864
43257	POA - Main Oil Tank Refurbishment	226,871	226,871
43138	POA - Air Heater Retube	205,374	205,374
47848	POA Boiler Arrowhead Replacement	194,838	194,838
47856	POA Limestone Pipe Refurbishment	140,635	140,635
47855	POA Coal Pile Run-off Pond Refurbishment	132,739	132,739
47861	POA Start Up Burner Upgrades	125,748	125,748
47860	POA Opacity Meter Upgrade	124,593	124,593
47852	POA PLC Migration	119,916	119,916
47845	POA HVAC Upgrades	105,408	105,408
47857	POA CW Valve Replacement	102,271	102,271
47858	POA Equipment Fuel Storage Tanks Replacement	101,294	101,294
47931	POA Coal System Guard Upgrade Phase 2	89,082	89,082
47850	POA Valve Component Replacement	87,172	87,172

CI#	Project Title	2016 Budget ($)	Project Total ($)
43144	POA - Plant Access Improvements	78,073	78,073
47849	POA Expansion Joint Replacment	77,068	77,068
47842	POA 4KV 600V Breaker Refurbishment	65,909	65,909
	Total Point Aconi New Spending	**$6,043,836**	**$8,365,593**
	Point Aconi Carryover Spending	**$3,513,800**	**$4,832,130**
	Point Aconi Routine Spending		
25647	POA DCMS Equipment Replacement	20,000	20,000
21485	POA - Kelly Rock Limestone Quarry	20,000	20,000
21484	POA Plant Tools & Equipment	52,530	52,530
10718	POA - Routine Equipment Replacement	216,186	216,186
27858	POA Roofing Routine	110,210	110,210
33865	POA Heat Rate Routine	42,105	42,105
	Point Aconi Routine Spending	**$461,031**	**$461,031**
	Total Point Aconi Capital Spending	**$10,018,667**	**$13,658,754**

Note: $92,530 of the above is General Plant spend (CI 25647, 21485, and 21484) included in table 6.1 and excluded from table 3.1.

3 Generation

Generation includes all items for NS Power's generation facilities. This includes replacements and additions to Thermal, Hydro, Wind, Tidal, Combustion Turbine and Biomass plants.

(Millions of Dollars)

F = Forecast, B=Budget in above figure

3.1 Generation – Highlights

The focus for Generation capital investments in 2016 is the continued investment in hydro infrastructure renewal and sustaining the current thermal asset base in alignment with the IRP. The $105.0 million Generation capital investment plan for 2016 is comprised of the following:

i	New 2016 capital spending for projects with total estimated project spend greater than $250,000 and for which approval is sought. (As provided in Section 2.2)	$34.2
ii	2016 capital spending for projects with total estimated project spend greater than $250,000 for which approval will be sought subsequent to the filing of ACE 2016. (As provided in Section 2.3)	16.1
iii	New capital spending for projects with total estimated spend less than $250,000 for which approval is not sought. (As provided in Section 2.4)	12.9
iv	Point Aconi Generating Station Capital Spending. (As provided in Section 2.5)	9.9
v	Carry-over capital spending. (As provided in Section 3.2)	28.1
vi	Routine capital Spending. (As provided in Section 7)	3.8
	Total 2016 Generation Capital Investment Plan	$105.0 M
	Request for ACE Approval (Items i and vi)	$38.0 M

*Totals may be off slightly due to rounding. Figures are noted in $millions.

3.2 Generation – Carry-over Capital Spending Summary

Project Number	CI#	Project Title	Start Date	Final Date	Previous Expenditure ($)	2016 Budget ($)	Subsequent Spending ($)	Total Estimate ($)
Hydro Generation Plant								
H517	16374	HYD Gaspereau Dam Safety Remedial Works	2007/05	2016/12	6,270,317	6,112,131	-	12,382,448
H715	44978	HYD-Wreck Cove Controls Upgrade	2014/01	2018/06	489,984	1,819,803	1,511,000	3,820,787
H655	41139	HYD - Annapolis Sluiceway Superstructure Refurbishment	2012/07	2016/12	803,329	1,786,459	-	2,589,788
H630	41142	HYD St. Margaret's Bay - Sandy Lake Fish Passage	2011/11	2016/12	2,369,442	19,289	-	2,388,731
H629	12079	HYD - SHH - RUF 1&2 Runner Replacement	2011/10	2016/12	1,011,884	403,245	-	1,415,129
H714	44669	HYD Wreck Cove Fire Suppression Upgrades	2013/06	2016/10	390,579	559,845	-	950,424
H660	17581	HYD - Weymouth Electrical Replacement	2012/07	2016/12	576,219	350,875	-	927,094
H674	43136	HYD - Weymouth Unit #1 Headcover Replacement	2012/11	2016/12	372,552	415,740	-	788,293
H685	43128	HYD - Gisborne Gearbox and Bearing Replacement	2015/08	2016/12	100,064	274,526	-	374,590
H688	20571	HYD - Weymouth Falls Tailrace Deck Refurbishment	2013/03	2016/12	52,033	202,525	-	254,558
H737	45330	HYD-WRC C3 Culvert Replacement	2014/01	2016/12	18,181	207,039	-	225,219
	Total Hydro Generation Plant				**$12,454,585**	**$12,151,477**	**$1,511,000**	**$26,117,062**
Steam Generation Plant								
SB90	44267	TRE Ash Lagoon Site Closure	2013/05	2017/04	2,506,639	5,474,564	-	7,981,203
SB67	44188	TRE Ash Site Phase 1 Capping	2013/04	2017/03	3,715,886	1,116,812	-	4,832,698
SE70	46068	LIN CW Debris Removal System	2015/02	2016/12	100,376	1,651,071	-	1,751,447
S901	35083	LIN 2011 Ash Site Sealing and Capping	2011/11	2016/12	742,117	259,308	-	1,001,425
SD76	46484	TUC - Unit 1&2 Analytical Panel Replacement	2015/03	2016/12	262,723	159,020	-	421,743
S795	28645	TRE6 - Turbine Controls Power Supplies Replacement	2012/03	2016/11	241,310	162,230	-	403,539
SC74	42943	TUC2 - Turbine-Generator (T-G) Area Fire Protection	2014/05	2016/06	225,832	46,161	-	271,993
	42973	TUC - #1, 2 and 4 WTP DCS upgrade	2015/08	2016/12	58,002	162,882	-	220,884
SA40	30163	POT - Control room and permit room upgrade	2012/04	2017/01	29,755	172,201	-	201,956
	44727	TUC3 - DCS Upgrade Phase 3	2015/07	2016/07	107,824	86,161	-	193,986

Project Number	CI#	Project Title	Start Date	Final Date	Previous Expenditure ($)	2016 Budget ($)	Subsequent Spending ($)	Total Estimate ($)
SB17	41229	LIN - Cable Spreading Rooms Fire Protection	2013/09	2016/12	113,650	53,453	-	167,103
SD31	43038	POT - FeS04 Dosing Control System	2014/09	2016/12	3,175	138,276	0	141,452
SB05	41226	LIN - Boiler Feed Pump Proportional Valve Replacements - Unit #1	2012/09	2016/12	-	140,098	-	140,098
SE54	46493	TUC2 - Polisher Upgrade	2015/07	2016/12	79,957	47,036	-	126,993
SE50	47493	POT - Turbine Dehumidifier	2015/04	2016/12	98,318	13,449	-	111,767
SE39	46375	POT - Condenser Level Control Upgrade	2015/02	2016/07	12,415	30,151	-	42,566
	Total Steam Generation Plant				**$8,297,981**	**$9,712,872**	**$0**	**$18,010,853**
Gas Combustion Turbine Generation Plant								
G180	33142	CT- Burnside #4 Unit Restoration	2014/03	2017/04	1,950,985	6,140,403	282,768	8,374,156
G173	45733	CT Burnside Unit#3 Generator Refurbishment U&U	2014/01	2016/12	2,386,563	138,865	-	2,525,428
	Total Combustion Turbine Generation Plant				**$4,337,549**	**$6,279,267**	**$282,768**	**$10,899,584**
Total Generation Carry Over Spending					**$25,090,114**	**$28,143,616**	**$1,793,769**	**$55,027,499**

3.3 Generation – New 2016 Capital Items for ACE Plan Approval

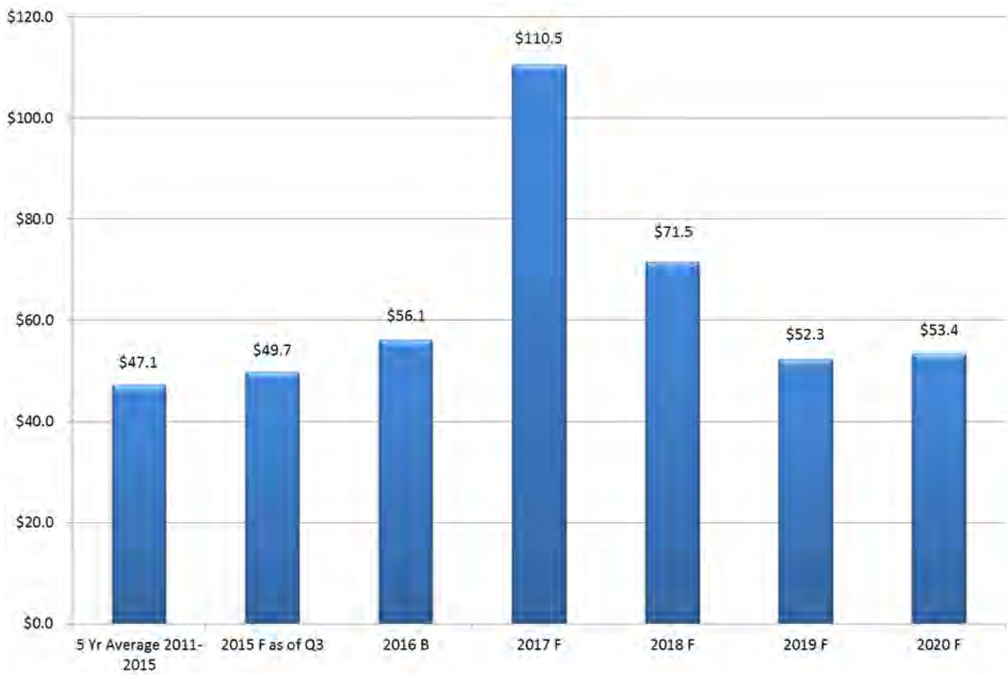
Tab #	CI#	Project Title	2016 Budget	Project Total
	Hydro Generation Plant			
G01	46298	HYD Five Mile Lake Dam Refurbishment	1,793,260	2,209,018
G02	47397	HYD - Gisborne Dam D4 and Spillway S4 Refurbishment PE	1,669,320	2,050,519
G03	47396	HYD Nictaux Powerhouse Dam Refurbishment	1,437,731	1,792,968
G04	47172	HYD - Tidewater 1 Overhaul	962,136	1,418,532
G05	47332	HYD - Methals Overhaul	1,216,083	1,392,927
G06	47432	HYD - Ridge Overhaul	869,304	869,304
		Total Hydro Generation Plant	**$7,947,834**	**$9,733,269**
	Steam Generation Plant			
Boiler				
G07	47552	TRE5 Boiler Refurbishment 2016	1,204,387	1,204,387
G08	47664	LIN4 Division Wall Replacement	619,243	619,243
G09	47613	PHB - Boiler Refurbishment 2016	604,193	604,193
G10	47666	LIN4 Boiler Refurbishment 2016	571,859	571,859

Tab #	CI#	Project Title	2016 Budget	Project Total
G11	47663	LIN4 - SH5 Boiler Tube Replacement	538,776	538,776
G12	46352	TRE5 Air Heater Refurbishments	530,139	530,139
G13	47689	LIN4 - Air Heater Refurbishment	521,951	521,951
G14	47761	LIN1 Boiler Refurbishment	506,845	506,845
G15	47690	LIN4 Burner Front Refurbishment	480,349	480,349
Turbine				
G16	47658	LIN4 L-0 Blade Replacement	3,550,915	4,597,152
G17	47755	LIN4 Turbine High Temperature Fasteners Replacement	1,073,877	1,073,877
G18	47911	TUC1 High Temperature Fastener Replacement	828,968	828,968
G19	46465	TUC2 Turbine Valve Refurbishment	651,362	651,362
G20	48018	TUC1 IP Blading Refurbishments	1,137,208	1,137,208
Generator				
G21	47673	LIN4 Generator Rotor Rewind	2,602,159	2,602,159
G22	43170	LIN4 AVR Replacement	418,432	842,207
G23	47657	LIN4 High Voltage Bushing Refurbishment	724,395	822,570
Chemical				
G24	47762	LIN4 Analytical Panel Replacement	401,658	401,658
G25	47961	LIN1 Condenser Tube Coating	333,944	333,944
G26	47704	POT - Replace Polisher Chemical Skid	321,950	321,950
G27	47945	TUC Electrode-ionization (EDI) Unit Replacement	275,154	275,154
Balance of Plant				
G28	47611	POT - Demolish Unit 1 Stack	1,732,346	1,732,346
G29	47505	LIN Coal Mill Refurbishment 2016	749,183	749,183
G30	47661	POT - Asbestos management 2016	721,551	721,551
G31	47869	LIN4 Bottom Ash	616,599	616,599
G32	47554	TRE5 5-1 FD Fan Refurbishment	494,802	494,802
G33	41505	TRE5 - 5F Conveyor Structural Refurbishment	484,801	484,801
G34	47872	LIN E Gallery Structural Steel Protective Coating	481,492	481,492
G35	47555	TRE5 Coal System Upgrades	414,085	469,942
G36	47510	LIN Coal Plant Structural Refurbishment Phase 2	359,425	359,425
G37	47662	POT Coal Mill Overhauls 2016	324,874	324,874
G38	47617	TRE6 Elevator Controls Upgrade	320,704	320,704
G39	47614	PHB - Fuel System Refurbishment 2016	296,556	296,556
G40	47668	POT - Plant Siding 2016	287,926	287,926
G41	47596	TRE6 ID Fan Damper Upgrades	272,239	272,239
G42	47507	LIN CW Pump Rebuild 2016	441,560	441,560
G43	47506	LIN CW Screen Refurbishment 2016	349,743	349,743
		Total Steam Generation Plant	**$26,245,653**	**$27,869,697**
	Total Generation New Spending		**$34,193,487**	**$37,602,965**

4 Transmission

Transmission includes items for replacement, reinforcement or expansion of the transmission system, which transmits electrical energy from the generation plants and throughout the province. Transmission includes assets and equipment operating at 69 kV level or higher. The increased investment in 2017 includes $18.5 million in Maritime Link Transmission and $28.9 million in Metro Transmission Upgrades.

(Millions of Dollars)



F = Forecast, B=Budget in above figure

4.1 Transmission – Highlights

The focus for Transmission capital investments in 2016 continues to reflect localized customer load growth and system reliability, as well as transmission required to integrate renewable projects. The $56.1 million Transmission capital investment plan for 2016 is comprised of the following:

i	New 2016 capital spending for projects with total estimated project spend greater than $250,000 and for which approval is sought. (As provided in Section 2.2)	$17.6
ii	2016 capital spending for projects with total estimated project spend greater than $250,000 for which approval will be sought subsequent to the filing of ACE 2016. (As provided in Section 2.3)	7.7
iii	New capital spending for projects with total estimated spend less than $250,000 for which approval is not sought. (As provided in Section 2.4)	0.6
iv	Point Aconi Generating Station Capital Spending. (As provided in Section 2.5)	0.0
v	Carry-over capital spending. (As provided in Section 4.2)	14.8
vi	Routine capital Spending. (As provided in Section 7)	15.2
	Total 2016 Transmission Capital Investment Plan	$56.1 M
	Request for ACE Approval (Items i and vi)	$32.9M

*Totals may be off slightly due to rounding. Figures are noted in $millions.

4.2 Transmission – Carry-over Capital Spending Summary

Project Number	CI#	Project Title	Start Date	Final Date	Previous Expenditure	2016 Budget	Subsequent Spending	Total Estimate
Transmission Plant								
T782	43324	L6513 Rebuild / Upgrade Line Terminals	2013/08	2017/12	2,203,128	99,126	16,202,656	18,504,910
T820	44987	L7003 Lidar Upgrades	2014/09	2017/01	5,026,209	2,982,685	2,101,254	10,110,148
T825	46339	120H Brushy Hill - SVC Controls Replacement	2014/11	2017/06	2,772,724	3,280,080	3,969,035	10,021,839
T822	45306	Prime Brook Substation Addition	2014/12	2017/01	998,744	2,375,945	270,714	3,645,403
T827	46513	3C Port Hastings BPS Upgrade	2014/12	2016/09	2,922,937	468,251	-	3,391,187
T786	43291	Protection Risk Reduction 67N-Onslow 230KV	2013/01	2016/05	3,041,136	293,342	-	3,334,478
T802	45066	Upgrade L6511 and L7019 Thermal Rating	2014/02	2017/12	2,662,110	222,948	176,199	3,061,258
T801	45067	67N Onslow 345 KV Node Swap	2014/03	2017/12	2,534,952	186,590	183,334	2,904,876
T808	43205	L5510 Insulator Replacements	2014/03	2016/02	2,434,904	448,468	-	2,883,371
T860	43490	Steel Tower Life Extension - Halifax Harbour	2015/07	2017/01	180,570	750,431	81,154	1,012,154
	43266	89S-ST2 Point Aconi Replace Station Service Transformer	2015/09	2017/01	280,283	1,180,263	-	1,460,546
T858	47131	L8001 Structure 58 Replacement	2015/04	2016/06	505,003	443,139	-	948,142
T835	43267	13V Gulch Hydro Replace 13V-GT1 and 13V-VR1	2014/12	2017/01	436,098	363,606	119,737	919,441
T832	44976	10H 25kV Breaker Replacement	2015/02	2016/06	121,974	763,416	-	885,390
T864	46333	L6538 Replacements	2015/07	2016/03	481,502	389,084	-	870,586
T831	43261	6V-GT1 Hollow Bridge Hydro Transformer Replacement	2015/02	2016/09	408,636	222,639	-	631,275
T712	41439	Mobile Refurbishments 5P & 6P	2012/02	2016/03	382,305	32,562	-	414,867
T839	46354	2015 Reactor Breaker Replacements	2015/02	2016/12	158,555	113,390	-	271,945
T854	46366	65V Middleton Substation RTU Addition	2016/05	2017/06	-	123,628	123,432	247,060
T855	46397	Substation Telemetry	2015/06	2016/10	70,356	92,204	-	162,560
	Total Transmission Plant				**$27,622,126**	**$14,831,796**	**$23,227,515**	**$65,681,437**
Total Transmission Carry Over Spending					**$27,622,126**	**$14,831,796**	**$23,227,515**	**$65,681,437**

4.3 Transmission – New 2016 Capital items for ACE Plan Approval

Tab #	CI#	Project Title	2016 Budget	Project Total
	Transmission Plant			
T01	46591	88S Lingan Replace 230kV GIS	1,351,406	14,249,882
T02	48066	2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program	2,160,890	3,500,427
T03	46587	Metro Voltage Support Add Capacitor	2,960,916	3,373,511
T04	46757	88S Lingan 230kV BPS Upgrades	265,641	3,218,221
T05	46811	2H Armdale Transformer Addition	1,292,601	2,545,596
T06	47950	L5017 Replacements & Upgrades	1,175,785	2,182,142
T07	44981	2C Port Hastings Add 138-25kV Transformer	548,727	2,053,799
T08	47952	L-7001 Replacements (Phase 3 & 4)	1,617,933	1,725,284
T09	48061	New Mobile Substation, 69-25/12-kV, 6MVA	173,005	1,728,234
T10	48114	2016 Steel Tower Life Extension - HRM	503,696	1,477,739
T11	47914	L-6537 Replacements and Upgrades	744,025	1,382,705
T12	47935	L5040 Replacements	668,692	1,241,298
T13	47949	L-5028 Replacements and Upgrades	598,866	1,144,355
T14	47912	L-6552 Replacements and Upgrades	1,054,326	1,054,326
T15	48113	2016 Steel Tower Refurbishment	960,453	1,032,578
T16	48059	2016/2017 Transmission Switch & Breaker Replacements	470,933	980,999
T17	48116	2016 Sacrificial Anode Installation Program	452,034	970,909
T18	48067	2016 Oil Containment Program	245,199	468,963
T19	48063	2016/2017 Capacitor Bank Breaker Replacements	199,159	385,850
T20	48062	2016/2017 Reactor Breaker Replacements	201,038	384,974
		Total Transmission Plant	**$17,645,326**	**$45,101,792**
	Total Transmission New Spending		**$17,645,326**	**$45,101,792**

5 Distribution

Distribution includes replacement of and additions to equipment for delivering electric energy from points on the transmission system to customers served at voltages below 69 kV. The increased investment levels in 2017-2019 are primarily due to investment related to the potential implementation of Automated Metering Infrastructure.

(Millions of Dollars)

F = Forecast, B=Budget in above figure

5.1 Distribution – Highlights

The focus for Distribution capital investments in 2016 continues to reflect localized customer load growth and customer reliability. The $74.8 million Distribution capital investment plan for 2016 is comprised of the following:

i	New 2016 capital spending for projects with total estimated project spend greater than $250,000 and for which approval is sought. (As provided in Section 2.2)	$7.4
ii	2016 capital spending for projects with total estimated project spend greater than $250,000 for which approval will be sought subsequent to the filing of ACE 2016. (As provided in Section 2.3)	13.0
iii	New capital spending for projects with total estimated spend less than $250,000 for which approval is not sought. (As provided in Section 2.4)	0.6
iv	Carry-over capital spending. (As provided in Section 5.2)	6.2
v	Routine capital Spending. (As provided in Section 7)	47.5
	Total 2016 Distribution Capital Investment Plan	$74.8M
	Request for ACE Approval (Items i and v)	$55.0M

*Totals may be off slightly due to rounding. Figures are noted in $millions.

5.2 Distribution – Carry-over Capital Spending Summary

Project Number	CI#	Project Title	Start Date	Final Date	Previous Expenditure	2016 Budget	Subsequent Spending	Total Estimate
Distribution Plant								
D454	40320	LED Street Light Conversion	2012/07	2019/09	17,877,023	4,681,027	12,519,375	35,077,425
D675	47471	131H-422G-East Uniacke Rd Load Growth P&A	2015/07	2016/12	885,443	41,338	-	926,781
D418	41383	2012 Halifax Underground Feeder Replacement	2012/03	2016/12	532,136	134,399	-	666,535
D592	46456	11W Yarmouth 4kV Conversion	2014/09	2016/02	604,392	45,273	-	649,665
D562	44826	2014 Build-to-Roadside	2014/03	2016/10	490,468	137,939	-	628,407
D674	47773	3N Oxford Conversion Phase 2	2015/08	2016/08	547,164	84,552	-	631,715
D664	46593	70V-311 Bridgetown Voltage Conversion	2015/05	2016/06	388,562	164,815	-	553,377
D630	45031	3N Oxford Conversion Phase 1	2015/03	2016/12	3,505	535,641	-	539,146
	44836	Halifax 4kV Conversion Part 2	2015/08	2016/12	260,574	273,599	-	534,173
D570	43177	103W-311 Gold River Reconductor Phase 3	2014/03	2016/12	315,353	21,713	-	337,066
D652	45003	2015 Hydraulic Recloser Replacements	2015/03	2016/10	101,339	103,445	-	204,784
	Total Distribution Plant				**$22,005,958**	**$6,223,742**	**$12,519,375**	**$40,749,075**
Total Distribution Carry Over Spending					**$22,005,958**	**$6,223,742**	**$12,519,375**	**$40,749,075**

5.3 Distribution – New 2016 Capital Items for ACE Plan Approval

Tab #	CI#	Project Title	2015 Budget	Project Total
	Distribution Plant			
D01	47721	2016 PCB Phase-out for Pole Top Transformers	2,562,582	4,409,579
D02	48093	2016 Padmount Replacement Program	1,761,336	1,911,470
D03	47752	4S-333 Bentinck St. Rebuild	575,357	575,357
D04	48092	2016 Substation Recloser Replacements	529,270	529,270
D05	47765	58C-405 Belle Cote Phase 2	477,154	477,154
D06	47766	70V-302 Centerlea Rebuild	456,314	456,314
D07	47734	1C-411 Highway 4 Reconductor	437,410	437,410
D08	47732	131H-424/137H-412 Hammonds Plains Feeder Tie	337,133	337,133
D09	47754	63V-313 Ward Rd Reconductor	308,994	308,994
		Total Distribution Plant	**$7,445,551**	**$9,442,682**
	Total Distribution New Spending		**$7,445,551**	**$9,442,682**

6 General Plant

General Plant includes computer infrastructure and communication equipment, which comprise the majority of capital expenditures incurred under this function. Other items such as furniture, office equipment and capital tools are also included under this function.

The General Plant function also includes vehicles. That is, replacement and additions to transportation and work vehicles, and construction equipment.

The General Plant function also includes all buildings except generating and substation facilities. It primarily pertains to customer service, work depot and head office facilities. The increased investment in 2016-2019 is largely driven by investment in IT applications and large telecommunication projects.

(Millions of Dollars)

F = Forecast, B=Budget in above figure

6.1 General Plant – Highlights

General Plant capital investment in 2016 continues to focus primarily on Information Technology and control system related projects and vehicle purchases. The $44.0 million General Plant capital investment plan for 2016 is comprised of the following:

i	New 2016 capital spending for projects with total estimated project spend greater than $250,000 and for which approval is sought. (As provided in Section 2.2)	$0.3
ii	2016 capital spending for projects with total estimated project spend greater than $250,000 for which approval will be sought subsequent to the filing of ACE 2016. (As provided in Section 2.3)	19.4
iii	New capital spending for projects with total estimated spend less than $250,000 for which approval is not sought. (As provided in Section 2.4)	1.2
iv	Point Aconi Generating Station Capital Spending. (As provided in Section 2.5)	0.1
v	Carry-over capital spending. (As provided in Section 6.2)	7.5
vi	Routine capital Spending. (As provided in Section 7)	15.4
	Total 2016 General Plant Capital Investment Plan	$44.0M
	Request for ACE Approval (Items i and vi)	$15.8M

*Totals may be off slightly due to rounding. Figures are noted in $millions.

6.2 General Plant – Carry-over Capital Spending Summary

Project Number	CI#	Project Title	Start Date	Final Date	Previous Expenditure	2016 Budget	Subsequent Spending	Total Estimate
	Telecommunications							
P960	46552	Backbone Communications System Upgrade	2015/02	2018/02	1,647,049	4,606,489	2,650,921	8,904,459
P943	43227	2014 RTU Replacements	2014/06	2016/06	422,939	308,065	-	731,005
P954	46307	2015 Multiplexer Network Upgrades	2015/02	2016/12	100,490	316,183	-	416,673
P955	46308	2015 Microwave System Capacity Upgrade	2015/01	2016/12	58,006	231,567	-	289,572
	46309	2015 Multiplexer & Teleprotection Equipment Replacement	2016/05	2016/11	-	158,158	-	158,158
P956	46310	2015 Telecom 48VDC Battery & Charger Replacements	2015/01	2016/07	13,208	131,751	-	144,959
P929	44969	Replace Multiplexer and Teleprotection Equipment 2014	2015/04	2016/07	50,289	76,641	-	126,930
P913	43173	2013 Upgrade Multiplexer Group	2013/07	2016/06	92,076	31,068	-	123,143
	Total Telecommunications				**$2,384,057**	**$5,859,921**	**$2,650,921**	**$10,894,899**
Computers								
P958	46739	IT - Outage Map Technology Upgrades	2015/02	2016/03	2,536,070	291,949	-	2,828,018
	46365	Maximo Enhancements for Substation Field Mobility	2015/03	2016/09	72,310	214,767	-	287,077
P945	46364	Maximo Enhancements for Telecom & Relays	2014/08	2016/06	208,601	54,342	-	262,943
	46078	IT - SharePoint Upgrade	2015/06	2016/05	118,051	95,232	-	213,283
	Total Computers				**$2,935,032**	**$656,290**	**$0**	**$3,591,322**
Other General Plant								
P833	29009	Right of Way Purchase Northern NS	2010/09	2016/05	3,319,775	288,000	-	3,607,775
P946	46411	Hydro Asset Management Implementation	2014/08	2016/12	283,001	275,459	-	558,460
P969	46306	2015 Telecom Building Replacement	2016/05	2017/01	-	240,504	-	240,504
	46590	T&D Asset Management Project	2015/04	2016/10	65,978	173,134	-	239,112
	Total Equipment Replacement				**$3,668,755**	**$977,098**	**$0**	**$4,645,852**
Total General Plant Carry Over Spending					**$8,987,843**	**$7,493,309**	**$2,650,921**	**$19,132,073**

6.3 General Plant – New 2016 Capital Items for ACE Plan Approval

Tab #	CI#	Project Title	2016 Budget	Project Total
Outage Performance				
GP01	48072	2016 ADMS Switch Order Management	305,469	305,469
Total Outage Performance Spending			**$305,469**	**$305,469**
Total New General Plant Spending			**$305,469**	**$305,469**

7 Routine Capital Program

This category includes recurring annual expenditures for replacement of equipment (like-for-like replacement), additions to existing equipment base resulting from system growth, and addition of customers to the system.

7.1 Routine Capital Spending by Function Yr/Yr

	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
Generation				
Generation Equipment Replacements	$2,904,887	$3,141,233	$2,898,936	$3,000,800
Generation Other Hydro	370,797	401,450	364,979	419,472
Generation Other Thermal	228,102	318,805	288,013	336,781
	3,503,786	3,861,488	3,551,928	3,757,053
Transmission				
Transmission Substation Replacement, Add'ns/Mod'ns	2,519,201	2,885,587	2,290,336	2,913,829
Primary Equipment Spares	140,221	215,000	175,980	250,000
Protection Modification & Replacement	392,333	427,653	334,466	433,690
Transmission Line Replacement, Add'ns/Mod'ns	5,591,933	4,688,380	4,220,618	5,640,857
Transmission Right-of-Way Widening	115,474	600,000	250,222	5,999,956*
	8,759,162	8,816,620	7,271,622	15,238,332
Distribution				
Meters	2,645,434	2,972,781	2,757,391	3,053,662
Distribution Upgrades and Replacement	20,890,787	19,792,780	18,794,803	19,425,941
New Customers	20,882,694	21,532,153	22,673,509	21,475,541
Joint Use	630,631	665,536	665,619	599,541
Distribution Right-of-Way Widening	688,403	600,000	600,000	2,994,461*
	45,737,949	45,563,251	45,491,322	47,549,147
General Plant				
Work Vehicles	2,441,354	5,628,171	6,293,091	6,953,300
Tools and Test Equipment	1,319,141	1,390,939	1,430,590	1,394,000
Telecommunications	828,169	844,326	818,056	796,256

	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
Computing Asset Management	2,743,171	2,680,249	1,671,415	2,754,623
Property Improvements and Furniture	2,093,753	3,005,000	2,974,248	2,205,000
Other	751,725	1,207,577	1,130,600	1,343,213
	10,177,313	14,756,262	14,318,001	15,446,393
Total Routine Capital Spending	**$68,178,210**	**$72,997,621**	**$70,632,874**	**$81,990,925**

Note 1: The entire Routine program totals $82.5 million including Pt. Aconi routines. The totals presented above and in the following information do not include Point Aconi routines.

* Please refer to Section 7.3 for a detailed explanation on the change in investment on Transmission and Distribution Right-of-Way Widening.

7.2 Routine Capital Spending Project Breakdown Yr/Yr

Project #	CI #	Project Title	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
G001	10634	CT - Routine Equipment Replacements	$44,165	$144,000	$157,440	144,000
H001	11622	HYD - Routine Equipment Replacement	436,909	701,531	700,410	723,687
H004	27867	HYD - Roofing Routine	18,070	169,480	69,480	170,104
S001	23428	GS - Routine Capital	110,343	132,000	77,735	0
	10645	POT - Routine Equipment Replacement	369,764	233,252	219,810	242,162
	10673	TRE - Routine Equipment Replacement	311,936	351,760	327,059	380,517
	43646	PHB - Routine Equipment Replacement	375,009	128,030	122,484	147,565
	10621	TUC - Routine Equipment Replacement	407,294	255,032	332,654	254,504
	10626	LIN - Routine Equipment Replacement	473,972	384,155	312,856	382,564
S004	27856	TRE - Roofing Routine	38,495	47,688	339,620	55,105
	27855	POT - Roofing Routine	35,373	268,242	2,000	270,126
	27854	TUC - Roofing Routine	174,566	200,000	109,108	101,637
	27857	LIN - Roofing Routine	221	0	13,274	0
G008	38899	CT'S Tooling Routine	29,914	28,000	13,977	28,000
W001	41830	Wind - Routine Equipment Replacement	78,856	98,064	101,029	100,828
		Generation Equipment Replacements Total	**$2,904,887**	**$3,141,233**	**$2,898,936**	**$3,000,800**

Project #	CI #	Project Title	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
H005	35583	HYD - Oil Release Risk Assessment	228,818	217,019	180,549	225,467
H006	35584	HYD - Gate Refurbishment	141,979	184,430	184,430	194,005
		Generation Hydro Total	**$370,797**	**$401,450**	**$364,979**	**$419,472**
S005	33871	TUC - Heat Rate Routine	53,945	80,000	73,541	104,913
	33867	POT - Heat Rate Routine	34,887	77,451	80,540	80,499
	33869	TRE - Heat Rate Routine	49,846	81,354	48,452	74,069
	33863	LIN - Heat Rate Routine	89,424	80,000	85,480	77,300
		Generation Thermal Total	**$228,102**	**$318,805**	**$288,013**	**$336,781**
T003	23120	Provincial - Trans Substation Primary	1,802,210	2,050,586	2,003,363	2,081,372
T004	23121	Provincial - Substation Additions & Replacements	716,991	835,001	286,973	832,457
		Transmission Subs Replace, Adds/Mods Total	**$2,519,201**	**$2,885,587**	**$2,290,336**	**$2,913,829**
T018	14973	Primary Equipment Spares	140,221	215,000	175,980	250,000
		Primary Equipment Spares Total	**$140,221**	**$215,000**	**$175,980**	**$250,000**
T016	14841	Protection Modification & Replacement	392,333	427,653	334,466	433,690
		Protection Modification & Replacement Total	**$392,333**	**$427,653**	**$334,466**	**$433,690**
T001	23115	Provincial Transmission Line Replace	2,461,875	857,506	857,418	876,369
T011	23118	Provincial - Planned Trans Line Replacement	3,130,057	3,830,874	3,363,200	4,764,488
		Transmission Line Replacements Total	**$5,591,933**	**$4,688,380**	**$4,220,618**	**$5,640,857**
T010	43827	Transmission Right-of-Way Widening	115,474	600,000	250,222	5,999,956
		Transmission Right-of-Way Widening Total*	**$115,474**	**$600,000**	**$250,222**	**$5,999,956**
D009	26496	Meter Routine	2,645,434	2,972,781	2,757,391	3,053,662
		Meters Total	**$2,645,434**	**$2,972,781**	**$2,757,391**	**$3,053,662**
D005	23158	Unplanned Replace Deteriorated	7,876,452	9,234,125	9,197,515	8,802,794
D006	23135	Regulatory Replacements - Province	891,757	941,562	943,692	993,306
D008	23361	Provincial Storm	5,671,795	2,463,027	1,463,027	2,391,974
D051	29038	System Performance Improvement Routine	239,415	303,860	823,433	450,562

Project #	CI #	Project Title	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
D055	23137	Planned Replacement Of Dist. Equip.	6,211,369	6,850,206	6,367,137	6,787,307
		Distribution Upgrades and Replacement Total	**$20,890,787**	**$19,792,780**	**$18,794,803**	**$19,425,941**
D004	26716	New Customer Upgrades	7,636,212	7,382,233	8,118,932	7,779,098
D018	23511	Primary Equipment Spares - Distribution	0	150,000	150,000	150,000
D061	39766	New Customers - Residential	8,355,597	8,437,808	8,259,881	8,124,181
D062	39770	New Customers - Commercial	4,890,885	5,562,112	6,144,696	5,422,263
		New Customers Total	**$20,882,694**	**$21,532,153**	**$22,673,509**	**$21,475,541**
D007	23136	Contractual Replacements (Joint Use)	630,631	665,536	665,619	599,541
		Joint Use Total	**$630,631**	**$665,536**	**$665,619**	**$599,541**
D010	23127	Distribution Right of Way Widening	688,403	600,000	600,000	2,994,461
		Right of Way Widening Total*	**$688,403**	**$600,000**	**$600,000**	**$2,994,461**
P006	20945	Replacement and Additional Work Vehicles	150,084	192,500	192,500	200,000
P009	16192	Mobile Transformer & Track Routine	29,412	70,671	70,354	70,862
P063	39304	Class 3 Work Vehicle Replacements	-2,814	280,000	280,000	323,000
P062	39305	Work Vehicle Replacements	1,170,806	3,375,000	3,764,323	4,579,438
P061	40236	Transportation Vehicle Replacements	1,093,865	1,710,000	1,985,913	1,780,000
		Work Vehicles Total	**$2,441,354**	**$5,628,171**	**$6,293,091**	**$6,953,300**
P002/P016		Tools and Equipment	1,228,856	1,300,939	1,340,590	1,304,000
P015	11611	Hydro Production Tools, Test Equipment	90,000	90,000	90,000	90,000
		Tools and Test Equipment Total	**$1,319,141**	**$1,390,939**	**$1,430,590**	**$1,394,000**
P025	16365	Mobile Radio Routine	30,703	58,578	34,430	57,702
P027	16551	Telecommunication Radio and Fibre Optics	123,926	148,180	142,238	141,043
P028	16550	Telecommunication Systems Replace & Modifications	500,724	506,049	506,463	465,998
P814	38243	Telecommunications Spares	172,816	131,520	134,925	131,512
		Telecommunications Total	**$828,169**	**$844,326**	**$818,056**	**$796,256**
P010	16073	SCADA Improvements Routine	56,590	154,092	140,469	131,831
P031	29114	NSPI Non-CGI Infrastructure	2,472,249	2,330,876	1,376,515	2,439,489
P040	28522	CTs Dcms Routine	42,792	20,000	10,000	20,000

Project #	CI #	Project Title	2014 Actual	2015 Budget	2015 Forecast	2016 ACE Plan
	25667	POT - DCMS Equipment Replacement Routine	27,777	25,500	28,117	30,000
	25626	TRE - DCMS Equipment Replacement Routine	29,551	45,301	37,467	44,950
	25646	TUC - DCMS Equipment Replacement Routine	102,684	50,000	51,498	50,000
	25668	LIN - DCMS Equipment Replacement Routine	11,529	54,480	27,349	38,353
		Computing Asset Management Total	**$2,743,171**	**$2,680,249**	**$1,671,415**	**$2,754,623**
P001/P030		Property Improvement and Furniture	2,093,753	3,005,000	2,974,248	2,205,000
		Property Improvement and Furniture Total	**$2,093,753**	**$3,005,000**	**$2,974,248**	**$2,205,000**
P012/P041		Other (HYD - Security Improvement & FAC - Land Acquisition)	318,777	639,577	592,132	646,913
P018	48158	Environment Equipment Replacement Routine	0	0	0	100,000
P816	38897	FAC Enviro Property Remediation Routine	102,990	222,500	215,601	222,500
P815	38896	FAC Environment Site Assess Routine	80,898	145,500	101,788	173,800
P032	38848	Purchasing Equip & Warehouse Routine	249,060	200,000	221,079	200,000
		Other Total	**$751,725**	**$1,207,577**	**$1,130,600**	**$1,343,213**
Routine Capital Spending			**$68,178,210**	**$72,997,621**	**$70,632,874**	**$81,990,925**

Note: POA amounts have been removed to represent the spend amount that requires UARB approval. POA amounts related to routines can be found in Section 2.5.

*Please refer to Section 7.3 for a detailed explanation on the change in investment on Transmission and Distribution Right-of-Way Widening.

7.3 2015 Routine Capital Spending Project Details

Transmission Substation Replacements, Additions and Modifications

T003 Provincial: Transmission Substation Primary Equipment	**2016 ACE Plan ($)**
Unplanned failures	1,166,372
PT and CT Replacements	200,000
Battery Bank & Charger Replacements	60,000
Transformer Radiator Replacements (Trenton)	245,000
Transformer Coolers (Lingan)	100,000
Substation Fencing & Gravel Replacements (82V and 124H)	75,000
96H Ruth Falls Hydro Retaining Wall Phase II	105,200
Footing Remediation (90H, 91H and 30N)	109,800
Substation Yard Lighting (90H, 120H)	20,000
Total T003 Provincial: Transmission Substation Primary Equipment	**$2,081,372**
T004 Provincial- Substation Additions & Replacements	
Unknown Additions	279,457
Substation On-line Monitoring (345kV Transformers)	195,000
Substation Recloser: Add Fibre Communications	135,000
Transformer Refurbishment (99W)	75,000
Install On-line Oil Filtration units	48,000
Control Building Air Conditioning (81S)	25,000
Switch Replacements (124H, 58H)	75,000
Total T004 Provincial - Substation Additions & Replacements	**$832,457**
Total Transmission Substation Replacements, Additions and Modifications	**$2,913,829**

Transmission Line Replacement, Additions/Modifications

Primary Equipment Spares

T018 Primary Equipment Spares	2016 ACE Plan ($)
Capacitors	50,000
Reactors	200,000
Total Primary Equipment Spares	**$250,000**

Protection Modification & Replacement

T016 Protection Modification & Replacement	2016 ACE Plan ($)
SEL TEAM Implementation	58,161
L-6020 & L-6021 Add Perm & TT	92,902
2C Replace Protection on L-6515	36,080
Replace Protection on L-5539	33,080
Replace 345 kV B SPS at 2C Port Hastings	15,241
Replace 345 kV B SPS at 79N Hopewell	15,241
Unplanned Relay Replacement	81,394
Replace 345 kV B SPS at 88S Lingan	15,241
43V Retire DFR	16,349
Replace B81 bus Protection at 67N	53,651
67N Retire DFR	16,349
Total Protection Modification & Replacement	**$433,690**

Transmission Line Replacement, Additions / Modifications

T001 Provincial Transmission Line Replacement (Unplanned)	2016 ACE Plan ($)
This routine has budgeted a 1% increase from 2015 Approved ACE Plan amounts.	$876,369

T011 Provincial- Planned Transmission Line Replacement

LINE #	Description	2016 ACE Plan ($)
L5003	90H Sackville to 99H Farrell St	224,035
L5016	17V St. Croix to 20V Five Points	143,181
L5039	103H Lakeside to 34 Geizer Hill	162,929
L5046	Wolfville Ridge Tap	12,562
L5047	Bridgetown Tap	122,879
L5054	16V Weymouth to 93V Saulnierville	55,104
L5530A	50W Milton to 46W Broad River	225,416
L5530B	46W Broad Rier to 36W Green Harbour	146,902
L5538	15V Sissiboo to 16V Weymouth	140,112
L5544	3W Big Falls to 1W Upper Lake	90,901
L5548	30N Maccan to 17N Brownell	227,306
L6002	99W Bridgewater to 90H Sackville	251,559
L6003	90H Sackville to 91H Tufts Cove	373,171
L6011	17V St. Croix to 120H Brushy Hill	160,412
L6517	2C Port Hastings to 1C Pt. Tupper	355,074
L6527	1N Onslow to 67N Onslow	116,249
L6545	5S Glentosh to 85S Wreck Cove	125,355
L7014	88S Lingan to 101S Woodbine	305,812
L7018	67N Onslow to 120H Brushy Hill	95,639
L8002	67N Onslow to 103H Lakeside	23,383
L8003	67N Onslow to 79N Hopewell	26,239
Various	1-6 Month Inspection Driven Work	1,380,269
T011 Provincial- Planned Transmission Line Replacement		**$4,764,488**
Transmission Line Replacement Total		**$5,640,857**

T010 Provincial Transmission Right of Way Widening

This forecast is developed based on the known level of widening in the current year.

	69 kV Only
L5023	183,664
L5024	17,570
L5039	178,133
L5040	230,273
L5053	1,363,940

69 kV Only	
L5502	872,170
L5510	236,273
Labour and Expenses	2,320,813
Total	5,402,836

> 69 kV	
L6001	21,650
L6004	55,329
L6012	48,112
L6503	66,154
L6511	54,126
L6552	66,154
L7003	33,678
L7009	72,168
L6514	37,287
L6538	60,140
L6539	82,323
Total	597,120
Total T010	5,999,956

The Board's consultant, Liberty Consulting Group (Liberty), carried out a review of NS Power's state of preparedness and response to Post-Tropical Storm Arthur (M06321). This report included a recommendation that NS Power "develop a comprehensive plan to manage the 69kV transmission line corridor Rights-of-Way including reclaiming and/or widening".[10] NS Power agreed with this recommendation and submitted a comprehensive 8-year plan[11] to the Board on July 31, 2015 to widen all of the 69kV transmission ROWs in the province to either 30m or 40m based on the criticality of the transmission line and to perform this work as a capital expenditure. In its Supplemental Decision, the Board stated as follows:

> The Board accepts NSPI's proposed improvements to the 69kV ROW as outlined in its letter and memorandum dated July 31, 2015. NSPI is proposing to carry out

[10] Review of Nova Scotia Power Inc.'s (NSPI) state of preparedness and response to Post-Tropical Storm Arthur, M06321, UARB Supplemental Decision, September 21, 2015, page 14.
[11] Review of Nova Scotia Power Inc.'s (NSPI) state of preparedness and response to Post-Tropical Storm Arthur, M06321, Letter, NS Power to UARB, Overview of 69kV Transmission Right-of-Way Widening Plan, Exhibit A-25, July 31, 2015.

> these improvements at a capital cost of approximately $36 million over 8 years starting in 2016. This expenditure would normally be approved as part of a general rate application or submitted as a capital expenditure application. The Board is prepared to entertain an application from NSPI.[12]

NS Power is seeking approval as part of the 2016 ACE Plan of $5,999,956 for the transmission widening routine T010 in 2016. This includes $4.5 million for the actual widening of 69kV ROWs, plus applicable AO and the standard routine amount of $600,000 for widening other transmission voltage classes.

[12] Review of Nova Scotia Power Inc.'s (NSPI) state of preparedness and response to Post-Tropical Storm Arthur, M06321, UARB Supplemental Decision, September 21, 2015, page 16.

Meters – D009 Meter Routine

Item#	Prg#	Meter Type	Meter Style	Description	2015 Forecast	Current Unit Cost ($)	Capital Cost ($)
1.0 Element, 120-240 volt							
1	294	FOCUS AL (Form 1S)	L+G	240V, 10A, 2W, 4 Jaw, 4 dial	200	60.12	$12,024.36
2	220	S4e w/battery + 1KYZ (Form 3S)	L+G	T/R, 2W, 4Jaw, TOU (KWH) c/w L.C. (ETS)	60	132.83	$7,969.64
3	230	FOCUS AXe (Form 3S)	L+G	T/R, 2W, 4Jaw, KW/KVA dmd	140	117.85	$16,499.09
4	239	AXRS4e w/battery + 1KYZ + modem	L+G	T/R, 2W, 4Jaw, TOU(KWH) c/w modem, L.P,L.C. (ETS)	0	430.64	$0.00
5	240	RXRS4e w/battery + modem	L+G	T/R, 2W, 4Jaw, KW/KVA dmd, c/w modem, L.P.	0	430.64	$0.00
6	296	S4e w/battery + 1KYZ (Form 3S)	L+G	T/R, 2W, 4jaw, BID, TOU LC(ETS)	20	211.69	$4,233.77

1.5 Element, 120-240 volt							
6	*N/A*	C1S	Centron	240V, 200A, 3W,4 Jaw, 5 dial	22000	22.50	$495,000.00
7	219	SS1S1T	Sentinel	S/C, 3W, 4Jaw, TOU(KWH) c/w L.C. (ETS)	700	130.00	$91,000.00
8	231	SS1S2D	Sentinel	S/C, 3W, 4Jaw, KW/KVA dmd	700	110.00	$77,000.00
9	232	SS1S2D	Sentinel	T/R, 3W, 4Jaw, KW/KVA dmd	0	125.00	$0.00
10	236	SS1S1L	Sentinel	S/C, 3W, 4Jaw, (KWH) c/w modem & L.P.	10	290.00	$2,900.00
11	241			S/C, 3W, 4Jaw, KW/KVA dmd,c/w modem,L.P.	0	350.00	$0.00
12	266			S/C, 3W, 4Jaw, (kWh), BID	20	130.00	$2,600.00
13	291			SC, 3W, 4Jaw, (kWh) TOU, BID, LC (ETS)	12	150.00	$1,800.00
14	292			S/C, 3W, 4Jaw, kWh/kW, BID	8	130.00	$1,040.00

2.0 Element, 120-480 volt							
11	N/A	CN1S	Centron	120V,200A,3W,5Jaw(9o,clock pos:), 5 dial	1600	52.00	$83,200.00
12	226	SS2S2D	Sentinel	S/C, 3W, 5Jaw(9 o,clock pos:) KW/KVA dmd,(Mult: 25)	60	110.00	$6,600.00
13	227	SS3S2D	Sentinel	T/R, 3W, 8Jaw, KW/KVA dmd, c/w KYZ pulses	0	160.00	$0.00
14	233	SS2S1T	Sentinel	S/C, 3W, 5Jaw(9 o,clock pos:)TOU(KWH) c/w L.C.(ETS)	60	135.00	$8,100.00
15	235	SS3S3L	Sentinel	T/R, 3W, 8Jaw, KW/KVA dmd, c/w modem, L.P.	4	290.00	$1,160.00
16	246			T/R, 3W, 8Jaw, KW/KVA dmd, c/w modem,L.P, KYZ	4	315.00	$1,260.00

Item#	Prg#	Meter Type	Meter Style	Description	2015 Forecast	Current Unit Cost ($)	Capital Cost ($)
17	254			S/C,3W, 5jaw(9 o,clock pos:)KW/KVA dmd, modem,LP,(Mult 25)	4	315.00	$1,260.00
18	271			T/R, 3W, 8 Jaw, kW/kVA dmd, Modem, LP (5-min int)	4	290.00	$1,160.00
19	272	SS3S3L	Sentinel	T/R , 3W, 8Jaw, kW/kVA dwd, Modem, LP (5-min int) KYZ	0	425.00	$0.00
20	297	SS3S2D	Sentinel	T/R, 3W, 8Jaw, KW/KVA dmd	150	116.00	$17,400.00
2.5 Element, 120-347 volt							
18	281	SS5S0	Sentinal	T/R,4W, 13Jaw, 120-480V, 0.1-10A (KWH)	40	105.00	$4,200.00
19	228	SS2S2D	Sentinel	T/R, 4W, 13Jaw, KW/KVA dmd	200	102.00	$20,400.00
20	229	SS5S2D	Sentinel	T/R, 4W, 13Jaw, KW/KVA dmd, c/w KYZ	0	135.00	$0.00
21	234	SS5S3L	Sentinel	T/R,4W, 13Jaw, KW/KVA dmd c/w modem, L.P.	40	315.00	$12,600.00
22	273	SS5S3L	Sentinel	T/R, 4W, 13 Jaw, kW/kVA dmd, modem, LP (5 min int)	0	290.00	$0.00
23	274	SS5S3L	Sentinel	T/R, 4W, 13 Jaw, kW/kVA dmd, modem, LP (5 min int), KYZ	0	350.00	$0.00
24	288			T/R, W, 13 Jaw, kW BID	8	140.00	$1,120.00
3.0 Element, 120-347 volt							
24	247	SS4S0D	Sentinel	S/C, 4 W, 7Jaw, (KWH)	300	105.00	$31,500.00
25	248	SS4S0	Sentinel	T/R, 4W, 13Jaw, (KWH)	0	105.00	$0.00
26	218	SS4S3L	Sentinal	T/R, 4W, 13Jaw, KW/KVA dmd, c/w modem, L.P.	20	315.00	$6,300.00
27	222	SS4S2D	Sentinel	S/C, 4W, 7Jaw, KW/KVA dmd, (Mult 25)	1000	105.00	$105,000.00
28	223	SS4S2D	Sentinel	T/R, 4W, 13Jaw, KW/KVA dmd	400	102.00	$40,800.00
29	225	SS4S2D	Sentinel	T/R,4W, 13Jaw, KW/KVA dmd, c/w KYZ	0	150.00	$0.00
30	243	SS4S3L	Sentinel	T/R, 4W, 13Jaw, KW/KVA, dmd, c/w modem, L.P, KYZ	20	350.00	$7,000.00
31	275	SS4S3L	Sentinel	T/R, 4W, 13 Jaw, kW/kVA dmd, modem, LP (5 min int)	4	315.00	$1,260.00
32	276	SS4S3L	Sentinel	T/R, 4W, 13 Jaw, kW/kVA dmd, modem, LP (5 min int), KYZ	0	400.00	$0.00
33	283			T/R, 4W, 13 Jak, kWh/kW, BID	20	128.00	$2,560.00
34	295			S/C, 4W, 7Jaw, kWh/kW, BID	20	128.00	$2,560.00
35	211			T/R, 4W, 13 Jaw, TOU, kWh	4	128.00	$512.00

Item#	Prg#	Meter Type	Meter Style	Description	2015 Forecast	Current Unit Cost ($)	Capital Cost ($)
36				TWACS Modules	100	26.00	$2,600.00

Total Meters	**27932**		**$1,070,619**
Misc Meters "ION"	5	$8,000	**$40,000**
Cellular Meters	100	$900	**$90,000**
CT and PT requirements			**$150,000**
Wire, Adapters and switches			**$90,000**
Total Materials			**$1,440,619**
Applied Overhead			**$869,979**
Labour			**$743,064**
D009 Meters Total			**$3,053,662**

Distribution Upgrades and Replacement

	2016 ACE Plan ($)
D005 Unplanned Replacement Deteriorated Equipment	
The forecast was developed based on an estimated 3,051 person-days of work at a unit cost of $2,916/person-day	**$8,802,794**
D006 Regulatory Replacements	
The forecast is developed based on experience or information from various government agencies. This amount could vary based on current year decisions by these agencies.	**$993,306**
D008 Provincial Storm	
This forecast is developed based on past experience. There can be significant variation in this amount based on yearly storm activity.	**$2,391,974**
D051 System Performance Improvement	
John's Cove Causeway Reinsulate	57,245
Antigonish Contingency Stepdowns & Voltage Regulators	165,161
Upgrade R324-122 and R3A03781	59,219
Replace and relocate G472-015	74,024
Upper Clyde Rd Relocation	94,913
Total D051 System Performance Improvement	**$450,562**
D055 Planned Replacement of Distribution Equipment	
Bin Work (Work resulting from NS Power's distribution line inspection program that has been identified as requiring follow up within one year.)	1,992,816
Streetlight/service removal (This funding is to support system upgrades required for street light installations. This includes transformer installs, service upgrades and/or new pole installations.)	444,602
Field Driven Work/Unapproved Bin	592,803
103H Feeder Exit Cable Replacements	35,108
54H Feeder Exit Cable Replacements	49,400
23H Clayton Park Rear Lot Rebuild	98,801
4S-332/321 Epoxy Arm Change-out - George St	74,100
100C-422G Re-Insulate	197,601
Re-Insulate 11S-411 and 11S-302 Double Circuit, Coxheath Rd	222,301
Voltage Regulator Replacements	197,601
3S-307 Epoxy Arm Change-out - Sydney Mines	74,100
57C-426 Amos Gillis Road Rebuild	123,501
59C-402G ICP - Device Replacement	123,501
81S-305 Water Street Rebuild - Glace Bay	247,001
Switching Cubicle Replacements	192,281
Manhole Cover Upgrades	98,801
22W-311 Daniel's Head Reconductor	353,898
36W-301 East Sable Rd Rebuild	176,374
12V-303G Clementsport rd Rebuild Phase 1	168,600
83V-301 Grand Pre - Reconductor	69,832

16W-301 Sanford Reconductor	223,999
12V-302H Granville Reconductor	206,767
88W-312G Wyman Rd Reconductor	135,898
25W-302G Lockes Island Reconductor	72,138
50V Kentville URD Replacements	48,297
4 6V-303 Remove Abandoned line, Broad River	29,640
16W-301 Rodney Rd Rebuild	335,729
46W-301 Port Joli Rebuild	201,818
Total D055 Planned Replacement of Distribution Equipment	**$6,787,307**
Distribution Upgrades and Replacement Total	**$19,425,941**

New Customers

	2016 ACE Plan ($)
D004 New Customer Upgrades	
This forecast developed as a % of D061 and D062 net of capital contributions. In 2016 this is estimated to be 57%.	**$7,779,098**
D018 Primary Equipment Spares Distribution	
This forecast is developed based on the probable amount of distribution spare equipment required during the year.	**$150,000**
D061 New Customers - Residential	
This forecast is for the costs associated with new residential customers net of capital contributions. Costs include metered services, unmetered services, line extensions and underground services.	**$8,124,181**
D062 New Customers - Commercial	
This forecast is for the costs associated with new commercial customers net of capital contributions. Costs include metered services, unmetered services, line extensions and underground services.	**$5,422,263**
Total New Customers	**$21,475,541**
Joint Use Total	
This forecast is developed based on prior spending levels for both Joint Use requests from NS Power's Joint Use Partner, Bell Aliant and communication utility requests.	**$599,541**
Right of Way Widening Total	
This forecast is developed based on the known level of widening in the current year.	**$2,994,461**
Distribution Total	**$47,549,147**

Right-of-Way Widening Total

This forecast is developed based on an identified level of widening in the current year. The spend in this Routine reflects the work that will be required to widen the following rights-of-way to standard.

Feeder Section	Geographic Location	Length (Km)	Managed Length (Km)	Avg Cost per Km	Cost	Admin Overheads	Total Segment Cost
76V-301G	Harmony to Maitland Bridge	52.51	18.38	$18,000	$330,798.76	$67,086	$397,885
92W-302G	Kemptville	78.52	27.48	$18,000	$494,681.61	$100,321	$595,003
46W-301G	Port Joli	43.96	8.79	$18,000	$158,239.73	$32,091	$190,331
16V-314G	Weaver Settlement	70.52	4.40	$18,000	$79,119.86	$16,046	$95,165
51V-301G	East Tremont	21.45	2.15	$18,000	$38,617.85	$7,832	$46,450
99V-314GAA	Lake Paul	30.51	21.36	$18,000	$384,399.92	$77,956	$462,356
619N-301	Upper Stewiacke	98.89	19.78	$18,000	$356,008.86	$72,199	$428,207
16W-302H	Hectanooga	25.35	12.67	$18,000	$228,148.74	$46,269	$274,417
7N-302G	Middleboro	38.85	23.31	$18,000	$419,560.02	$85,087	$504,647
Total							**$2,994,461**

Liberty's report on its review of NS Power's response to Post-Tropical Storm Arthur also included a recommendation that for distribution ROWs NS Power should "develop a comprehensive plan for reclaiming and/or widening the overgrown ROW corridors".[13] In its Supplemental Decision on September 21, 2015, the Board wrote:

[13] Review of Nova Scotia Power Inc.'s (NSPI) state of preparedness and response to Post-Tropical Storm Arthur, M06321, Liberty Consulting Group, Comments on Review of NS Power's Storm Response, Exhibit A-4, September 9, 2014, page 7.

> [a] circumstance where it will take 32 years for the distribution vegetation management program to become sustainable causes the Board significant concern… The Board is intrigued by the stakeholder discussion concerning innovative financing options and directs NSPI to pursue that issue…[14]

NS Power is seeking approval as part of the 2016 ACE Plan of $3 million for the distribution widening routine, D010, in 2016. The $3 million comes from the portion of the annual $10.4 million that is spent on managing the vegetation in distribution ROWs to a sustainable state. This work will expand the ROW to the standard width and will reduce the future operating costs for the ROW asset as the vegetation will no longer need to be reclaimed; the new ROW width will only need to be sustained.

[14] Review of Nova Scotia Power Inc.'s (NSPI) state of preparedness and response to Post-Tropical Storm Arthur, M06321, UARB Supplemental Decision, September 21, 2015, page 14.

Work Vehicles

P006 Replacement and Additional Work Vehicles	Quantity	Unit Price	2016 ACE Plan ($)
Reel and Pole Trailers	5	$40,000	$200,000
Total P006 Replacement and Additional Work Vehicles			**$200,000**
P009 Mobile Transformer & Track			
This forecast is developed based on estimated refurbishment or modifications to track machines or the mobile transformers.			**$70,862**
P061 Transportation Vehicle Replacements	60	$31,000	$1,860,000
		Salvage	-$80,000
			$1,780,000
P062 Work Vehicle Replacements	16	$295,590	$4,729,438
		Salvage	-$150,000
			$4,579,438
P063 Class 3 Work Vehicle Replacements	3	$111,000	$333,000
		Salvage	-$10,000
			$323,000
	Total Work Vehicles		**$6,953,300**

Tools and Equipment

Description	Quantity	Estimated Unit Cost ($)	2016 ACE Plan ($)
Meter Shop Tools and Equipment			$50,000
Provincial Line Tools & Equipment			
Western Territory			$122,438
Eastern Territory Total			98,015
Central Territory Total			224,400
T&D Asset Total			380,047
Total Fleet			3,500
System Maintenance Total			147,600
P002 Tools and Equipment Total			**$1,026,000**
P015 Hydro Production Tools & Test Equipment			**$90,000**

Description	Quantity	Estimated Unit Cost ($)	2016 ACE Plan ($)
P016 Thermal Production Tools & Test Equipment			
POT Tools & Equipment			$75,000
TUC Tools & Equipment			70,000
TRE Tools & Equipment			80,000
LIN Tools & Equipment			53,000
P016 Thermal Production Tools & Test Equipment Total			**$278,000**
Tools and Test Equipment Total			**$1,394,000**

Telecommunications

P025 Mobile Radio	**ACE 2016 Plan ($)**
Replacement Radio Equipment Hardware and Upgrades	13,216
Equipment refurbishment - PO	12,028
Miscellaneous Support for existing system	32,458
P025 Mobile Radio Total	**$57,702**
P027 Telecommunication Radio & Fibre Ops	
HVAC & Generator Upgrades - 2 sites	101,727
Radio Site repairs - Miscellaneous	19,623
Add Generator Alarms And Controls at various sites	5,401
Miscellaneous Replacements	14,293
P027 Telecommunication Radio & Fibre Ops Total	**$141,043**
P028 Telecommunication Systems Replace & Modifications	
Replace DPR and Tone Protection Equipment	49,204
Upgrade Site Access Equipment	25,348
Install Multiplex Shelves @ RAL	30,693
Remove Old Bayly Multiplex Equipment	12,338
Backup Control Center Circuits	14,331
Backup Time Synch for Backup Control Centre	2,488
Battery Replacements Various Sites	15,622
Replace Miscellaneous Power Supplies	5,000
UPS Replacements Various Sites	5,000
Replace Ethernet Spread Spectrum Radios (Wide Area Network -WAN)	26,932
Cable & Entrance Protection - Positron	15,000
Switched Communications - System Operations Phones	5,000
Replace Fibre Optic Equipment (NEC & ADC)	72,573

Install One Fibre Link from Substation to Radio Site	17,098
Network Monitoring - upgrade TMON alarming system	31,894
Alarm Commissioning for new sites into SCADA	13,894
Review and Update System Drawings and Records	39,194
Replace Cable List Program	68,687
Tower Lighting Upgrades	15,702
P028 Telecommunication Systems Replace & Modifications Total	**$465,998**
P814 Telecommunications Spares	
Alcatel-Lucent MPR9500 Microwave Radio	25,814
Net Guardian Alarm Monitoring Equipment	25,814
Ethernet Spares	10,814
MDS SD9, Transnet, INet	10,814
SEL 2505, 2506 Spares	10,814
RFL IMUX and 9745 Spares	25,814
Battery Charger Spare	10,814
RTU and Misc. Spares	10,814
P814 Telecommunications Spares Total	**$131,512**
Telecommunications Total	**$796,256**

Computing and Asset Management

P010 SCADA Improvements		**2016 ACE Plan ($)**
	This forecast is developed based on anticipated SCADA equipment/operator interfaces failures or modifications	
P010 SCADA Improvements Total		**$131,831**

P031 NSPI IT Infrastructure

Infrastructure Component	**Asset Management Plan**	**Volume to be Refreshed**	**2016 ACE Plan ($)**
Voice and Data Network	Network Infrastructure & Equipment		$1,029,445
Servers	Servers Refresh, Licenses, & Storage		1,045,787
Laptop and Desktop Computers	New laptop or desktop computers	175	175,000
Laptop and Desktop Computers	Laptop/Desktop Mgmt Tool-capacity upgrade		53,086
Laptop and Desktop Computers	New software licenses		106,171
Power Supplies	Replaced after 10 years		20,000

Accessories	Accessories	10,000
P031 NSPI IT Infrastructure Total		**$2,439,489**
P040 DCMS Equipment Replacement		
	CTs DCMS Equipment Replacement	$20,000
	LIN DCMS Equipment Replacement	38,353
	POT DCMS Equipment Replacement	30,000
	TRE DCMS Equipment Replacement	44,950
	TUC DCMS Equipment Replacement	50,000
		$183,304
	Computing and Asset Management Total	**$2,754,623**
Property Improvement and Furniture		
P001	FAC - Property Improvements**	$2,105,000
P030	FAC - Lower Water Street	100,000
	Property Improvement and Furniture Total	**$2,205,000**
Other		
P012	HYD - Security Improvement	$546,913
P018*	Environmental Equipment Replacement	100,000
P041	FAC - Land Acquisition Routine	100,000
P816	FAC - Environment Property Remediation	222,500
P815	FAC - Environment Site Assessment	173,800
P032	FAC - Equipment & Warehouse	200,000
	Other Total	**$1,343,213**
	General Plant Total	**$15,446,393**

*P018 Environmental Equipment Replacement is replacing S001 GS Routine Capital to properly reflect the type of equipment being purchased. This is comprised of environmental equipment required to support all functions of the business and is now being included in General Plant (P018) as opposed to Generation (S001).

**P001 FAC – Property Improvements

PLANNED PROJECT WORK		**2016 ACE Plan ($)**
Building Protective Coatings	4-6 depots	50,000
Roofing	6-12 depots	150,000
Grading/Drainage	Stellarton/Various	200,000
Fence Gate Repairs		83,000
Pole Brows	Stellarton	300,000
General Contract Work		327,000
Transformer Dock	Stellarton & Various	200,000
Consultant		70,000

B&M HVAC	Various		210,000
Sub Stations Improvements	Various		150,000
Generator	Yarmouth Generator		50,000
Protective Signage	Replacement of Aged Signage		5,000
Security	Improvements Provincial		10,000
1H Office Building General Repairs	GC Improvements		300,000
TOTAL		**$**	**2,105,000**

8 Directives and Miscellaneous

8.1 UARB ACE Plan Directives and Stakeholder Commitments

NS Power has received a number of Directives from prior ACE Plan Decisions. It has also agreed to a number of commitments with stakeholders. In accordance with the format developed in prior ACE Plans, responses to each of these Directives and stakeholder commitments are provided below.

8.1.1 Impact of 2016 ACE Plan on Revenue Requirement and Affordability

Introduction

Revenue requirement and its effect on rates are well understood: increases in revenue requirement create upward pressure on rates. NS Power recognizes that rate increases are of particular concern for our customers and stakeholders which, through ongoing engagements with them, is frequently expressed in terms of affordability.

As such, over the years the UARB has directed NS Power to provide information regarding the ACE Plan's revenue requirement impact. Directive 7 of the 2011 ACE Plan Decision and Directive 12 of the 2012 ACE Plan Decision direct NS Power to provide the estimated effect the ACE Plan may have on revenue requirement over the next five years. This is provided in the tables that follow.

This information has been provided in prior ACE Plans and, through discussion and agreement with stakeholders as well as further direction from the UARB, has grown to include tables breaking out the revenue requirement impact of:

- Economically Justified capital investments (2013 CEJC stakeholder engagement),
- Current Asset capital investments (2014 stakeholder engagement), and
- Work Support Facilities capital investments (UARB 2013 ACE Plan Decision Directive 13)

Considered as a whole, this information provides the UARB and stakeholders an impression of the impact NS Power's capital program is expected to have on revenue requirement and helps inform discussions on affordability. NS Power submits that the 2016 ACE Plan, designed largely as a sustainable capital program, continues to be about investing where required to best maintain the performance and reliability of our assets, while lessening upward pressure on rates.

The overall revenue requirement table, "Long-Term Capital Planning & Revenue Requirement", shows that NS Power's capital expenditures have a decreasing effect on NS Power's revenue requirement over the next five years when one considers the contribution to fixed costs provided by new customer additions.

Overall Revenue Requirement

The overall revenue requirement calculation that follows shows the effect on rate base and the effect on revenue requirement. The underlying assumption of this calculation is that, to the extent capital expenditures equal depreciation expense in a given year, there is no incremental effect on rate base or associated revenue requirement and therefore it is not included in the calculation.

The revenue requirement assessment incorporates the following inputs:

- Capital expenditures compared to forecasted depreciation expense annually.

- Administrative overhead credit based on the proration of capital expenditures in excess of depreciation expense in each year.

- Depreciation expense of assets added during the examined timeframe based on the proportion of capital expenditures in excess of depreciation expense of all assets in each year.

- Incremental interest based on the cost of debt multiplied by the portion of debt to total capital of the incremental rate base.

- AFUDC based on the proportion of capital expenditures in excess of depreciation expense of all assets in each year.

- Income taxes based on the resultant effects and prorated Capital Cost Allowance for tax purposes.

- Net earnings based on the rate of return multiplied by the portion of equity to total capital of the incremental rate base.

- Additional fixed cost recovery received from customer growth achieved through capital investment to serve these customers.

Depreciation expense and additional fixed cost recoveries are delineated in the overall revenue requirement calculation.

This method does not address the revenue requirement effect should the capital projects not be completed. Costs resulting from not completing certain projects include items such as increased operating costs, increased fuel costs, increased repair costs, and other risks or implications. The Economic Analysis Model used to decide whether an economically justified capital project is the best option for customers includes estimates of the avoided expenses; these avoided cost benefits are not included in this revenue requirement calculation. The effect of economic projects and their savings is broken out separately in the subsequent section.

LONG-TERM CAPITAL PLANNING & REVENUE REQUIREMENT

NOVA SCOTIA POWER ($M)	2016 ACE	2017	2018	2019	2020
Capital Expenditures (Spend)	$279.9	$346.0	$382.1	$296.4	$262.9
Less: Depreciation of all assets	189.7	196.0	203.7	211.0	217.1
Incremental Spend over Depreciation (Growth)	90.2	150.0	178.4	85.4	45.8
Incremental Spend as a portion of Total Spend	32.2%	43.3%	46.7%	28.8%	17.4%
Including Fixed Cost Recovery					
Change in Incremental Revenue Requirement from Previous Year	($16.7)	($3.5)	$7.0	$20.2	$9.1
Incremental Revenue Requirement of five-year capital plan	(16.7)	(20.3)	(13.2)	7.0	16.0
Rate Impact of five-year capital Plan	-1.3%	-1.6%	-1.0%	0.5%	1.3%
Excluding Fixed Cost Recovery					
Change in Incremental Revenue Requirement from Previous Year	(12.6)	0.6	11.2	24.4	13.2
Incremental Revenue Requirement of five-year capital plan	(12.6)	(12.0)	(0.8)	23.6	36.8
Rate Impact of five-year capital Plan	-1.0%	-0.9%	-0.1%	1.9%	2.9%

Expenses					
OM&G	(4.2)	(8.3)	(12.5)	(16.6)	(20.8)
Administrative Overhead	(11.0)	(17.5)	(18.5)	(10.8)	(5.5)
Depreciation	0.8	3.9	7.8	6.9	5.2
Interest	1.6	6.0	11.8	16.4	18.5
AFUDC	(1.5)	(2.6)	(3.8)	(1.6)	(1.0)
Earnings before tax	(2.5)	(1.8)	1.9	12.7	19.5
Income Tax less Impact of Administrative Overhead	(1.8)	(4.0)	(5.7)	(0.9)	2.6
Income Tax Impact of Administrative Overhead	(2.4)	(3.8)	(4.0)	(2.3)	(1.2)
Net Earnings	$1.6	$5.8	$11.4	$15.8	$17.9
New Incremental Regulated Capital Assets					
Beginning Balance	-	89.4	235.5	406.1	484.6
Capital Spend	90.2	150.0	178.4	85.4	45.8
Depreciation	0.8	3.9	7.8	6.9	5.2
Ending Balance	89.4	235.5	406.1	484.6	525.2
Average Incremental Net Book Value of projects in five-year plan	44.7	162.4	320.8	445.4	504.9
Capital Cost Allowance					
Depreciation of Assets added 2016-2020	2.8	12.4	24.3	20.9	15.2

Does not included avoided costs related to economically justified projects.

The overall revenue requirement shown above, in the line item "Incremental Revenue Requirement of five-year capital plan", shows a decreasing revenue requirement over a five year period. Years 2016 to 2018 show a decrease in revenue requirement in each year as a result of the new capital investment. This is due to additional fixed cost recovery received from customer growth achieved through capital investments to serve these customers, Administrative Overhead and AFUDC credits related to construction of capital assets, and the income tax impact of new capital investment.

Years 2019 and 2020 are forecasted to have an increase in revenue requirement in each year as a result of the new capital investment due to increased depreciation expense, interest and return on equity of capital assets. However, the cumulative effect of all years 2016 to 2020 is a decrease to revenue requirement, resulting in a lessening of upward pressure on rates.

Categories of Capital Expenditures and Revenue Requirement

Not unlike the functional classes of capital expenditures noted throughout the ACE Plan, overall revenue requirement can be broken down into different sub-categories. A table breaking out "Current Asset Investment" is provided in the following table.

Current Asset Investment is made up of all capital investment on our current asset base which includes both compliance and sustaining capital projects. (It does not include investment that creates new assets (e.g. customer growth and wind farms) or substantially alters current assets (e.g. transmission upgrades for Wind/Maritime Link)).

CURRENT ASSET INVESTMENT

NOVA SCOTIA POWER ($M)	2016 ACE	2017	2018	2019	2020
Capital Expenditures (Spend)	$232.2	$223.0	$223.0	$198.5	$192.9
Less: Depreciation of all assets	189.7	194.4	199.3	204.1	208.4
Incremental Spend over Depreciation (Growth)	42.5	28.7	23.7	(5.6)	(15.6)
Incremental Spend as a portion of Total Spend	18.3%	12.9%	10.6%	-2.8%	-8.1%
Change in Incremental Revenue Requirement from Previous Year	($2.5)	$4.4	$2.8	$3.7	$0.0
Incremental Revenue Requirement of five-year capital plan	($2.5)	$1.9	$4.7	$8.5	$8.5
Rate impact of five-year plan	-0.2%	0.1%	0.4%	0.7%	0.7%
Expenses					
Fuel	-	-	-	-	-
OM&G	-	-	-	-	-
Administrative Overhead	(4.6)	(3.3)	(2.7)	0.6	1.8
Depreciation	0.4	0.9	1.3	(0.5)	(1.7)
Interest	0.8	2.1	3.0	3.3	2.9
AFUDC	(0.8)	(0.5)	(0.4)	0.1	0.3
Earnings before tax	1.7	2.8	3.7	4.9	5.1
Income Tax	(1.0)	(0.6)	(0.4)	2.0	3.0
Net Earnings	$0.7	$2.0	$2.9	$3.2	$2.9
Average incremental Net Book Value of projects in five-year plan	21.0	56.0	81.1	89.8	80.3

Compliance investment is required to meet a variety of regulatory requirements.

Sustaining investment includes projects in Transmission & Distribution (T&D), Work Support Facilities, and Generation necessary to sustain those assets:

- Sustaining investment in Work Support Facilities is based on technical, economic or regulatory requirements of the assets.

- Sustaining investment in our generation, transmission and distribution assets is done through our asset management program and developed through ongoing inspection programs and based on condition and criticality of the asset. Sustaining investments in generation are backed up with economic analysis stating it is more economical to complete this project compared to a "do nothing" option.

Current Asset Investments represent those projects that NS Power is required to complete to maintain system reliability and performance.

Reductions in NS Power's current asset investment in T&D assets could lead to a decrease in reliability. Likewise, reductions in current asset investment in generation assets, and corresponding economically justified projects, could lead to reduced generation performance and outages resulting in an increase in revenue requirement due to incurring expenses that would otherwise be avoided.

<u>Effect of Economically Justified Projects</u>

NS Power's overall revenue requirement, of which NS Power's capital revenue requirement is a part, is influenced by economically justified projects.

Economically justified projects contribute to lessening upward pressure on rates by keeping NS Power's overall revenue requirement lower than it otherwise would be.

The table below includes the effect of all new economically justified projects in the 2016 ACE Plan.

ECONOMICALLY JUSTIFIED PROJECTS

NOVA SCOTIA POWER ($M)	2016	2017	2018	2019	2020
Capital Expenditures (Spend)	$25.6	$0.3	$0.0	$0.0	$0.0
Electric Revenue	($5.6)	($7.1)	($9.0)	($10.2)	($11.8)
Operating Expense	(1.9)	-	-	-	-
Avoided Expenses	(3.2)	(5.5)	(7.7)	(9.0)	(10.7)
Depreciation Expense	0.3	0.6	0.6	0.6	0.6
Interest	0.5	1.0	0.9	0.9	0.9
AFUDC	(0.3)	-	-	-	-
Earnings before taxes	(0.7)	0.3	0.6	0.7	0.8
Income taxes	(1.1)	(0.5)	(0.2)	(0.1)	0.0
Net Earnings	$0.4	$0.8	$0.8	$0.8	$0.8
Revenue Requirement of Capital Investment	($2.3)	($1.5)	($1.3)	($1.2)	($1.1)
Total Revenue Requirement	($5.6)	($7.1)	($9.0)	($10.2)	($11.8)

The "Incremental Revenue Requirement of five-year capital plan" line in the Long-Term Capital Planning & Revenue Requirement table shows that NS Power's overall revenue requirement by completing these projects is less than the overall revenue requirement if these projects were not completed. In other words, NS Power's revenue requirement in 2016, if NS Power did not pursue its economically justified capital projects, would be $5.6 million higher.

As can be seen in the above table, the avoided $5.6 million in Revenue Requirement is composed mostly of avoided expenses. These avoided expenses do not represent a reduction in NS Power's capital. Rather, they are primarily avoided replacement energy costs, as shown in each economically justified project's Economic Analysis Model.

Upward pressure on rates caused by NS Power's overall revenue requirement is lessened when economically justified projects are completed as compared to not completing them. The benefit of completing these projects is seen immediately in the first year.

Conclusion

NS Power's revenue requirement shows a decrease in 2016 to 2018 as a result of undertaking this capital plan. Years 2019 and 2020 are forecasted to have an increase in revenue requirement due to this capital plan. However, the cumulative effect of all years 2016 to 2020 is a decrease in revenue requirement, resulting in a lessening of upward pressure on rates.

Investment in the Current Asset Base has a small impact on revenue requirement while maintaining reliability and performance of assets, and is justified based on need and/or economics per the requirements of the CEJC.

Investment in economically justified projects lessens upward pressure on overall revenue requirement and rates by avoiding considerable expenses primarily related to replacement energy that would otherwise be incurred.

NS Power recognizes that this describes the influence of our capital program only. NS Power also recognizes that all aspects of our business contribute to the complete picture of our revenue requirement in any given year. Those other aspects include, broadly, fuel costs, operating, maintenance, and general (OM&G) costs, and past investments.

Examined on its own, the 2016 ACE Plan emphasizes affordability for customers by minimizing capital expenditures while maintaining NS Power's Generation, Transmission and Distribution systems. This sustaining capital investment plan provides a stable year over year investment plan in order to properly replace and refurbish our existing assets.

Addendum: Work Support Facilities

NS Power has broken out the revenue requirement effect of Work Support Facilities projects. Work Support Facilities projects, according to the CEJC, are those typically associated with building, facilities replacement, and modifications, telecontrol and telecommunications, and information technology.

Work Support Facilities projects that NS Power submits for approval provide a clear benefit or are considered necessary. For example, Information Technology related capital projects are frequently necessary due to a number of factors including obsolescence of previous technology, manufacturer support expiring, or improving work practices in line with industry trends. Work

Support Facilities capital work orders will be assessed and submitted per the criteria found in the CEJC, and, pursuant to the 2014 ACE Plan Terms of Consensus approved by the Board on June 5, 2014, will describe the corresponding justification for the project, be it technical or economic.

WORK SUPPORT FACILITIES

NOVA SCOTIA POWER ($MM)	2016 ACE	2017	2018	2019	2020
Capital Expenditures (Spend)	$41.5	$42.3	$43.2	$44.0	$44.9
Less: Depreciation of assets	28.1	24.0	23.0	31.3	37.1
Incremental Spend over Depreciation (Growth)	13.4	18.3	20.2	12.7	7.8
Incremental Spend as a portion of Total Spend	32.2%	43.3%	46.7%	28.8%	17.4%
Change in Incremental Revenue Requirement from Previous Year	($0.5)	$1.2	$1.8	$1.9	$1.1
Incremental Revenue Requirement of five-year capital plan	($0.5)	$0.8	$2.6	$4.5	$5.6
Expenses					
Fuel	-	-	-	-	-
OM&G	-	-	-	-	-
Administrative Overhead	(0.7)	(0.9)	(1.0)	(0.6)	(0.4)
Depreciation	0.2	0.8	1.6	1.4	1.1
Interest	0.2	0.8	1.5	2.0	2.3
AFUDC	(0.2)	(0.2)	(0.3)	(0.2)	(0.1)
Earnings before tax	(0.0)	0.3	0.9	1.9	2.7
Income Tax	(0.3)	(0.5)	(0.6)	(0.0)	0.4
Net Earnings	$0.2	$0.8	$1.4	$2.0	$2.3
Average incremental Net Book Value of projects in five-year plan	6.6	21.9	40.0	54.9	63.9

*Whereas NS Power has not determined the future planned investments in Work Support Facilities beyond 2016, the analysis assumes that the level of investment would increase by an inflation rate of 2 percent annually. The incremental spend as a portion of total spend is assumed to be the same as the entire capital program. The revenue requirement effect includes the same factors as those used in the Long-Term Capital Planning & Revenue Requirement table.

8.1.2 Sustaining Capital – 2016 ACE Plan Alignment with the Integrated Resource Plan

The 2015 ACE Plan Terms of Consensus provide the following:

> (8) NS Power will also engage with interested stakeholders on the issue of NS Power including information in future ACE Plans to show how its long-term planning assumptions regarding projections of sustaining capital investment in existing thermal plants presented in the IRP and future ACE Plans are consistent. This stakeholder consultation process will begin within 30 days of the Board issuing its decision in this matter.[15]

During the stakeholder consultation process in early 2015, NS Power discussed the issue of including information in future ACE Plans to show how its long-term planning assumptions regarding projections of sustaining capital investment in existing thermal plants presented in the IRP and future ACE Plans are consistent. A mock-up of this commitment was provided to and agreed upon by stakeholders pursuant to NS Power's report submitted to the Board on June 30, 2015. NS Power provides this information below.

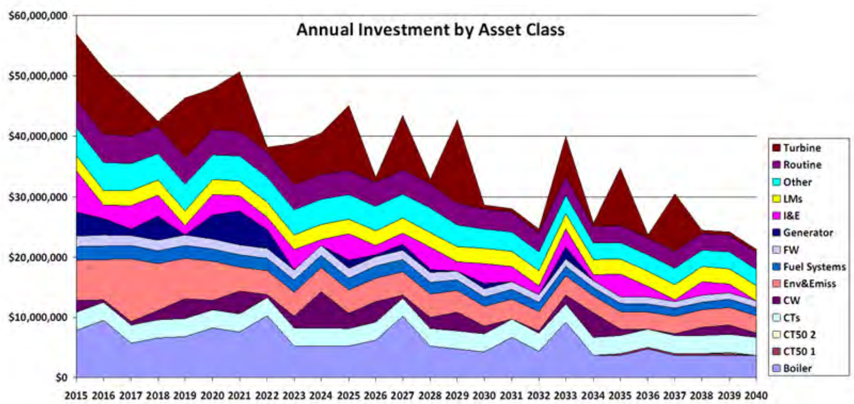
NS Power introduced sustaining capital assumptions for the thermal generating fleet for the first time in the 2014 Integrated Resource Plan (IRP). This was made necessary by efforts to include unit retirement assumptions in the IRP analysis. The 2016 ACE Plan was derived using the same asset management practices used for the sustaining capital forecast assumptions for the 25 year planning period of the 2014 IRP. As a result the sustaining capital investments in NS Power's thermal and combustion turbine fleet are well aligned with the assumptions used throughout the 2014 IRP. The capital investment included in the 2016 ACE Plan would not be expected to change regardless of the resource plan used in the 2014 IRP process.

When comparing a singular capital year from an ACE Plan to a long term planning exercise such as the IRP, it is important to take into consideration the leveling of investment done for the 25 year capital forecast used within the IRP. Outside of major asset classes (turbines, generators, etc.), the investment in asset classes are levelized throughout the expected life of the associated generating unit.

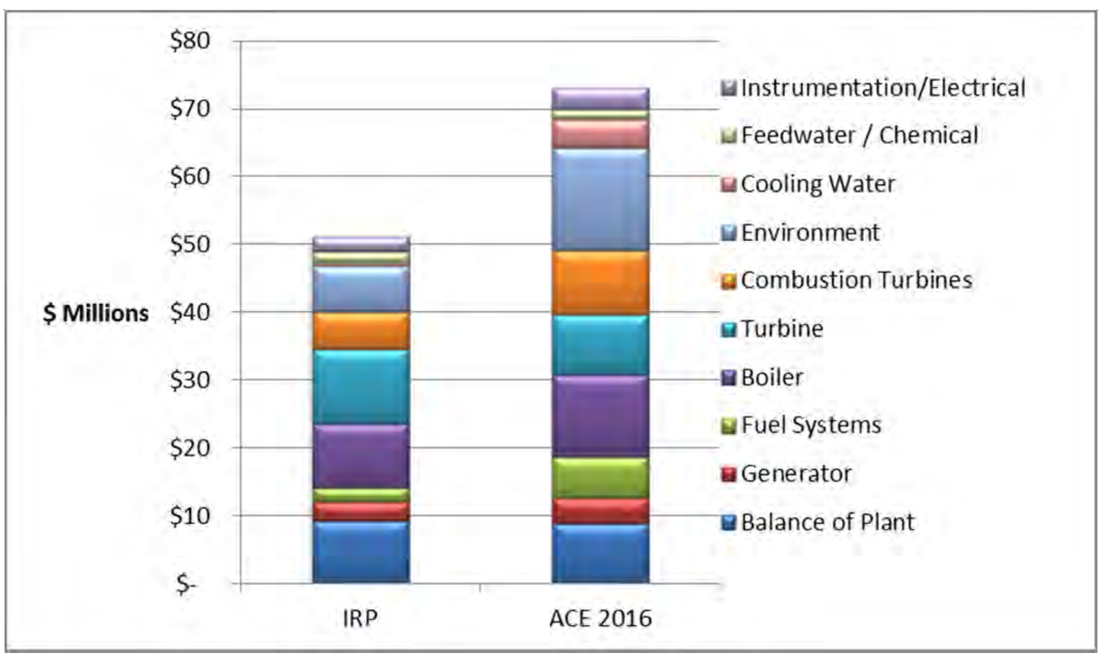
[15] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, page 2.

The capital investment forecast used in the 2014 IRP is shown below.

2014 IRP Sustaining Capital Forecast



Per the table below, NS Power has completed a more detailed, single year capital forecast; the 2016 capital forecast has changed as compared to the amount used in the 2014 IRP.

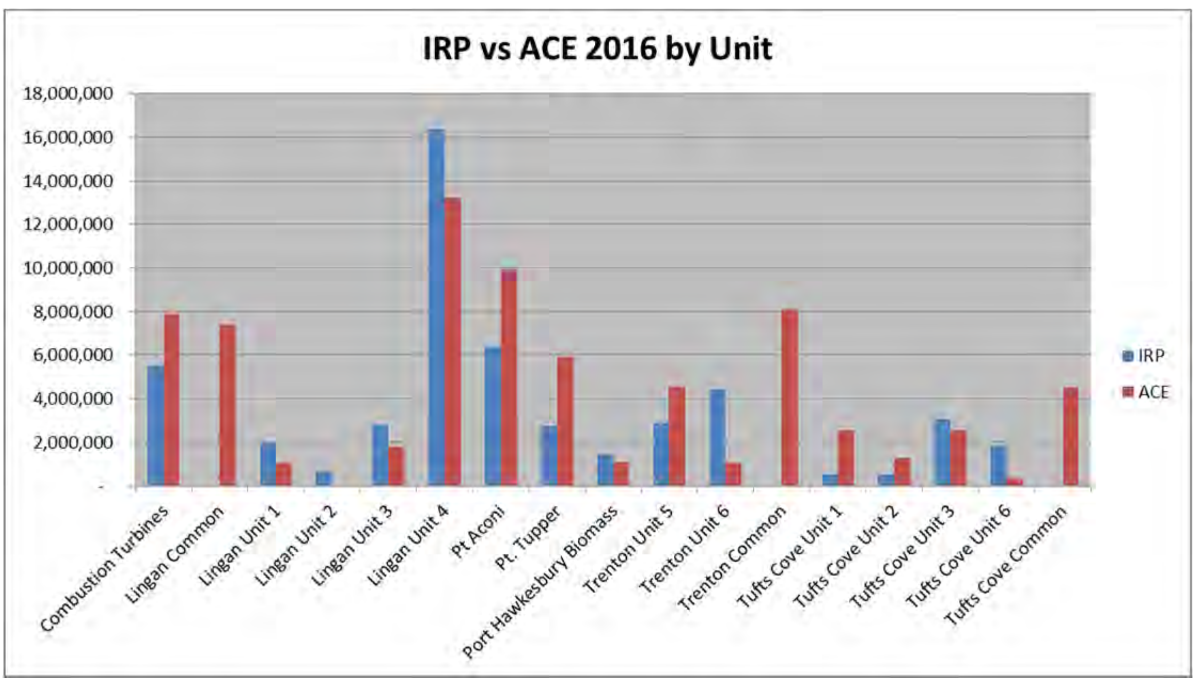


While the 2016 ACE Plan forecast is higher than the 2014 IRP forecast for 2016, the variance is largely due to the following items.

The first is the investment in ash sites. Ash Site investment was levelized throughout the planning period of the IRP. However, it can be expected to have a varying amount of investment year over year. In addition to this, Ash Site investment should be considered a sunk cost. The majority of this investment is required and driven by regulatory requirements, even if the associated thermal plant were to be retired today.

The second is the investment in our Combustion Turbine fleet. Investment, originally anticipated to occur in future years, is now being completed in 2016. The large driver of this investment is the return to service of the Burnside Unit #4 Combustion Turbine.[16] This increased investment does not have an effect on alignment with the IRP as all Combustion Turbines are anticipated to operate throughout the IRP Planning Period, an assumption that was common to all of the Resource Plans evaluated in the IRP.

The third is the purchase of an Auxiliary Boiler for the Tuft's Cove Generating station. However, investment in boilers is otherwise consistent with the IRP forecast. This investment facilitates the economic dispatch of the Tufts Cove steam units as it permits operation as described in the IRP analysis.



[16] CI 33142 – CT – Burnside Unit #4 Restoration was submitted to the UARB on October 30, 2015.

8.1.3 Summary of 2016 ACE Plan Capital Items Related to NERC and/or NPCC Standards

The table below is provided pursuant to the UARB's 2011 ACE Plan Decision Directive 9.

CI#	Project Title	2016 ACE Plan	Total Estimate	2016 ACE Category
46513	3C Port Hastings BPS Upgrade	$468,251	$3,391,187	Carryover
43291	Protection Risk Reduction 67N-Onslow 230KV	$293,342	$3,334,478	Carryover
46757	88S Lingan 230kV BPS Upgrades	$265,641	$3,218,221	Request Approval
46671	NERC CIP Version 5 Implementation	$552,227	$1,528,492	Subsequent Submission
NERC and/or NPCC Compliance Total		**$1,579,461**	**$11,472,378**	

** The primary justification for the projects listed is compliance with NERC Standards and/or NPCC Criteria. Other capital projects (e.g. generation projects that preserve reserve margins or maintain Black-Start Capability) provide important compliance benefits but these are secondary to the project primary justification.*

8.1.4 Annual Ranking/Prioritization of Capital Projects

Pursuant to the UARB's 2011 ACE Plan directive 11 and 2013 ACE Plan directive 7, below is NS Power's capital project ranking criteria.

NS Power capital projects are ranked according to the following criteria:

- Health and Safety: Operating Permits, Personnel Safety
- Regulatory Compliance: Renewable Electricity Standards, GHG Regulations, Air, Emission Regulations, NERC/NPCC Requirements, Generating Unit Operating Approvals issued by NSE
- Customer Reliability: SAIDI, SAIFI, CAIDI
- Requirement to Serve
- Economics: Based on Net Present Value of the Project, Levelized Cost Analysis, $/Avoided Customer Hours of Interruption (ACHI)

Each year, the capital program includes those projects which are essential for health and safety objectives, regulatory compliance, and those which are required to provide service to an area. Projects which serve to address customer reliability are evaluated based on factors related to performance targets (System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), Customer Average Interruption Duration Index (CAIDI), etc.). Economic initiatives are evaluated based on their economic ranking.

NS Power Ranking Methodology

NS Power has expanded the ranking method used for Generation in 2015 to now include Transmission and Distribution projects. This new ranking methodology has been discussed and agreed upon in principle with stakeholders during the 2015 capital stakeholder engagement process. It was incorporated into the recently revised CEJC and submitted to the UARB for review and approval on June 30, 2015. This ranking methodology uses a two axis method which results in a final ranking of 1-25. Ranking (also termed risk) is developed by determining the “Criticality” (ranked 1-5) and “Condition” (ranked 1-5) of each asset and multiplying the two to determine the overall risk.

Criticality and Condition values are typically influenced by one predominant factor and ranked accordingly. However, other factors may also influence the ranking of a project. In the event that multiple factors are present for a project, individual rankings will be taken into consideration in determining the overall Criticality rankings. For example, Health and Safety considerations for a project may warrant a Criticality ranking of serious (3), while Environmental considerations for the same project may also independently warrant a Criticality ranking of serious (3); this project may therefore warrant a higher Criticality ranking due to multiple influencing factors.

Considerations of multiple influencing factors, all rankings applied to projects under the ranking methodology noted above, and the order of completion of projects ahead of others, are all subject to the evaluation and professional judgment of NS Power staff and third party industry experts.

The tables that follow identify the projects included in the 2016 ACE Plan, their ranking category and ranking value where applicable.

Hydro – 2016 ACE Plan Capital Item Rankings

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
29807	HYD - Tusket Falls Main Dam	257,292	New	Health & Safety	5.00	4.00	20.00
44595	HYD - Hollow Bridge Canal and Intake Refurbishment	2,907,602	New	Health & Safety	4.00	4.00	16.00
46298	HYD Five Mile Lake Dam Refurbishment	1,793,260	New	Health & Safety	3.00	5.00	15.00
47397	HYD - Gisborne Dam D4 and Spillway S4 Refurbishment PE	1,669,320	New	Health & Safety	4.00	4.00	16.00
47396	HYD Nictaux Powerhouse Dam Refurbishment	1,437,731		Health & Safety	4.00	4.00	16.00
46254	HYD - Mill Lake Surge Tank Refurbishment	1,380,899	New	Business Sustainability	4.00	4.00	16.00
47172	HYD - Tidewater 1 Overhaul	962,136	New	Business Sustainability	4.00	5.00	20.00
47332	HYD - Methals Overhaul	1,216,083	New	Business Sustainability	4.00	5.00	20.00
47167	HYD - Sandy Lake Surge Tank Refurbishment	1,316,587	New	Business Sustainability	4.00	5.00	20.00
47551	HYD - SHH Controls Upgrade	524,406	New	Business Sustainability	3.00	5.00	15.00
48020	HYD - RUT3 Generator Refurbishment	774,422	New	Business Sustainability	4.00	5.00	20.00
47163	HYD - Tusket Controls Upgrade	472,153	New	Business Sustainability	3.00	5.00	15.00
47432	HYD - Ridge Overhaul	869,304	New	Health & Safety	3.00	5.00	15.00
47166	HYD - McAskill Brook Decommissioning	71,722	New	Business Sustainability	4.00	5.00	20.00

Steam – 2016 ACE Plan Capital Item Rankings

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
47658	LIN4 L-0 Blade Replacement	3,550,915	New	Business Sustainability	5.00	4.00	20.00
48157	TUC Auxiliary Boiler Purchase	2,822,565	New	Business Sustainability	4.00	5.00	20.00
47673	LIN4 Generator Rotor Rewind	2,602,159	New	Business Sustainability	5.00	4.00	20.00
47611	POT - Demolish Unit 1 Stack	1,732,346	New	Health & Safety	3.00	5.00	15.00
47552	TRE5 Boiler Refurbishment 2016	1,204,387	New	Business Sustainability	3.00	5.00	15.00
48018	TUC1 IP Blading Refurbishments	1,137,208	New	Business Sustainability	5.00	4.00	20.00
47755	LIN4 Turbine High Temperature Fasteners Replacement	1,073,877	New	Business Sustainability	3.00	5.00	15.00
47687	POT Boiler Chemical Recondition	855,348	New	Business Sustainability	4.00	4.00	16.00
47870	LIN Cofferdam Outer Cell Refurbishment	850,609	New	Business Sustainability	4.00	4.00	16.00
43170	LIN4 AVR Replacement	418,432	New	Business Sustainability	4.00	4.00	16.00
47911	TUC1 High Temperature Fastener Replacement	828,968	New	Business Sustainability	3.00	5.00	15.00
47657	LIN4 High Voltage Bushing Refurbishment	724,395	New	Business Sustainability	4.00	4.00	16.00
47505	LIN Coal Mill Refurbishment 2016	749,183	New	Business Sustainability	3.00	5.00	15.00
47661	POT - Asbestos management 2016	721,551	New	Health & Safety	5.00	3.00	15.00
47871	LIN Stack Re-Coating	707,696	New	Business Sustainability	3.00	5.00	15.00
46465	TUC2 Turbine Valve Refurbishment	651,362	New	Business Sustainability	4.00	4.00	16.00
47664	LIN4 Division Wall Replacement	619,243	New	Business Sustainability	3.00	5.00	15.00
47869	LIN4 Bottom Ash	616,599	New	Business Sustainability	3.00	5.00	15.00
47613	PHB - Boiler Refurbishment 2016	604,193	New	Business Sustainability	3.00	5.00	15.00
47666	LIN4 Boiler Refurbishment 2016	571,859	New	Business Sustainability	3.00	5.00	15.00
47663	LIN4 - SH5 Boiler Tube Replacement	538,776	New	Business Sustainability	3.00	5.00	15.00
46352	TRE5 Air Heater Refurbishments	530,139	New	Business Sustainability	3.00	5.00	15.00

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
47689	LIN4 - Air Heater Refurbishment	521,951	New	Business Sustainability	3.00	5.00	15.00
47761	LIN1 Boiler Refurbishment	506,845	New	Business Sustainability	3.00	5.00	15.00
47953	LIN Rail Car Positioner Upgrade	507,812	New	Business Sustainability	3.00	5.00	15.00
47554	TRE5 5-1 FD Fan Refurbishment	494,802	New	Business Sustainability	4.00	4.00	16.00
41505	TRE5 - 5F Conveyor Structural Refurbishment	484,801	New	Business Sustainability	4.00	4.00	16.00
47872	LIN E Gallery Structural Steel Protective Coating	481,492	New	Business Sustainability	3.00	5.00	15.00
47690	LIN4 Burner Front Refurbishment	480,349	New	Business Sustainability	3.00	5.00	15.00
47555	TRE5 Coal System Upgrades	414,085	New	Business Sustainability	5.00	3.00	15.00
47507	LIN CW Pump Rebuild 2016	441,560	New	Business Sustainability	4.00	4.00	16.00
47762	LIN4 Analytical Panel Replacement	401,658	New	Business Sustainability	4.00	4.00	16.00
47510	LIN Coal Plant Structural Refurbishment Phase 2	359,425	New	Health & Safety	4.00	4.00	16.00
47506	LIN CW Screen Refurbishment 2016	349,743	New	Business Sustainability	3.00	5.00	15.00
47961	LIN1 Condenser Tube Coating	333,944	New	Business Sustainability	3.00	5.00	15.00
47662	POT Coal Mill Overhauls 2016	324,874	New	Business Sustainability	3.00	5.00	15.00
47704	POT - Replace Polisher Chemical Skid	321,950	New	Business Sustainability	3.00	5.00	15.00
47617	TRE6 Elevator Controls Upgrade	320,704	New	Health & Safety	5.00	3.00	15.00
47893	TUC3 Generator Hydrogen Panel Upgrade	301,806	New	Business Sustainability	5.00	3.00	15.00
47614	PHB - Fuel System Refurbishment 2016	296,556	New	Business Sustainability	3.00	5.00	15.00
47668	POT - Plant Siding 2016	287,926	New	Health & Safety	3.00	5.00	15.00
47945	TUC Electrode-ionization (EDI) Unit Replacement	275,154	New	Business Sustainability	3.00	5.00	15.00
47596	TRE6 ID Fan Damper Upgrades	272,239	New	Business Sustainability	4.00	4.00	16.00
47894	TUC2 Boiler Nat Gas Ignitors	244,362	New	Business Sustainability	3.00	5.00	15.00
47868	LIN Stack Lighting Replacement	241,895	New	Business Sustainability	3.00	5.00	15.00

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
47719	POT - Unit 2 Boiler Refurbishment 2016	240,083	New	Business Sustainability	3.00	5.00	15.00
41664	TRE5 Precip Refurbishment	239,816	New	Environment	4.00	5.00	20.00
47933	LIN4 Turbine Vibration Monitoring Upgrade	238,216	New	Business Sustainability	3.00	5.00	15.00
47874	LIN Ash Scale Replacement	237,241	New	Business Sustainability	3.00	5.00	15.00
47895	TUC3 Lube Oil Purifier Upgrade	234,808	New	Business Sustainability	4.00	4.00	16.00
47867	LIN Bunker Chute Sealing Phase 2	225,956	New	Business Sustainability	3.00	5.00	15.00
47947	TUC6 Condenser Waterbox Coating	225,210	New	Business Sustainability	3.00	5.00	15.00
47692	POT - Fire system upgrades 2016	224,304	New	Health & Safety	5.00	3.00	15.00
47498	LIN - Crusher & Dumper Building Fire System Refurbishment	222,648	New	Health & Safety	5.00	3.00	15.00
45176	ICP - Pier Belting	221,043	New	Business Sustainability	3.00	5.00	15.00
47635	TRE Facilities Upgrades	219,301	New	Business Sustainability	3.00	5.00	15.00
47875	LIN PF Line Replacement	214,575	New	Business Sustainability	4.00	4.00	16.00
47896	TUC2 Main Steam Piping Weld Replacement (Creep Damage)	214,384	New	Business Sustainability	5.00	3.00	15.00
47897	TUC 4kV/600V Breaker Replacements	210,845	New	Business Sustainability	3.00	5.00	15.00
47898	TUC Asbestos Abatement	209,234	New	Health & Safety	5.00	3.00	15.00
47701	POT - Lab upgrades phase 3	207,803	New	Business Sustainability	3.00	5.00	15.00
46358	TRE5 Burner Refurbishments	207,190	New	Business Sustainability	3.00	5.00	15.00
47863	LIN4 Turbine Valves Refurbishment	204,548	New	Business Sustainability	4.00	4.00	16.00
47865	LIN Heavy Oil Suction Line Replacement Phase 1	201,870	New	Business Sustainability	3.00	5.00	15.00
47960	LIN1 Control Valve Rebuild	197,976	New	Business Sustainability	4.00	4.00	16.00
43386	POT - LP dosing automation	195,807	New	Business Sustainability	3.00	5.00	15.00
47593	TRE Sodium Bisulphite Injection System	194,093	New	Business Sustainability	3.00	5.00	15.00
46419	POT - Bay door replacements	193,523	New	Business Sustainability	3.00	5.00	15.00

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
46371	POT - Refurbish 4160KV motors	183,270	New	Business Sustainability	3.00	5.00	15.00
47892	TUC1 Turbine Valves	184,092	New	Business Sustainability	4.00	4.00	16.00
22410	TRE5 5-1 Condensate Extraction Pump Refurbishment	180,956	New	Business Sustainability	4.00	4.00	16.00
43429	TRE5 Lube Oil Cooler Retube	178,666	New	Business Sustainability	4.00	4.00	16.00
47599	TRE5 5-4 Mill Refurbishments	176,181	New	Business Sustainability	4.00	4.00	16.00
47839	ICP Locomotive Truck Refurbishment 2016	173,116	New	Business Sustainability	3.00	5.00	15.00
47703	POT - Replace DCS servers	172,078	New	Business Sustainability	3.00	5.00	15.00
47899	TUC1 TSE/Data Management Upgrades	171,599	New	Business Sustainability	3.00	5.00	15.00
43239	LIN4 BFP Proportional Recirculation Line Control	158,524	New	Business Sustainability	3.00	5.00	15.00
47676	POT Expansion joint replacements	158,506	New	Business Sustainability	3.00	5.00	15.00
47901	TUC Bailey Control Valves' Replacement	158,479	New	Business Sustainability	3.00	5.00	15.00
47497	LIN - Flyash Transport Air Compressor Replacement	158,439	New	Business Sustainability	3.00	5.00	15.00
47606	TRE5 Sootblower Controls Replacement	158,399	New	Business Sustainability	3.00	5.00	15.00
47602	TRE Oil Forwarding Pump Area Fire Protection	157,172	New	Business Sustainability	5.00	3.00	15.00
47900	TUC1 MgOH Powder System Upgrade	156,145	New	Business Sustainability	3.00	5.00	15.00
47866	LIN4 Condenser Tube Protective Coating	156,043	New	Business Sustainability	3.00	5.00	15.00
47600	TRE Asbestos Abatement (2016)	154,303	New	Health & Safety	5.00	3.00	15.00
47688	POT - Refurbish condensate extraction pump	154,069	New	Business Sustainability	4.00	4.00	16.00
47702	POT - Wastewater Treatment Plant chemical system refurbishment	153,313	New	Business Sustainability	3.00	5.00	15.00
47963	LIN Waster Water Stand Pipe Refurbishment	152,065	New	Business Sustainability	3.00	5.00	15.00
47601	TRE Ash Site Management (2016)	145,235	New	Environment	3.00	5.00	15.00
44357	LIN 3 4 Stack Cap Refurbishment	135,801	New	Business Sustainability	3.00	5.00	15.00
47835	ICP May St. Crossing Signal House Replacement	125,796	New	Business Sustainability	3.00	5.00	15.00

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
28249	POT Structural Steel Refurbishment on South ID fan and Precipitator ductwork steel	125,179	New	Business Sustainability	3.00	5.00	15.00
47955	LIN4 ID FAN Shaft Refurbishment	124,952	New	Business Sustainability	4.00	4.00	16.00
47832	ICP Rail Center Roof Refurbishment	124,807	New	Business Sustainability	3.00	5.00	15.00
47605	TRE Carbon Sulphur Analyzer Replacement	124,788	New	Business Sustainability	3.00	5.00	15.00
47836	ICP Ranger Belt Conveyor Structural Refurbishment	118,713	New	Business Sustainability	3.00	5.00	15.00
47508	LIN Coal System Guard Upgrade Phase 2	114,493	New	Health & Safety	5.00	4.00	20.00
47607	TRE5 Common Water Piping Replacements	106,858	New	Business Sustainability	3.00	5.00	15.00
47904	TUC3 Vacuum Pump Refurbiushment	105,695	New	Business Sustainability	3.00	5.00	15.00
47674	POT - Circulating Water Pumphouse Motor Control Center Refurbishment351	104,836	New	Business Sustainability	3.00	5.00	15.00
47642	TRE6 Feeder Controls Upgrade	104,734	New	Business Sustainability	3.00	5.00	15.00
47864	LIN 4160V and 600V Breaker Refur.	104,343	New	Business Sustainability	3.00	5.00	15.00
46426	TRE6 Fly Ash Compressor Replacement	103,868	New	Business Sustainability	3.00	5.00	15.00
47873	LIN Plant Communications Upgrade	102,250	New	Health & Safety	5.00	3.00	15.00
47504	LIN Facilities Upgrade	100,667	New	Business Sustainability	3.00	5.00	15.00
43407	TRE5 Cable Rooms Fire Protection	99,011	New	Health & Safety	5.00	3.00	15.00
46495	TUC3 - DCS Upgrade	89,617	New	Business Sustainability	3.00	5.00	15.00
47838	ICP Pier Fire Detection	89,537	New	Health & Safety	5.00	3.00	15.00
47903	TUC2 Lube Oil Coolers' Inlet/Outlet Waterbox Replacement	87,877	New	Business Sustainability	4.00	4.00	16.00
47645	TRE6 6B Instr Air Compressor Replacement	86,196	New	Business Sustainability	3.00	5.00	15.00
47501	LIN Boiler Fill Pump Suction Line Replacement	84,499	New	Business Sustainability	3.00	5.00	15.00
47707	POT - Replace D belt and refurbish frames and rollers	83,822	New	Business Sustainability	3.00	5.00	15.00
47708	POT - Vacuum cleaning system upgrade	77,847	New	Business Sustainability	3.00	5.00	15.00
42944	TUC3 - Boiler Drum North PSV Replacement	75,132	New	Business Sustainability	4.00	5.00	20.00

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
47499	LIN Precip Fire Detection Upgrade	60,752	New	Health & Safety	5.00	3.00	15.00
47710	POT - Replace selected Polisher valves and solenoid panel	57,840	New	Business Sustainability	3.00	5.00	15.00
47709	POT - Replace raw water flow meter	57,117	New	Business Sustainability	3.00	5.00	15.00
48014	TUC DC Battery Bank Replacement	55,524	New	Business Sustainability	5.00	3.00	15.00
47907	TUC6 Vacuum Pumps' Seal Water Cooler Upgrade	55,068	New	Business Sustainability	3.00	5.00	15.00
47909	TUC Nat Gas Valves Refurbishment	54,855	New	Business Sustainability	3.00	5.00	15.00
47905	TUC1 Chimney Access Infrastructure Refurbishment	54,313	New	Business Sustainability	5.00	3.00	15.00
47906	TUC6 Arc Flash Relays	53,881	New	Health & Safety	5.00	3.00	15.00
47615	PHB - HVAC System Upgrades	52,511	New	Business Sustainability	3.00	5.00	15.00
47503	LIN Propane Skid Steer Tractor Replacement	48,811	New	Business Sustainability	3.00	5.00	15.00
47711	POT - PI interface to DCS	46,863	New	Business Sustainability	3.00	5.00	15.00
47647	TRE5 4kV Switch Gear Room Fire Protection	45,544	New	Business Sustainability	5.00	3.00	15.00
47646	TRE5 Relay Room Fire Protection	44,564	New	Health & Safety	5.00	3.00	15.00
47837	ICP Rail Center Fire System Water Supply	42,462	New	Health & Safety	5.00	3.00	15.00

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1 *Combustion Turbine – 2016 ACE Plan Capital Item Rankings*

2

CI	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
44775	TUC#4 LM6000 Generator Stator Re-wedge	1,586,056	New	Business Sustainability	4.00	5.00	20.00
46191	Tusket Fuel System Upgrade	606,082	New	Business Sustainability	3.00	5.00	15.00
44788	BGT1 Vibration Monitoring & Protection System Upgrade	252,674	New	Business Sustainability	3.00	5.00	15.00
29065	CT - BGT Replace Halon Fire Protection System	229,422	New	Health & Safety	5.00	4.00	20.00
47812	BGT Fuel Tank 3 Refurbishment	147,059	New	Business Sustainability	3.00	5.00	15.00
47941	TUC4 LM6000 Enclosure Protective Coating	66,126	New	Business Sustainability	3.00	5.00	15.00
47942	TUC5 LM6000 Enclosure Protective Coating	66,126	New	Business Sustainability	3.00	5.00	15.00
47944	TUC4 LM6000 Higgot Kane Crack Repair	33,063	New	Business Sustainability	4.00	4.00	16.00
47939	TUC4 LM6000 Replace all SS Tubing and Fittings	20,000	New	Business Sustainability	3.00	5.00	15.00
47940	TUC5 LM6000 Replace all SS Tubing and Fittings	20,000	New	Business Sustainability	3.00	5.00	15.00

3

1 **Transmission & Distribution**

2

3 *Transmission and Distribution – 2016 ACE Plan Capital Item Rankings*

4

FP / CI Number	Project Title	2016 ACE Budget	Project Type	Ranking Category	Criticality	Condition	Ranking
Transmission Capital Items Included in 2016 ACE Plan							
48066	2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program	2,160,890	New	Environment	5.0	4.0	20.0
46587	Metro Voltage Support Add Capacitor	2,960,916	New	Business Sustainability	4.0	5.0	20.0
46757	88S Lingan 230kV BPS Upgrades	265,641	New	Business Sustainability	4.0	5.0	20.0
46811	2H Armdale Transformer Addition	1,292,601	New	Business Sustainability	4.0	4.0	16.0
47950	L5017 Replacements & Upgrades	1,175,785	New	Business Sustainability	4.0	5.0	20.0
44981	2C Port Hastings Add 138-25kV Transformer	548,727	New	Business Sustainability	4.0	5.0	20.0
48061	New Mobile Substation, 69-25/12-kV, 6MVA	173,005	New	Business Sustainability	4.0	4.0	16.0
47952	L-7001 Replacements (Phase 3 & 4)	1,617,933	New	Business Sustainability	4.0	5.0	20.0
48114	2016 Steel Tower Life Extension - HRM	503,696	New	Business Sustainability	4.0	4.0	16.0
47914	L-6537 Replacements and Upgrades	744,025	New	Business Sustainability	4.0	5.0	20.0
47935	L5040 Replacements	668,692	New	Business Sustainability	4.0	4.0	16.0
47949	L-5028 Replacements and Upgrades	598,866	New	Business Sustainability	4.0	5.0	20.0
47912	L-6552 Replacements and Upgrades	1,054,326	New	Business Sustainability	4.0	5.0	20.0
48113	2016 Steel Tower Refurbishment	960,453	New	Business Sustainability	4.0	4.0	16.0
48059	2016/2017 Transmission Switch & Breaker Replacements	470,933	New	Business Sustainability	4.0	5.0	20.0
48116	2016 Sacrificial Anode Installation Program	452,034	New	Business Sustainability	4.0	4.0	16.0
48067	2016 Oil Containment Program	245,199	New	Business Sustainability	4.0	4.0	16.0
48025	L7018 Upgrade to 345kV & Capacitor Bank Addition	1,982,135	New	Business Sustainability	4.0	5.0	20.0
41519	Harbour East 138 kV Transmission Line	2,120,250	New	Business Sustainability	4.0	5.0	20.0
48063	2016/2017 Capacitor Bank Breaker Replacements	199,159	New	Business Sustainability	4.0	4.0	16.0

48062	2016/2017 Reactor Breaker Replacements	201,038	New	Business Sustainability	4.0	4.0	16.0
43678	Separate L8004/L7005 on Canso Crossing Double Circuit Tower(DCT)	270,900	New	Business Sustainability	5.0	5.0	25.0
48022	Spider Lake Substation Addition	1,093,651	New	Business Sustainability	4.0	5.0	20.0
48024	90H - Sackville: Capacitor Bank Addition & L-6010/L6005 Breaker Upgrades	794,131	New	Business Sustainability	4.0	5.0	20.0
48023	103H - Lakeside: Capacitor Bank Additions & L-6003 Breaker Upgrades	794,131	New	Business Sustainability	4.0	5.0	20.0
48154	L5527 Reconductor	297,828	New	Business Sustainability	4.0	5.0	20.0
43268	9W-B53 Tusket Replace Supporting Structure	354,151	New	Business Sustainability	4.0	5.0	20.0
48151	2016 Insulator Replacement Program	244,828	New	Business Sustainability	4.0	4.0	16.0
48111	East Switch Upgrades 15S	122,220	New	Business Sustainability	4.0	4.0	16.0
48156	East Switch Upgrades 58C	122,220	New	Business Sustainability	4.0	4.0	16.0
48112	11W King Street Substation Retirement	91,927	New	Business Sustainability	4.0	4.0	16.0
48026	L-6033/L6035 CT Ratio Changes at 1H - Water St.	50,372	New	Business Sustainability	4.0	5.0	20.0
Distribution Capital Items Included in 2016 ACE Plan							
47721	2016 PCB Phase-out for Pole Top Transformers	2,562,582	New	Environment	5.0	4.0	20.0
48093	2016 Padmount Replacement Program	1,761,336	New	Business Sustainability	4.0	4.0	16.0
47760	85S-402 Re-Insulate	387,024	New	Business Sustainability	4.0	4.0	16.0
47776	111S Prime Brook Feeder Exits & Feeders	1,474,738	New	Business Sustainability	4.0	4.0	16.0
47787	2H Armdale New Feeder	451,838	New	Business Sustainability	4.0	4.0	16.0
44749	Tiverton Tower Refurbishment	880,250	New	Business Sustainability	4.0	5.0	20.0
47753	24C-442GB Highway 16 Reconductor Phase 2	669,565	New	Business Sustainability	4.0	5.0	20.0
47784	103H-Lakeside Feeder Reconfiguration	579,868	New	Business Sustainability	4.0	4.0	16.0
47752	4S-333 Bentinck St. Rebuild	575,357	New	Business Sustainability	4.0	4.0	16.0
48092	2016 Substation Recloser Replacements	529,270	New	Business Sustainability	4.0	4.0	16.0
47765	58C-405 Belle Cote Phase 2	477,154	New	Business Sustainability	4.0	4.0	16.0
47766	70V-302 Centerlea Rebuild	456,314	New	Business Sustainability	3.0	5.0	15.0

47734	1C-411 Highway 4 Reconductor	437,410	New	Business Sustainability	4.0	4.0	16.0
47792	Distribution Automation Remote Communications	378,666	New	Business Sustainability	4.0	4.0	16.0
48152	20H-Spryfield Voltage Conversion Phase II	375,848	New	Business Sustainability	4.0	4.0	16.0
47732	131H-424/137H-412 Hammonds Plains Feeder Tie	337,133	New	Business Sustainability	4.0	4.0	16.0
47403	Load Research Sample Update	286,872	New	Business Sustainability	3.0	5.0	15.0
47786	129H Kearney Lake New Feeder	311,817	New	Business Sustainability	4.0	4.0	16.0
47754	63V-313 Ward Rd Reconductor	308,994	New	Business Sustainability	4.0	4.0	16.0
48195	Halifax 4kV Conversion Ph 3	249,336	New	Business Sustainability	4.0	4.0	16.0
47756	36V-303 Reconductor Middle Dyke Rd	226,303	New	Business Sustainability	4.0	5.0	20.0
47775	67C/58C Inverness Transfer Scheme	141,564	New	Business Sustainability	4.0	4.0	16.0
47777	70W-321 Wiles Lake Road	122,264	New	Business Sustainability	3.0	5.0	15.0
47774	546C-311 West Bay Upgrade	81,516	New	Business Sustainability	4.0	4.0	16.0

General Plant – Capital Item Rankings

The projects brought forward under General Plant primarily involve information technology, telecommunications, and facilities initiatives. These areas are too diverse to develop a comparable and useful ranking system across the groups, and therefore the determination of whether a project will proceed is based upon technical justifications or economic benefit.

8.1.5 2016 to 2020 Forecasted ACE Plan Expenditures by Functional Class and Spending Program

Pursuant to 2011 ACE Plan Directive 12, NS Power provides its forecasted spend by functional class and spending program. NS Power does not anticipate a significant change in the investment level for projects under $250,000 or the Routine program from 2016 to 2020. Justifications for projects determined as capital investments are scoped on an annual basis. Capital investment on the basis of health and safety, environmental compliance and requirement to serve remains non-discretionary. The following table identifies anticipated sustaining capital by function and specific notable investments included in this ACE Plan.

Investment levels from 2016 to 2020 are subject to change based on operating conditions, updated asset assessments, regulatory directives, or legislation.

Sustaining capital funding levels represent typical annual investment by function in a given year to sustain the integrity of existing assets. Notable capital projections reflect specific projects. Included in these specific projects are strategic multi-year program investments and asset growth.

	2016 ACE	2017	2018	2019	2020
Base Capital Investment ($M)					
Thermal Generation	53.3	51.2	49.8	46.5	44.1
Combustion Turbines	9.5	8.0	8.5	5.5	8.0
Hydro Generation	29.1	25.0	22.6	23.0	23.5
Wind Generation	0.1	0.1	0.1	0.1	0.1
Transmission	49.2	57.3	58.3	52.3	53.4
Distribution	63.2	62.1	63.3	61.5	62.7
General Plant	44.0	36.2	30.6	27.8	27.1
Total Base Capital Expenditure ($M)	**248.4**	**239.9**	**233.2**	**216.8**	**218.9**
Notable Capital Investment ($M)					
Thermal:					
Lingan Unit #4 Major Outage	13.0				
General Plant:					
IT - CIS Replacement	0.0	3.0	9.0	9.0	4.0
Replace Mobile Radio System	0.0	4.0	3.7	2.6	
Distribution:					
Automated Metering Infrastructure	7.0	38.0	30.0	25.0	
LED Streetlights	4.7	4.9	5.0	3.0	
Transmission:					
Maritime Link Transmission	0.8	18.5	6.3		
Metro Transmission Upgrades*	4.7	28.9			
Lingan GIS Replacement	1.4	5.8	6.9		
Hydro:					
Hydro Infrastructural Renewal					
Wreck Cove Overhaul			60.0		
Annapolis Overhaul			8.0		
Mersey Re-Development		3.0	20.0	40.0	40.0
Total Notable Capital ($M)	**31.5**	**106.1**	**148.9**	**79.6**	**44.0**

	2016 ACE	2017	2018	2019	2020
Total Annual Capital Investment ($M)	**279.9**	**346.0**	**382.1**	**296.4**	**262.9**

*Includes Capital Items 48022, 48023, 48024 & 48025 in Section 2.3 and Capital Item 48026 in Section 2.4

8.1.6 Routine Expenditures

Pursuant to Directive 2 of the UARB's 2013 ACE Plan Decision, NS Power was directed "to analyze the routine expenditures to determine what are the "like-for-like" totals", and "explain why those totals, if they are similar in magnitude to the Board's analysis, are growing at an annual rate in excess of inflation."

A summary of NS Power's total routine and like-for-like routine spending is provided below:

ANNUAL COST OF LIKE-FOR-LIKE ROUTINE REPLACEMENTS

NOVA SCOTIA POWER ($M)	2012 Actual	2013 Actual	2014 Actuals	2015 Forecast	2016 ACE Plan
Total Routine Spending	$74.9	$66.8	$68.2	$70.6	$82.0
Less:					
New Customers	24.2	20.6	20.9	22.7	21.5
System Growth and Performance	3.0	3.0	2.0	2.2	10.6
Other	1.3	1.3	0.7	1.1	1.3
Like-for-Like	46.4	41.8	44.6	44.6	48.6
Work Vehicles (Like-for-like)	5.6	2.7	2.4	6.3	7.0
Net (Like-for-like)	40.8	39.1	42.1	38.3	41.7

*Point Aconi amounts have been removed in order to reflect the spend totals that require UARB approval.

As can be seen in the table above, like-for-like spending has remained relatively stable over the last several years. NS Power's forecast for 2016 is also consistent with this routine spending trend.

Routine classifications are determined by the primary classification of each routine project. If the majority of the work completed under the routine is like-for-like replacements, the routine was classified as like-for-like. New Customer routines, System Growth and Performance routines (such as heat rate, system improvement and right-of-way widening routines) and other routines (such as joint use and environmental assessment routines) were not included in the like-for-like totals.

NS Power addresses reactive items within routines by using the professional judgment of its personnel to assess the urgency of each job. At an overall routine level, NS Power actively evaluates and prioritizes work in order to manage costs within budget. Each month, NS Power monitors the activities within the routines to evaluate whether the work is necessary.

8.1.7 Impact of Reliability Projects

The UARB's 2013 ACE Plan decision Directive 14 stated:

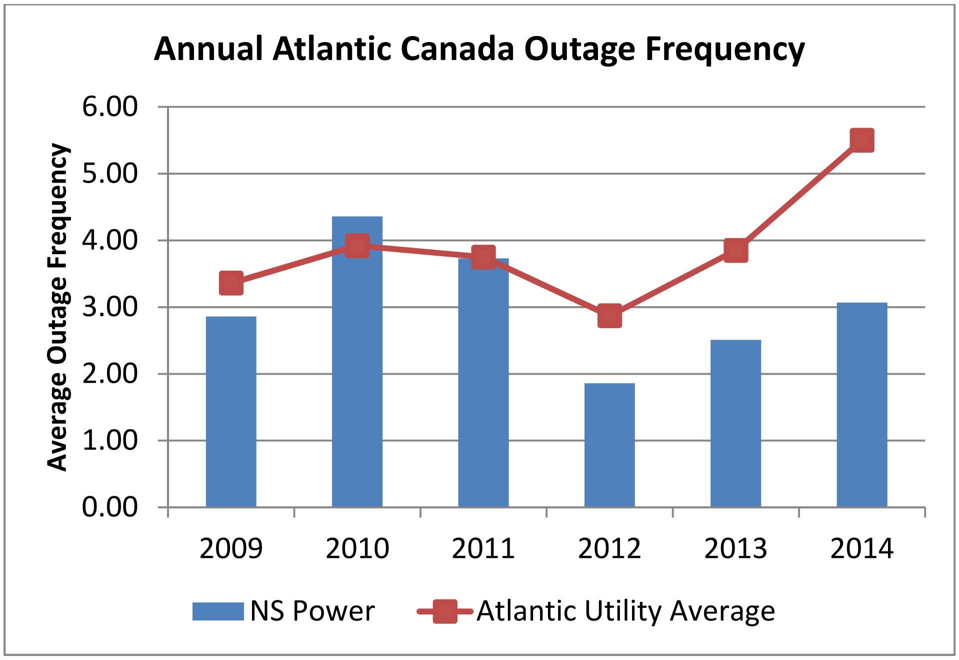
> …the Board expects NSPI to monitor the impact of the deferral of reliability projects in the original 2013 ACE Plan closely and to provide a report on the results in the next ACE Plan.[17]

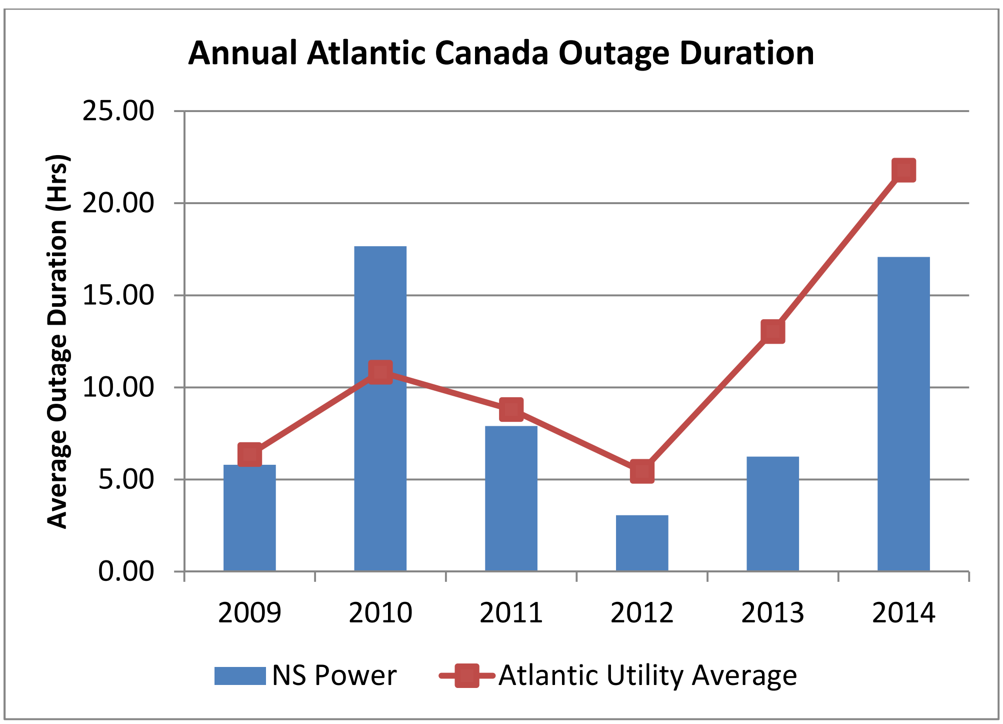
Due to the events of Post Tropical Storm Arthur in early July 2014 and following discussion with Board staff, it was considered appropriate to provide this directive in the 2015 ACE Plan. Pursuant to NS Power's commitment noted in the 2015 ACE Plan Terms of Consensus, this directive is expanded upon in this year's ACE Plan to include additional information regarding continued investments in reliability.

Reliability Statistics

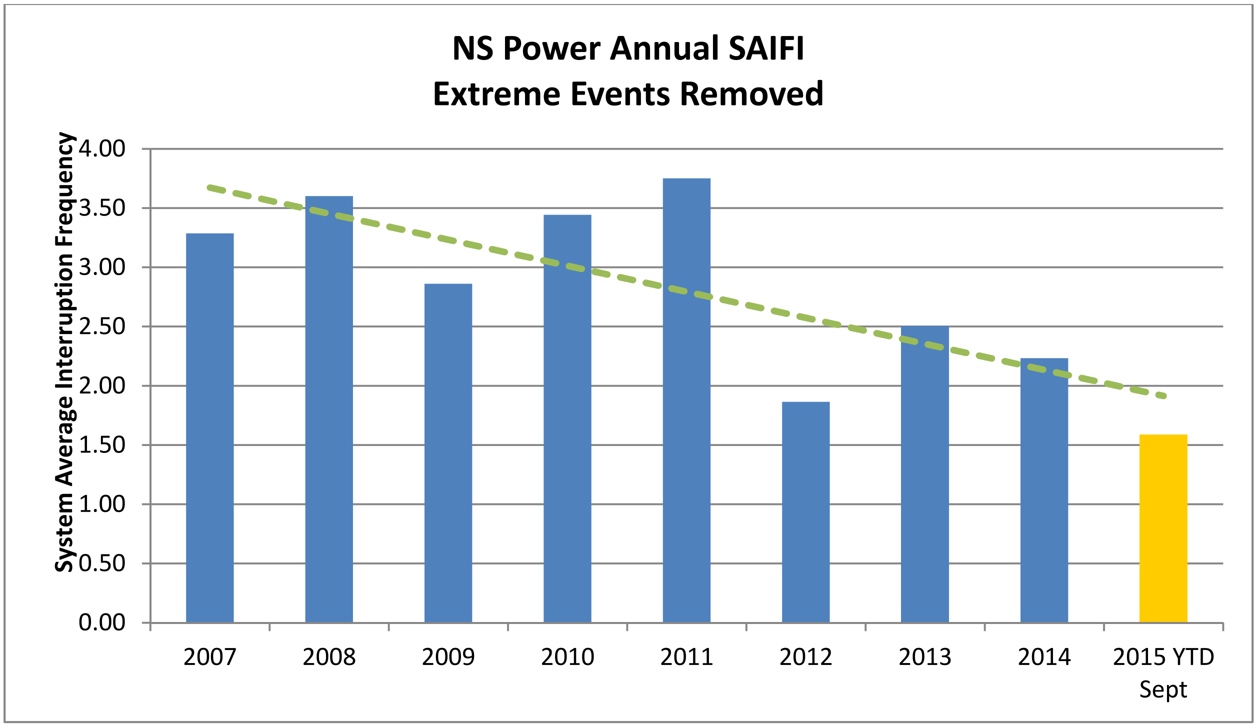
In 2012 and 2013 NS Power experienced its best reliability results in recent years. As shown in the charts below, NS Power's annual outage frequency and duration continues to be better than the average of Atlantic Canada utilities. The data for 2014 is higher due to Post Tropical Storm Arthur, but NS Power is still below the average of the Atlantic Canadian utilities, as reported to the CEA.

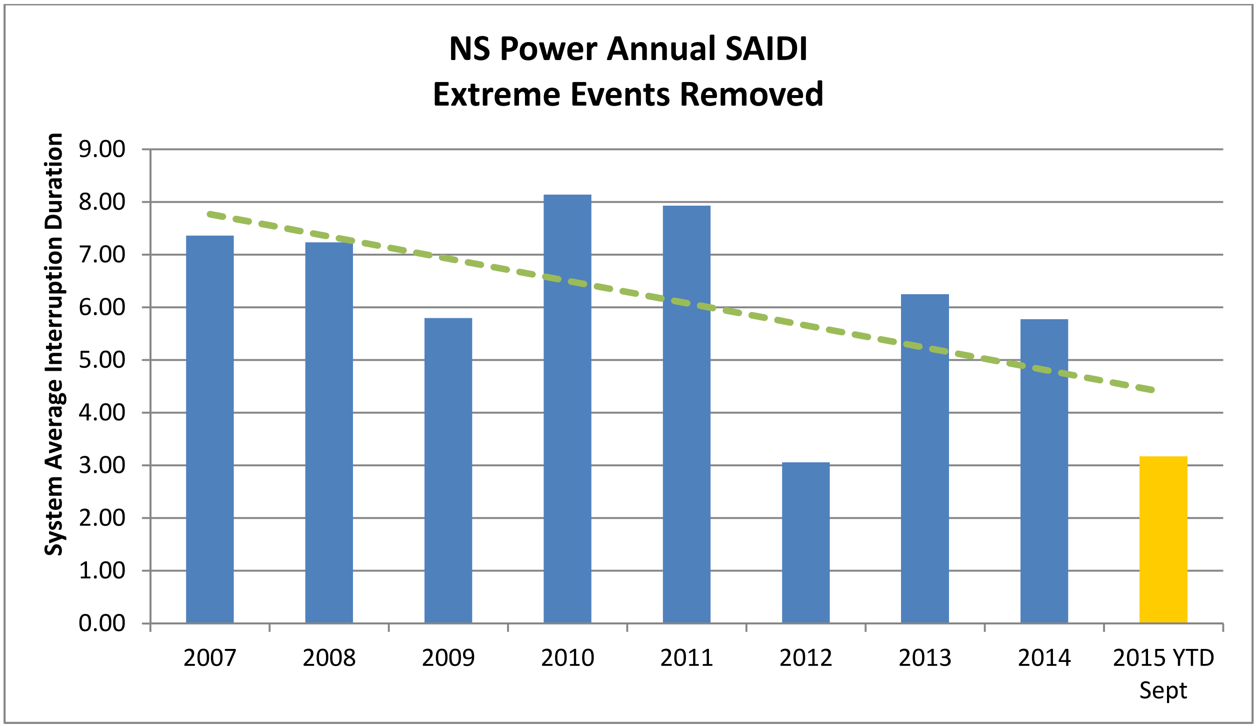
[17] NS Power 2013 ACE Plan, Decision, M05339, May 27, 2013, page 44, line 174.


Annual Atlantic Canada Outage Frequency
Average Outage Frequency
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2009
2010
2011
2012
2013
2014
NS Power
Atlantic Utility Average

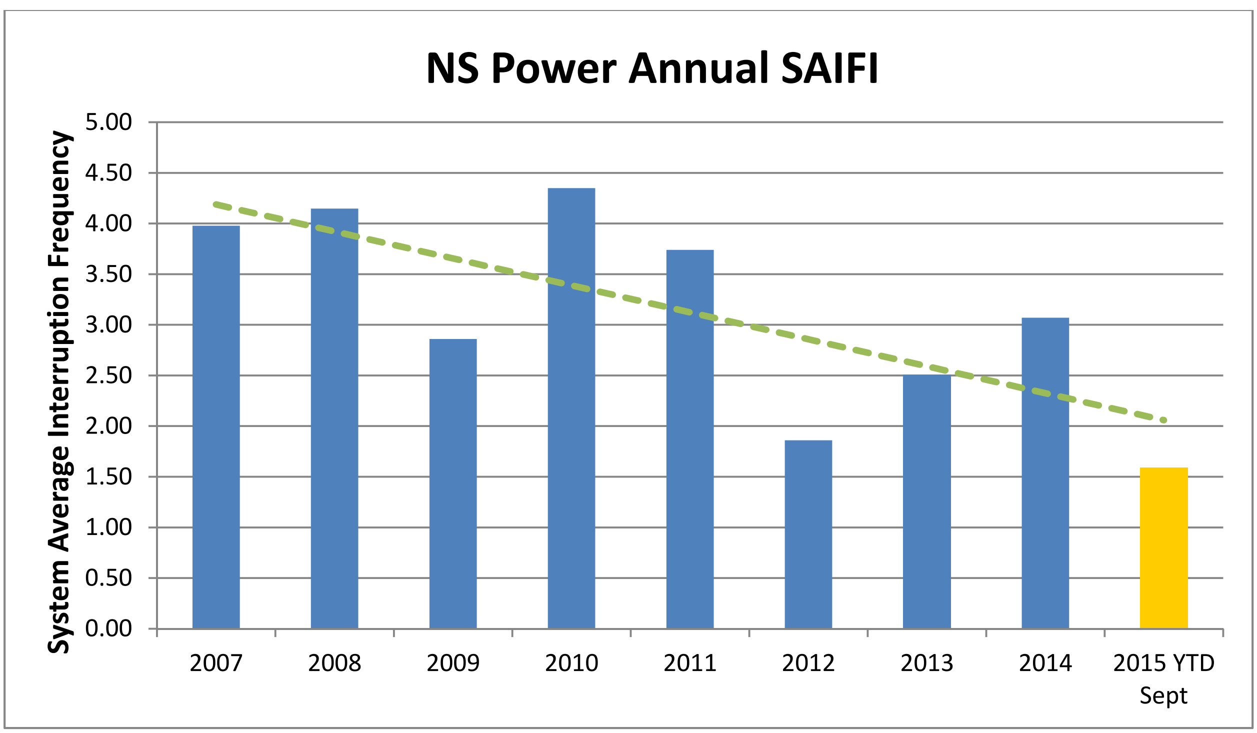

Annual Atlantic Canada Outage Duration
Average Outage Duration (Hrs)
25.00
20.00
15.00
10.00
5.00
0.00
2009
2010
2011
2012
2013
2014
NS Power
Atlantic Utility Average

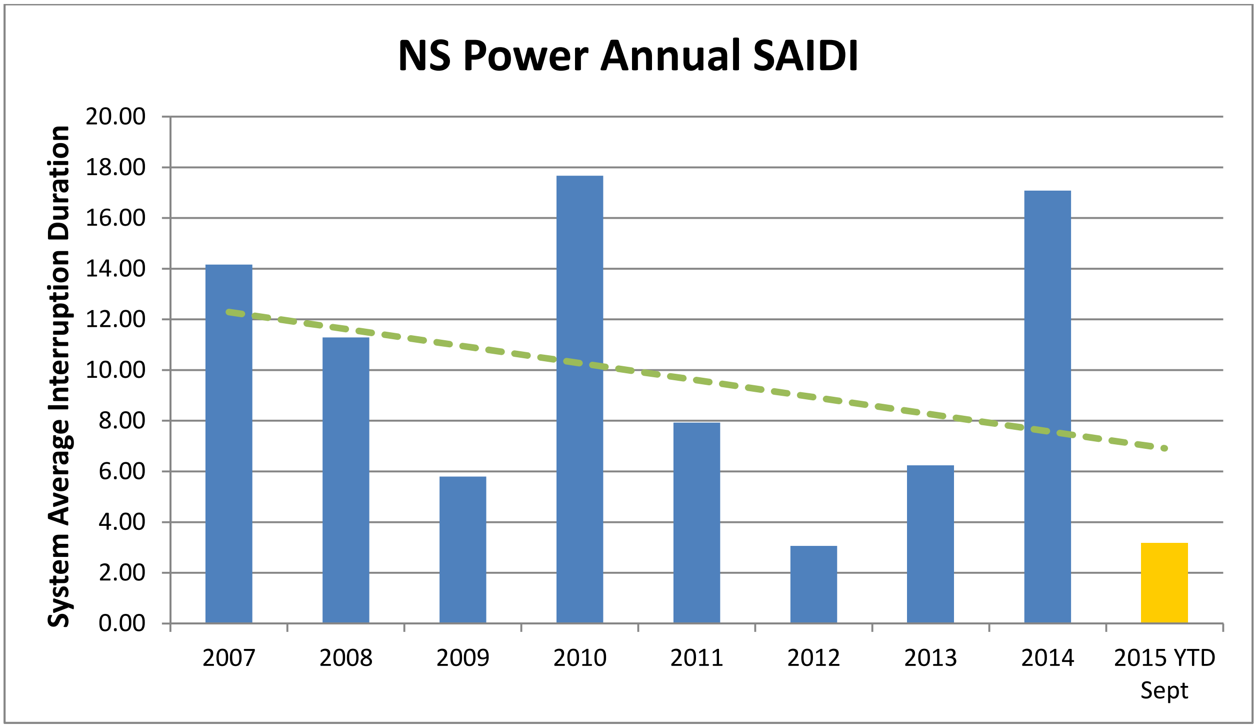
The two charts below represent NS Power's reliability statistics with Extreme Events (such as Post-Tropical Storm Arthur) removed from the data. This shows a normalized comparison between yearly performance and the trend shows reliability improvements for customers.





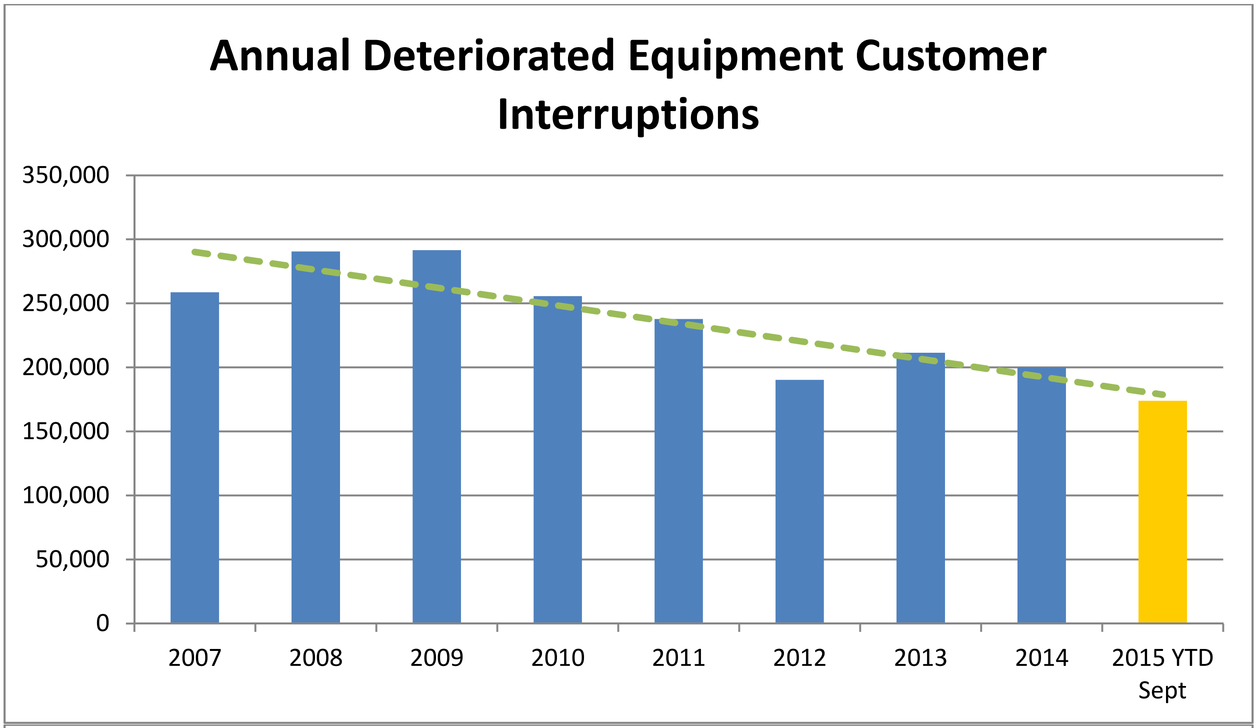
The following charts represent NS Power's reliability statistics with Extreme Events included.

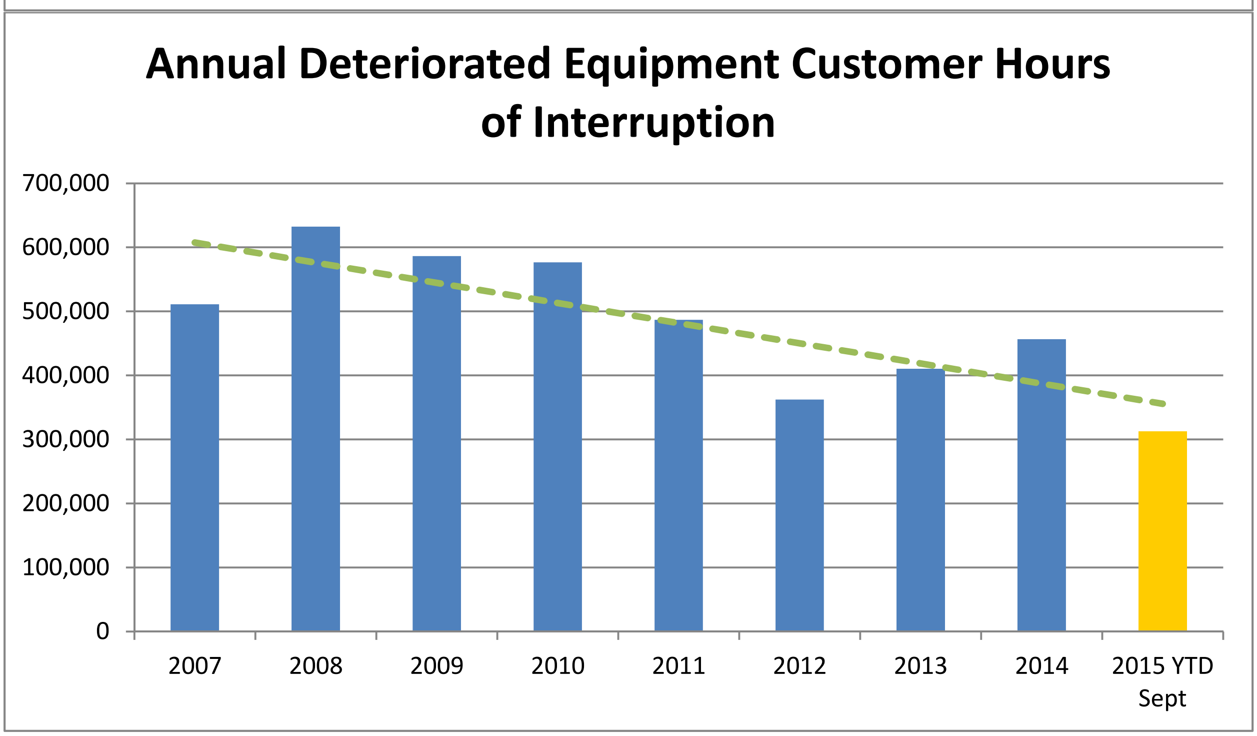




Historically, the two leading causes of NS Power customer outages for all days (storm and non-storm) are Deteriorated Equipment and Tree Contacts. These cause categories and NS Power's associated investments are described in more detail below.

The following two charts demonstrate reliability gains realized through upgrades and replacements of targeted distribution equipment. There has been a steady improvement in both customer interruptions and customer hours of interruption due to deteriorated equipment.





Taking a further look into the 2014 reliability data, deteriorated equipment outages can be classified by type. This is shown in the table below.

Device Failed	2014 Customer Hours of Interruption	% of Hours
Primary Conductor	108,452	24%
Pin Insulator	85,312	19%
Cutout	54,863	12%
Pin Hardware	47,223	10%
Tie Wire	36,058	8%
Jumper	18,417	4%
Polemount Transformer	11,709	3%

The following 2016 capital projects directly impact the equipment failures referenced in the table above.

Routine Programs:

- D005 Unplanned Replace Deteriorated Distribution Equipment
- D055 Planned Replacement of Distribution Equipment - This program includes multiple reconductor, rebuild, reinsulate and replacement projects.

Special Capital - Rebuild (address multiple issues and overall line performance):

- CI 47766 70V-312G Centerlea Rebuild
- CI 47756 36V-303 Reconductor and Structure Replacements
- CI 47752 4S-333 Bentinck Street Rebuild
- CI 45031 3N Oxford Conversation Phase 1
- CI 47773 3N Oxford Conversation Phase 2
- CI 47765 Belle Cote Phase 2
- CI 47774 546C-311 Upgrade
- CI 46456 11W Yarmouth 4kV Conversion

Special Capital - Pin Insulator:

- CI 47760 Re-Insulate Wreck Cove to Indian Brook

Special Capital - Primary Conductor:

- CI 47734 1C-411 Reconductor
- CI 47754 63V-313G Ward Rd Reconductor
- CI 43177103W-311 Gold River Reconductor
- CI 47777 70W-321G Reconductor and Structure Replacements
- CI 47753 24C-442GB Highway 16 Reconductor PH2

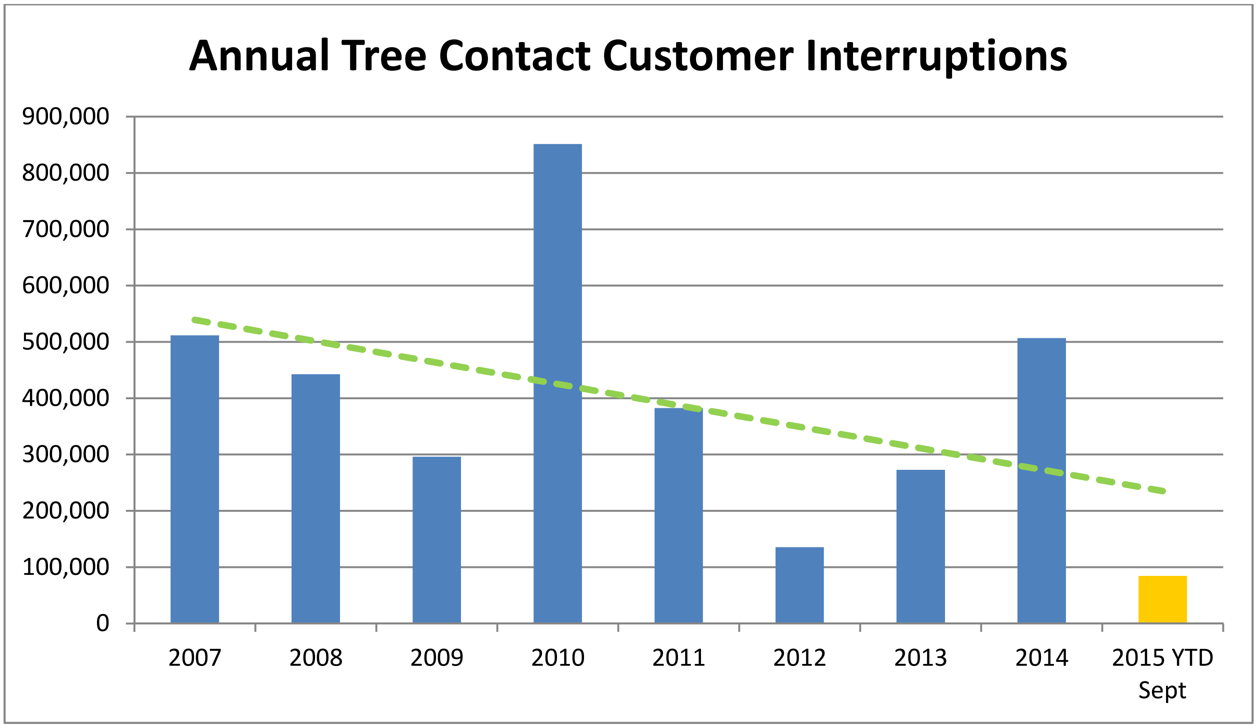
Special Capital - Recloser:

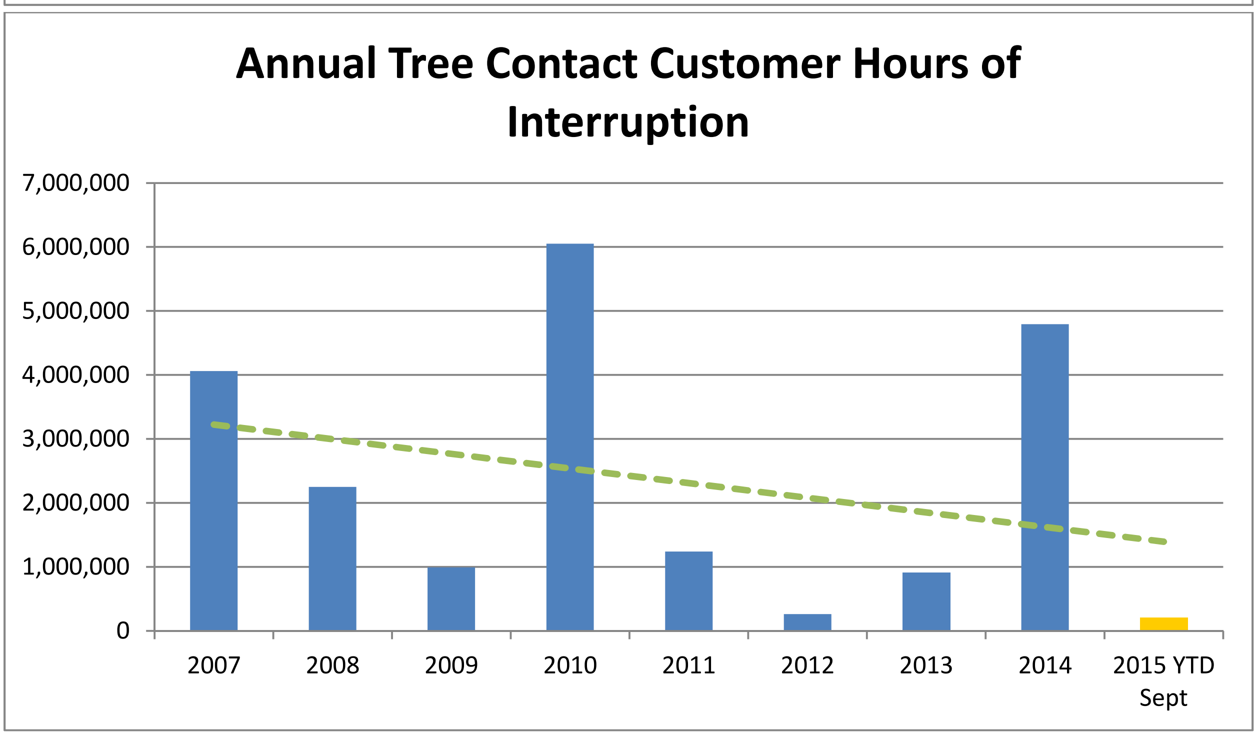
- CI 45003 2015 Hydraulic Recloser Replacements

Special Capital - Underground Primary Cable:

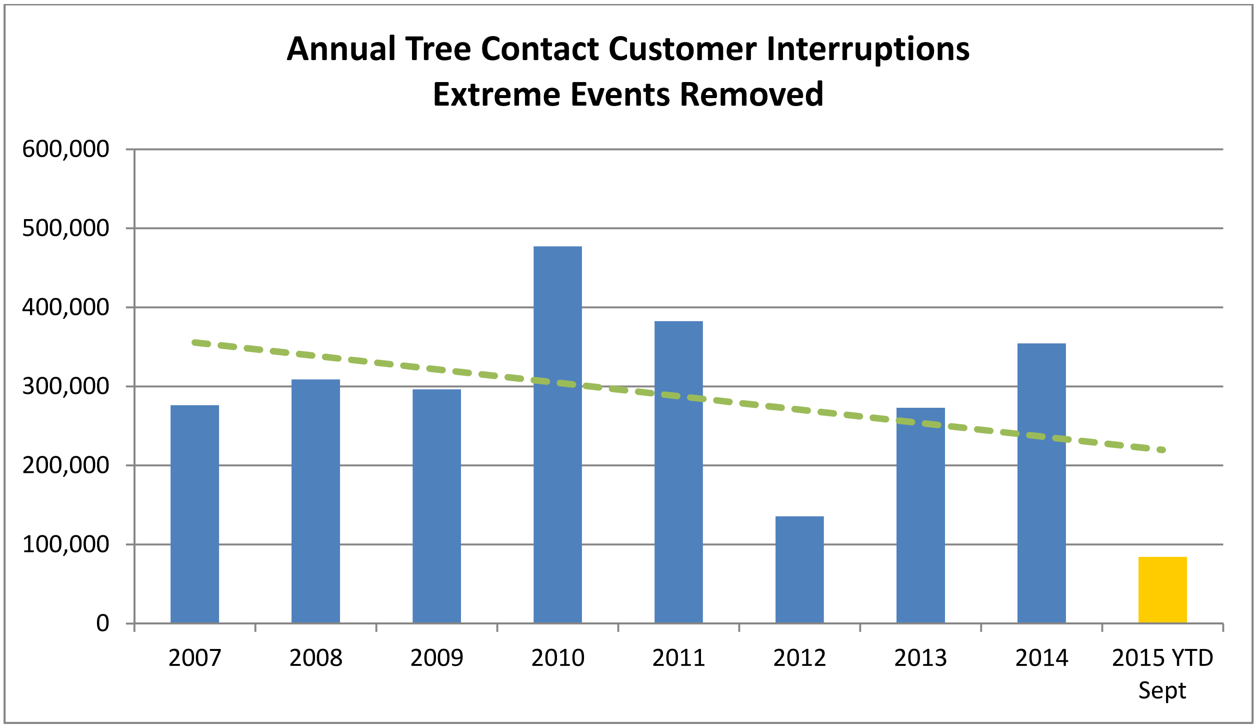
- CI 41383 Halifax UG Feeder Cable Replacement
- CI 47787 Armdale New Feeders

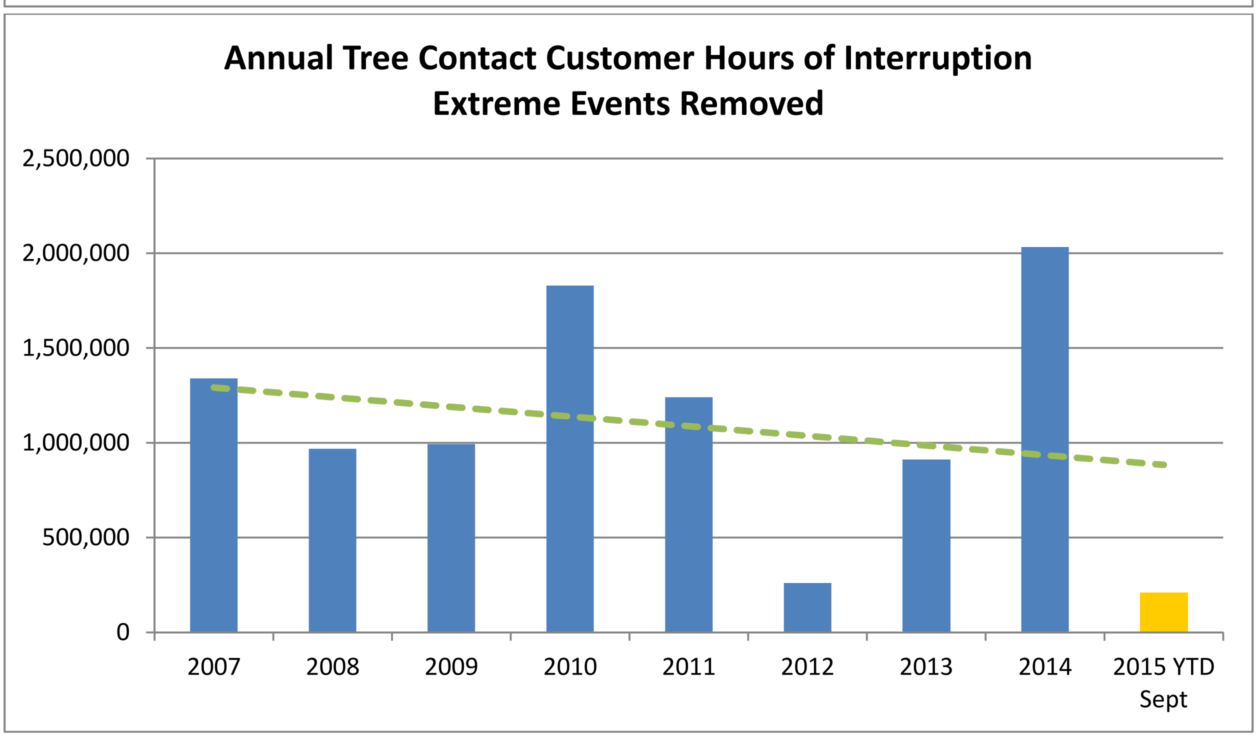
The following two charts demonstrate both customer interruptions and customer hours of interruption due to tree contacts. As can be seen in these charts, in 2014 Post Tropical Storm Arthur has had the greatest effect on tree contact caused interruptions.





The two charts below show the data normalized with Extreme Events removed. With Extreme Events (such as Post Tropical Storm Arthur) removed, in the years 2010 and 2014 the data demonstrates the vegetation effects of major storms and their impact for months following the storm event. There were also 14 storm days in 2014 (not including Post Tropical Storm Arthur), compared to 2015 that has only experienced 3 storm days to date.





In a continued effort to minimize storm effects and overall reliability, NS Power has proposed capital spending in the following routines in 2016 for Transmission and Distribution to address vegetation management. These targeted capital investments for managing vegetation aim to minimize outage frequency and duration, while seeking to improve access to the system.

- D010 Distribution Right of Way Widening
- T010 Transmission Right of Way Widening

<u>Plans for Replacement of Aging T&D Equipment & Storm Performance</u>

The 2015 ACE Plan Terms of Consensus included two commitments with respect to reliability:

(4) As part of the reliability directive in future ACE Plans, NS Power will provide additional information regarding its plans for replacement of aging transmission and distribution equipment in accordance with the following recommendation on this matter made by the SBA's consultant, Mary Neal, at page 12 of her evidence in this proceeding dated January 16, 2015:

> "I recommend NSPI provide more information regarding its plans for replacement of aging transmission and distribution equipment to better show how it justified the target investments. This should include (where possible):
>
> - Descriptions of assets to be replaced and their ages,
> - Goals for strategic replacement programs, such as targets for age profiles of different asset classes,
> - Expected improvements in asset age profiles due to each ACE Plan project involving replacement of transmission and distribution equipment considered at end-of-life,
> - More detailed descriptions of how NSPI targets specific assets every year, whether based on age, performance degradation, or other factors, and
> - Any recent, relevant inspection data."

(5) As part of the reliability directive in future ACE Plans, NS Power will provide an update on its storm performance and related capital investment strategies to improve storm performance.[18]

The Terms of Consensus were approved by the UARB on May 5, 2015. These are addressed below.

Plans for Replacement of Aging Transmission and Distribution Equipment

Notwithstanding the effects of Post Tropical Storm Arthur in 2014, the multi-year Reliability Investment Strategy has resulted in a step-change towards improved reliability for NS Power customers. NS Power continually monitors outages and performance of transmission, substation and distribution assets, and future investments will continue at an appropriate level to ensure affordable and reliable service. To sustain these reliability performance improvements, NS Power is implementing asset management principles to prioritize investments in T&D plant.

These asset management principles follow existing project ranking principals of utilizing condition and criticality to determine replacement rankings for asset classes.[19] These asset management principals will also deploy replacement targets to reduce the overall risk for the asset class.

Annual estimated replacement targets developed based on asset age profiles and the Iowa Survivor curves for equipment failure are used to reduce the overall risk for each asset class. While the suitable investments for a specific asset class may vary from year to year depending on system performance, the estimated replacements analysis provides a working range in which to evaluate the appropriateness of proposed sustaining capital investments.

NS Power uses a variety of factors to determine the specific assets targeted for replacement as part of the annual capital investment program. Generally, targeted assets have experienced degradation in performance manifesting in decreased reliability, increased maintenance frequency and cost, or reduced functionality. These effects are identified through reliability

[18] NS Power 2015 ACE Plan, Terms of Consensus Agreement, M06514/P-128.15, February 18, 2015, page 2.
[19] Per the revised CEJC, submitted to the UARB on June 30, 2015.

tracking, field inspections, and test results of the impacted assets. Considerations such as criticality of the asset to continued operations of the NS Power system and any risks posed to people and the environment can also play a role in determining specific assets for replacement.

Asset age is a concern when the frequency of required maintenance is increased, the availability of replacement parts or critical spares is limited, or performance is negatively impacted. This information can be used to inform project prioritization. However, age profiles are used in concert with asset condition, performance, and legislated requirements; it is never the single determining element in an investment decision. Capital project justifications outline the reasoning behind a given replacement program considering all relevant elements.

In 2014, NS Power embarked on further formalizing the identification and prioritization of assets for replacement by creating a regimented framework to determine the condition, criticality, and risk individual assets within a given class pose to the NS Power system. While the risk score of an asset does not determine its suitability for replacement alone, it can aid in identifying assets requiring more detailed investigation by technical experts and subsequent mitigation activities.

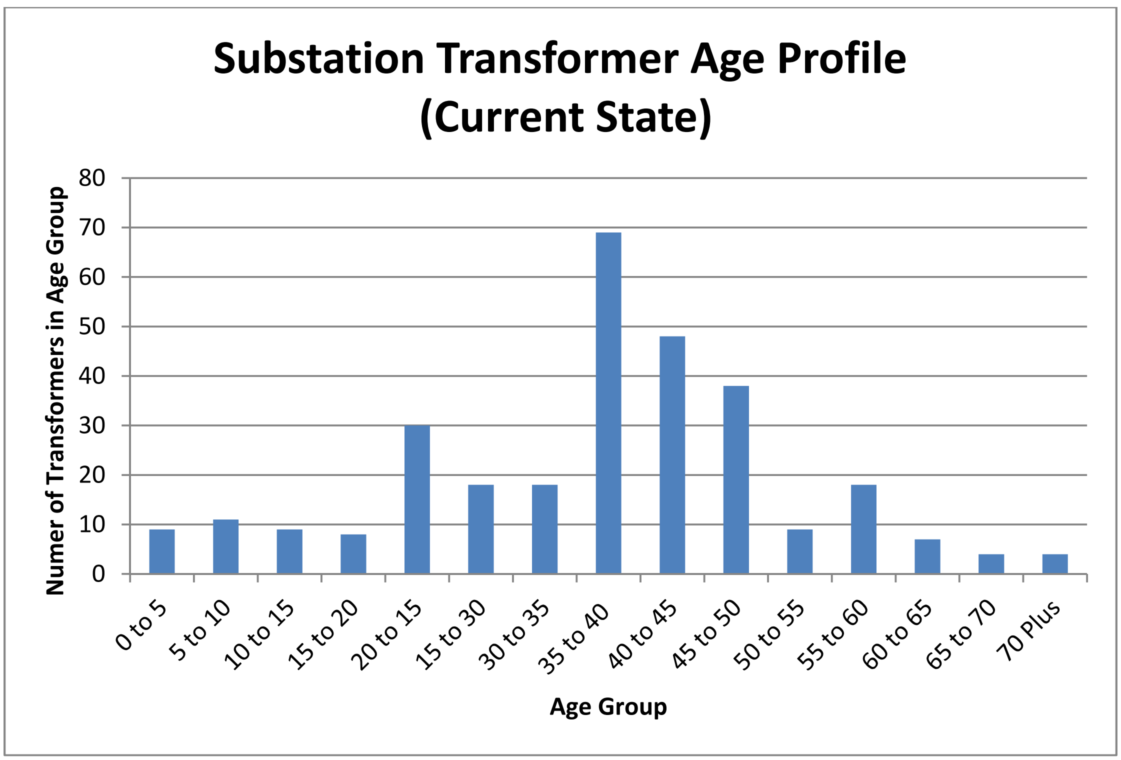
The target ranges for T&D assets covered by this analysis is provided in the table below.

		High Band Replacements		Low Band Replacements	
Asset Classification	**Quantity on Grid**	**Estimated Useful Life**	**Annual Replacements**	**Estimated Useful Life**	**Annual Replacements**
Distribution Conductor (km)	42,078	45	935	55	765
Distribution Structure	483,160	50	5,798	60	4,832
Transmission Structures	28,239	55	513	65	434
Pole Top Transformer	134,240	35	3,835	45	2,983
Substation Transformer	315	50	6	60	5
Transmission Conductor (km)	5,196	55	94	65	80
Breakers	548	45	12	55	10
Padmount Transformers	3,541	35	101	45	79
Underground Conductor (km)	745	45	17	55	14

Age demographics information is presently not available for all transmission and distribution asset classes. Substation Transformers, Substation Breakers, Transmission Conductor and Padmount Transformers are assets classes where this information is available at this time. As asset information improves for individual asset classes, their age profiles provide a more complete picture of the current state across the T&D system.

As T&D equipment reaches end-of-life, capital investments are used to mitigate impacts related to aging infrastructure. This ultimately results in an overall positive shift in age profile towards a younger equipment fleet. This effect is reflected in the change of age profiles for the four T&D asset classes described in the following sections.

Substation Transformers

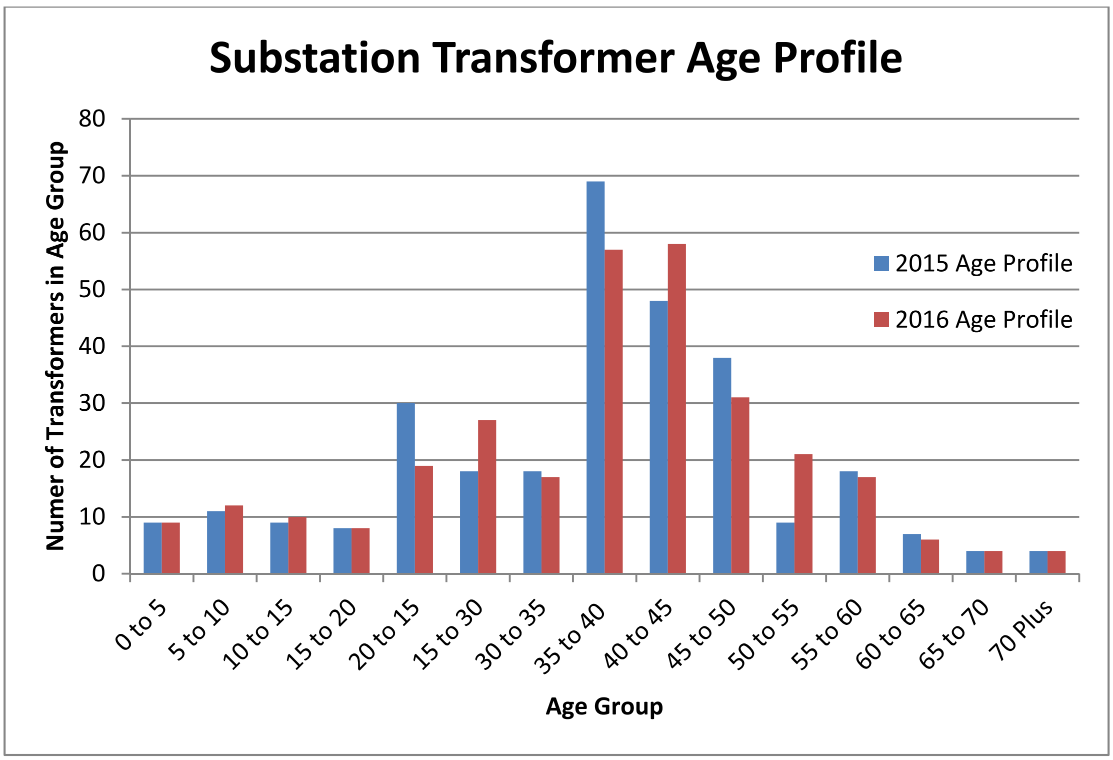


- Expected useful life of 50-60 years depending on the transformer type, loading, and environmental conditions.

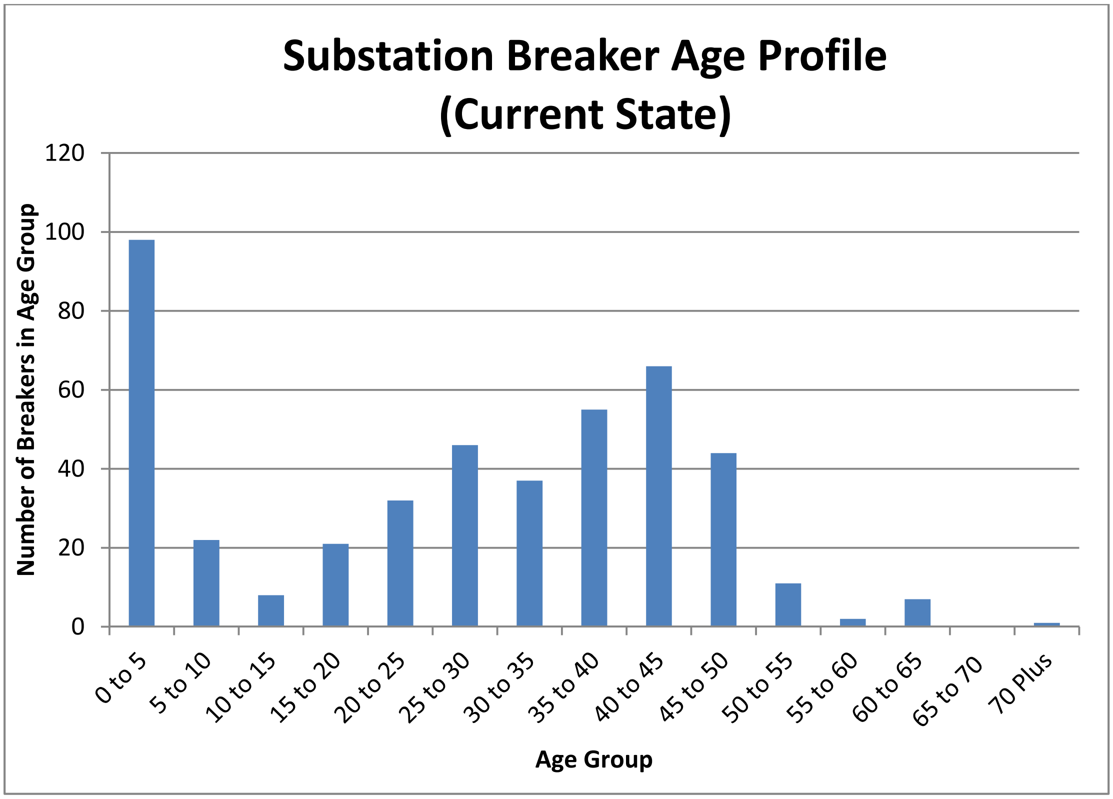
- Age Demographics – 11% of transformers are beyond 50 years of service.

- Targeted number of replacements – 5 to 6 units per year.

- Improvements to age demographics – As a result of the proposed capital investments in substation transformers during 2016, the age profile for this asset class will experience an approximately 6% reduction in assets beyond 55 years of age. The following graph illustrates the overall change in asset age profile for Substation Transformers between 2015 and 2016.



Substation Breakers

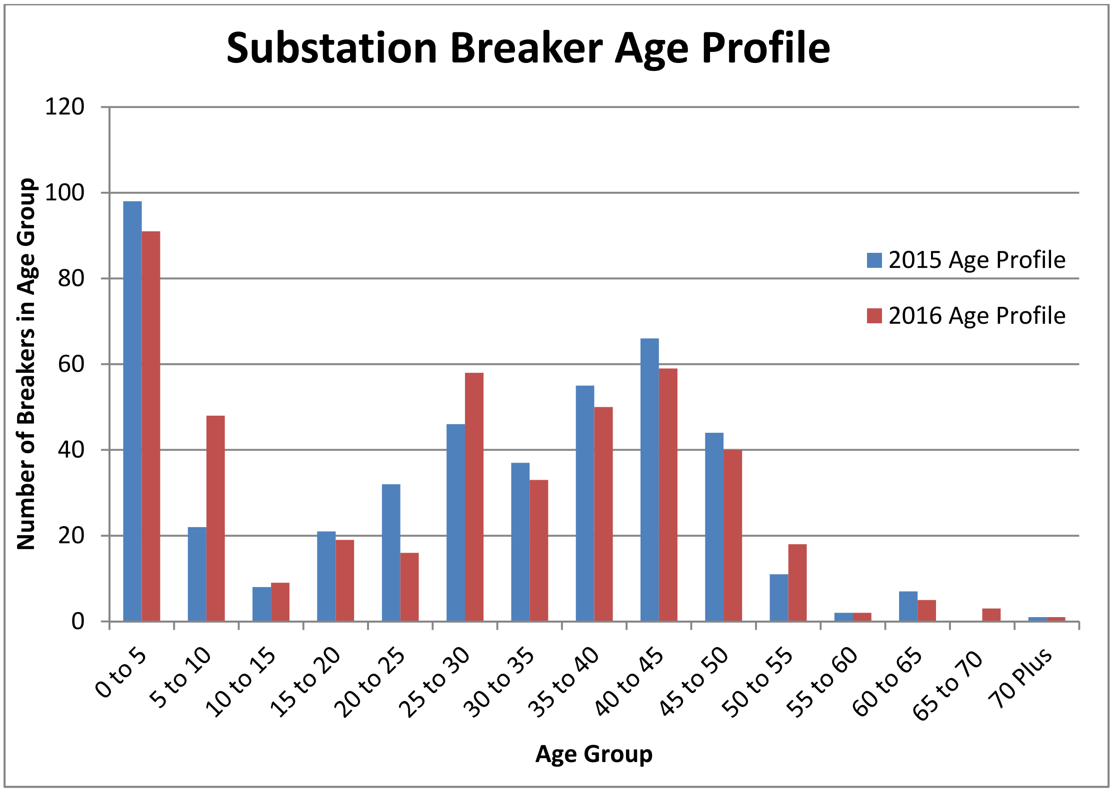


- Expected useful life of 45-55 years depending on the breaker type, operations count, and environmental conditions.

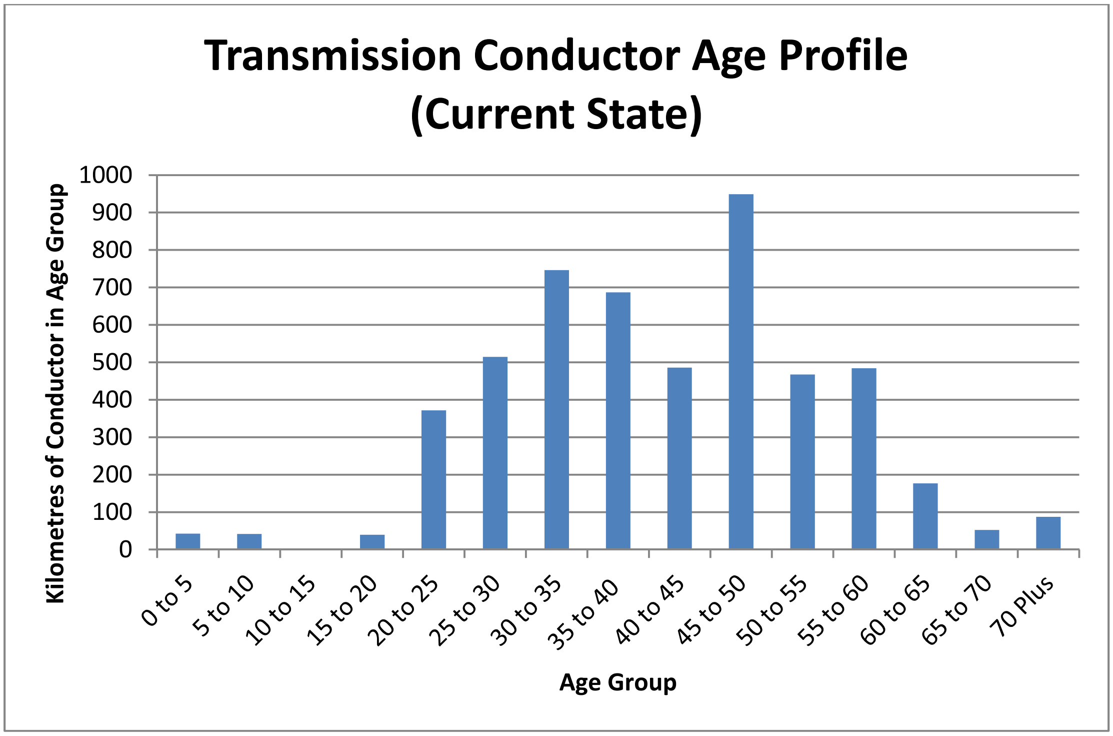
- Age Demographics – 15% of breakers are beyond 45 years of service.

- Targeted number of replacements – 10 to 12 units per year.

- Improvements to age demographics – As a result of the proposed capital investments in Substation Breakers during 2016, the age profile for this asset class will experience an approximately 2.5% reduction in assets beyond 40 years of age. The following graph illustrates the overall change in asset age profile for Substation Breakers between 2015 and 2016.


Substation Breaker Age Profile
Number of Breakers in Age Group
120
100
80
60
40
20
0
2015 Age Profile
2016 Age Profile
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 35
35 to 40
40 to 45
45 to 50
50 to 55
55 to 60
60 to 65
65 to 70
70 Plus
Age Group

Transmission Conductor

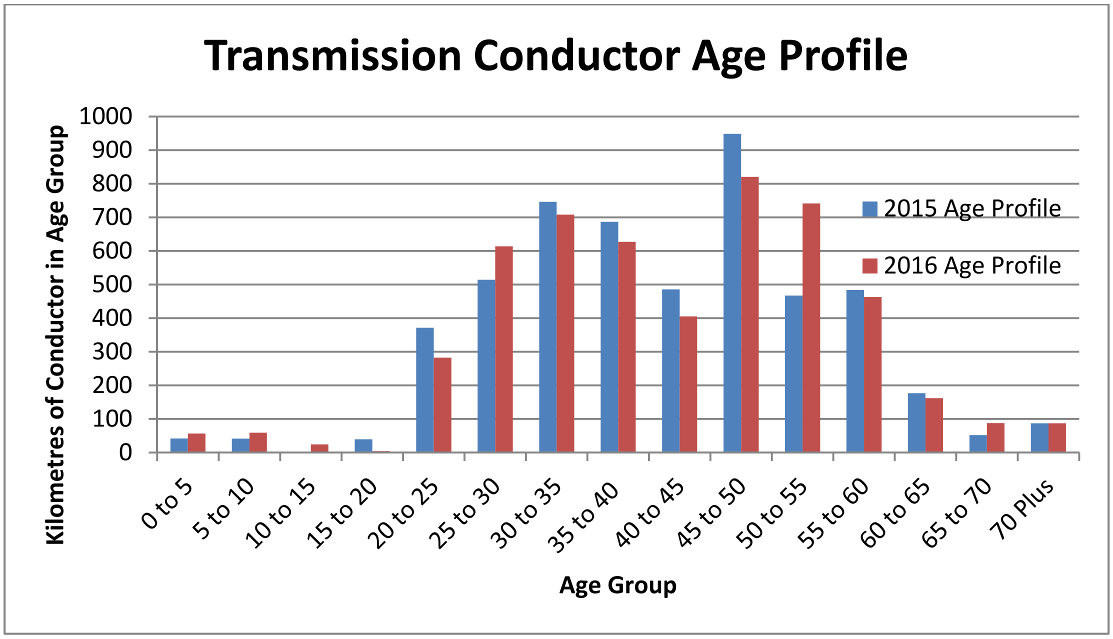


- Expected useful life of 55-65 years depending on the conductor design and environmental conditions.

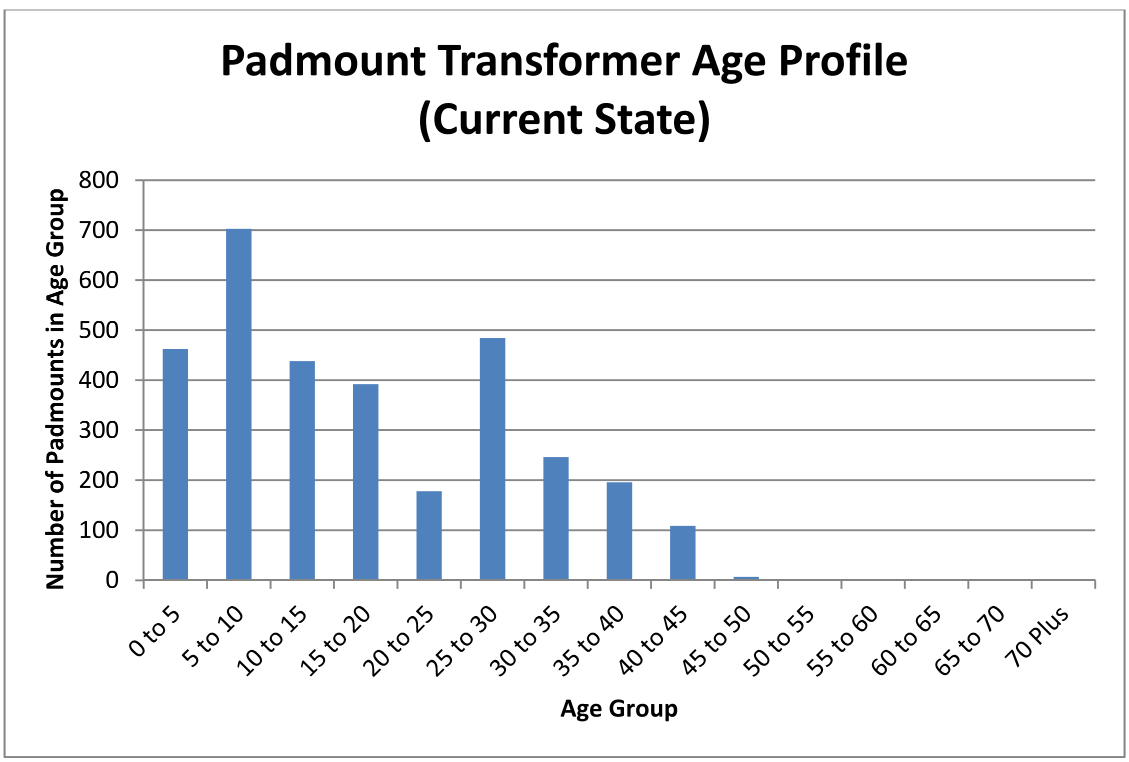
- Age Demographics – 14% of conductor is beyond 55 years of service.

- Targeted number of replacements – 80 to 94 km per year.

- Improvements to age demographics – As a result of the proposed capital investments in Transmission Conductor during 2016, the age profile for this asset class will experience an approximately 1% reduction in assets beyond 30 years of age. The following graph illustrates the overall change in asset age profile for Transmission Conductor between 2015 and 2016.



Padmount Transformers

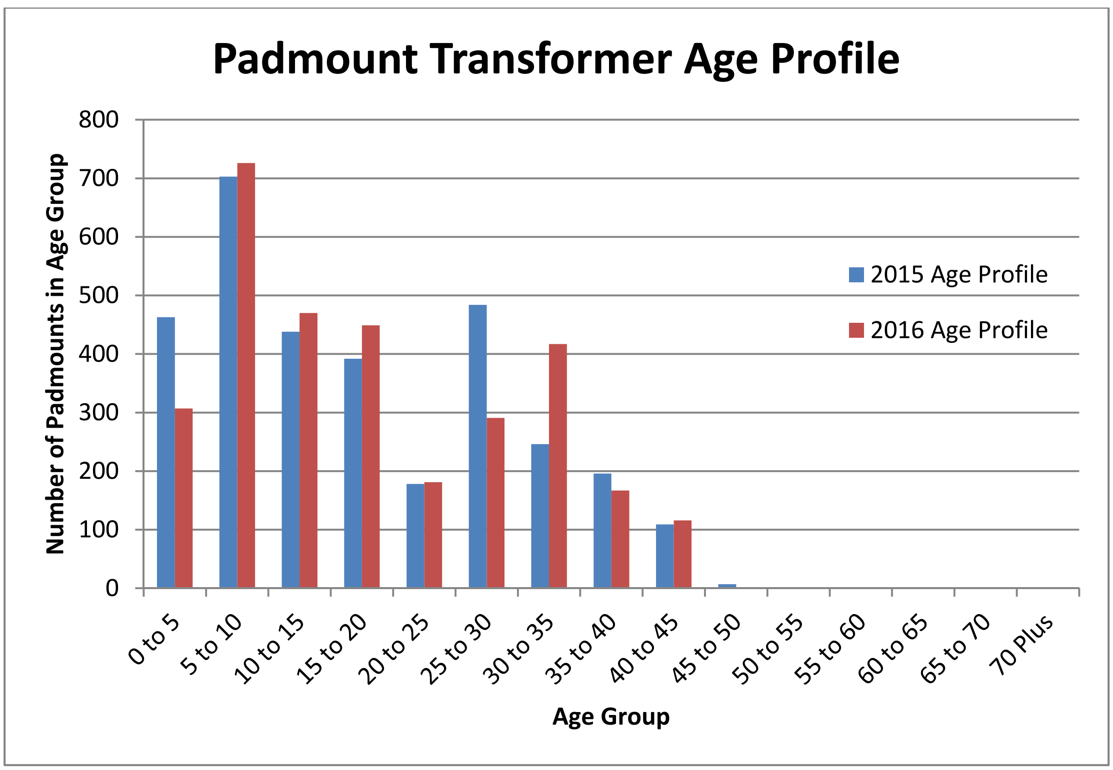


- Expected useful life of 35-45 years depending on the padmount design, loading, and environmental conditions.

- Age Demographics – 4% of padmounts are beyond 35 years of service.

- Targeted number of replacements – 79 to 101 per year.

- Improvements to age demographics – As a result of the proposed capital investments in Padmount Transformers during 2016, the age profile for this asset class will experience an approximately 5% reduction in assets beyond 25 years of age. The following graph illustrates the overall change in asset age profile for Padmount Transformers between 2015 and 2016.



Update on storm performance and related capital investments

The impact of storms varies storm-to-storm and year-to-year. The wind speeds, rainfalls, time of year, time of day and weather forecast accuracy all contribute to a storm's impact.

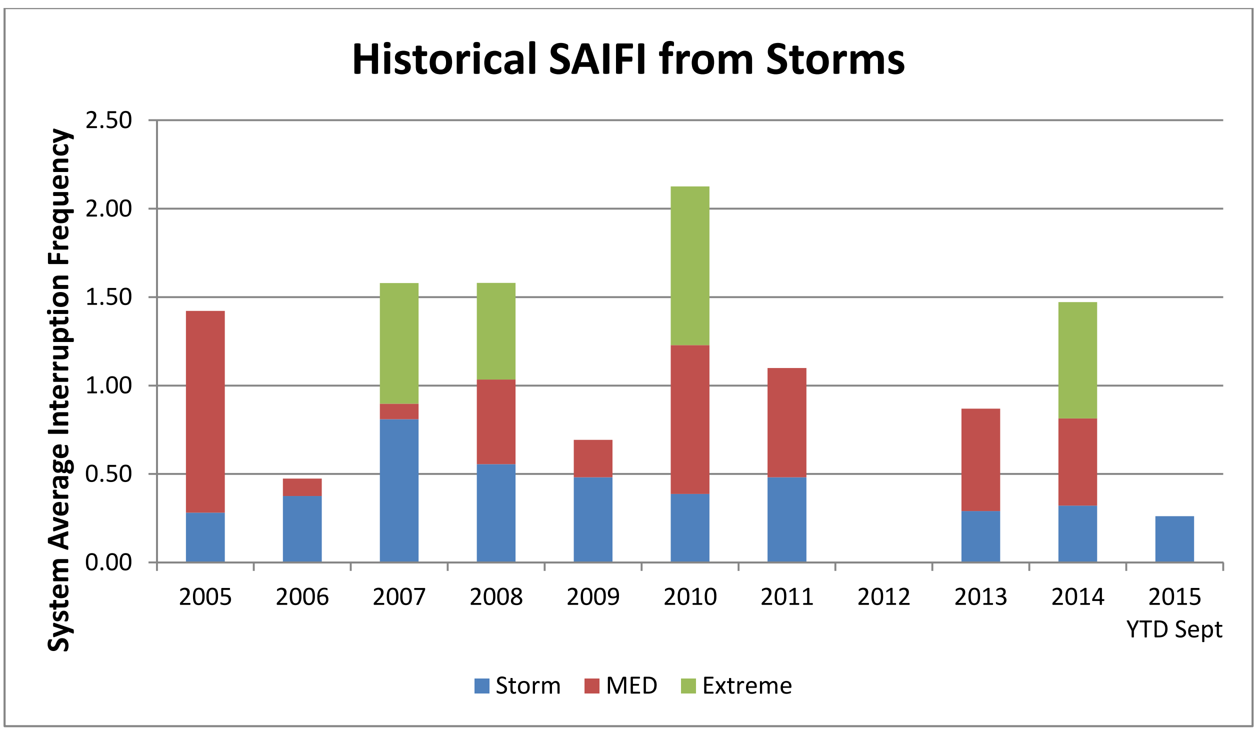
As of September 30, 2015, NS Power has experienced 3 storm days and 0 extreme event days. The tables below provide NS Power's historical performance for SAIDI and SAIFI during storm events.

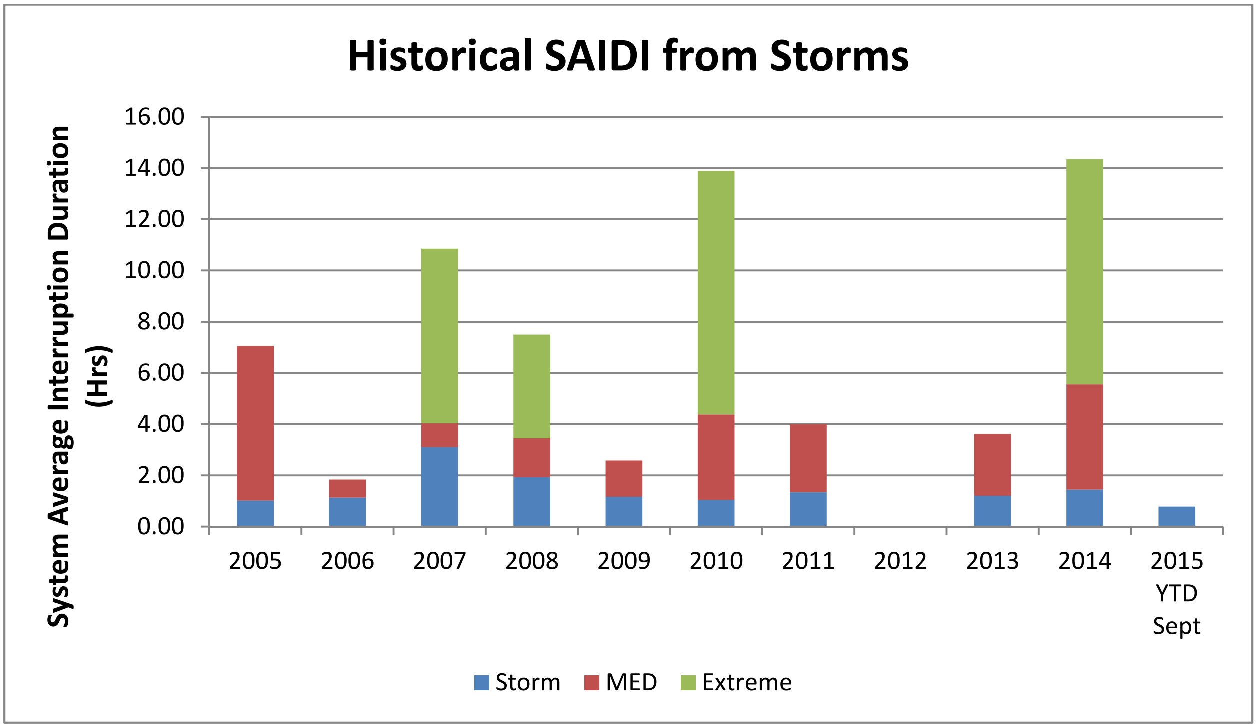
NS Power has the following capital programs for storm response and reactive work for 2016:

- D008 – Provincial Storm Distribution
- T001 – Transmission Line Unplanned

As noted earlier, NS Power continues to invest in capital to address vegetation management. These investments aim to minimize tree contact and maximize access to our Transmission and Distribution systems.

<u>2015 Storm Performance vs. Previous Years</u>





Through the first eight months of the year, customers experienced 3 storm days. This year, the average number of interruptions per customer is 0.26 due to storms. The system average interruption duration for customers served is 0.78 hours due to storms.

The table below provides detail on each of the three storm days and outage causes for each.

		Storm 1	Storm 2	Storm 3	
Code	**CEA Cause Code**	**Hours of Interruption**	**Hours of Interruption**	**Hours of Interruption**	**% of Hours**
0	Unknown	13,099	40	52	3%
1	Scheduled Outage	0	0	0	0%
2	Loss of Supply	0	154,057	113,209	69%
3	Tree Contacts	24,125	45	2	6%
4	Lightning	0	1,323	4,691	2%
5	Damaged Equipment	10,821	2,226	12,502	7%
6	Adverse Weather	48,327	0	0	13%
7	Adverse Environment	0	0	0	0%
8	Human Element	2	0	0	0%
9	Foreign Interference	1,228	56	186	0%
	Total	**97,602**	**157,746**	**130,643**	**100%**

For the three storm days noted above, 69% of the outages year-to-date in 2015 have been caused by loss of supply from the Transmission system. Each of these outages was due to substation lightning strikes and occurred on back-to-back days. Historically, the two leading causes of NS Power customer outages for all days (storm and non-storm) are Deteriorated Equipment and Tree Contacts.

To address and minimize the Loss of Supply issues at Transmission Substations, the following projects are identified for 2016:

- CI 48111 15S Switch Upgrade
- CI 48156 58C Switch Upgrade
- CI 48059 2016 Switch & Breaker Program
- CI 48062 2016 Reactor Breaker Replacement
- CI 48063 2016 Capacitor Bank Breaker Replacement
- CI 48151 2016 Substation Insulator Replacement Program

8.1.8 Interruptible Customers

The UARB's 2013 ACE Plan Decision Directive 15 stated:

> …an annual report, as part of the ACE Plan filing, tracking interruptions to interruptible customers is useful and reasonable. The Board directs NSPI to provide this information in future ACE Plans.[20]

The North American Electric Reliability Corporation (NERC) requires NS Power to maintain defined levels of Operating Reserve capacity (capacity or load that can be activated/reduced within ten minutes). While NS Power begins each day with a generation plan designed to serve customers and to maintain the required Operating Reserves, circumstances do arise where this reserve requirement cannot be met with available resources. In these situations, interruptible customers are called upon to temporarily cease their electricity consumption to protect service to firm customers and maintain or restore Operating Reserves.

[20] NS Power 2013 ACE Plan, Decision, M05339, May 27, 2013, page 44, line 175.

NS Power offers four tariffs that require customers to reduce their loads within 10 minutes when instructed to do so. The four tariffs are:

(1) The Large Industrial Interruptible Rider (LIIR) Tariff
(2) The Port Hawkesbury Paper Load Retention Mechanism (PHP LRM) Tariff
(3) The Generation Replacement and Load Following (GR&LF) Rate
(4) The Shore Power Tariff

The process for interruption of loads for each group is essentially the same: telephone notification with the requirement to reduce load within 10 minutes. Some customers can be controlled with remote switching, but are notified by phone as well.

In exchange for allowing their load to be interrupted, interruptible customers receive a discount based on the avoided capital costs associated with peaking units that would otherwise have been required to serve a larger firm peak load. If an interruptible customer is unable to comply with the provisions of their tariff, a penalty is applied.

The LIIR class was historically interrupted once or twice per year and would experience periods where they were not called at all for several years. Comparatively, the last several years have seen more frequent interruptions; in particular, in 2009 and 2013 per the table below.

The largest change in conditions leading to these interruptions is the absence of the priority interruption provided by the customers subscribed to the Extra Large Industrial tariff (paper mills). Increased difficulty in securing imports due to transmission constraints outside of the Nova Scotia system has also contributed. Studies have indicated that more interruptions can be expected as more variable generation from renewable sources such as wind is added to the power system.

However, thus far in 2015, there have been no LIIR or PHP interruptions due in part to the Interruptible Tariffs Pilot. On December 3, 2013, the UARB approved a pilot program to amend the interruption provisions of the LIIR and LRT tariffs. The project aims to have NS Power control participating customers' load, which will enable this load to be counted as 10 minute reserve under NERC requirements, which should reduce the number and duration of customer interruptions. Eligible customers were required to install the necessary equipment at their own cost. In the case of the PHP mill, the equipment was already in place as it was installed during construction of the supply infrastructure. Customers who have provided direct load control to NS Power provide 10-minute reserve without having to interrupt to free up generation.

Below is a table summarizing interruptions in the LIIR customer class from 2009 to October 31, 2015.

Year	**LIIR Customers**			
	Date	**Number of LIIR customers interrupted**	**Estimated load interrupted (MW)**	**Estimated average duration**
2009	January 26	26	80	2 hours
	April 9	25	67	1.5 hours
	December 1	7	30	1.2 hours
	December 17	25	82	1.5 hours
2010	February 1	8	25	40 minutes
2011	January 23	25	74	45 minutes
2012	N/A	0	0	
2013	January 2	8	26	55 minutes
	January 3	2	16	1 hour
	January 16	22	69	40 minutes
	February 8	10	34	2 hours
2014	April 25	6	28	4 hours
2015	N/A	0	0	0

Below is a table summarizing recent interruptions to the PHP LRT.

PHP LRT Interruptions*		
Date	**Load Interrupted (MW)**	**Estimated Average Duration**
Jan 2, 2013	15	1.5 hours
Jan 3, 2013	11	50 minutes
Jan 16, 2013	37	1.75 hours
Feb 8, 2013	41	2.67 hours
2015	0	0

*PHP LRT came into effect September 27, 2012.
*As PHP is counted as 10-minute reserve and the LIIR interruptions called in April 2014 were intended to restore reserves to 171 MW, no interruption was called for PHP.

Below is a table summarizing recent interruptions to the GR&LF customers.

GR&LF Interruptions*	
Date	**Estimated Average Duration**
Sept 6, 2012	1.5 hours
Dec 1, 2012	1.75 hours
Jan 2, 2013	1.58 hours
Jan 3, 2013	1 hour
Jan 6, 2013	1.25 hours
Jan 16, 2013	1.75 hours
Feb 8, 2013	2.75 hours
April 25, 2014	3 hours
June 1, 2015	3.5 hours

*There is no significant load relief associated with GR&LF interruptions.

All interruptions to these classes of customers were required to maintain the system operator's 10-minute reserve requirements and were executed in accordance with the applicable tariff.

8.2 2016 Capital Spending by Justification Criteria

Items in the 2016 ACE Plan have been developed using the CEJC. Definitions of the various criteria referenced in the following table are included in the CEJC.

(Millions of Dollars)

Justification Criteria	**2016 Budget**	**Projects included for Approval**	**Routine Spend**	**Less than $250K**	**Items for Later Filing 2016**	**Carryover**	**Pt. Aconi**
Distribution System*	$62.5	$5.2	$44.5	$0.6	$6.0	$6.2	$0.0
Thermal	57.6	22.3	2.5	11.1	8.5	8.9	4.3
Work Support*	41.3	0.0	14.2	0.9	19.4	6.8	0.0
Hydro	12.8	3.0	1.9	0.1	4.5	3.4	0.0
Health and Safety	23.1	8.8	0.0	1.4	3.2	9.2	0.5
Transmission Plant	53.6	15.2	15.2	0.6	7.7	14.8	0.0
Environmental	18.3	5.0	0.6	0.6	0.0	6.9	5.2
Metering Equipment	10.1	0.0	3.1	0.0	7.0	0.0	0.0
System Design	0.2	0.0	0.0	0.0	0.0	0.2	0.0
Facilities/Land and Right-of-Way	0.4	0.0	0.1	0.0	0.0	0.3	0.0
Total	**$279.9**	**$59.6**	**$82.0**	**$15.3**	**$56.3**	**$56.7**	**$10.0**

*Details of justification sub-criteria are provided on the following section.

8.3 2016 Capital Spending by Justification Sub-Criteria

(Millions of Dollars)

Justification Sub-Criteria	2015 Budget	Projects included for Approval	Routine Spend	Less than $250K	Items for Subsequent Submission	Carryover
Distribution System						
Requirement to Serve	$37.5	$0.0	$34.1	$0.1	$3.2	$0.0
Pole Strength	7.8	1.1	6.8	0.0	0.0	0.0
Joint Use Agreement	0.6	0.0	0.6	0.0	0.0	0.0
Deteriorated Conductor	1.1	0.7	0.0	0.2	0.0	0.2
Equipment Replacement	9.2	2.7	0.0	0.1	1.5	4.8
Outage Performance	3.8	0.3	3.0	0.0	0.4	0.1
Overloaded Equipment	0.5	0.0	0.0	0.1	0.4	0.0
Service Voltage	0.0	0.0	0.0	0.0	0.0	0.0
Other Distribution System	2.0	0.3	0.0	0.0	0.6	1.1
Total	**$62.5**	**$5.5**	**$44.5**	**$0.6**	**$6.0**	**$6.2**
Work Support Facilities						
Buildings	$2.6	$0.0	$2.4	$0.0	$0.0	$0.2
Furniture & Fixtures	0.0	0.0	0.0	0.0	0.0	0.0
Telecommunications	7.2	0.0	0.8	0.1	0.4	5.9
Computers / IT	23.1	0.0	2.6	0.8	19.0	0.7
Tools & Equipment	1.4	0.0	1.4	0.0	0.0	0.0
Vehicles	7.0	0.0	7.0	0.0	0.0	0.0
Equipment Replacement	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0
Total	**$41.3**	**$0.0**	**$14.2**	**$0.9**	**$19.4**	**$6.8**

8.4 Quick Reference Sheet

2016 AFUDC Rate for Capital 7.23%

Please refer to section 1.3 regarding NS Power's application for approval of the 2016 AFUDC rate.

2016 O/H Rates

Generation		**Customer Operations**		**Shared Services**	
PP Regular	20.27%	Regular	69.90%	IT	32.51%
Hydro	46.12%	Contract	20.28%	Proj. Support	60.74%
Contractor	10.21%	Vehicle	47.18%		

1 **8.5 2016 Depreciation Rates**

	2016
Steam Production Plant	
Lingan	
Lingan 1-2	4.12%
Lingan 3-4	2.28%
Lingan - Common	4.48%
Total Lingan	3.35%
Point Aconi 1	2.27%
Point Tupper	
Point Tupper 1 (Common)	3.97%
Point Tupper 2	2.82%
Total Point Tupper	2.89%
Trenton	
Trenton 5	3.10%
Trenton 6	2.34%
Trenton - Common	0.47%
Total Trenton	2.47%
Tufts Cove	
Tufts Cove 1	4.24%
Tufts Cove 2	3.68%
Tufts Cove 3	2.33%
Tufts Cove - Common	3.44%
Total Tufts Cove	3.27%
Port Hawkesbury Biomass	2.50%
Point Tupper Marine Terminal	4.06%
International Coal Pier	2.60%
General	2.82%
Total Steam Production Plant	**2.82%**

2

	2016
Hydro Production Plant	
Avon	3.02%
Bear River	1.80%
Black River	2.04%
Dickie Brook	3.16%
Fall River	1.82%
Harmony	4.55%
Lequille System	2.33%
Roseway	2.29%
Mersey	2.00%
St. Margaret's	2.85%
Sheet Harbour	3.38%
Tusket	2.64%
Wreck Cove System	1.67%
Annapolis Tidal	2.32%
General	2.10%
Total Hydro Production	**2.10%**

1

	2016
Other Production - Combustion Turbines	
Burnside	2.40%
Tusket	6.42%
Victoria Junction	3.17%
Tufts Cove Unit 4	2.55%
Tufts Cove Unit 5	2.77%
Tufts Cove Unit 6	3.03%
Wind Turbines	
Pre 2009 Wind	5.52%
Post 2009 Wind	4.0%
Transmission Plant	
Land Rights - Easements	1.26%
Station Equipment	2.14%
Towers & Fixtures	1.26%
Poles & Fixtures	4.32%
Overhead Conductors & Devices	1.96%
Underground Conduit	1.53%
Underground Conductors & Devices	2.61%
Roads, Trails & Bridges	1.74%
Total Transmission Plant	**2.35%**

	2016
Distribution Plant	
Land Rights - Easements, Surveys & Clearing	1.56%
Structures & Improvements	5.31%
Station Equipment	1.28%
SCADA Equipment	9.68%
Remote Monitoring Equipment	10.32%
Station Equipment - Miscellaneous	12.49%
Poles, Towers & Fixtures	3.79%
Overhead Conductors & Devices	3.33%
Underground Conduit	1.51%
Underground Conductors & Devices	3.17%
Line Transformers	4.09%
Services	5.33%
Meters	6.87%
Street Lighting & Signal Systems	5.33%
Total Distribution Plant	**3.89%**

	2016
General Plant	
Land Rights - General Plant	1.93%
Structures & improvements	2.85%
Office Furniture & Equipment	9.26%
Office Furniture & Equip - Comp Hardware	20.00%
Office Furniture & Equip - Comp Software	10.00%
Transportation Equipment	9.55%
Stores Equipment	14.97%
Communication Equipment	4.38%
Communication Equipment - SCADA Eq	1.33%
Remote Monitoring Equipment	10.27%
Miscellaneous Equipment	5.02%
Roads, Bridges & Traps (Kelly Rock)	2.58%
Mining Equipment (Kelly Rock)	2.92%
Total General Plant	**8.16%**

8.6 Summary of Economically Justified Projects

Revenue Requirement Summary							Change in Revenue Requirement due to:			PV of Revenue Requirement by Year							
CI	Project	Alternative	Rank as Filed	As Filed	Capital Spend Increased 10%	Avoided Expenses Reduced 10%	Deferral of 1 year	Deferral of 2 years	Deferral of 3 years	Year 0 / 2014	Year 1 / 2015	Year 2 / 2016	Year 3 / 2017	Year 4 / 2018	Year 5 / 2019	Years 6 to end of life / 2020+	Total
43170	LIN4 AVR Replacement	Replace AVR vs Replacement Energy/Repair Costs	1	(4,542,810)	(4,465,012)	(4,010,731)	58,088	155,414	332,765	-	(84,956)	(60,984)	(166,698)	(158,615)	(213,404)	(3,858,154)	(4,542,810)
46352	TRE5 Air Heater Refurbishments	Air Heater Refurbishment vs Replacement Energy & Repair Costs	1	(841,654)	(793,637)	(709,471)	116,876	242,176	358,987	-	(161,880)	(96,600)	(104,968)	(142,358)	(157,932)	(177,916)	(841,654)
46587	Metro Voltage Support Add Capacitor	100 MVAR Capacitor Bank	1	(25,880,327)	(25,613,006)	(25,880,327)	126,635	2,976,906	5,543,463	(70,726)	(672,703)	(2,707,601)	(2,514,511)	(2,344,046)	(2,185,560)	(15,385,181)	(25,880,327)
47172	HYD - Tidewater 1 Overhaul	Replace Runner vs Replacement Energy & Repair Costs	1	(2,972,332)	(2,861,767)	(2,629,379)	100,315	243,577	368,735	(25,946)	(303,858)	(236,548)	(152,508)	(110,729)	(96,251)	(2,046,491)	(2,972,332)
47172	HYD - Tidewater 1 Overhaul	Repair Runner vs Replacement Energy& Repair & Costs	2	(42,436)	132,737	100,963	84,109	170,790	269,883	-	(199,240)	(21,105)	(74,116)	(75,206)	(78,317)	405,548	(42,436)
47332	HYD - Methals Overhaul	Replace Runnner vs Replacement Energy & Repair Costs	1	(2,827,012)	(2,722,605)	(2,480,431)	99,788	201,078	319,233	(2,656)	(306,231)	(201,532)	(158,968)	(115,744)	(99,737)	(1,942,144)	(2,827,012)
47332	HYD - Methals Overhaul	Repair Runner vs Replacement Energy & Repair Costs	2	(2,130,885)	(1,981,292)	(1,784,305)	86,065	179,730	289,978	-	(154,493)	(46,853)	(98,789)	(97,751)	(98,931)	(1,634,069)	(2,130,885)
47432	HYD - Ridge Overhaul	Ridge Overhaul vs Replacement Energy & Repair Costs	1	(8,664,451)	(8,599,238)	(7,732,792)	154,494	335,931	553,066	-	(324,051)	(146,737)	(208,651)	(255,618)	(303,758)	(7,425,636)	(8,664,451)
47505	LIN Coal Mill Refurbishment 2016	Refurbish Mills vs Replacement Energy & Repair Costs	1	(1,073,584)	(1,001,716)	(894,357)	150,891	420,788	663,130	-	(169,592)	(217,810)	(214,843)	(211,814)	(342,278)	82,753	(1,073,584)
47506	LIN CW Screen Refurbishment 2016	Refurbish Screens vs. Replacement Energy & Repair Costs	1	(590,866)	(558,546)	(499,459)	79,418	145,766	201,013	-	(103,672)	(41,731)	(42,186)	(115,051)	(113,158)	(175,067)	(590,866)
47507	LIN CW Pump Rebuild 2016	Refurbish CW Pump vs Replacement Energy & Repair Costs	1	(917,245)	(876,535)	(784,810)	47,043	136,149	286,356	-	(66,155)	(69,889)	(144,590)	(168,198)	(184,741)	(283,672)	(917,245)
47552	TRE5 Boiler Refurbishment 2016	Boiler Refurbishments vs Replacement Energy & Repair Costs	1	(4,910,848)	(4,799,675)	(4,308,590)	134,075	376,377	561,148	-	(205,098)	(177,839)	(158,339)	(330,162)	(321,058)	(3,718,351)	(4,910,848)
47554	TRE5 5-1 FD Fan Refurbishment	FD Fan Refurbishment vs Replacement Energy & Repair Costs	1	(13,077,296)	(13,030,412)	(11,722,682)	502,909	1,200,503	1,840,792	-	(508,356)	(671,706)	(629,711)	(996,914)	(1,074,355)	(9,196,256)	(13,077,296)
47596	TRE6 ID Fan Damper Upgrades	ID Fan Damper Upgrades vs Replacement Energy & Repair Costs	1	(758,618)	(733,201)	(657,339)	75,518	125,627	176,306	-	(82,968)	(38,179)	(47,094)	(43,722)	(45,468)	(501,187)	(758,618)
47657	LIN4 High Voltage Bushing Refurbishment	Refurbish HVB vs Replacement Energy & Repair Costs	1	(3,055,346)	(2,981,325)	(2,675,790)	131,067	326,928	630,614	-	(179,160)	(160,050)	(293,009)	(282,565)	(349,286)	(1,791,275)	(3,055,346)
47658	LIN4 L-0 Blade Replacement	Replace Blades vs Replacement Energy & Repair Costs	1	(6,881,034)	(6,462,499)	(5,774,395)	254,613	604,588	1,184,303	-	(469,131)	(150,656)	(520,749)	(376,213)	(509,180)	(4,855,106)	(6,881,034)
47662	POT Coal Mill Overhauls 2016	Refurbish Mill vs Replacement Energy & Repair Costs	1	(168,972)	(137,783)	(120,886)	45,177	132,698	267,519	-	(47,522)	(71,567)	(128,936)	(162,357)	21,054	220,355	(168,972)
47663	LIN4 - SH5 Boiler Tube Replacement	Tube Replacement vs. Replacement Energy & Repair Costs	1	(1,084,704)	(1,037,275)	(928,805)	53,604	173,302	315,995	-	(96,948)	(96,056)	(135,541)	(102,925)	(107,849)	(545,385)	(1,084,704)
47664	LIN4 Division Wall Replacement	Replace Division Wall vs Replacement Energy & Repair Costs	1	(1,680,386)	(1,624,854)	(1,456,815)	76,320	138,933	281,810	-	(114,563)	(35,637)	(134,825)	(197,285)	(276,106)	(921,971)	(1,680,386)
47666	LIN4 Boiler Refurbishment 2016	Refurbish Boiler vs Replacement Energy & Repair Costs	1	(768,638)	(718,229)	(641,365)	76,320	222,118	367,691	-	(121,581)	(120,714)	(137,989)	(200,261)	(278,899)	90,807	(768,638)
47673	LIN4 Generator Rotor Rewind	Rotor Rewind vs. Replacement Energy & Repair Costs	1	(1,421,790)	(1,181,662)	(1,039,483)	282,950	617,501	1,051,294	-	(366,988)	(222,465)	(401,048)	(332,030)	(338,338)	239,079	(1,421,790)
47689	LIN4 - Air Heater Refurbishment	Replace Baskets and Seals vs. Replacement Energy & Repair Costs	1	(583,449)	(535,529)	(477,184)	74,898	166,191	288,456	-	(94,650)	(68,748)	(115,643)	(104,967)	(124,753)	(74,688)	(583,449)
47690	LIN4 Burner Front Refurbishment	Replace Components vs Replacement Energy & Repair Costs	1	(421,473)	(376,723)	(334,575)	49,746	148,746	320,060	-	(60,421)	(78,395)	(165,343)	(193,741)	(252,600)	329,027	(421,473)

Revenue Requirement Summary							Change in Revenue Requirement due to:			PV of Revenue Requirement by Year							
CI	Project	Alternative	Rank as Filed	As Filed	Capital Spend Increased 10%	Avoided Expenses Reduced 10%	Deferral of 1 year	Deferral of 2 years	Deferral of 3 years	Year 0 / 2014	Year 1 / 2015	Year 2 / 2016	Year 3 / 2017	Year 4 / 2018	Year 5 / 2019	Years 6 to end of life / 2020+	Total
47704	POT - Replace Polisher Chemical Skid	Replace Skid vs Replacement Energy & Repair Costs	1	(4,058,077)	(4,027,030)	(3,621,222)	234,360	527,171	877,895	-	(236,873)	(276,953)	(344,891)	(373,435)	(424,878)	(2,401,047)	(4,058,077)
47755	LIN4 Turbine High Temperature Fasteners Replacement	Replace Fasteners vs Replacement Energy & Repair Costs	1	(2,498,566)	(2,400,792)	(2,150,935)	131,418	280,369	468,531	-	(181,314)	(102,413)	(174,406)	(170,428)	(206,088)	(1,663,916)	(2,498,566)
47761	LIN1 Boiler Refurbishment	Refurbish Boiler vs Replacement Energy & Repair Costs	1	(168,459)	(121,515)	(104,670)	35,824	91,783	173,282	-	(70,108)	(22,491)	(64,622)	(92,860)	(93,782)	175,404	(168,459)
47869	LIN4 Bottom Ash	Refurbish Bottom Ash vs. Replacement Energy & Repair Costs	1	(1,676,643)	(1,622,112)	(1,454,448)	26,747	72,209	154,991	-	(73,415)	(18,466)	(74,649)	(88,733)	(125,422)	(1,295,958)	(1,676,643)
47961	LIN1 Condenser Tube Coating	Install Coating vs. Replacement Energy & Repair Costs	1	(1,117,372)	(1,086,485)	(974,748)	63,678	127,929	198,943	-	(86,752)	(42,192)	(59,887)	(60,152)	(148,731)	(719,659)	(1,117,372)
	Summary of all Economically Justified Projects		**1**	(92,914,584)	(90,631,002)	(84,309,048)	3,183,961	10,197,177	17,801,300	(99,327)	(5,190,884)	(6,138,538)	(7,302,772)	(7,742,466)	(8,368,156)	(58,072,440)	(92,914,584)

Generation

Hydro

Hydro Generation

NS Power's Hydro generation fleet operates on 17 rivers systems, with 33 powerhouses, 54 generating units and 153 main dams, ranging in ages up to 93 years old.

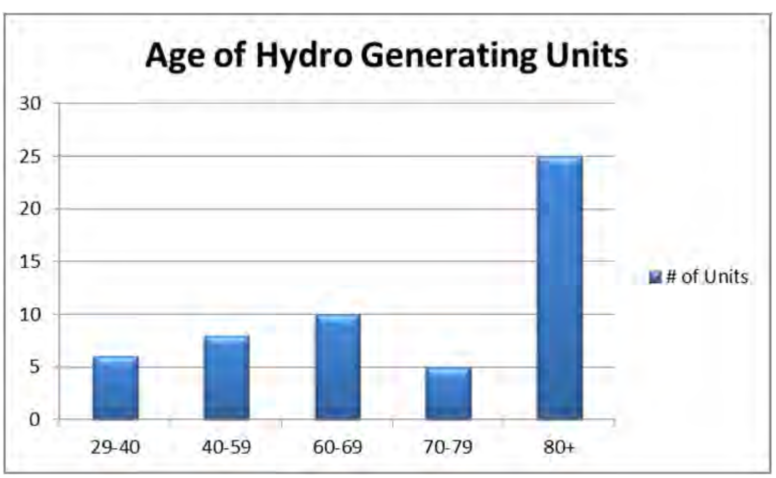
Asset classes in Hydro generation that typically require an ongoing investment plan include Dams, Pipelines, Generators, Turbines, Gates and Water Control Structures, and other associated (Balance of Plant) equipment.

Dams represent the single largest investment requirement. NS Power maintains a comprehensive program to assess Dam Safety and plan investment on a prioritized risk basis. Similar to other Power Production asset classes Criticality (consequence) and Condition are considered when calculating risk.

Pipelines also represent a significant investment. Hydro has been engaged in a program of Pipeline replacements which has seen the move from original woodstave technology to a more robust and environmentally friendly product such as High Density Polyethylene. The original woodstave pipelines are not serviceable to end of the generation unit's life and therefore an active program to replace these pipelines, based on their condition has been ongoing.

As Hydro has some 54 generating units, multiple major overhauls are required annually in order to sustain reliable generation. Major overhauls typically include work on the Generators, Turbines and water control structures. These major outages are also determined on a condition basis and could include the replacement of Turbine Runners, refurbishment of Wicket Gates and Generator rewinds

Balance of Plant equipment, such as Electrics and Controls, is typically replaced as a function of serviceability (obsolescence).



CI Number: 46298

Title: HYD Five Mile Lake Dam Refurbishment

Start Date: 2015/04
In-Service Date: 2016/11
Final Cost Date: 2017/05
Function: Hydro
Forecast Amount: $2,209,018

DESCRIPTION:

The project includes the refurbishment of the dams and sluiceway on Five Mile Lake in order to address structural deficiencies due to ice loading identified in the 2009 dam safety review.

Full project scope includes:

- The Five Mile Lake Main Dam will be stabilized by placing rock-fill material along the downstream side of the dam.
- The spillway will be lengthened by cutting down a portion of the existing concrete dam and placing rock-fill on both the upstream and downstream side to form an overflow spillway section.
- A new sluiceway with trash racks will be added.
- For the Mack Lake Dam, the downstream slope will be flattened, using the existing dam fill material, to alleviate the downstream slope stability concerns.
- For the Beeswanger Dam, a toe berm will be placed along the downstream toe.

Five Mile Lake is on St. Margaret's Bay Hydro system and is a storage reservoir at the highest point on the hydro system. This work focuses on the main dam and two wing dams (Mack Lake and Beeswanger).

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Hydraulic Production Plant - St. Margaret's Bay Hydro System

Estimated Life of the Asset: 70 Years

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

The most recent Dam Safety Review (2009) concluded that the dams are in poor condition with concrete degradation and stability concerns with ice loading. This dam provides a large water storage that feeds the St Margaret's Bay Hydro system. Correcting these deficiencies reduces the risk of a dam failure as well as extends the useful life.

Why do this project now?

The most recent Dam Safety Review (2009) concluded that the dam requires refurbishment related to concrete degradation and stability concerns with ice loading. NS Power carries out dam safety projects on a priority basis based on risk. Completing this project in 2016 will mitigate any risks associated with the structural deficiencies. This is the last dam on the St Margaret's Bay system to be modernized and will support the safe and productive operation of the hydro system into the future.

Generation from NS Power's legacy hydro facilities qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Power's compliance plan to serve 25 percent of sales from qualifying renewable generation sources (and 40% in 2020). The refurbishment of the dams is scheduled to be implemented in 2016 as part of a general dam safety improvement program.

Why do this project this way?

Refurbishing the dams is the most economic option to correct the deficiencies. A dam replacement is not necessary and would add significant additional cost.

CI Number : 46298-H726 - HYD Five Mile Lake Dam Refurbishment **Project Number** H726

Parent CI Number : -

Cost Centre : 440 - 440-St.Margaret's Hydro System **Budget Version** 2016 ACE Plan

Capital Item Accounts

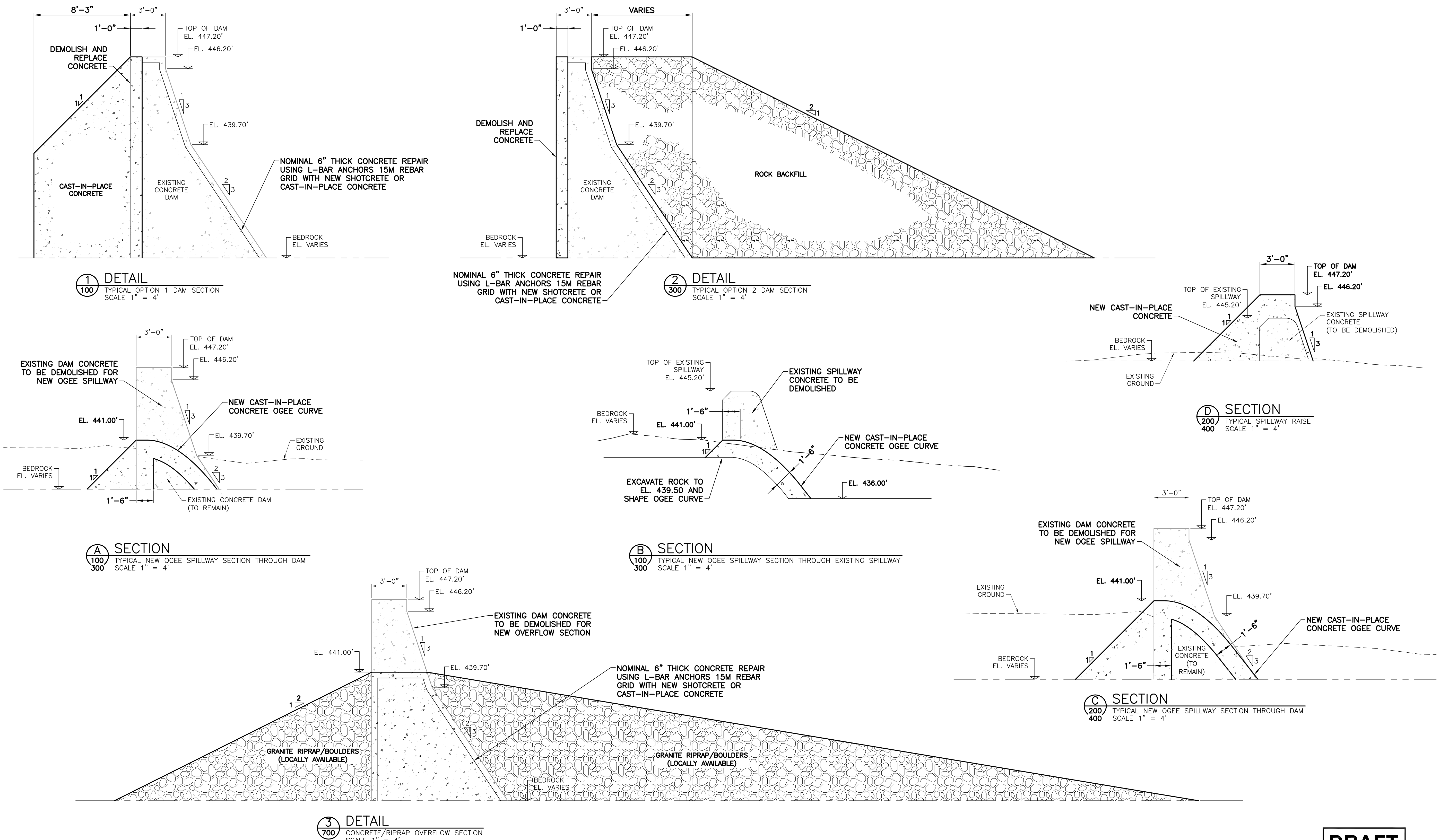
Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		46,331	0	46,331
095		095-Hydro Regular Labour AO		1,682	0	1,682
095		095 - Proj Supp Regular Labour AO		36,760	0	36,760
095		095-Thermal & Hydro Contracts AO		140,291	0	140,291
001	028	001 - HYDRO Regular Labour	028 - HGP - Dams & Spillways	3,648	0	3,648
011	028	011 - Travel Expense	028 - HGP - Dams & Spillways	11,000	0	11,000
012	028	012 - Materials	028 - HGP - Dams & Spillways	[redacted]	0	[redacted]
013	028	013 - POWER PRODUCTION Contracts	028 - HGP - Dams & Spillways	[redacted]	0	[redacted]
028	028	028 - Consulting	028 - HGP - Dams & Spillways	157,500	0	157,500
041	028	041 - Meals & Entertainment	028 - HGP - Dams & Spillways	2,150	0	2,150
001	085	001 - Proj Supp Regular Labour	085 Design	60,796	0	60,796
066	085	066 - Other Goods & Services	085 Design	[redacted]	0	[redacted]
013	087	013 - POWER PRODUCTION Contracts	087 Field Super.& Ops.	90,000	0	90,000
			Total Cost:	2,209,018	0	2,209,018
			Original Cost:			

Capital Project Detailed Estimate

Location: Hydro
CI# : 46298
Title: HYD Five Mile Lake Dam Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Engineering	PD	150	$ 405	$ 60,796		
Hydro River Staff	PD	10	$ 365	$ 3,648		
			Sub-Total	$ 64,444		
011 Travel Expense						
Engineering Staff	L/S	1	$ 11,000	$ 11,000		
			Sub-Total	$ 11,000		
012 Materials						
Sluice Gate	L/S	1	[redacted]	[redacted]		
Misc. Steel	L/S	1				
Trash Rack	L/S	1				
			Sub-Total	[redacted]		
013 Contracts						
Contractor Mob/Demob	L/S	1	[redacted]	[redacted]		
Site Access	L/S	1				
Environmental (Tree Clearing, etc.)	L/S	1				
Water Control (Cofferdams, etc.)	L/S	1				
Clearing & Grubbing	L/S	1				
Foundation Grouting (if required)	L/S	1				
Excavation	L/S	1				
Earthfill/Rockfill Materials	cu.yd.	6,715				
Concrete (Formwork, Rebar, Concrete)	cu.yd.	777				
Sluice Gate/Trash Rack Installation	L/S	1				
Demolition	L/S	1				
Construction Supervisor	Mth	6	$ 15,000	$ 90,000		
			Sub-Total	[redacted]		
028 Consulting						
Design Consultant	L/S	1	$ 157,500	$ 157,500		
			Sub-Total	$ 157,500		
041 Meals & Entertainment						
Engineering Staff	L/S	1	$ 2,150	$ 2,150		
			Sub-Total	$ 2,150		
066 Other Goods & Services						
Contingency - Design	L/S	1	[redacted]	[redacted]		
Contingency - Construction	%	20%				
			Sub-Total			
094 Interest Capitalized						
AFUDC				$ 46,331		
				$ -		
			Sub-Total	$ 46,331		
095 Administrative Overhead						
Hydro Reg. Labour AO				$ 1,682		
Thermal / Hydro Contracts AO				$ 140,291		
Project Support Regular AO				$ 36,760		
			Sub-Total	$ 178,733		
			SUB-TOTAL (no AO, AFUDC)	$ 1,983,954		
			TOTAL (AO, AFUDC included)	$ 2,209,018		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.



DRAFT

NOT FOR CONSTRUCTION

FOR INFORMATION ONLY

1. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS NOTED OTHERWISE.
2. ALL ELEVATIONS AND COORDINATES ARE IN FEET UNLESS NOTED OTHERWISE.

NEW WORKS ARE ILLUSTRATED IN BOLD. BACKGROUND LINEWORK & TEXT (I.E. NOT BOLD) ILLUSTRATE EXISTING PROJECT FEATURES.

THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED (i.e. 1" = 1' etc.) ARE BASED ON 22" X 34" FORMAT DRAWINGS

SCALE 1" = 4'-0" 0 4 8 ft.

REFERENCE DRAWINGS | DWG.NO.

SEAL | DEPARTMENTAL APPROVALS | CIVIL | E & I | MECH | CONST | APPROVED | DATE

ISSUED FOR #### DATE:2015-##-##

REFERENCE NO.	500
SCALE	As Noted
UNITS	
DESIGNED	HM
DRAWN	SB
CHECKED	FT
CHECKED	
DATE	
W.O.	

amec foster wheeler

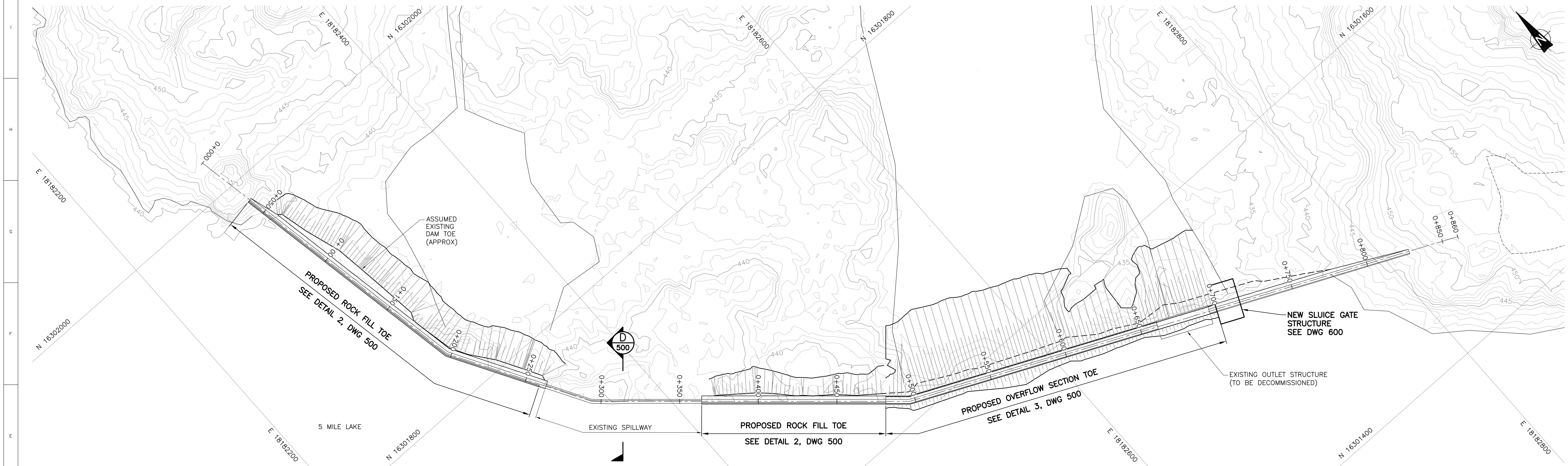
Nova Scotia POWER An Emera Company

FIVE MILE LAKE
MAIN DAM

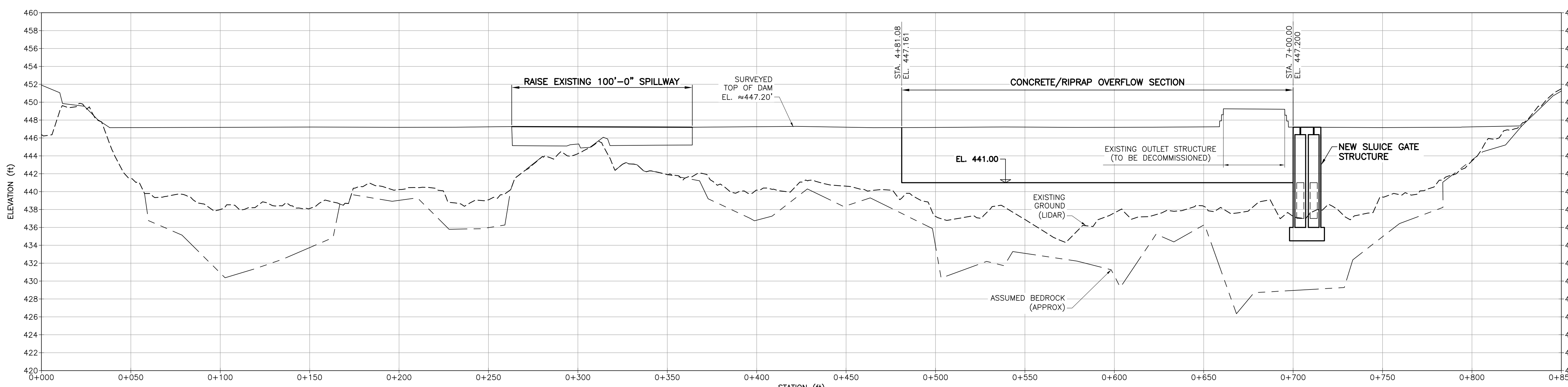
SECTIONS AND DETAILS

DWG. NO. 0 0.0.0.0.0 0 0.0.0 0.0 0.0.0 REV. A

DWG. NO. 0 0.0.0.0.0 0 0.0.0 0.0 0.0.0



PLAN
SCALE HOR. 1" = 30'



PROFILE
SCALE HOR. 1" = 30'
VER. 1" = 6'

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SCALES
1" = 30'-0" 0 30 60 ft.
1" = 6'-0" 0 6 12 ft.

REFERENCE DRAWINGS | DWG.NO.

SEAL

DEPARTMENTAL APPROVALS
CIVIL | E & I
MECH | CONST
APPROVED
DATE

REFERENCE NO. 700
SCALE As Noted
UNITS
DESIGNED HM
DRAWN CF
CHECKED FT
CHECKED
DATE
W.O.

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FIVE MILE LAKE
MAIN DAM
OPTION 2C – DAM STABILIZATION, ROCK FILL AND NEW BROADCRESTED SPILLWAY ALONG EXISTING DAM SECTION

0 0.0.0.0.0 0 0.0.0 0.0 0.0.0 REV. A

CI Number: 47397

Title: HYD - Gisborne Dam D4 and Spillway S4 Upgrade

Start Date:	2015/04
In-Service Date:	2016/12
Final Cost Date:	2017/05
Function:	Hydro
Forecast Amount:	$2,050,519

DESCRIPTION:

The project will involve the refurbishment of the Gisborne Dam D-4 on the Wreck Cove System to address structural deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The scope includes raising the dam crest by 2.5 feet and the construction of a rock fill toe berm along the downstream toe, over a defined area, to meet slope stability requirements.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Hydraulic Production Plant- Wreck Cove System

Estimated Life of the Asset: 40 Years

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

The most recent Dam Safety Review (2010) concluded that Dam D-4 did not meet the stability requirements for the steady state seepage condition on the downstream slope and did not meet the Normal or Minimum Freeboard requirements.

Dam D-4 has a dam classification of High, and therefore, the inflow design flood (IDF) is 1/3 between the 1/1000-year and the PMF (Probable Maximum Flood). A high classification represents a risk where in the event of a failure, significant infrastructure damage, in this instance, can be expected.

Why do this project now?

NS Power carries out dam safety projects on a priority basis based on risk. Based on the current condition of the Gisborne D-4 dam and to mitigate the risk associated with overtopping and slope stability, this work will be completed in 2016.

Generation from NS Power's legacy hydro facilities qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Power's compliance plan to serve 25 percent of sales from qualifying renewable generation sources and 40% by 2020. The rehabilitation of the dam is scheduled to be implemented in 2016 as part of a general dam safety improvement program.

Why do this project this way?

As the dam crest has to be raised to meet minimum freeboard requirements, this is the only alternative that will achieve the requirement.

CI Number : 47397-H734 - HYD - Gisborne Dam D4 and Spillway S4 Upgrade **Project Number** H734

Parent CI Number : -

Cost Centre : 480 - 480-Wreck Cove Hydro System **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		52,167	0	52,167
095		095 - Proj Supp Regular Labour AO		38,264	0	38,264
095		095-Hydro Regular Labour AO		1,682	0	1,682
095		095-Thermal & Hydro Contracts AO		135,965	0	135,965
001	028	001 - HYDRO Regular Labour	028 - HGP - Dams & Spillways	3,648	0	3,648
011	028	011 - Travel Expense	028 - HGP - Dams & Spillways	35,000	0	35,000
013	028	013 - POWER PRODUCTION Contracts	028 - HGP - Dams & Spillways	[redacted]	0	[redacted]
041	028	041 - Meals & Entertainment	028 - HGP - Dams & Spillways	7,400	0	7,400
001	085	001 - Proj Supp Regular Labour	085 Design	63,228	0	63,228
028	085	028 - Consulting	085 Design	127,149	0	127,149
066	085	066 - Other Goods & Services	085 Design	[redacted]	0	[redacted]
013	087	013 - POWER PRODUCTION Contracts	087 Field Super.& Ops.	110,000	0	110,000
			Total Cost:	2,050,519	0	2,050,519
			Original Cost:			

Capital Project Detailed Estimate

Location: Hydro
CI# : 47397
Title: HYD - Gisborne Dam D4 and Spillway S4 Upgrade
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Engineering	PD	156	$ 405	$ 63,228		
Hydro River Staff	PD	10	$ 365	$ 3,648		
			Sub-Total	$ 66,876		
011 Travel Expense						
Engineering Staff	L/S	1	$ 35,000	$ 35,000		
			Sub-Total	$ 35,000		
013 Contracts						
Mob/Demob	L/S	1	[redacted]	[redacted]		
Site Access	L/S	1	[redacted]	[redacted]		
Environmental (Tree Clearing, etc.)	L/S	1	[redacted]	[redacted]		
Water Control	L/S	1	[redacted]	[redacted]		
Clearing & Grubbing	L/S	1	[redacted]	[redacted]		
Quarry Development	L/S	1	[redacted]	[redacted]		
Sort & Crush Blasted Materials	L/S	1	[redacted]	[redacted]		
Excavation	L/S	1	[redacted]	[redacted]		
Rockfill	cu.yd.	40	[redacted]	[redacted]		
Weirs	L/S	1	[redacted]	[redacted]		
Construction Supervisor	L/S	1	$ 110,000	$ 110,000		
			Sub-Total	[redacted]		
028 Consulting						
Design Consultant	L/S	1	$ 127,149	$ 127,149		
			Sub-Total	$ 127,149		
041 Meals & Entertainment						
Engineering Staff	L/S	1	$ 7,400	$ 7,400		
				$ -		
			Sub-Total	$ 7,400		
066 Other Goods & Services						
Contingency - Design	L/S	1	[redacted]	[redacted]		
Contingency - Construction	%	20%	[redacted]	[redacted]		
			Sub-Total	[redacted]		
094 Interest Capitalized						
AFUDC				$ 52,167		
				$ -		
			Sub-Total	$ 52,167		
095 Administrative Overhead						
Hydro Reg. Labour AO				$ 1,682		
Thermal / Hydro Contracts AO				$ 135,965		
Project Support Regular AO				$ 38,264		
			Sub-Total	$ 175,911		
			SUB-TOTAL (no AO, AFUDC)	$ 1,822,441		
			TOTAL (AO, AFUDC included)	$ 2,050,519		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47396

Title: HYD Nictaux Powerhouse Dam Refurbishment

Start Date:	2015/04
In-Service Date:	2016/11
Final Cost Date:	2017/05
Function:	Hydro
Forecast Amount:	$1,792,968

DESCRIPTION:

This project includes the construction of a new concrete dam with a vertical lift gate immediately downstream of the existing Nictaux Powerhouse dam. The existing dam will be left in-place and will be used as a cofferdam during construction. The existing dam will be cut down by approximately 3 to 4 feet following the construction of the new dam and the area between the two dams will be filled with rock-fill material. This work will address the structural deficiencies related to stability requirements and will meet the requirements of the Canadian Dam Association (CDA) Guidelines.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Hydraulic Production Plant - Lequille System - Nictaux and Paradise

Estimated Life of the Asset: 40 Years

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

The most recent Dam Safety Review (DSR 2012) concluded that the Nictaux Powerhouse Dam was in poor condition with significant concrete deterioration and cracking and did not meet the stability requirements for the usual ice and flood loading conditions. The Nictaux Powerhouse Dam was not classified as part of the 2010 Flood Study; however, a dam classification of Low was conservatively used in the 2012 DSR analyses. A classification of low represents a dam that could fail even in a low scale flood event (1/100 years).

Why do this project now?

NS Power carries out dam safety projects on a priority basis based on risk. Failure of the dam would result in the undermining of the buried Nictaux penstock, which is located immediately upstream of the Powerhouse Dam, and ultimately could result in the failure of the penstock. If the dam were to fail, the water pressure would undermine the penstock which could cause significant damage.

Generation from NS Power's legacy hydro facilities qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Power's compliance plan to serve 25 percent of sales from qualifying renewable generation sources, and 40% in 2020. The rehabilitation of the dam is scheduled to be implemented in 2016 as part of a general dam safety improvement program.

Why do this project this way?

An alternative of constructing a smaller concrete dam with rock anchors immediately downstream of the existing dam was examined. The cost of this option was comparable to the proposed option; however, a smaller concrete dam with rock anchors is less desirable than a larger concrete dam. The reliability of a larger concrete structure is greater than relying on rock anchors, where are more difficult to assess their condition over time. Construction using rock anchors can be quite difficult on a narrow dam crest such as this one.

CI Number : 47396-H733 - HYD Nictaux Powerhouse Dam Refurbishment **Project Number** H733

Parent CI Number : -

Cost Centre : 431 - 431-Nictaux/Paradise System **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		41,794	0	41,794
095		095 - Proj Supp Regular Labour AO		42,181	0	42,181
095		095-Hydro Regular Labour AO		1,682	0	1,682
095		095-Thermal & Hydro Contracts AO		109,273	0	109,273
001	028	001 - HYDRO Regular Labour	028 - HGP - Dams & Spillways	3,648	0	3,648
001	028	001 - Proj Supp Regular Labour	028 - HGP - Dams & Spillways	6,485	0	6,485
011	028	011 - Travel Expense	028 - HGP - Dams & Spillways	12,000	0	12,000
012	028	012 - Materials	028 - HGP - Dams & Spillways	[redacted]	0	[redacted]
013	028	013 - POWER PRODUCTION Contracts	028 - HGP - Dams & Spillways	[redacted]	0	[redacted]
041	028	041 - Meals & Entertainment	028 - HGP - Dams & Spillways	4,000	0	4,000
001	085	001 - Proj Supp Regular Labour	085 Design	63,228	0	63,228
028	085	028 - Consulting	085 Design	152,377	0	152,377
066	085	066 - Other Goods & Services	085 Design	[redacted]	0	[redacted]
013	087	013 - POWER PRODUCTION Contracts	087 Field Super.& Ops.	90,000	0	90,000
			Total Cost:	1,792,968	0	1,792,968
			Original Cost:	0		

Capital Project Detailed Estimate

Location: Hydro
CI# : 47396
Title: HYD Nictaux Powerhouse Dam Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Engineering	PD	156	$ 405.31	$ 63,228		
Hydro River Staff	PD	10	$ 364.79	$ 3,648		
Environmental Staff	PD	16	$ 405.31	$ 6,485		
			Sub-Total	$ 73,361		
011 Travel Expense						
Engineering Staff	L/S	1	$ 12,000	$ 12,000		
			Sub-Total	$ 12,000		
012 Materials						
Sluice Gate	L/S	1	[redacted]	[redacted]		
Trash Rack	L/S	1	[redacted]	[redacted]		
Misc. Steel (Catwalk, etc.)	L/S	1	[redacted]	[redacted]		
			Sub-Total	[redacted]		
013 Contracts						
Mob/Demob	L/S	1	[redacted]	[redacted]		
Site Access	L/S	1	[redacted]	[redacted]		
Environmental (Tree Clearing, etc.)	L/S	1	[redacted]	[redacted]		
Water Control (Cofferdam, etc.)	L/S	1	[redacted]	[redacted]		
Clearing & Grubbing	L/S	1	[redacted]	[redacted]		
Foundation Grouting (if required)	L/S	1	[redacted]	[redacted]		
Excavation	L/S	1	[redacted]	[redacted]		
Rockfill Materials	cu.yd.	500	[redacted]	[redacted]		
Concrete (Rebar, Formwork, Concrete)	cu.yd.	765	[redacted]	[redacted]		
Sluice Gate/Trash Rack Installation	L/S	1	[redacted]	[redacted]		
Demolition	L/S	1	[redacted]	[redacted]		
Construction Supervisor	Mnth	6	$ 15,000	$ 90,000		
			Sub-Total	[redacted]		
028 Consulting						
Design Consultant	L/S	1	$ 152,377	$ 152,377		
			Sub-Total	$ 152,377		
041 Meals & Entertainment						
Engineering Staff	L/S	1	$ 4,000	$ 4,000		
			Sub-Total	$ 4,000		
066 Other Goods & Services						
Contingency - Design	L/S	1	[redacted]	[redacted]		
Contingency - Construction	%	20%	[redacted]	[redacted]		
			Sub-Total	[redacted]		
094 Interest Capitalized						
AFUDC				$ 41,794		
				$ -		
			Sub-Total	$ 41,794		
095 Administrative Overhead						
Hydro Reg. Labour AO				$ 1,682		
Thermal / Hydro Contracts AO				$ 109,273		
Project Support Regular AO				$ 42,181		
			Sub-Total	$ 153,136		
			SUB-TOTAL (no AO, AFUDC)	$ 1,598,038		
			TOTAL (AO, AFUDC included)	$ 1,792,968		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47172

Title: HYD Tidewater Unit 1 Overhaul

Start Date:	2015/06
In-Service Date:	2016/10
Final Cost Date:	2017/04
Function:	Hydro
Forecast Amount:	$1,418,532

DESCRIPTION:

This project includes the replacement of the runner, the refurbishment of the wicket gates, rewind of the rotor and replacement/refurbishment of bushings, governor, bearings, and oil release protection.

Tidewater Unit #1 is located on the St. Margaret's Bay Hydro system and has been in service since 1922. It had a condition assessment completed in 2014 which determined that the runner and wicket gates are experiencing significant cavitation and the rotor required additional assessment. The runner, wicket gates and rotor are original to the generating unit.

Summary of Related CIs +/- 2 years:
No related projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Hydro – St. Margaret's Bay Hydro System

Estimated Life of the Asset: 40 years

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

The condition of the runner and wicket gates has deteriorated to the point where the reliability of the unit is now in question. The cavitation on the runner and wicket gates has removed section width from the components, increasing the localized stresses and increasing risk of failure.

Replacing the runner will also lead to an improvement in unit efficiency.

Why do this project now?

The condition of the runner, wicket gates and other components are deteriorated to the point where a failure can be reasonably expected if left to operate in their current condition. Completing this overhaul will avoid replacement energy costs in the event of an unplanned outage due to a failure of one of the components slated for replacement or refurbishment.

As of 2015, generation from NS Power's legacy hydro facilities will qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Powers compliance plan to serve 25 percent of sales from qualifying renewable generation sources.

Why do this project this way?

There were two options considered for this overhaul:

1. Replace Runner – This option includes a new runner being installed, which increases the efficiency of the unit, leading to a higher energy output. Replacement will mitigate the need to have any runner related overhauls in the foreseeable future.

2. Refurbish Runner – This option includes the refurbishment of the current runner, returning it to serviceable operation. If the runner is simply refurbished, a full runner replacement will still be required in 10-15 years, and no unit efficiency increase will be realized.

Option 1 is both the preferred and most economic alternative for this CI.

CI Number : 47172-H735 - HYD - Tidewater Unit 1 Overhaul **Project Number** H735

Parent CI Number : -

Cost Centre : 440 - 440-St.Margaret's Hydro System **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		42,302	0	42,302
095		095-Hydro Regular Labour AO		24,977	0	24,977
095		095-Thermal & Hydro Contracts AO		78,296	0	78,296
001	024	001 - HYDRO Regular Labour	024 - HGP - Turbine (Hydro)	57,209	0	57,209
011	024	011 - Travel Expense	024 - HGP - Turbine (Hydro)	10,900	0	10,900
012	024	012 - Materials	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
013	024	013 - POWER PRODUCTION Contracts	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
015	024	015 - Frt, Post & Delivery	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
028	024	028 - Consulting	024 - HGP - Turbine (Hydro)	37,534	0	37,534
041	024	041 - Meals & Entertainment	024 - HGP - Turbine (Hydro)	400	0	400
066	024	066 - Other Goods & Services	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
			Total Cost:	1,418,532	0	1,418,532
			Original Cost:	90,842		

Capital Project Detailed Estimate

Location: Hydro
CI# : 47172
Title: HYD Tidewater Unit 1 Overhaul
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Hydro River Staff - Construction	PD	85	364.79	$ 31,007		
Engineering Staff	PD	47	405.31	$ 19,049		
Hydro River Staff - Removal	PD	20	364.79	$ 7,153		
			Sub-Total	$ 57,209		
011 Travel Expense						
Temporary Report Point	Lot	1	$ 10,900	$ 10,900		
			Sub-Total	$ 10,900		
012 Materials						
Francis Runner & Coupling Bolts	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #2	
Wicket Gate Replacement	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #3	
Bushing, Pins & Bearings	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #4	
			Sub-Total	[redacted]		
013 Contracts						
Scoll Case blast and coat	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #5	
Disassembly and Reassembly	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #6	
Miscellaneous Items	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #7	
Rotor Pole Repair	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #8 (new coils)	
Electrical Testing	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #9	
Exciter Field Coil Rewind	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Contingency Items	
Exciter Brush Holder	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Contingency Items	
Bottom Ring - Bronze Wear Ring	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Contingency Items	
Headcover / Bottom Ring Facing Plate	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Contingency Items	
			Sub-Total	[redacted]		
028 Consulting						
Unit assessment and Overhaul Planning	Lot	1	$ 37,534	$ 37,534		
			Sub-Total	$ 37,534.00		
015 Freight						
Shipping	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item #10	
			Sub-Total	[redacted]		
041 Meals & Entertainment						
Meals	Lot	1	$ 400	$ 400		
			Sub-Total	$ 400		
066 Other Goods & Services						
Contingency	%	10%	[redacted]	[redacted]		
			Sub-Total	[redacted]		
094 Interest Capitalized						
AFUDC				$ 42,302		
			Sub-Total	$ 42,302		
095 Administrative Overhead						
Hydro Reg. Labour AO				$ 24,977		
Thermal / Hydro Contracts AO				$ 78,296		
			Sub-Total	$ 103,274		
			SUB-TOTAL (no AO, AFUDC)	$ 1,272,956		
			TOTAL (AO, AFUDC included)	$ 1,418,532		
Original Cost				$ 90,842		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

HYD - Tidewater Overhaul
Summary of Alternatives

Division :	Power Production		**Date :**	**03-Nov-15**
Department :	Hydro		**CI Number:**	47172
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Runner vs Replacement Energ	6.11%	-2,972,332	2,383,099	1	19.52%	6.3 years
B	Repair Runner vs Replacement Energy	6.11%	-42,436	-132,583	2	4.60%	8.9 years
C	Test 3	6.11%	0	0	3	#NUM!	0.0 years
D	Test 4	6.11%	0	0	3	#NUM!	0.0 years

Recommendation :

Based on the economic analysis it is more economic to replace the runner in 2016.

Notes/Comments :

Replace Runner vs Replacement Energy & Repair Costs

Option compares the refurbishment of the the runner and lost generation to the replacement of the runner with new. The calculation assumes a plant outage for the duration of the refurbishment work.

Repair Runner vs Replacement Energy& Repair & Costs

Option compares the lost generation to the capital costs for repair and a deferred runner replacement.

Test 3

Test 4

HYD - Tidewater Overhaul
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Hydro	**CI Number:**	47172
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runner vs Replacement Energy & Repai	6.11%	-2,972,332	2,383,099	1	19.52%	6.3 years
B	Repair Runner vs Replacement Energy& Repair &	6.11%	-42,436	-132,583	2	4.60%	8.9 years
C	Test 3	6.11%	0	0	3	#NUM!	0.0 years
D	Test 4	6.11%	0	0	3	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runner vs Replacement Energy & Repai	10%	-2,861,767	2,290,826	1	17.99%	6.6 years
B	Repair Runner vs Replacement Energy& Repair &	10%	132,737	-282,191	4	3.28%	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	110,564	-92,272	0	-1.53%	0.4 years
	B	175,173	-149,608	2	-1.32%	-8.9 years
	C	0	0	-1	#NUM!	0.0 years
	D	0	0	-1	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runner vs Replacement Energy & Repai	-10%	-2,629,379	2,104,929	1	18.12%	6.9 years
B	Repair Runner vs Replacement Energy& Repair &	-10%	100,963	-237,543	4	3.59%	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	342,953	-278,169	0	-1.40%	0.7 years
	B	143,399	-104,960	2	-1.01%	-8.9 years
	C	0	0	-1	#NUM!	0.0 years
	D	0	0	-1	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	100,315	243,577	368,735	No
	B	84,109	170,790	269,883	No
	C	0	0	0	No
	D	0	0	0	No

HYD - Tidewater Overhaul
Avoided Cost Calculations

Nova Scotia POWER
An Emera Company

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Hydro	**CI Number:**	47172
Originator :		**Project No. :**	

Replace Runner vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	100%	50%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	4300.0	4300.0				
Duration (Hours)	1	1				
Totals	$90,190	$195,435	$0	$0	$90,190	$195,435
Total Capital Cost of Alternative						$1,418,532

Repair Runner vs Replacement Energy& Repair & Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	75%	50%	75%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	4300.0	4300.0				
Duration (Hours)	1	1				
Totals	$90,190	$146,576	$0	$0	$90,190	$146,576
Total Capital Cost of Alternative						$2,827,838

Test 3

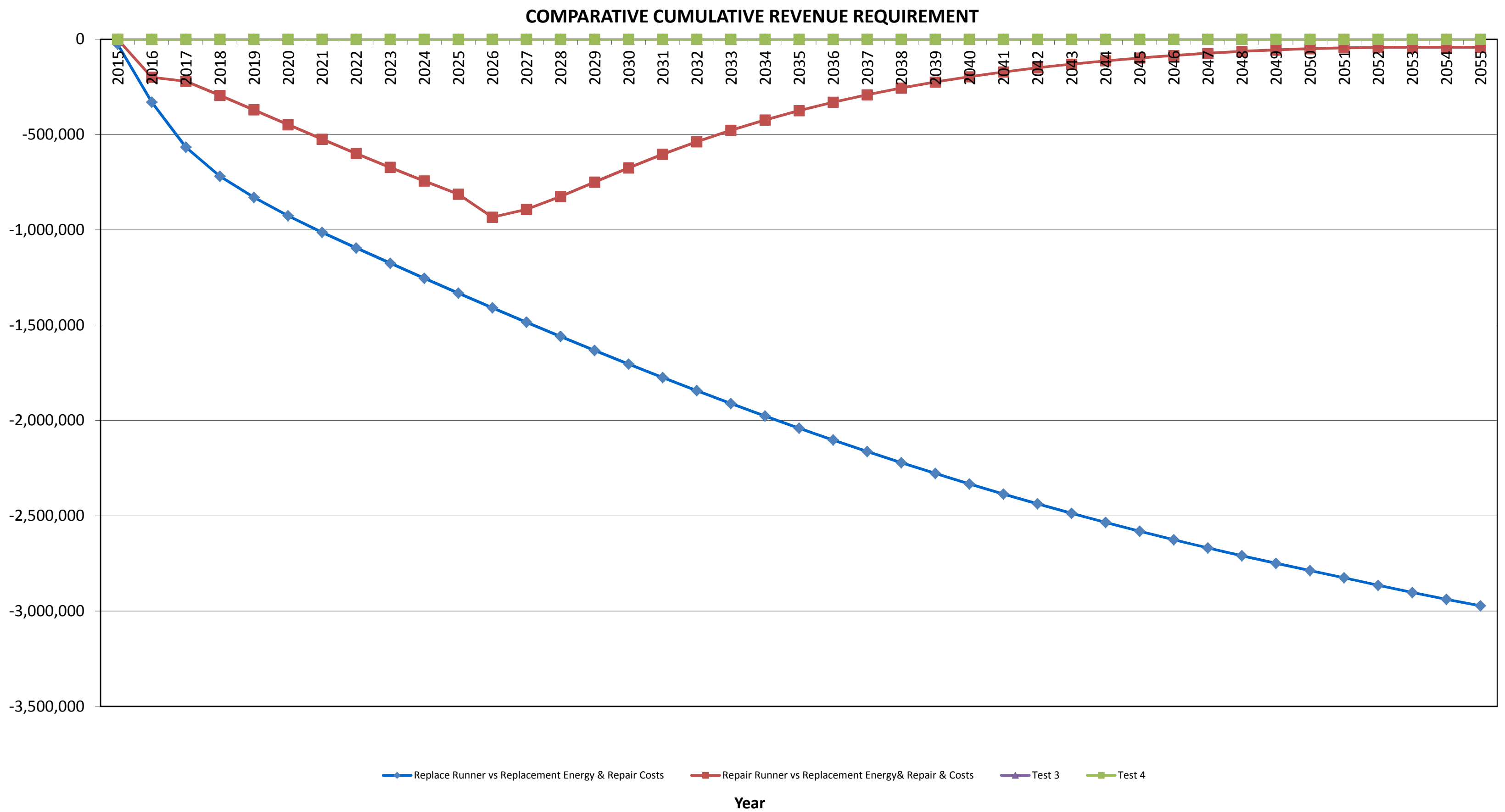
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

HYD - Tidewater Overhaul
Replace Runner vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	(429,342.8)	-	-	(429,342.8)	-	(429,342.8)	(429,342.8)	1.00	(429,342.8)
2016	33,793.5	-	90,189.7	(885,915.7)	318,239.0	970,208.1	(761,932.6)	60,219.3	(701,713.3)	(661,307.4)	0.94	(1,090,650.2)
2017	36,356.9	-	195,434.8	-	477,358.5	469,613.0	231,791.7	76,125.7	307,917.4	273,477.5	0.89	(817,172.7)
2018	39,517.2	-	214,643.3	-	238,679.3	219,315.5	254,160.5	(4,799.2)	249,361.3	208,718.1	0.84	(608,454.6)
2019	40,829.0	-	223,090.2	-	119,339.6	94,166.7	263,919.2	(44,819.7)	219,099.6	172,828.8	0.79	(435,625.8)
2020	43,272.2	-	234,647.0	-	59,669.8	31,592.3	277,919.2	(67,657.3)	210,261.9	156,307.2	0.74	(279,318.6)
2021	44,137.7	-	239,339.9	-	29,834.9	305.1	283,477.6	(78,629.2)	204,848.4	143,514.1	0.70	(135,804.4)
2022	45,020.4	-	244,126.7	-	14,917.5	(15,338.5)	289,147.1	(85,011.2)	204,135.9	134,779.9	0.66	(1,024.5)
2023	45,920.8	-	249,009.2	-	7,458.7	(23,160.3)	294,930.1	(89,116.1)	205,814.0	128,063.2	0.62	127,038.7
2024	46,839.3	-	253,989.4	-	3,729.4	(27,071.2)	300,828.7	(92,100.8)	208,727.9	122,397.8	0.59	249,436.5
2025	47,776.0	-	259,069.2	-	1,864.7	(29,026.6)	306,845.3	(94,544.0)	212,301.3	117,324.7	0.55	366,761.2
2026	48,731.6	-	264,250.6	-	932.3	(30,004.3)	312,982.2	(96,735.4)	216,246.7	112,623.8	0.52	479,385.0
2027	49,706.2	-	269,535.6	-	466.2	(30,493.2)	319,241.8	(98,820.4)	220,421.4	108,187.7	0.49	587,572.7
2028	50,700.3	-	274,926.3	-	233.1	(30,737.6)	325,626.6	(100,872.0)	224,754.6	103,962.5	0.46	691,535.1
2029	51,714.3	-	280,424.8	-	116.5	(30,859.8)	332,139.2	(102,927.0)	229,212.2	99,919.3	0.44	791,454.4
2030	52,748.6	-	286,033.3	-	58.3	(30,920.9)	338,782.0	(105,004.3)	233,777.6	96,041.3	0.41	887,495.7
2031	53,803.6	-	291,754.0	-	29.1	(30,951.5)	345,557.6	(107,113.8)	238,443.8	92,317.7	0.39	979,813.4
2032	54,879.7	-	297,589.1	-	14.6	(30,966.8)	352,468.7	(109,260.8)	243,208.0	88,740.2	0.36	1,068,553.6
2033	55,977.3	-	303,540.9	-	7.3	(30,974.4)	359,518.1	(111,448.4)	248,069.8	85,302.2	0.34	1,153,855.8
2034	57,096.8	-	309,611.7	-	3.6	(30,978.2)	366,708.5	(113,678.5)	253,030.0	81,997.8	0.32	1,235,853.6
2035	58,238.7	-	315,803.9	-	1.8	(30,980.1)	374,042.7	(115,952.7)	258,090.0	78,821.5	0.31	1,314,675.1
2036	59,403.5	-	322,120.0	-	0.9	(30,981.1)	381,523.5	(118,272.0)	263,251.5	75,768.4	0.29	1,390,443.6
2037	60,591.6	-	328,562.4	-	0.5	(30,981.6)	389,154.0	(120,637.6)	268,516.4	72,833.6	0.27	1,463,277.2
2038	61,803.4	-	335,133.6	-	0.2	(30,981.8)	396,937.1	(123,050.4)	273,886.6	70,012.5	0.26	1,533,289.7
2039	63,039.5	-	341,836.3	-	0.1	(30,981.9)	404,875.8	(125,511.5)	279,364.3	67,300.7	0.24	1,600,590.4
2040	64,300.3	-	348,673.0	-	0.1	(30,982.0)	412,973.3	(128,021.7)	284,951.6	64,693.9	0.23	1,665,284.2
2041	65,586.3	-	355,646.5	-	0.0	(30,982.0)	421,232.8	(130,582.2)	290,650.6	62,188.1	0.21	1,727,472.3
2042	66,898.0	-	362,759.4	-	0.0	(30,982.0)	429,657.4	(133,193.8)	296,463.6	59,779.3	0.20	1,787,251.6
2043	68,236.0	-	370,014.6	-	0.0	(30,982.0)	438,250.6	(135,857.7)	302,392.9	57,463.9	0.19	1,844,715.5
2044	69,600.7	-	377,414.9	-	0.0	(30,982.0)	447,015.6	(138,574.8)	308,440.8	55,238.1	0.18	1,899,953.6
2045	70,992.7	-	384,963.2	-	0.0	(30,982.0)	455,955.9	(141,346.3)	314,609.6	53,098.5	0.17	1,953,052.1
2046	72,412.6	-	392,662.5	-	0.0	(30,982.0)	465,075.0	(144,173.3)	320,901.8	51,041.8	0.16	2,004,094.0
2047	73,860.8	-	400,515.7	-	0.0	(30,982.0)	474,376.5	(147,056.7)	327,319.8	49,064.8	0.15	2,053,158.8
2048	75,338.0	-	408,526.0	-	0.0	(30,982.0)	483,864.1	(149,997.9)	333,866.2	47,164.4	0.14	2,100,323.1
2049	76,844.8	-	416,696.6	-	0.0	(30,982.0)	493,541.3	(152,997.8)	340,543.5	45,337.5	0.13	2,145,660.7
2050	78,381.7	-	425,030.5	-	0.0	(30,982.0)	503,412.2	(156,057.8)	347,354.4	43,581.5	0.13	2,189,242.1
2051	79,949.3	-	433,531.1	-	0.0	(30,982.0)	513,480.4	(159,178.9)	354,301.5	41,893.4	0.12	2,231,135.6
2052	81,548.3	-	442,201.7	-	0.0	(30,982.0)	523,750.0	(162,362.5)	361,387.5	40,270.7	0.11	2,271,406.3
2053	83,179.3	-	451,045.8	-	0.0	(30,982.0)	534,225.0	(165,609.8)	368,615.3	38,710.9	0.11	2,310,117.2
2054	84,842.8	-	460,066.7	-	0.0	(30,982.0)	544,909.5	(168,922.0)	375,987.6	37,211.5	0.10	2,347,328.7
2055	86,539.7	-	469,268.0	-	0.0	(30,982.0)	555,807.7	(172,300.4)	383,507.3	35,770.2	0.09	2,383,098.9
Total	**2,400,409.4**	**-**	**12,923,678.3**	**(1,315,258.6)**	**1,272,956.1**		**14,008,829.0**	**(4,355,850.8)**	**9,652,978.3**	**2,383,098.9**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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-2,500,000
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-3,500,000
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2055
Replace Runner vs Replacement Energy & Repair Costs
Repair Runner vs Replacement Energy& Repair & Costs
Test 3
Test 4
Year

NORCAN
HYDRAULIC TURBINE INC.

50 Bruce Crescent, Carleton Place, ON Canada K7C 3V6 T (613) 257-4755 F (613) 257-4215 E nht@norcanhydro.com www.norcanhydro.com

Aug 18, 2015 *

Andrea MacKay
Procurement Team Lead
NS Power Inc.
Andrea.MacKay@nspower.ca
(902) 428-3000 ext. 5265

Ref: Firm proposal for the supply of one (1) Replacement Upgraded Francis Runner and Turbine/Generator refurbishment for the NSPI Tidewater Power Station (RFP P-15-072). Norcan Reference # Q15-2223 Rev 1*

Dear Andrea,

Norcan Hydraulic Turbine Inc. is pleased to submit the following as a firm proposal for the supply of one (1) Replacement Upgraded Francis Runner and Turbine/Generator refurbishment for the NSPI Tidewater Power Station based on the supplied site data. A new custom CFD designed Runner will be manufactured to suit the existing Turbine assembly.

Attached, please find a general summary, detailed scope of supply and performance curves. I hope this proposal meets your requirements.

If you have any questions or require clarifications, please let us know.

Sincerely,
Norcan Hydraulic Turbine Inc.

ROD FOSTER
OPERATIONS MANAGER
NORCAN HYDRAULIC TURBINE INC.
T613-257-4755 EXT 17
F613-257-4215
C613-883-3503

TABLE OF CONTENTS

1.0 GENERAL SUMMARY

1.1 Pricing *

Item	**General Description**	**Qty**	**Amount (CAD/Dollar)**
Equipment Supply	Turbine/Generator assessment, design and manufacture of one (1) Francis Runner/Coupling Bolts, dismantling/removal, refurbishment and installation.		(Itemized costs shall equal below sum):
1	• ~~Assessment (Turbine/Generator)~~	~~1~~	[redacted]
2	• Francis Runner & Coupling Bolts	1	[redacted]
3	• Wicket Gate Refurbishment	1 set	[redacted]
4	• Bushings and Pins (Distributor Refurbishment)	1 set	[redacted]
	• Turbine Guide Bearing Refurbishment *	1	[redacted]
	• Generator Babbitt Bearing Refurbishment	1 set	[redacted]
5	• Scroll Case Blast & Coat	1	[redacted]
6	• Disassembly & Reassembly	1	[redacted]
7	• Miscellaneous Items	1	[redacted]
8	• Rotor Pole Repair (Existing Coils) *	24	[redacted]
	• Rotor Pole Repair (New Coils) *	24	[redacted]
9	• Electrical Testing (Stator, Rotor & Exciter Repair) *	1	[redacted]
10	• Shipping	1	[redacted]
	TOTAL		-
	Contingency Items		
	• Lead Paint Abatement	1	T/M
	• ~~Asbestos Abatement~~	~~1~~	[redacted]
	• Replacement Wicket Gates	1	[redacted]
	• In place Machining Headcover Flange	1	[redacted]
	• Spare Split CIP Hydro Split Sleeve *	1	[redacted]
	• Headcover Cold Stitch Repairs	1	[redacted]
	• Rotor Pole Core Replacement	1	[redacted]
	• Core Iron Replacement	1	[redacted]
	• ~~Generator Rewind~~	~~1~~	[redacted]
	• Exciter Field Coil Rewind *	1	[redacted]
	• Exciter Brush Holder *	24	[redacted]
	• Bottom Ring - Bronze Wear Ring *	1	[redacted]
	• Headcover/Bottom Ring Facing Plate *	2	[redacted]
	• Pressure Grouting (Per day)	1	[redacted]
	• Weld Repairs (Per lbs)	1	[redacted]

1.2 Notes

- Engineering/Design of civil structures not included
- Electrical engineering and protection study not included
- High Voltage interconnect by others
- Taxes not included
- Delivery time of eleven (11) to twelve (12) months from reception of the P.O. and receipt of the down payment

- Delivery INCOTERM: FOB (St. Margaret's Bay, NS)
- Warranty for one year from commissioning or eighteen (18) months after delivery, whichever is sooner
- Quote valid for 90 days

2.0 CUSTOMER DATA

2.1 Turbine Data:

Runner Type:	Vertical Francis
Number of Unit(s):	2
Location:	St. Margaret's Bay, Nova Scotia
Net Head	27.4m/90 ft
Rated Flow:	8.49 cms/300 cfs
Turbine Speed:	300 RPM

3.0 DETAILED SCOPE OF SUPPLY

3.1 Assessment

The Owner will dewater and de-energize the unit prior to commencing the work of this task. Prior to disassembly, *Norcan* will perform all applicable confined space air monitoring/recue and fall arrest procedures. Assessment tasks will be as follows:

- Perform visual and dimensional inspection of the Scroll Case and Stay Ring.
- Perform visual and dimensional inspection of Wicket Gate seal edges in closed position.
- Perform visual and dimensional inspection of Wicket Gate opening (at 10% opening increments) versus servomotor stroke for a minimum of five (5) representative pairs of Wicket Gates.
- Perform visual and dimensional inspection of Runner radial seal clearance.
- Perform visual and dimensional inspection of Runner axial position within the Distributor.
- Perform visual and dimensional inspection of Turbine Shaft to Turbine Guide Bearing radial clearance.
- Perform visual and dimensional inspection of Generator Shaft to Generator Guide Bearing radial clearance.
- Perform visual and dimensional inspection of Generator air gap readings.
- Perform 4 wire inspections to verify existing Turbine/Generator Shaft plumbness.
- Perform visual and dimensional runout (TIR) inspection of rotating assembly with the rotor turned at 45° intervals and match mark shaft couplings.
- Perform visual and Generator winding inspection without disassembly.
- Perform Lead Paint inspection and verification of Turbine/Generator assembly.
- Perform Asbestos inspection and verification of Generator assembly.
- Submit As Found report to Owner with suggested "contingency" repair items.

3.2 Francis Runner

Material

The Crown, Blades and Band components will be of cast ASTM CF8 stainless steel or approved equivalent.

Construction

The Runner will be designed to meet the allowable stress requirements for the materials used as defined in ASME B&PV SECTION II Part D.

The Runner will be fabricated, machined and ground in accordance with Norcan manufacturing design standards and tolerances stated in DWI050-Rev 3. The Runner will meet or exceed IEC standard publication 60193 1999-11.

The Runner Crown and Band will be cast and/or fabricated and fully pre-machined. The Blades will be cast, pre-machined and hand ground. The Blades will be welded to the Crown and Band as follows:

The first 15% of the Blade length at the inlet and discharge will have 100% penetration. The remaining length of the Blade will have 1/3 of the Blade thickness V weld per side. A concave fillet weld will finish the Blade to Crown and Blade to Band. The fillet weld will be hand ground to the required finish with no permissible undercuts. The weld filler material will be ER308L. All welders are qualified to QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code or CSA W47.1. (Ref. DWI-059, DWI-015)

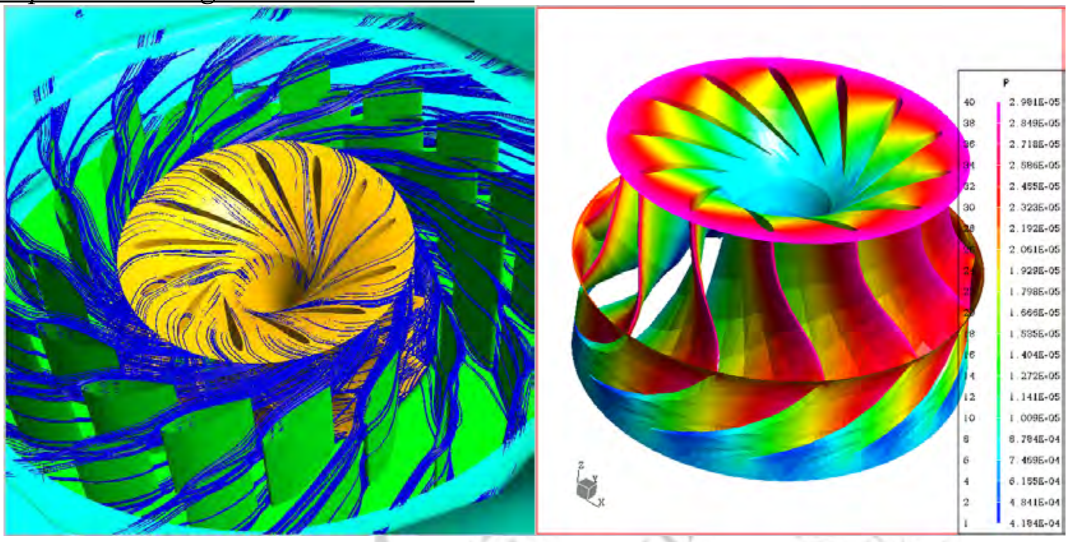
The Runner minimum finish will be as follows:

Water passages	
Upper two thirds of the Blade	125 finish
Lower one third of the Blade	63 finish
Runner	
Outside finish all over with axis	250 finish
Seal surfaces	125 finish
All other surfaces	125 finish

Balancing

The Runner will be statically balanced to meet or exceed the standards of ISO 1940 G6.3. Weights shall be added or removed in such a manner that there will be no projections or depressions from the finished surfaces. No eccentric machining will be performed.

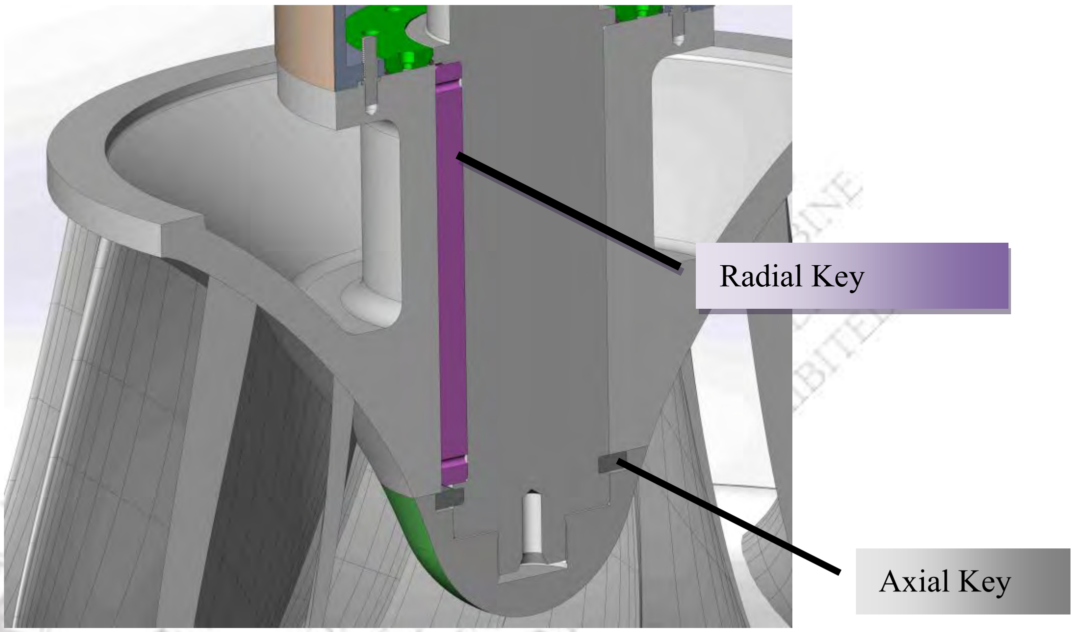
Example CFD designed Francis Runner



3.3 Runner Keys

The Runner Keys (axial and radial) will be supplied to fasten the Replacement Upgraded Francis Runner to the existing Turbine Shaft. The Runner Key material will be of AISI 1045 carbon steel or approved equivalent.

Example Francis Runner Keys



3.4 Turbine Performance

3.5 General Data (300rpm) "Design A"

Turbine

1. Turbine manufacturer	Norcan Hydraulic Turbine Inc.
2. Maximum flow	[redacted]
3. Flow at maximum efficiency	[redacted]
4. Maximum Wicket Gate opening (degree)	TBA

For Net head 27.44 m/90.0 ft*

5. Maximum efficiency (%)	91.45%
6. Efficiency at maximum flow (%)	88.31%
7. Max. Power at Turbine Shaft	2584 kW

Data

8. Operating speed	300 rpm
9. Runaway speed	540 rpm
11. Runner diameter nominal	1295 mm/51.0"
12. Power vs. efficiency	See Section 3.6
13. Power vs. flow	See Section 3.6

*Net Head (as per IEC code), measured between the Spiral Case Intake (downstream of the case inlet flange) and the Draft Tube exit:

*As defined by IEC Code 60041.

3.6 Performance Curves "Design A"

Hnet =	90.0	ft	=	27.44	m IEC code
Dth (nom) =	51.00	in	=	1.295	m
n =	300	rpm			

Turbine Efficiency	Flow	Flow	Turbine Shaft Power	Turbine Shaft Power			
[%]	[cms]	[cfs]	[kW]	[hp]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

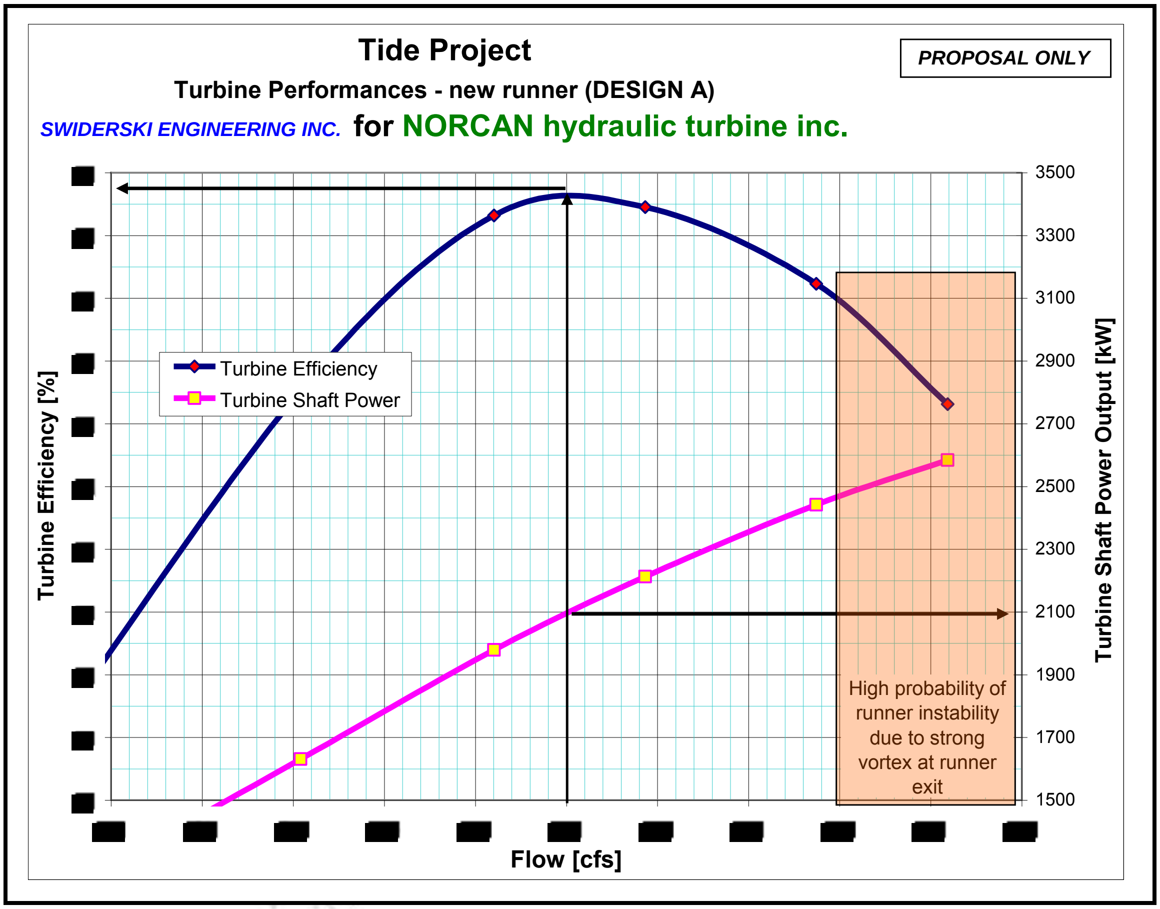


FIG. 1 Expected Turbine performance curves for the Turbine equipped with Runner optimized for the 300cfs of flow

3.7 General Data (300rpm) "<u>Design B</u>"

Turbine

1. Turbine manufacturer	Norcan Hydraulic Turbine Inc.
2. Maximum flow	[redacted]
3. Flow at maximum efficiency	[redacted]
4. Maximum Wicket Gate opening (degree)	TBA

For Net head 27.44 m/90.0 ft*

5. Maximum efficiency (%)	91.92%
6. Efficiency at maximum flow (%)	90.45%
7. Max. Power at Turbine Shaft	3057 kW

Data

8. Operating speed	300 rpm
9. Runaway speed	540 rpm
11. Runner diameter nominal	1295 mm/51.0"
12. Power vs. efficiency	See Section 3.8
13. Power vs. flow	See Section 3.8

*Net Head (as per IEC code), measured between the Spiral Case Intake (downstream of the case inlet flange) and the Draft Tube exit:

*As defined by IEC Code 60041.

3.8 *Performance Curves "<u>Design B</u>"*

Hnet =	90.0	ft	=	27.44	m IEC code
Dth (nom) =	51.00	in	=	1.295	m
n =	300	rpm			

Turbine Efficiency	Flow	Flow	Turbine Shaft Power	Turbine Shaft Power			
[%]	[cms]	[cfs]	[kW]	[hp]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

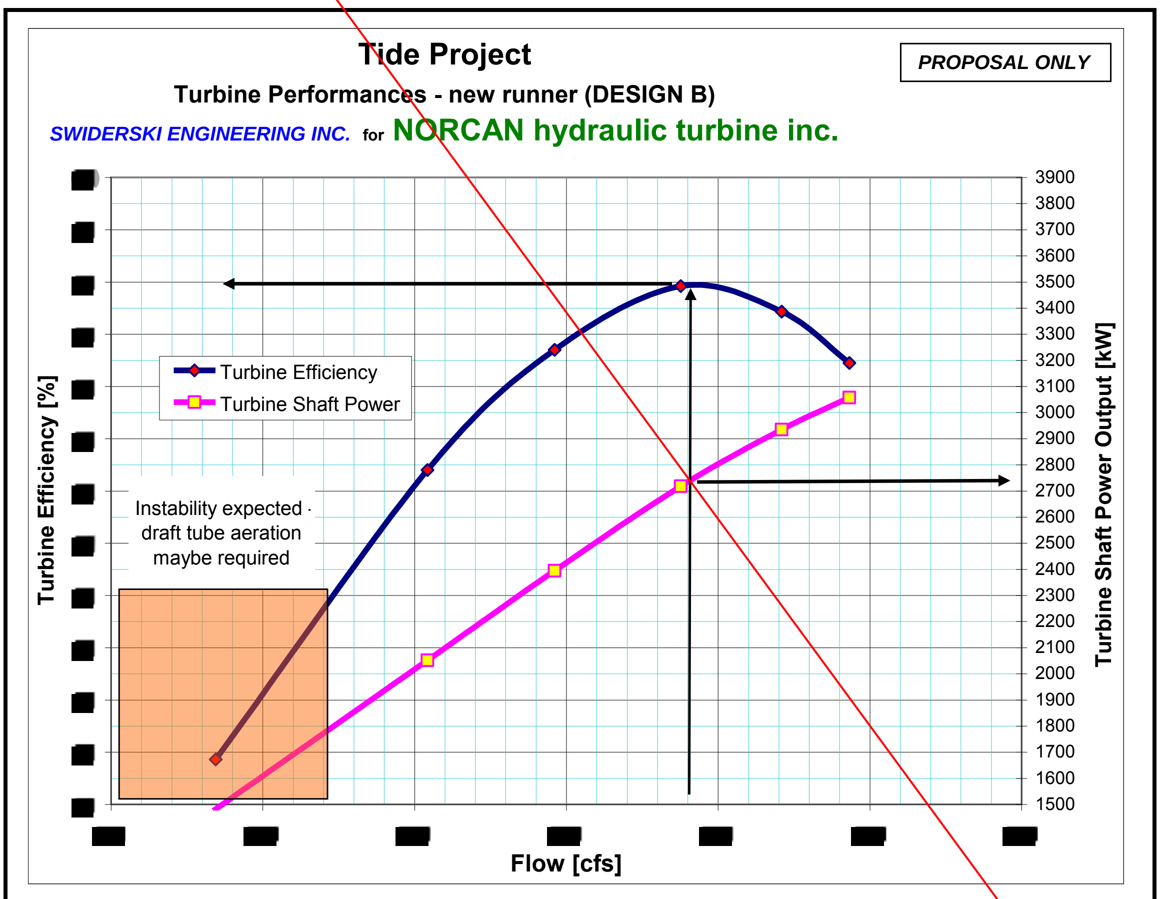


FIG. 2 Expected Turbine performance curves for the Turbine equipped with Runner optimized for the 390cfs of flow capable of achieving full generator capacity.

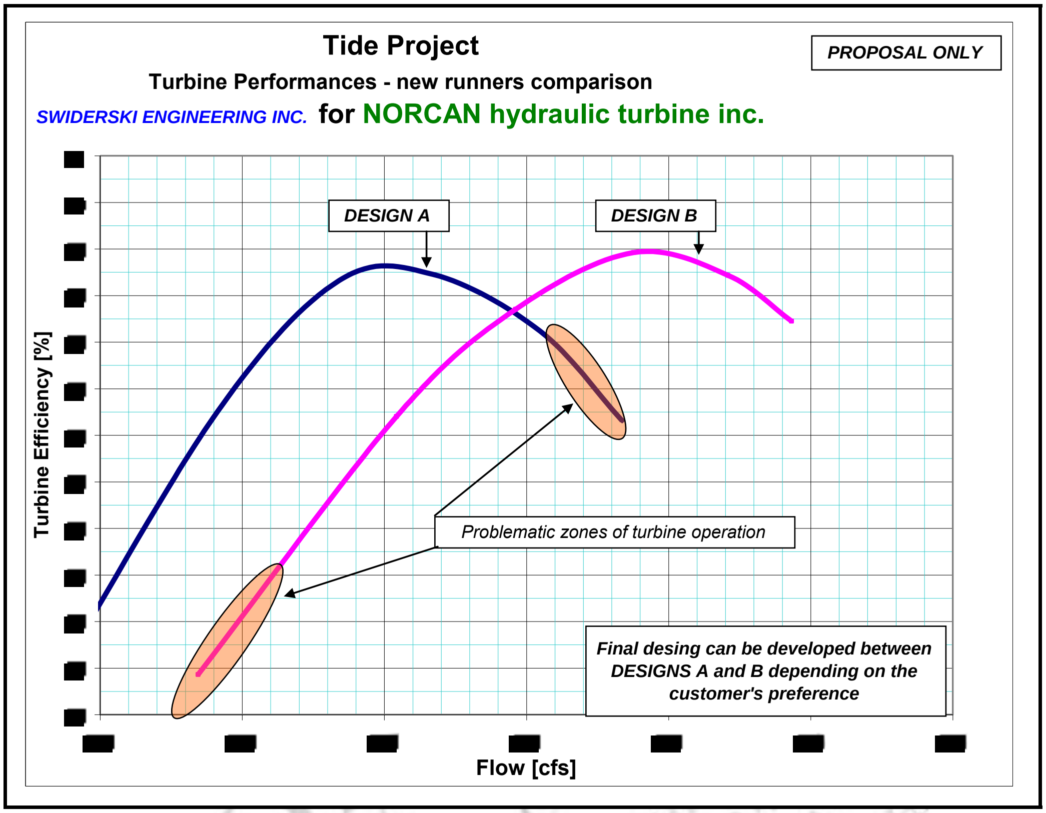


FIG. 3 Comparison of efficiency characteristics for two extreme designs (A and B). The final design target should be decided upon the annual energy production analysis.

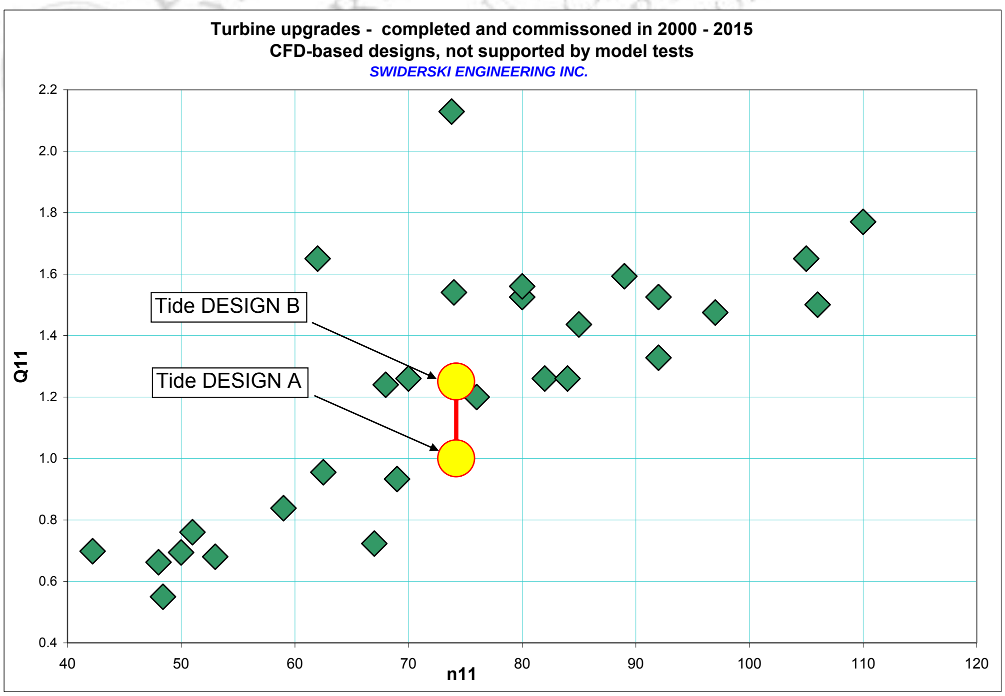
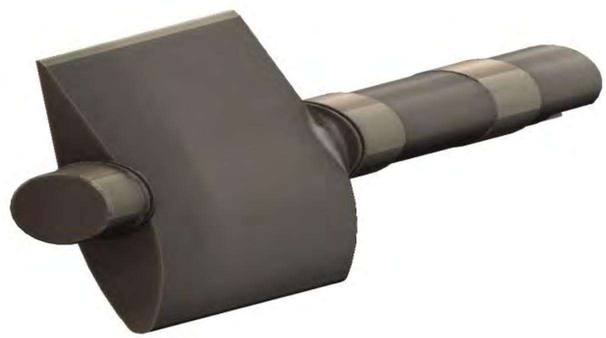


FIG. 4 Design zone for the Tidewater project shown versus other completed projects in terms of hydrodynamic similarities (double reduced flow (Q11) and speed (n11))

3.9 Wicket Gate Refurbishment

The existing Wicket Gates will be cleaned and a visual, dimensional, as well as an NDE (MPI) and positive material inspection (PMI) will be completed. Areas found with minor defects will be weld repaired. The Wicket Gate end faces and shut off seal faces will be re-machined to ensure proper clearances upon reassembly. The Wicket Gate stem bearing and seal journals will be fitted with a 316L stainless steel sleeve. The body of the Wicket Gate will be sandblasted to meet SSPC-10 and coated with 2 part epoxy paint (Rustoleum 9100 series).

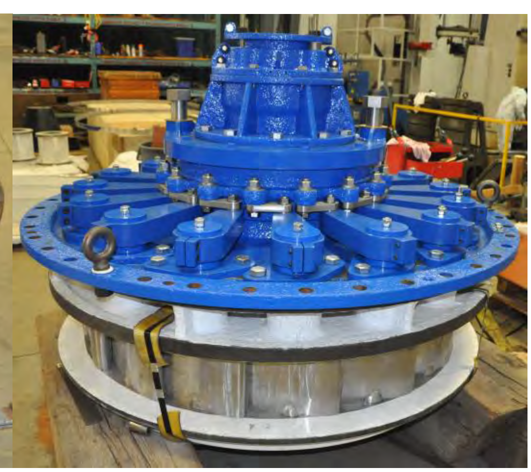
Example Assembly Refurbished Wicket Gate with stainless steel sleeved journals



3.10 Bushings and Pins (Distributor Refurbishment)

All components, including but not limited to: Regulating Ring, Headcover, Bottom Ring, Lever Arms, Transfer Links, and Pins will be disassembled, sandblasted, and cleaned of any oil and debris. A visual, dimensional, as well as an NDE (MPI) inspection will be completed. If necessary, the applicable Headcover faces will be machined to achieve flatness and concentricity with the Regulating Ring and Wicket Gates. The Wicket Gate bores of the Headcover and Bottom Ring will be match bored. All of the Headcover, Bottom Ring and Wicket Gate linkage bushings as well as the Regulating Ring guides will be replaced with CIP hydro self-lubricating material. The Headcover, Bottom Ring, Regulating Ring and Wicket Gate linkage system will be sandblasted to meet SSPC-10 and coated with 2 part epoxy paint (Rustoleum 9100 series).

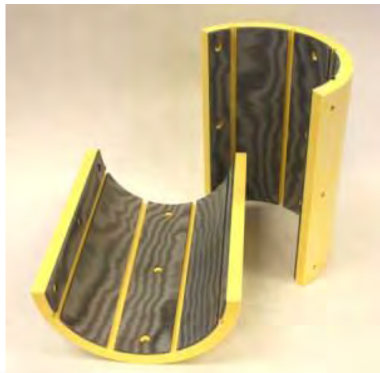
Example Refurbished Distributor Assembly



3.11 Turbine Guide Bearing Refurbishment *

The existing Turbine Guide Bearing (wet bearing) will be disassembled, sandblasted and cleaned of any oil and debris. A visual, dimensional, as well as an NDE (MPI) inspection will be completed. The existing wet bearing staves will be replaced with split sleeve water lubricated CIP hydro bearing. The Turbine Guide Bearing housing will be sandblasted to meet SSPC-10 and coated with 2 part epoxy paint (Rustoleum 9100 series).

Example CIP "Split Sleeve" Water Lubricated Turbine Guide Bearing



3.12 Generator Babbitt Bearing Refurbishment

The existing Generator Babbitt Bearings will be disassembled and cleaned of any oil and debris. A visual, dimensional, as well as an NDE (MPI) inspection will be completed to verify as found condition. The Generator Babbitt Bearings material is then to be replaced and re-machined to as new condition. The Generator Babbitt bearing housings will be sandblasted to meet SSPC-10 and coated with Glyptol 1201 enamel paint.

Example Babbitt Bearing Refurbishment

3.13 Scroll Case Blast & Coat

If applicable, Lead Paint Abatement will be completed to the existing steel portion of the embedded Scroll Case. The Scroll Case will then be visually inspected for cracks or other defects and repaired as necessary. Proper embedment will be verified by a "knock test" and if found necessary localized pressure grouting will be completed. The Scroll Case will be sandblasted to meet SSPC-10 and coated with 2 part epoxy paint (Rustoleum 9100 series).

Example Scroll Case (Stayring) Blast & Coat

3.14 Disassembly & Reassembly

General Conditions – Mob/Demob, Temporary Structures, Equip.
Handling, storage & incidental work includes:

a. Mobilization and demobilization;
b. Providing the manpower and temporary structures and facilities to perform the work at the site;
c. Providing temporary on-site storage;
d. Dismantling temporary structures;
e. Provide all necessary confined space and fall arrest equipment
f. Disposal of equipment and materials not used in the final rehabilitated assembly and maintaining the powerhouse and site during the course of the work in a manner that is satisfactory to the Owner.

Upon the completion of the work, the powerhouse and site will be cleaned of all debris to the satisfaction of the Owner.

3.15 Unit Disassembly

a. Match mark and label and digitally photograph all components that are to be disassembled.

b. All low voltage electrical cables will be identified, disconnected and protected from injury during the course of the work. Information such as size, interconnected equipment, etc. will be labeled and documented for reinstallation.

c. If required, remove and dispose of any loose hazardous materials (Asbestos, Lead Paint prior to disassembly.

d. Disassemble any auxiliary systems (lubrication systems, governor oil, air and cooling water piping, instrumentation, walkways, etc.).

e. Disassemble Generator noting and digitally photographing all significant findings.

f. Disassemble Turbine noting and digitally photographing all significant findings.

g. Disassemble and dispose of any components, systems, or materials that are to be discontinued or replaced.

h. All equipment and parts to be reused are to be shipped to Norcan Hydraulic Turbine to be cleaned and inspected to verify that they are in good condition and suitable for reuse. All such parts will be tagged, identified and securely stored. Small parts (bolts, washers, nuts, pins, etc.) will be kept in suitable containers; container contents shall be appropriately identified.

i. Equipment not found to be in good condition will be documented and brought to the attention of the Owner for a determination of its disposition (i.e., rehabilitate, replace).

j. Any equipment stored inside the powerhouse will be at a location to be designated by the Owner.

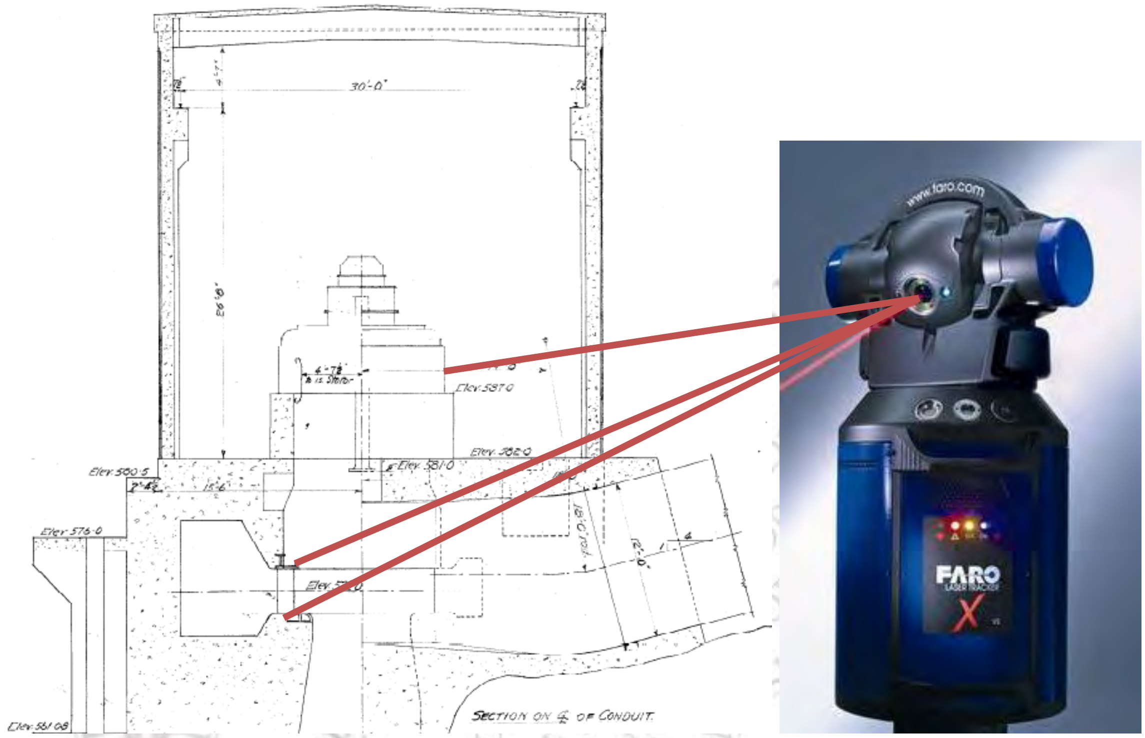
k. Unless otherwise directed, any equipment to be stored outside the powerhouse (on-site) will be stored and protected in a secure, lockable, weatherproof enclosure. Such an enclosure shall be subject to the approval of the Owner.

3.16 Stay Ring

The Stay Ring will be cleaned and visually inspected for cracks or cavitation damage and weld repaired as necessary.

3.17 As Found Alignment

Upon completion of dismantling and cleaning the existing Turbine/Generator, the alignment will be verified by means of a Faro Laser Tracker. If necessary, in-place machining will be completed to ensure levelness and concentricity of the Headcover and Stator to the embedded Stay Ring.



3.18 Oil Lubrication System

a. Examine the existing oil lubrication system and replace or repair items in order to alleviate any leakage and filter problems. Replace oil with Teresso 46.

3.19 Unit Reassembly

a. Document and digitally photograph all lifting hardware and assembly procedures.
b. Assemble Turbine; adjust (if required) all Wicket Gate Arms to assure complete Wicket Gate closure at "0" gate opening.
c. Assemble and operationally test all auxiliary systems (lube oil, governor oil, cooling water piping, and supporting instrumentation).
d. Assemble Generator and all associated wiring.
e. Install Terresso 46 lubricant in all unit bearings.

3.20 Unit Alignment Check

Perform a complete unit alignment check as follows:

a. Install center wire in unit and adjust the Stator Winding and Generator Upper and Lower Bridge to be concentric and level to embedded Stay Ring, Bottom Ring and Throat Ring.
b. After completion of preliminary alignment by means of the center wire the adjusted Stator and Generator Upper and Lower Bridge will be verified by means of a Faro Laser Tracker.
c. Once the unit is reassembled and sitting on the Thrust Bearing assembly, perform four-wire alignment check and TIR check.

3.21 Pre-Start up Dry Tests:

a. Check installed calibration of all instruments (coordinate w/Owner).
b. Prior to energizing all conductors, devices, and systems the unit shall be "rung out" and tested for continuity to verify that they are connected in accordance with the wiring diagrams and that they perform as required. If a wiring diagram does not exist, one shall be provided showing the "as built" wiring.
c. These dry tests are to be witnessed by the Owner or Engineer.

3.22 Pre-Start Up Wet Tests:

a. Shaft run out (TIR) - Take Shaft run out readings at Generator Upper and Lower Guide Bearing and Turbine Guide Bearing areas.
b. During unit start up and on-line testing, the Generator Upper and Lower Bearings, Thrust Bearings, and Turbine Guide Bearing temperature shall NOT exceed 60° C/140° F (set point).
c. NOTE: If ANY bearing temperature should exceed this set point, the test should be stopped and the Owner and Engineer shall be notified immediately.

3.23 Start-Up and On-Line Tests:

Perform post-overhaul power-ascension tests.

3.24 Miscellaneous Items (Recommended)

Turbine Shaft Refurbishment

- Clean and inspect NDE (UT, MPI)
- Dimensional Inspection (Dimensional, TIR)
- Replacement SS ASTM A743 CA-15 split sleeve (Packing Gland journal)

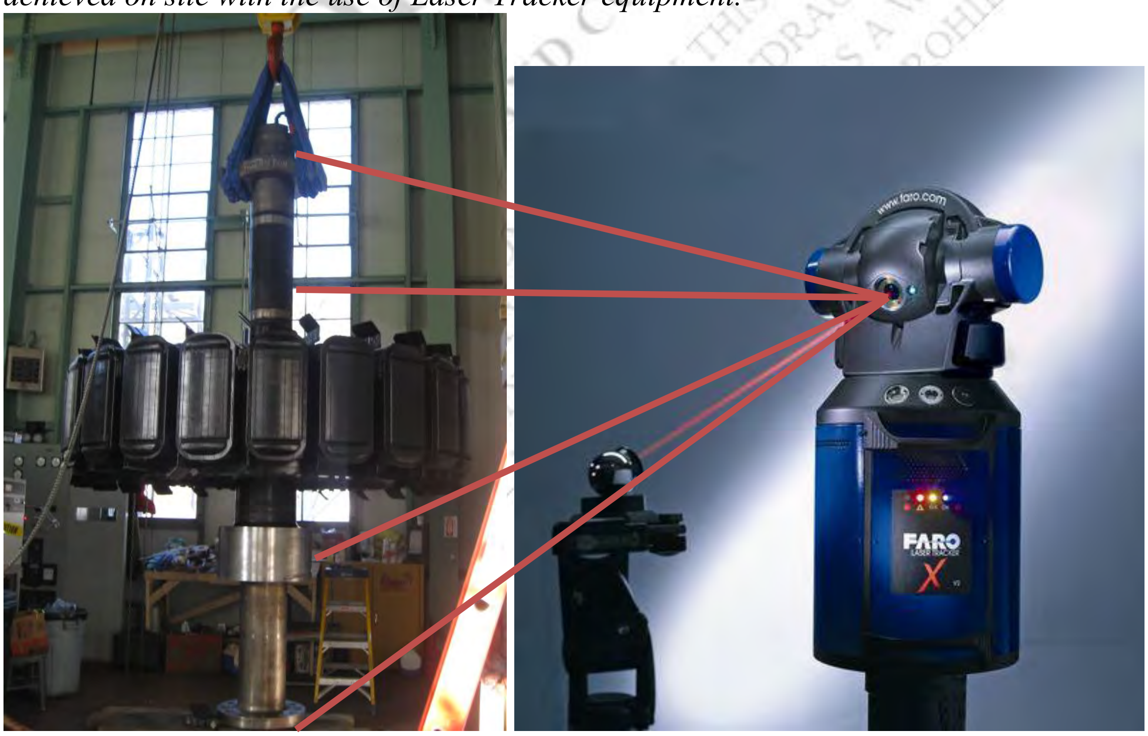
Packing Gland Refurbishment

- Clean and inspect NDE (MPI)
- Dimensional Inspection (Dimensional)
- Replace Wear Rings Labyrinth and Packing Material
- Sandblast to meet SSPC-10 and coated with 2 part epoxy paint (Rustoleum 9100 series).

Generator Shaft

- Clean and inspect NDE (UT, MPI)
- Perform visual and dimensional inspection of all bearing journals
- On Site Faro Inspection of the Generator Shaft

It is recommended that the existing Generator Shaft be dimensionally inspected to verify straightness and trueness of the bearing journals to the coupling face. This can be achieved on site with the use of Laser Tracker equipment.



3.25 Rotor Pole Repair (Generator)

- Disassembly and removal of damaged Rotor Pole on site
- Transport to repair shop
- Disassembly of Coil from the Core
- Cleaning and varnishing of existing coil
- Replacement Pole insulation
- Supply new insulated washers
- Reassemble on site
- Final testing

3.26 Electrical Testing (Generator)

(On site Work)

- Electrical testing (Generator Stator, Rotor, and Stator exciter)
- Dry Ice cleaning (Stator, Rotor, and Stator exciter)
- Epoxy Painting of windings
- Cleaning of Brush holder and Commutator
- Reassembly and adjustment of Brush holder and Commutator (Brushes supplied by Owner)
- Generator Brake (Clean, inspect, report findings, reinstall Brake Pads)

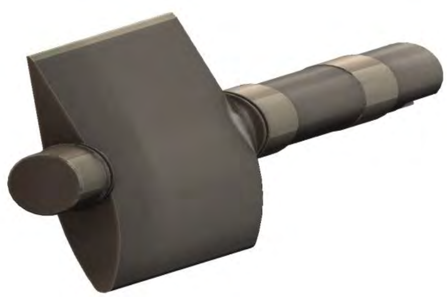
(Off site Shop Work)

- Steam cleaning and oven drying of Exciter Armature
- Electrical Testing
- Machining, Chamfering and undercut Commutator
- Dynamic Balancing

3.27 Contingency Items

- Lead Paint Abatement (testing and costs to be completed during assessment)
- ~~Asbestos Abatement (testing and costs to be completed during assessment)~~
- Replacement Wicket Gates
- In place Machining of the Stay Ring mounting flanges (if deemed necessary)
- Spare *CIP hydro material "split sleeve"* for Turbine Guide Bearing.
- Headcover Cold Stitch Repairs (if deemed necessary)
- Core Iron Replacement (if deemed necessary)
- Headcover/Bottom Ring facing plates
- ~~Generator Rewind (if deemed necessary)~~
- Pressure Grouting (Per day)
- Weld Repairs (Per lbs)

Example Replacement Wicket Gate



Example CIP "Split Sleeve" Water Lubricated Turbine Guide Bearing

Example Face plate *

Example Cold Stitch Repair

4.0 COMMERCIAL TERMS

4.1 Delivery

- Assessment report 2 weeks from completion of the on-site assessment
- Runner manufacturing 10-11 months after receipt of the contract and receipt of the down payment.
- Disassembly/removal, 3-4 weeks from mobilization.
- Refurbishment of Turbine and Generator 14-16 weeks from completion of disassembly.
- Installation 4-6 weeks from completion of Runner manufacturing and refurbishment of Turbine and Generator

* *All delivery times start from the date of acceptance of the order and receipt of the down payment.*

4.2 Project Schedule

A detailed schedule will be presented three (3) weeks after completion of the assessment.

4.3 Payment Schedule

The following terms of Payment shall apply:

20% Down payment with the order
15% Upon receipt of Runner construction materials (Castings, Forgings, Plate)
15% Completion of on-site disassembly
10% Completion of fabrication (Runner)
10% Completion of refurbished components
10% All components ready for shipping
10% Completion of on-site reassembly
10% Commissioning

5.0 GENERAL CONDITIONS OF CONTRACT

(Note: Any reference to "Norcan" is a reference to Norcan Hydraulic Turbine Inc.)

Indemnification

Norcan shall indemnify and hold harmless the Customer against all claims, demands, losses, damages and costs, all as finally judicially determined, excluding loss of profit and any punitive, exemplary, indirect, consequential or special losses or damages, whether in contract or in tort or otherwise, by third parties where such claims, demands, losses, damages and costs are:

(i) attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property;

(ii) caused by negligent acts or omissions of Norcan or anyone for whose acts Norcan may be liable; and

(iii) made in writing within a period of two years from the date of delivery to the Customer of each Norcan supplied equipment.

The Customer expressly waives the right to indemnity for claims other than those stated above.

The obligations of Norcan to indemnify hereunder shall be limited to an aggregate amount no greater than the amount payable to Norcan under this Contract hereinafter referred to as the "total Contract price".

The Customer shall indemnify and hold harmless Norcan and Norcan's agents and employees from and against claims, demands, losses, costs, damages, actions, suits or proceedings arising out of Norcan's performance of the work under this Contract which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the place where the Norcan supplied equipment is delivered and, or installed.

Force Majeure

Any delay or failure in the performance by Norcan hereunder shall be excused and no liability whatsoever will rest with Norcan where such delay or failure is caused by Force Majeure. For the purposes of this Agreement, Force Majeure shall mean an event or cause beyond Norcan's control and shall include, but is not limited to, acts of God, riots, wars, insurrection, acts of public enemy, sabotage, terrorism, vandalism, embargo, national emergency, accident, restraint of government, governmental acts, fires, floods and other natural disasters, explosions, severe weather including hurricanes and storms, injunctions, labour strikes or inability to obtain required labour, materials or manufacturing facilities from normal sources, acts of a customer and/or owner, wrecks or delays in transportation.

Warranty

The warranty period with respect to this Contract terminates on a date which is the sooner of:

(i) that day which is 12 months from the completion of the initial test runs of the installed Norcan equipment; and,

(ii) that day which is 18 months from the date of delivery of the Norcan supplied equipment.

Norcan shall be responsible for the proper performance of its work and for the work of those for whose acts Norcan may be liable to the extent that this Contract and related documents permits such performance, save that it is understood and agreed that:

(i) Norcan accepts no liability for the design of civil works, intake and trash racks, powerhouse or foundation stability, tail race or other associated water passages or for work improperly done by others, nor does Norcan accept liability for lack of or errors in water availability, flow duration studies or the condition of the water flowing into the turbine. Furthermore, Norcan does not accept liability for damage to the turbine components due to debris (rock metal, lumber, etc.) passing through the turbine intake;

(ii) Norcan shall not be liable to remedy defects or deficiencies which have arisen as a result of the acts or omissions of those over whom Norcan does not exercise control;

(iii) This warranty is void and unenforceable unless Norcan is afforded the opportunity to complete a final inspection of the completed work within **14** (fourteen) days of installation of the Norcan supplied equipment.

Subject to the provisions of this clause Norcan shall correct promptly, at Norcan's expense, defects and deficiencies in its work which appear prior to and during the warranty period specified herein.

The Customer shall promptly give Norcan notice in writing of observed defects and deficiencies that occurred during the warranty period and Norcan shall be immediately afforded the opportunity to inspect and observe the alleged defects and deficiencies.

Where Norcan fails to correct defects or deficiencies brought to its attention for which it would otherwise be liable, it shall be liable to the Customer to pay for the reasonable costs incurred by the Customer in correcting such defects or deficiencies.

It is understood and agreed that Norcan's liability under this warranty is limited to an aggregate amount which shall not exceed 10 percent (10%) of the total Contract price.

Damages

It is agreed and understood that should turbine performance be within three percent (3%) of anticipated output, such shall not be considered a defect or deficiency in the work of Norcan and for the purposes of this Contract shall be considered to be an acceptable outcome of the performance of the work by Norcan.

Norcan shall in no event be responsible for damages for loss of profit and other punitive, exemplary, indirect, consequential or special losses or damages, whether in contract or in tort or otherwise, including, without limitation, any business or commercial losses.

To the extent that Norcan is liable for damages as a result of the performance of its work or the performance of the work by those for whom it is liable, such damages shall not exceed, in the aggregate, an amount equal to 10 percent (10%) of the total Contract price.

The above is understood and agreed to by the following:

Signed and sealed this 8th day of May 2015

In the presence of:

(Seal) (Seal)

NORCAN Hydraulic Turbine Inc.

6.0 NORCAN HYDRUALIC TURBINE INC. DIEM RATES AND TERMS

(for the period of January 01, 2015 to December 31, 2015)

Description	Regular Rate per hour	Overtime per hour	Double time per hour
Turbine Engineering Technician	[redacted]	[redacted]	[redacted]
Supervisor	[redacted]	[redacted]	[redacted]
Turbine mechanic millwright	[redacted]	[redacted]	[redacted]
Engineer	[redacted]	[redacted]	[redacted]
Travel rate	[redacted]	[redacted]	[redacted]
Drafting & Project Management	[redacted]	[redacted]	[redacted]
Shop Machining (CNC)	[redacted]	[redacted]	[redacted]
Shop General Machining	[redacted]	[redacted]	[redacted]
Welder	[redacted]	[redacted]	[redacted]
General Labour	[redacted]	[redacted]	[redacted]
Field Machining: Rates as per equipment requirements			

Note: The above rates are for normal 8 hour days, Monday to Friday (Normal working hours are between 7:00 am to 6:00 pm. A [redacted] premium will apply to hours outside the normal hours)

Saturday - overtime for first 8 hours - double time
Sunday - double time
Statutory holidays - 2.5 * regular rate

Parts and materials [redacted]
Meals & Accommodation [redacted]
Mileage [redacted]

General Terms:

1. Daily rates apply from the time the Norcan personnel leave the Office/Shop until their return to the Office/Shop. Should the Norcan personnel start from, return to, or proceed to a point other than the office/shop, charges for travel expenses and per diem rates shall not exceed charges that normally would have been incurred from or to the Office/Shop. Travel time will be charged at the specific base rates for up to a maximum of "8" hours per day for each day of travel.

2. Standby time: The time during which Norcan personnel are available for work, but are unable to do so because of circumstances beyond Norcan's control shall be considered as standby time and billing will be made as follows:
   - At full applicable charges plus expenses for any weekdays (whether at site or not) and for any weekend days or holidays when the Norcan personnel is kept on standby at the jobsite or put on call off-site.

3. Unless otherwise specified and negotiated during the contract, weekdays, weekend, and holidays are defined as follows:
   - Weekdays: Monday through Friday, working days
   - Weekends: Saturday through Sunday
   - Holidays: All recognized days that are celebrated in Canada
   - A Workday is classified as an 8 hour day

4. For out of country work, the weekdays, weekends and holidays must be specified and agreed to during contract negotiation.

5. No additional charges will be made for the use of expendable small tools and test equipment normally carried by Norcan personnel. However, when additional expendable tools or hardware must be purchased for a particular job, then the charge for such tools or hardware will be billed to the customer at cost plus a 15% processing fee.

6. When special equipment is required a rental fee will be charged depending on the type of equipment and the length of time required. The customer will be billed for all special transportation costs plus a 15% processing fee. The customer is responsible for the safe storage at site, the timely return, and overall condition and function of said special equipment.

7. Subcontractors: Labour and material supplied through Norcan will be billed at cost plus a 15% processing fee.

8. The customer shall provide Norcan personnel with free and unobstructed access to the jobsite.

9. The customer shall provide safe and proper working conditions in accordance with all federal, provincial and local laws, rules and regulations.

10. The customer shall provide suitable required power, washroom facilities, and safe storage space for Norcan's equipment.

11. All oil, grease, water, and normal operating items required for the operation of the equipment will be provided by the customer. Disposal of above components is the responsibility of the customer.

12. All required permits and monitoring equipment are the responsibility of the customer

13. Technical Advisory Services:
    These terms and conditions shall apply to Norcan's Technical Advisory Services incidental to the installation, overhaul, inspection, repair, modification or conversion of equipment which is located at the customers and/or owners location. Norcan's Technical Advisory Services function exclusively in an advisory capacity. The equipment, machinery and property shall be at all times in complete care, custody and control of the customer and/or owner. The buyer and/or customer will furnish qualified labour and supervisory personal to perform the required work.

14. Force Majeure:
    Any delay or failure in the performance by Norcan hereunder shall be excused and no liability whatsoever will rest with Norcan where such delay or failure is caused by Force Majeure. For the purposes of this Agreement, Force Majeure shall mean an event or cause beyond Norcan's control and shall include, but is not limited to, acts of God, riots, wars, insurrection, acts of public enemy, sabotage, terrorism, vandalism, embargo, national emergency, accident, restraint of government, governmental acts, fires, floods and other natural disasters, explosions, severe weather including hurricanes and storms, injunctions, labour strikes or inability to obtain required labour, materials or manufacturing facilities from normal sources, acts of a customer and/or owner, wrecks or delays in transportation.

15. Limitation of Liability:
    The remedies of the customer set forth herein are exclusive. The total liability of Norcan with respect to all claims under said services and contract, whether based on the services, contract, indemnity, tort, strict liability, or otherwise shall not exceed the purchase price of the services upon which such liability is based. Norcan shall in no event be liable for any consequential, incidental, or indirect damages arising out of said services (and the performance thereof) or out of any breach thereof, whether or not such loss or damage is based on the services, contract, indemnity, tort, strict liability, or otherwise.

CI Number: 47332

Title: HYD – Methals Overhaul

Start Date: 2015/06
In-Service Date: 2016/09
Final Cost Date: 2017/03
Function: Hydro
Forecast Amount: $1,392,927

DESCRIPTION:

This project is for the replacement of the propeller type runner, refurbishment of the wicket gates and general refurbishment of bushings and bearings. Methals Generating Station is a 3.4MW Generating Unit on the Black River Hydro System, originally commissioned in 1948. This overhaul will increase the generating capacity of this unit to 3.6 MW.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Hydro - Black River System

Estimated Life of the Asset: 40 years

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

Methals has an original propeller type runner from 1948 that is suffering from increased deterioration. This increased deterioration exposes the unit to the risk of a failure. Additionally due to wicket gate leakage, the unit is difficult to stop on unit shutdown. To maintain the reliability of this unit and not lose its generation capacity, a runner replacement and general unit refurbishment is required.

Why do this project now?

The rate of deterioration of the propeller blades indicates that the unit is losing efficiency. The condition of the blades is such that if continued to operate in the current condition a failure of the blades can be reasonably expected.

As of 2015, generation from NS Power's legacy hydro facilities will qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Powers compliance plan to serve 25 percent of sales from qualifying renewable generation sources.

Why do this project this way?

A runner replacement is the most cost effective option to have the unit operate in a reliable manner on a go forward. The runner is cast, is very costly to refurbish, and will still require full replacement in 10-15 years. A replacement is done in a timelier manner, which also limits unit downtime and associated replacement energy costs. Replacement of the wicket gates, bushings and bearings is not necessary at this time; therefore, refurbishment is the more cost effective option.

CI Number : 47332-H736 - HYD - Methals Overhaul **Project Number** H736

Parent CI Number : -

Cost Centre : 460 - 460-Black River Hydro System **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		23,676	0	23,676
095		095-Thermal & Hydro Contracts AO		69,734	0	69,734
095		095-Hydro Regular Labour AO		23,855	0	23,855
001	024	001 - HYDRO Regular Labour	024 - HGP - Turbine (Hydro)	54,777	0	54,777
011	024	011 - Travel Expense	024 - HGP - Turbine (Hydro)	10,900	0	10,900
012	024	012 - Materials	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
013	024	013 - POWER PRODUCTION Contracts	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
028	024	028 - Consulting	024 - HGP - Turbine (Hydro)	[redacted]	0	[redacted]
041	024	041 - Meals & Entertainment	024 - HGP - Turbine (Hydro)	350	0	350
066	024	066 - Other Goods & Services	024 - HGP - Turbine (Hydro)	102,450	0	102,450
			Total Cost:	1,392,927	0	1,392,927
			Original Cost:	754,572		

Capital Project Detailed Estimate

Location: Hydro
CI# / FP#: 47332
Title: HYD - Methals Overhaul
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Hydro River Staff - Construction	PD	85	364.79	$ 31,007		
Engineering Staff	PD	41	405.31	$ 16,618		
Hydro River Staff - Removal	PD	20	364.79	$ 7,153		
			Sub-Total	$ 54,777		
011 Travel Expenses						
Site Visits	Lot	1	900	$ 900		
Temporary Report Point	Lot	1	10000	$ 10,000		
			Sub-Total	$ 10,900		
012 Materials						
Fixed Blade Propeller Runner & Coupling Bolts	Lot	1	[redacted]	[redacted]	Cost Support #1 Page 3 - Item 2	
Wicket Gate Refurbishment	Lot	1	[redacted]	[redacted]	Cost Support #2	
Bushings and Pins	Lot	1	[redacted]	[redacted]	Cost Support #2	
Bearing Refurbishment	Lot	1	[redacted]	[redacted]	Cost Support #2	
Babitted Bearing Guide	Lot	1	[redacted]	[redacted]	Cost Support #2	
			Sub-Total	[redacted]		
013 Power Production Contracts						
Disassembly and Reassembly	Lot	1	[redacted]	[redacted]	Cost Support #2	
Scroll Case blast and coat	Lot	1	[redacted]	[redacted]	Cost Support #2	
Miscellaneous Items (Fastener)	Lot	1	[redacted]	[redacted]	Cost Support #2	
Electrical Testing	Lot	1	[redacted]	[redacted]	Cost Support #2	
			Sub-Total	[redacted]		
028 Consulting						
Unit assessment and Overhaul Planning	Lot	1	[redacted]	[redacted]	Cost Support #2	
			Sub-Total	[redacted]		
041 Meals and Entertainment						
Site Visits	Lot	1	350	$ 350		
			Sub-Total	$ 350		
066- Other Goods and Services						
Contract Contingency (15%)	%	15%	$ 683,000	$ 102,450		
			Sub-Total	$ 102,450		
094 Interest Capitalized						
AFUDC				$ 23,676		
				$ -		
			Sub-Total	$ 23,676		
095 Administrative Overhead						
Hydro Regular Labour AO				$ 23,855		
Thermal & Hydro Contracts AO				$ 69,734		
			Sub-Total	$ 93,590		
			Sub-Total (no AO, AFUDC)	$ 1,275,662		
			TOTAL (AO, AFUDC included)	$ 1,392,927		
Original Cost				$ 754,572		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

HYD Methals Overhaul
Summary of Alternatives

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Hydro	**CI Number:**	47332
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Runnner vs Replacement Ene	6.11%	-2,827,012	2,250,914	1	19.37%	6.6 years
B	Repair Runner vs Replacement Energy	6.11%	-2,130,885	1,591,598	2	15.91%	7.9 years
C	Test 3	6.11%	0	0	3	#NUM!	0.0 years
D	Test 4	6.11%	0	0	3	#NUM!	0.0 years

Recommendation :

The economics lead us to replace the runner in 2016.

Notes/Comments :

Replace Runnner vs Replacement Energy & Repair Costs

This option compares leaving the unit off line in the case of a runner failure to the proactive replacement of the runner with new. This includes refurbishment of all wear components down with a complete dissassembly.

Repair Runner vs Replacement Energy & Repair Costs

This option compares leaving the unit off line in the case of runner failure to the proactive repair of the runner. This option still requires the unit to be dissassembled completely to access the runner for repair. Wear components would also be replaced in this option.

Test 3

Test 4

HYD Methals Overhaul
Summary of Sensitivities

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Hydro	**CI Number:**	47332
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runnner vs Replacement Energy & Repa	6.11%	-2,827,012	2,250,914	1	19.37%	6.6 years
B	Repair Runner vs Replacement Energy & Repair (	6.11%	-2,130,885	1,591,598	2	15.91%	7.9 years
C	Test 3	6.11%	0	0	3	#NUM!	0.0 years
D	Test 4	6.11%	0	0	3	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runnner vs Replacement Energy & Repa	10%	-2,722,605	2,161,672	1	17.85%	7.2 years
B	Repair Runner vs Replacement Energy & Repair (	10%	-1,981,292	1,454,629	2	14.35%	24.2 years
C	Test 3	10%	0	0	3	#NUM!	0.0 years
D	Test 4	10%	0	0	3	#NUM!	0.0 years

Change: **A**	104,407	-89,241	0	-1.53%	0.6 years
B	149,593	-136,969	0	-1.57%	16.3 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Runnner vs Replacement Energy & Repa	-10%	-2,480,431	1,969,339	1	17.88%	7.3 years
B	Repair Runner vs Replacement Energy & Repair (	-10%	-1,784,305	1,310,023	2	14.22%	24.4 years
C	Test 3	-10%	0	0	3	#NUM!	0.0 years
D	Test 4	-10%	0	0	3	#NUM!	0.0 years

Change: **A**	346,581	-281,575	0	-1.50%	0.7 years
B	346,581	-281,575	0	-1.69%	16.5 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**Delay?**
Yrs Delay:	1	2	3	
A	99,788	201,078	319,233	No
B	86,065	179,730	289,978	No
C	0	0	0	No
D	0	0	0	No

HYD Methals Overhaul
Avoided Cost Calculations

Division :	Power Production	Date :	03-Nov-15
Department :	Hydro	CI Number:	47332
Originator :		Project No. :	

Replace Runnner vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	75%	50%	75%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	4400.0	4400.0				
Duration (Hours)	1	1				
Totals	$92,287	$149,985	$0	$0	$92,287	$149,985
Total Capital Cost of Alternative						$1,392,927

Repair Runner vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	75%	50%	75%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	4400.0	4400.0				
Duration (Hours)	1	1				
Totals	$92,287	$149,985	$0	$0	$92,287	$149,985
Total Capital Cost of Alternative						$3,070,524

Test 3

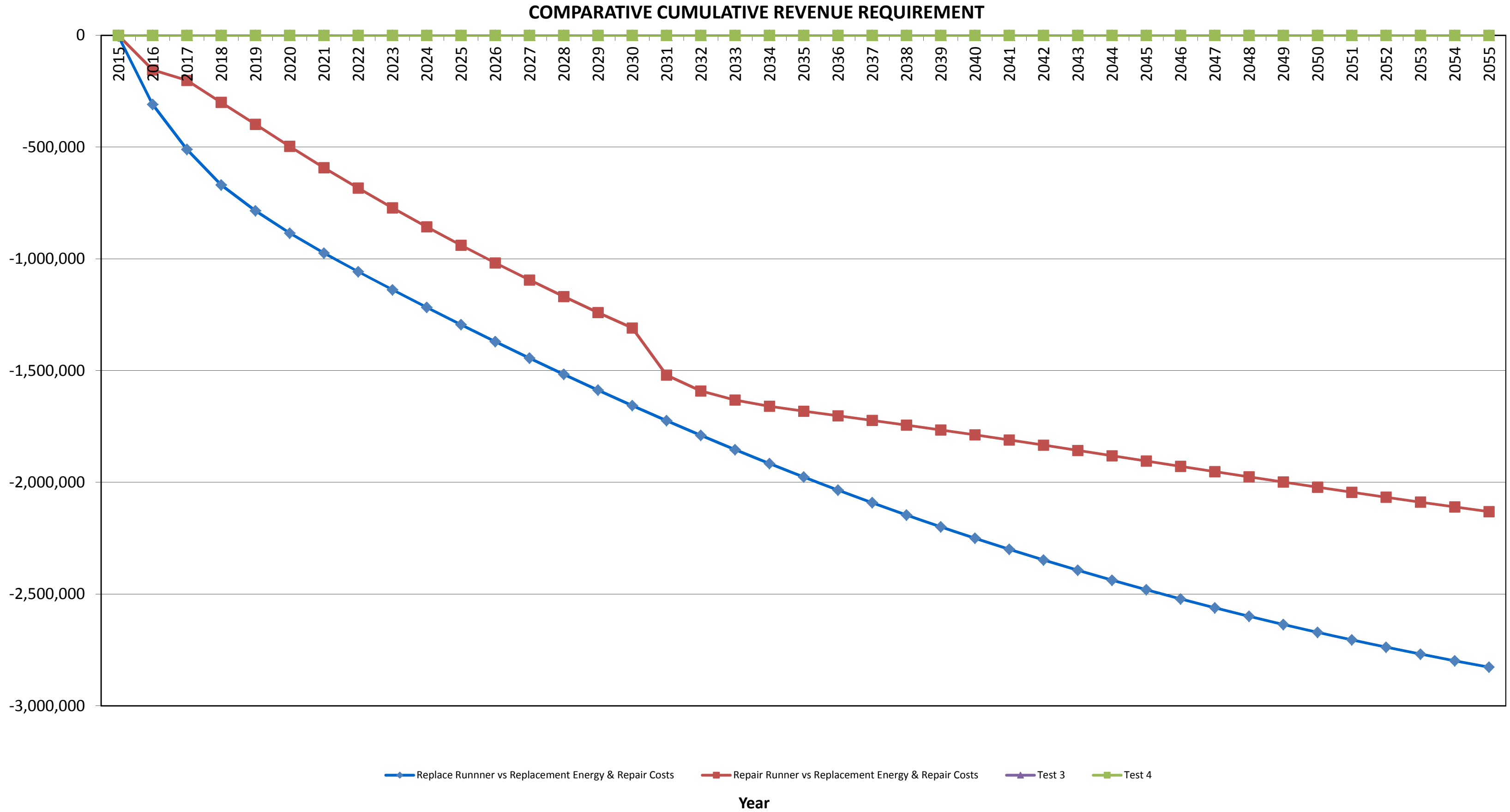
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

HYD Methals Overhaul
Replace Runnner vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	(176,126.6)	-	-	(176,126.6)	-	(176,126.6)	(176,126.6)	1.00	(176,126.6)
2016	21,120.9	-	92,287.1	(1,123,211.1)	318,915.5	970,785.0	(1,009,803.1)	63,707.3	(946,095.8)	(891,617.9)	0.94	(1,067,744.5)
2017	22,723.1	-	149,984.8	-	478,373.3	471,354.0	172,707.9	94,756.3	267,464.2	237,548.9	0.89	(830,195.6)
2018	24,698.3	-	219,635.0	-	239,186.6	221,638.6	244,333.2	(1,595.4)	242,737.8	203,174.2	0.84	(627,021.5)
2019	25,518.1	-	228,278.4	-	119,593.3	96,780.8	253,796.5	(41,603.0)	212,193.5	167,381.3	0.79	(459,640.2)
2020	27,045.2	-	240,103.9	-	59,796.7	34,351.9	267,149.0	(64,279.2)	202,869.8	150,812.0	0.74	(308,828.2)
2021	27,586.1	-	244,905.9	-	29,898.3	3,137.5	272,492.0	(75,204.0)	197,288.0	138,217.4	0.70	(170,610.8)
2022	28,137.8	-	249,804.1	-	14,949.2	(12,469.7)	277,941.8	(81,527.7)	196,414.1	129,681.6	0.66	(40,929.2)
2023	28,700.5	-	254,800.1	-	7,474.6	(20,273.3)	283,500.7	(85,568.1)	197,932.6	123,159.2	0.62	82,230.0
2024	29,274.5	-	259,896.1	-	3,737.3	(24,175.1)	289,170.7	(88,484.4)	200,686.3	117,682.3	0.59	199,912.2
2025	29,860.0	-	265,094.1	-	1,868.6	(26,126.0)	294,954.1	(90,856.5)	204,097.6	112,791.1	0.55	312,703.3
2026	30,457.2	-	270,396.0	-	934.3	(27,101.5)	300,853.2	(92,974.8)	207,878.3	108,265.4	0.52	420,968.7
2027	31,066.4	-	275,803.9	-	467.2	(27,589.2)	306,870.2	(94,985.0)	211,885.3	103,998.0	0.49	524,966.7
2028	31,687.7	-	281,320.0	-	233.6	(27,833.1)	313,007.7	(96,960.0)	216,047.7	99,935.0	0.46	624,901.7
2029	32,321.5	-	286,946.3	-	116.8	(27,955.0)	319,267.8	(98,936.8)	220,331.0	96,047.7	0.44	720,949.5
2030	32,967.9	-	292,685.3	-	58.4	(28,016.0)	325,653.2	(100,934.4)	224,718.8	92,319.8	0.41	813,269.2
2031	33,627.2	-	298,539.0	-	29.2	(28,046.4)	332,166.2	(102,962.5)	229,203.7	88,740.3	0.39	902,009.5
2032	34,299.8	-	304,509.8	-	14.6	(28,061.7)	338,809.6	(105,026.4)	233,783.1	85,301.3	0.36	987,310.8
2033	34,985.8	-	310,600.0	-	7.3	(28,069.3)	345,585.7	(107,129.3)	238,456.4	81,996.5	0.34	1,069,307.3
2034	35,685.5	-	316,812.0	-	3.6	(28,073.1)	352,497.5	(109,273.1)	243,224.4	78,820.1	0.32	1,148,127.5
2035	36,399.2	-	323,148.2	-	1.8	(28,075.0)	359,547.4	(111,459.1)	248,088.3	75,767.0	0.31	1,223,894.4
2036	37,127.2	-	329,611.2	-	0.9	(28,076.0)	366,738.4	(113,688.6)	253,049.7	72,832.2	0.29	1,296,726.6
2037	37,869.7	-	336,203.4	-	0.5	(28,076.4)	374,073.1	(115,962.5)	258,110.6	70,011.1	0.27	1,366,737.7
2038	38,627.1	-	342,927.4	-	0.2	(28,076.7)	381,554.6	(118,281.9)	263,272.7	67,299.3	0.26	1,434,037.0
2039	39,399.7	-	349,786.0	-	0.1	(28,076.8)	389,185.7	(120,647.5)	268,538.2	64,692.6	0.24	1,498,729.6
2040	40,187.7	-	356,781.7	-	0.1	(28,076.9)	396,969.4	(123,060.5)	273,908.9	62,186.8	0.23	1,560,916.4
2041	40,991.4	-	363,917.4	-	0.0	(28,076.9)	404,908.8	(125,521.7)	279,387.1	59,778.1	0.21	1,620,694.5
2042	41,811.3	-	371,195.7	-	0.0	(28,076.9)	413,007.0	(128,032.2)	284,974.8	57,462.7	0.20	1,678,157.2
2043	42,647.5	-	378,619.6	-	0.0	(28,076.9)	421,267.1	(130,592.8)	290,674.3	55,237.0	0.19	1,733,394.2
2044	43,500.4	-	386,192.0	-	0.0	(28,076.9)	429,692.4	(133,204.7)	296,487.8	53,097.5	0.18	1,786,491.6
2045	44,370.4	-	393,915.8	-	0.0	(28,076.9)	438,286.3	(135,868.7)	302,417.5	51,040.8	0.17	1,837,532.4
2046	45,257.8	-	401,794.2	-	0.0	(28,076.9)	447,052.0	(138,586.1)	308,465.9	49,063.8	0.16	1,886,596.3
2047	46,163.0	-	409,830.0	-	0.0	(28,076.9)	455,993.0	(141,357.8)	314,635.2	47,163.4	0.15	1,933,759.7
2048	47,086.3	-	418,026.6	-	0.0	(28,076.9)	465,112.9	(144,185.0)	320,927.9	45,336.6	0.14	1,979,096.3
2049	48,028.0	-	426,387.2	-	0.0	(28,076.9)	474,415.2	(147,068.7)	327,346.5	43,580.6	0.13	2,022,676.9
2050	48,988.5	-	434,914.9	-	0.0	(28,076.9)	483,903.5	(150,010.1)	333,893.4	41,892.6	0.13	2,064,569.4
2051	49,968.3	-	443,613.2	-	0.0	(28,076.9)	493,581.5	(153,010.3)	340,571.3	40,269.9	0.12	2,104,839.3
2052	50,967.7	-	452,485.5	-	0.0	(28,076.9)	503,453.2	(156,070.5)	347,382.7	38,710.1	0.11	2,143,549.4
2053	51,987.0	-	461,535.2	-	0.0	(28,076.9)	513,522.2	(159,191.9)	354,330.3	37,210.7	0.11	2,180,760.2
2054	53,026.8	-	470,765.9	-	0.0	(28,076.9)	523,792.7	(162,375.7)	361,416.9	35,769.4	0.10	2,216,529.6
2055	54,087.3	-	480,181.2	-	0.0	(28,076.9)	534,268.5	(165,623.2)	368,645.3	34,384.0	0.09	2,250,913.6
Total	**1,500,255.8**	**-**	**13,174,234.0**	**(1,299,337.7)**	**1,275,662.1**		**13,375,152.1**	**(4,153,636.6)**	**9,221,515.5**	**2,250,913.6**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Replace Runnner vs Replacement Energy & Repair Costs
Repair Runner vs Replacement Energy & Repair Costs
Test 3
Test 4
Year

NORCAN
HYDRAULIC TURBINE INC.

50 Bruce Crescent, Carleton Place, ON Canada K7C 3V6 T (613) 257-4755 F (613) 257-4215 E nht@norcanhydro.com www.norcanhydro.com

Sept 10, 2015*

Jonathan Lorette, P.Eng
Engineering Lead-Hydro & Wind
NS Power Inc.
jonathan.lorette@nspower.ca
T: 902-876-3383 | C: 902-717-0890
www.nspower.ca

Ref: Firm proposal for the supply of one (1) Replacement Upgraded Fixed Blade Propeller Runner for the NSPI Methals Power Station (RFP P-15-072). Norcan Reference # Q15-2222 Rev 2*

Dear Jonathan,

Norcan Hydraulic Turbine Inc. is pleased to submit the following as a firm proposal for the supply of one (1) Replacement Upgraded Fixed Blade Propeller Runner for the NSPI Methals Power Station based on the supplied site data. A new custom CFD designed Runner will be manufactured to suit the existing Turbine assembly.

Attached, please find a general summary, detailed scope of supply and performance curves. I hope this proposal meets your requirements.

If you have any questions or require clarifications, please let us know.

Sincerely,
Norcan Hydraulic Turbine Inc.

ROD FOSTER
OPERATIONS MANAGER
NORCAN HYDRAULIC TURBINE INC.
T613-257-4755 EXT 17
F613-257-4215
C613-883-3503

TABLE OF CONTENTS

1.0 GENERAL SUMMARY

1.1 Pricing

Item	General Description	Qty	Amount (CAD/Dollar)*
Equipment Supply	Turbine/Generator assessment, design and manufacture of one (1) Fixed Blade Propeller Runner/Coupling Bolts, dismantling/removal, refurbishment and installation.		(Itemized costs shall equal below sum):
1	• Fixed Blade Propeller Runner & Coupling Bolts	1	[redacted]
	• Fit up and Assembly of Existing Shaft to Fixed Blade Propeller Runner	1	[redacted]
	• Shipping from Norcan to Site	1	[redacted]
	TOTAL		[redacted]

1.2 Notes

- Engineering/Design of civil structures not included
- Electrical engineering and protection study not included
- High Voltage interconnect by others
- Taxes not included
- Delivery time of eleven (11) to twelve (12) months from reception of the P.O. and receipt of the down payment
- Delivery INCOTERM: FOB (Kings County, NS)
- Warranty for one year from commissioning or eighteen (18) months after delivery, whichever is sooner
- Quote valid for 90 days

2.0 CUSTOMER DATA

2.1 Turbine Data:

Runner Type:	Vertical Fixed Blade Propeller
Number of Unit(s):	1
Location:	Kings County, Nova Scotia
Net Head	13.57m/44.5 ft
Rated Flow:	32.55 cms/1350 cfs
Turbine Speed:	240 RPM

3.0 DETAILED SCOPE OF SUPPLY

3.1 Fixed Blade Propeller Runner

Material

The Hub, Blades and Nose Cone components will be of cast ASTM A743 CA6NM stainless steel or approved equivalent.

Construction

The Runner will be designed to meet the allowable stress requirements for the materials used as defined in ASME B&PV SECTION II Part D.

The Runner will be fabricated, machined and ground in accordance with Norcan manufacturing design standards and tolerances stated in NOR014-2. The Runner will meet or exceed IEC standard publication 60193 1999-11.

The Runner Hub and Blades will be cast and/or fabricated and machined. The Blades will be welded to the Hub as follows:

The pre-machined Blades and Hub will be will be aligned with dowel pins and coupled in position by retaining bolts in the interior of the Runner Hub. The first 15% of the Blade length at the inlet and discharge will have 100% penetration. The remaining length of the Blade will have 1/3 of the Blade thickness V weld per side. A concave fillet weld will finish the Blade to the Hub. The fillet weld will be hand ground to the required finish with no permissible undercuts. The weld filler material will be ER309L. All welders are qualified to QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code or CSA W47.1. (Ref. DWI-059, DWI-015)

The Runner minimum finish will be as follows:

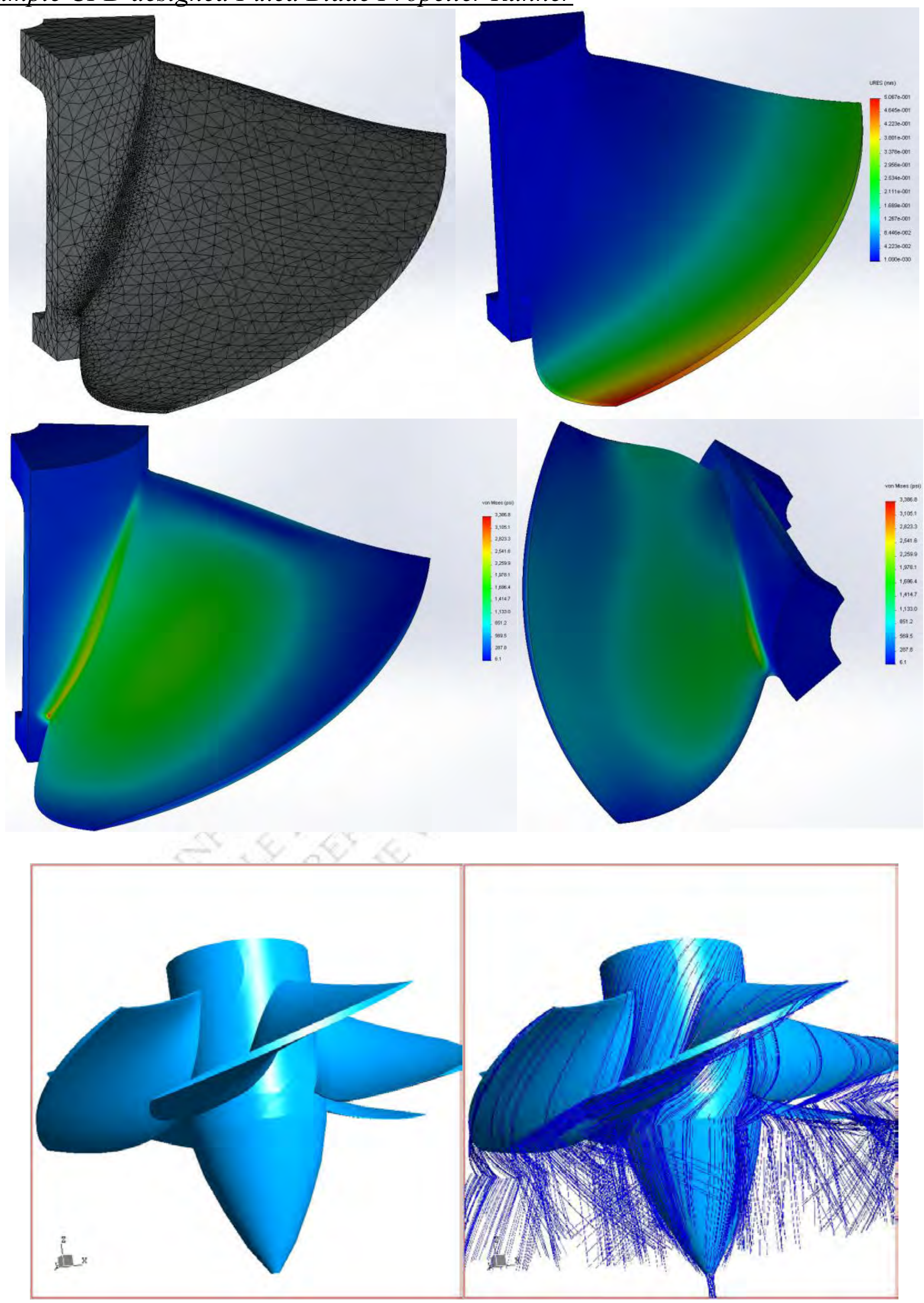
Water passages	
Surface of the Blade	125 finish
Inlet one third of the Blade	63 finish
Discharge one third of the Blade	63 finish
Runner Hub	
Outside finish all over with axis	125 finish

Flange surfaces	125 finish

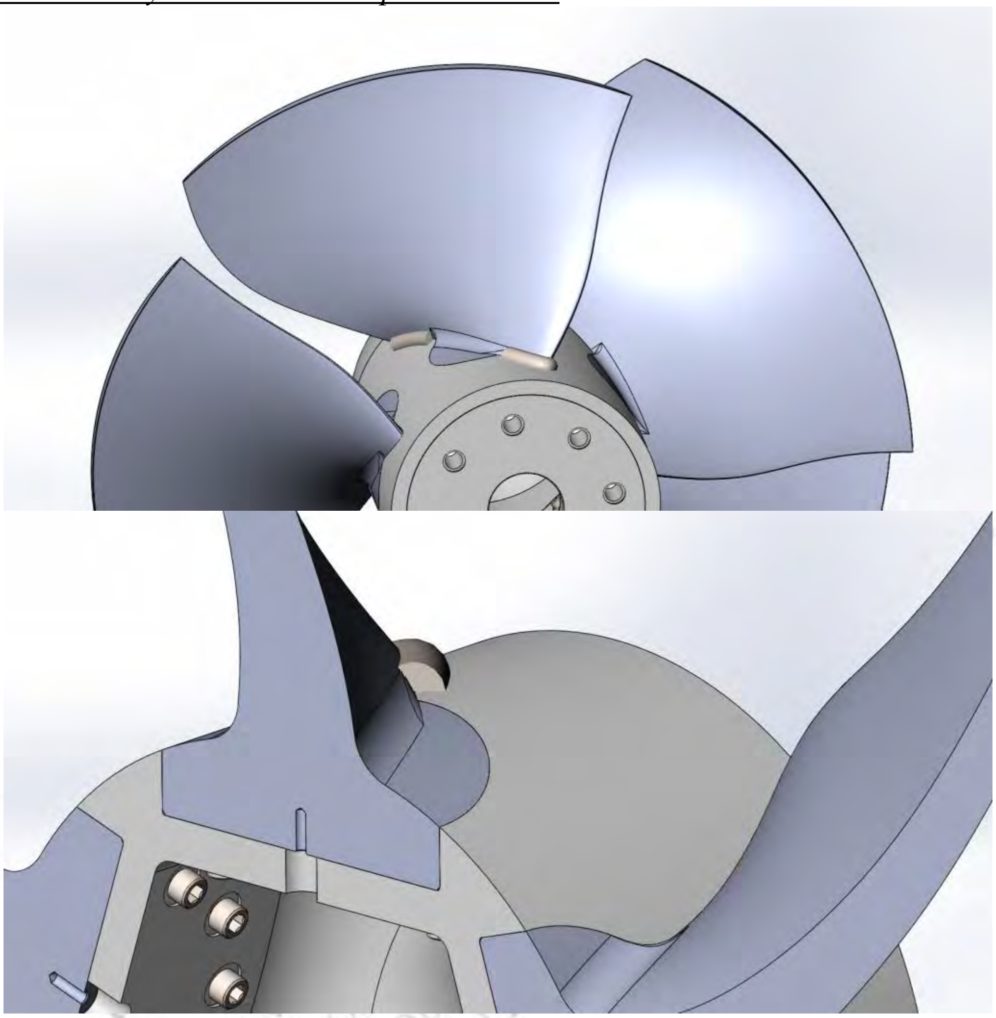
Balancing

The Runner will be statically balanced to meet or exceed the standards of ISO 1940 G6.3. Weights shall be added or removed in such a manner that there will be no projections or depressions from the finished surfaces. No eccentric machining will be performed.

Example CFD designed Fixed Blade Propeller Runner



Example Assembly Fixed Blade Propeller Runner



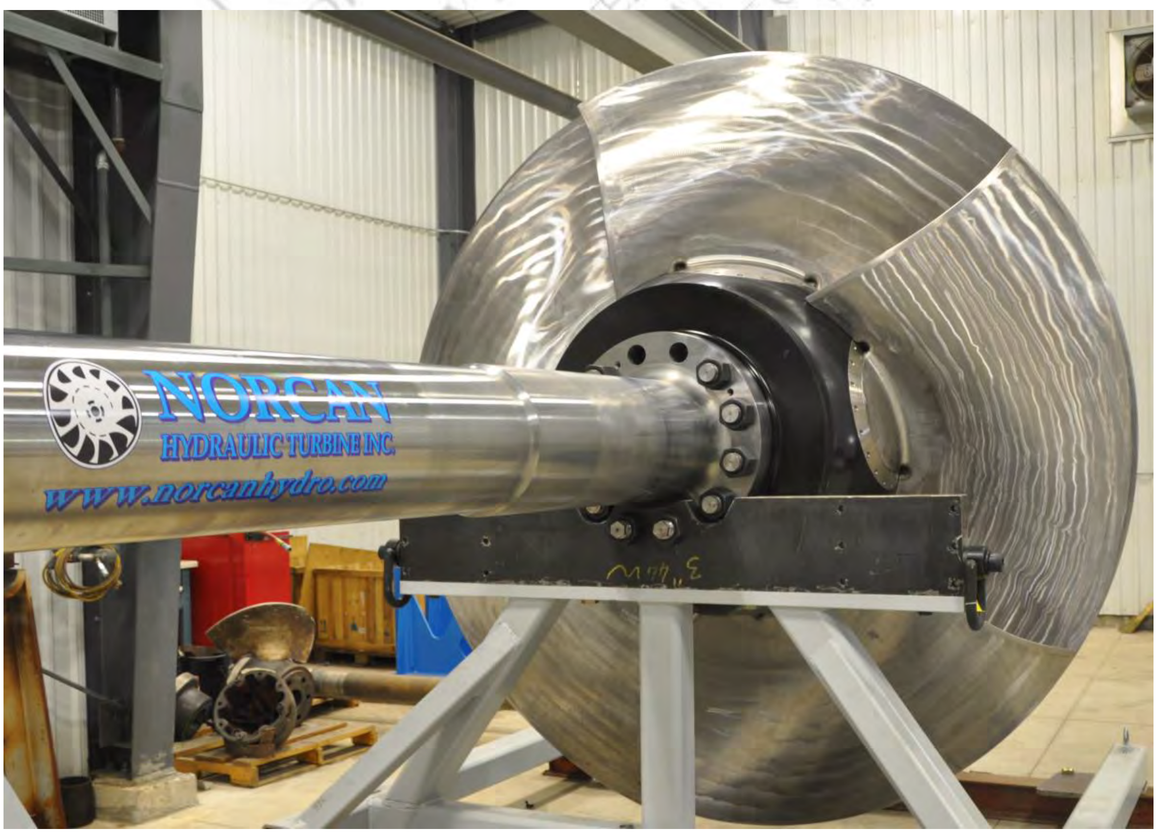
3.2 Runner Coupling Studs

The Runner Coupling Studs will be manufactured from AISI 4140/4142 HT+SR (ASTM A193 B7). The Hex Nuts will be manufactured to ASTM A194 Gr.2H or approved equivalent.

Example Runner Coupling Studs

3.3 Fit up of Existing Turbine Shaft to Fixed Blade Propeller Runner

The Runner and Shaft Coupling Bolt pattern will be matched bored. The existing Turbine Shaft Coupling Bolt BCD will be dimensionally inspected and if possible drilled to common BCD.



4.0 TURBINE PERFORMANCE

4.1 General Data (240rpm) "Existing Stayvanes"

Turbine

1.	Turbine manufacturer	Norcan Hydraulic Turbine Inc.
2.	Maximum flow	[redacted]
3.	Flow at maximum efficiency	[redacted]
4.	Maximum Wicket Gate opening (degree)	TBA

For Net head 13.57 m/44.5 ft*

5.	Maximum efficiency (%)	88.01%
6.	Efficiency at maximum flow (%)	86.09%
7.	Max. Power at Turbine Shaft	3900 kW

Data

8.	Operating speed	240 rpm
9.	Runaway speed	600 rpm
11.	Runner diameter nominal	2.286mm/90.0"
12.	Power vs. efficiency	See Section 4.2
13.	Power vs. flow	See Section 4.2

*Net Head (as per IEC code), measured between the Spiral Case Intake (downstream of the case inlet flange) and the Draft Tube exit:

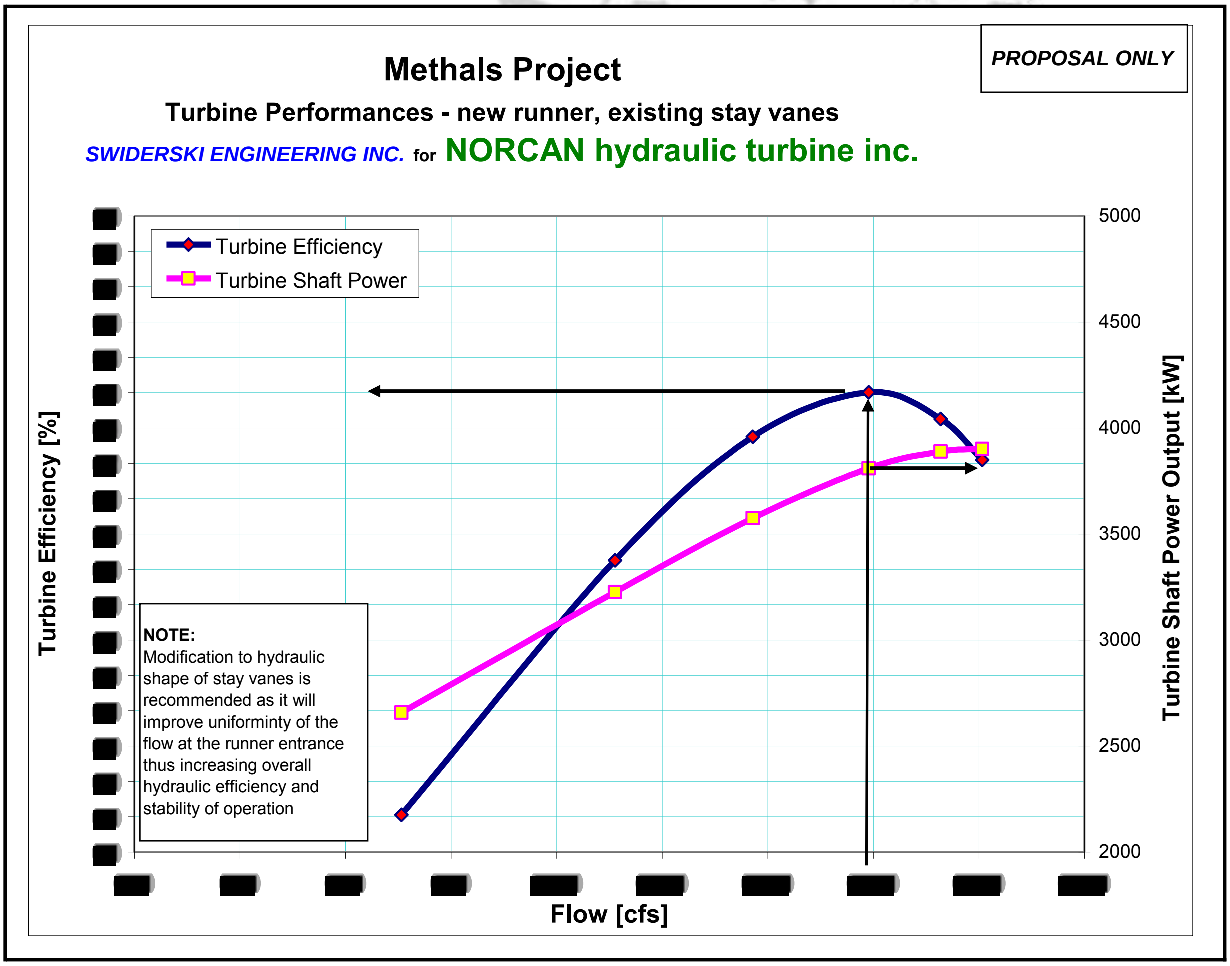
*As defined by IEC Code 60041.

4.2 Performance Curves "Existing Stayvanes"

Hnet =	44.5	ft	=	13.57	m IEC code
Dth (nom) =	90.00	in	=	2.286	m
n =	240	rpm			

EXISTING STAY VANES

Turbine Efficiency	Flow	Flow	Turbine Shaft Power	Turbine Shaft Power			
[%]	[cms]	[cfs]	[kW]	[hp]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]



5.0 COMMERCIAL TERMS

5.1 Delivery

- Runner manufacturing 11-12 months after receipt of the contract and receipt of the down payment.

** All delivery times start from the date of acceptance of the order and receipt of the down payment.*

5.2 Project Schedule

A detailed schedule will be presented three (4) weeks after receipt of contract and receipt of the down payment.

5.3 Payment Schedule

The following terms of Payment shall apply:

25% Down payment with the order
25% Upon receipt of Runner construction materials (Castings, Forgings, Plate)
25% Completion of fabrication (Runner)
15% All components ready for shipping
10% Commissioning

6.0 GENERAL CONDITIONS OF CONTRACT

(Note: Any reference to "Norcan" is a reference to Norcan Hydraulic Turbine Inc.)

Indemnification

Norcan shall indemnify and hold harmless the Customer against all claims, demands, losses, damages and costs, all as finally judicially determined, excluding loss of profit and any punitive, exemplary, indirect, consequential or special losses or damages, whether in contract or in tort or otherwise, by third parties where such claims, demands, losses, damages and costs are:

(i) attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property;

(ii) caused by negligent acts or omissions of Norcan or anyone for whose acts Norcan may be liable; and

(iii) made in writing within a period of two years from the date of delivery to the Customer of each Norcan supplied equipment.

The Customer expressly waives the right to indemnity for claims other than those stated above.

The obligations of Norcan to indemnify hereunder shall be limited to an aggregate amount no greater than the amount payable to Norcan under this Contract hereinafter referred to as the "total Contract price".

The Customer shall indemnify and hold harmless Norcan and Norcan's agents and employees from and against claims, demands, losses, costs, damages, actions, suits or proceedings arising out of Norcan's performance of the work under this Contract which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the place where the Norcan supplied equipment is delivered and, or installed.

Force Majeure

Any delay or failure in the performance by Norcan hereunder shall be excused and no liability whatsoever will rest with Norcan where such delay or failure is caused by Force Majeure. For the purposes of this Agreement, Force Majeure shall mean an event or cause beyond Norcan's control and shall include, but is not limited to, acts of God, riots, wars, insurrection, acts of public enemy, sabotage, terrorism, vandalism, embargo, national emergency, accident, restraint of government, governmental acts, fires, floods and other natural disasters, explosions, severe weather including hurricanes and storms, injunctions, labour strikes or inability to obtain required labour, materials or manufacturing facilities from normal sources, acts of a customer and/or owner, wrecks or delays in transportation.

Warranty

The warranty period with respect to this Contract terminates on a date which is the sooner of:

(i) that day which is 12 months from the completion of the initial test runs of the installed Norcan equipment; and,

(ii) that day which is 18 months from the date of delivery of the Norcan supplied equipment.

Norcan shall be responsible for the proper performance of its work and for the work of those for whose acts Norcan may be liable to the extent that this Contract and related documents permits such performance, save that it is understood and agreed that:

(i) Norcan accepts no liability for the design of civil works, intake and trash racks, powerhouse or foundation stability, tail race or other associated water passages or for work improperly done by others, nor does Norcan accept liability for lack of or errors in water availability, flow duration studies or the condition of the water flowing into the turbine. Furthermore, Norcan does not accept liability for damage to the turbine components due to debris (rock metal, lumber, etc.) passing through the turbine intake;

(ii) Norcan shall not be liable to remedy defects or deficiencies which have arisen as a result of the acts or omissions of those over whom Norcan does not exercise control;

(iii) This warranty is void and unenforceable unless Norcan is afforded the opportunity to complete a final inspection of the completed work within **14** (fourteen) days of installation of the Norcan supplied equipment.

Subject to the provisions of this clause Norcan shall correct promptly, at Norcan's expense, defects and deficiencies in its work which appear prior to and during the warranty period specified herein.

The Customer shall promptly give Norcan notice in writing of observed defects and deficiencies that occurred during the warranty period and Norcan shall be immediately afforded the opportunity to inspect and observe the alleged defects and deficiencies.

Where Norcan fails to correct defects or deficiencies brought to its attention for which it would otherwise be liable, it shall be liable to the Customer to pay for the reasonable costs incurred by the Customer in correcting such defects or deficiencies.

It is understood and agreed that Norcan's liability under this warranty is limited to an aggregate amount which shall not exceed 10 percent (10%) of the total Contract price.

Damages

It is agreed and understood that should turbine performance be within three percent (3%) of anticipated output, such shall not be considered a defect or deficiency in the work of Norcan and for the purposes of this Contract shall be considered to be an acceptable outcome of the performance of the work by Norcan.

Norcan shall in no event be responsible for damages for loss of profit and other punitive, exemplary, indirect, consequential or special losses or damages, whether in contract or in tort or otherwise, including, without limitation, any business or commercial losses.

To the extent that Norcan is liable for damages as a result of the performance of its work or the performance of the work by those for whom it is liable, such damages shall not exceed, in the aggregate, an amount equal to 10 percent (10%) of the total Contract price.

The above is understood and agreed to by the following:

Signed and sealed this 8th day of May 2015

In the presence of:

(Seal) (Seal)

NORCAN Hydraulic Turbine Inc.

7.0 NORCAN HYDRUALIC TURBINE INC. DIEM RATES AND TERMS

(for the period of January 01, 2015 to December 31, 2015)

Description	Regular Rate per hour	Overtime per hour	Double time per hour
Turbine Engineering Technician	[redacted]	[redacted]	[redacted]
Supervisor	[redacted]	[redacted]	[redacted]
Turbine mechanic millwright	[redacted]	[redacted]	[redacted]
Engineer	[redacted]	[redacted]	[redacted]
Travel rate	[redacted]	[redacted]	[redacted]
Drafting & Project Management	[redacted]	[redacted]	[redacted]
Shop Machining (CNC)	[redacted]	[redacted]	[redacted]
Shop General Machining	[redacted]	[redacted]	[redacted]
Welder	[redacted]	[redacted]	[redacted]
General Labour	[redacted]	[redacted]	[redacted]
Field Machining: Rates as per equipment requirements			

Note: The above rates are for normal 8 hour days, Monday to Friday (Normal working hours are between 7:00 am to 6:00 pm. A [redacted] premium will apply to hours outside the normal hours)

Saturday - overtime for first 8 hours - double time
Sunday - double time
Statutory holidays - 2.5 * regular rate

Parts and materials [redacted]
Meals & Accommodation [redacted]
Mileage [redacted]

General Terms:

1. Daily rates apply from the time the Norcan personnel leave the Office/Shop until their return to the Office/Shop. Should the Norcan personnel start from, return to, or proceed to a point other than the office/shop, charges for travel expenses and per diem rates shall not exceed charges that normally would have been incurred from or to the Office/Shop. Travel time will be charged at the specific base rates for up to a maximum of "8" hours per day for each day of travel.

2. Standby time: The time during which Norcan personnel are available for work, but are unable to do so because of circumstances beyond Norcan's control shall be considered as standby time and billing will be made as follows:
   - At full applicable charges plus expenses for any weekdays (whether at site or not) and for any weekend days or holidays when the Norcan personnel is kept on standby at the jobsite or put on call off-site.

3. Unless otherwise specified and negotiated during the contract, weekdays, weekend, and holidays are defined as follows:
   - Weekdays: Monday through Friday, working days
   - Weekends: Saturday through Sunday
   - Holidays: All recognized days that are celebrated in Canada
   - A Workday is classified as an 8 hour day

4. For out of country work, the weekdays, weekends and holidays must be specified and agreed to during contract negotiation.

5. No additional charges will be made for the use of expendable small tools and test equipment normally carried by Norcan personnel. However, when additional expendable tools or hardware must be purchased for a particular job, then the charge for such tools or hardware will be billed to the customer at cost plus a 15% processing fee.

6. When special equipment is required a rental fee will be charged depending on the type of equipment and the length of time required. The customer will be billed for all special transportation costs plus a 15% processing fee. The customer is responsible for the safe storage at site, the timely return, and overall condition and function of said special equipment.

7. Subcontractors: Labour and material supplied through Norcan will be billed at cost plus a 15% processing fee.

8. The customer shall provide Norcan personnel with free and unobstructed access to the jobsite.

9. The customer shall provide safe and proper working conditions in accordance with all federal, provincial and local laws, rules and regulations.

10. The customer shall provide suitable required power, washroom facilities, and safe storage space for Norcan's equipment.

11. All oil, grease, water, and normal operating items required for the operation of the equipment will be provided by the customer. Disposal of above components is the responsibility of the customer.

12. All required permits and monitoring equipment are the responsibility of the customer

13. Technical Advisory Services:
These terms and conditions shall apply to Norcan's Technical Advisory Services incidental to the installation, overhaul, inspection, repair, modification or conversion of equipment which is located at the customers and/or owners location. Norcan's Technical Advisory Services function exclusively in an advisory capacity. The equipment, machinery and property shall be at all times in complete care, custody and control of the customer and/or owner. The buyer and/or customer will furnish qualified labour and supervisory personal to perform the required work.

14. Force Majeure:
Any delay or failure in the performance by Norcan hereunder shall be excused and no liability whatsoever will rest with Norcan where such delay or failure is caused by Force Majeure. For the purposes of this Agreement, Force Majeure shall mean an event or cause beyond Norcan's control and shall include, but is not limited to, acts of God, riots, wars, insurrection, acts of public enemy, sabotage, terrorism, vandalism, embargo, national emergency, accident, restraint of government, governmental acts, fires, floods and other natural disasters, explosions, severe weather including hurricanes and storms, injunctions, labour strikes or inability to obtain required labour, materials or manufacturing facilities from normal sources, acts of a customer and/or owner, wrecks or delays in transportation.

15. Limitation of Liability:
The remedies of the customer set forth herein are exclusive. The total liability of Norcan with respect to all claims under said services and contract, whether based on the services, contract, indemnity, tort, strict liability, or otherwise shall not exceed the purchase price of the services upon which such liability is based. Norcan shall in no event be liable for any consequential, incidental, or indirect damages arising out of said services (and the performance thereof) or out of any breach thereof, whether or not such loss or damage is based on the services, contract, indemnity, tort, strict liability, or otherwise.

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1117 de Roberval Sud
Granby (Québec) J2J 0N3
Tel. : 450.994.2020 Fax : 450.994.2121
www.enerserv.ca

June 3rd, 2015

Nova Scotia Power
A/S Andrea Mackay, Procurement Team Lead
1223 Lower Water St,
Halifax, Nova Scotia
B3J 3S8

Andrea.mackay@nspower.ca

Subject :	**Proposal n° SO-15324-NSP**
Project Title:	**Mechanical Overhaul Tidewater & Methals Hydro Generator**

Mrs. Mackay,

Following your recent request for proposal P-15-072, we are pleased to submit this proposal for the project as described above. We are aware that the submittal date is past due, but as per your email dated May 15th, 2015 we are submitting this proposal for all the work excluding the Runner Supply.

Please find below the scope of work, details and conditions of our proposal as well as our price, calculated on a Time and Material basis as per our Rates Sheet, attached in Appendix A and Terms and Conditions attached in Appendix B.

* Note: Numbering starts at 10.

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10. Amount of our budgetary estimate

Attachment "G" the RFP

	TASK	Unit	Price
Tidewater Unit 1	Unit Assessment	1	[redacted]
	Runner Supply	N/A	N/A
	Wicket Gate Refurbishment	1	[redacted]
	Bushings and Pins	1	
	Bearing Refurbishment	1	
	Scroll Case Blast & Coat	1	
	Disassembly & Reassembly Estimate	1	
	Misc Items (fastener)	1	
	Rotor Pole Repair (24)	1	
	Electrical Testing Dismantling / Assembly	1	
	Babitted bearing guide (2) trust (1)	1	
	Contingency		[redacted]
	Total		[redacted]
Methals	Unit Assessment	1	[redacted]
	Runner Supply	N/A	N/A
	Wicket Gate Refurbishment	1	[redacted]
	Bushings and Pins	1	
	Bearing Refurbishment	1	
	Scroll Case Blast & Coat	1	
	Disassembly & Reassembly Estimate	1	
	Misc Items (Fastener)	1	
	Electrical Testing Dismantling / Assembly	1	
	Babitted bearing guide (2) trust (1)	1	
	Contingency		[redacted]
	Total		[redacted]

CI Number: 47432

Title: HYD – Ridge Overhaul

Start Date:	2016/01
In-Service Date:	2016/09
Final Cost Date:	2017/04
Function:	Hydro
Forecast Amount:	$869,304

DESCRIPTION:

This project includes the refurbishment of the Ridge Hydro unit on the Bear River Hydro System. The work includes the disassembly and reassembly of the unit and refurbishment of the rotor, runner, draft tube, wicket gates and all bushings, bearing and linkages. The unit was last overhauled in 1994 and is due for another overhaul based on current condition assessments.

Summary of Related CIs +/- 2 years:
2017 CI TBD Ridge Surge Tank Refurbishment $TBD

JUSTIFICATION:

Justification Criteria: Hydro, Wind and Biomass

Why do this project?

This project is being completed to maintain the reliability of the generating unit and prevent forced outage situations. The major failure modes that will be mitigated with this project include:

1. Rotor Pole Failure
2. Wicket gate bushing failure
3. Draft tube failure
4. Bearing temperature – leads to bearing failure

The unit is valuable to the system in its provision of firm capacity and renewable energy and also as in its support of western grid stability. A forced outage would compromise unit contributions to these operation objectives.

Why do this project now?

The condition of the rotor, runner, draft tube, wicket gates and other components have reached a point where refurbishment or replacement is necessary. Completing this overhaul will avoid replacement energy costs in the event of an unplanned outage due to a failure of one of the components slated for replacement or refurbishment.

As of 2015, generation from NS Power’s legacy hydro facilities will qualify under the provisions of the Nova Scotia Renewable Electricity Regulations. Generation from hydro facilities is an important part of NS Powers compliance plan to serve 25 percent of sales from qualifying renewable generation sources.

Why do this project this way?

Refurbishing this unit is the most economical way to maintain reliability. The timing of the refurbishment is planned to mitigate lost generation related to unplanned outages due to failure. The option of deferring the project increases the risk of a significant forced outage with the potential of collateral damage to other components on the unit.

CI Number : 47432 - HYD - Ridge Overhaul **Project Number**

Parent CI Number : -

Cost Centre : 410 - 410-Bear River Hydro System **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		7,728	0	7,728
095		095-Hydro Term Labour AO		49,482	0	49,482
095		095-Hydro Regular Labour AO		76,972	0	76,972
095		095-Thermal & Hydro Contracts AO		30,426	0	30,426
095		095-Hydro Overtime Labour AO		8,247	0	8,247
001	024	001 - HYDRO Regular Labour	024 - HGP - Turbine (Hydro)	166,895	0	166,895
002	024	002 - HYDRO Overtime Labour	024 - HGP - Turbine (Hydro)	35,763	0	35,763
004	024	004 - HYDRO Term Labour	024 - HGP - Turbine (Hydro)	107,290	0	107,290
011	024	011 - Travel Expense	024 - HGP - Turbine (Hydro)	21,000	0	21,000
012	024	012 - Materials	024 - HGP - Turbine (Hydro)	52,000	0	52,000
013	024	013 - POWER PRODUCTION Contracts	024 - HGP - Turbine (Hydro)	98,000	0	98,000
028	024	028 - Consulting	024 - HGP - Turbine (Hydro)	5,000	0	5,000
041	024	041 - Meals & Entertainment	024 - HGP - Turbine (Hydro)	10,500	0	10,500
013	025	013 - POWER PRODUCTION Contracts	025 - HGP - Generator	200,000	0	200,000
			Total Cost:	869,304	0	869,304
			Original Cost:	550,495		

Capital Project Detailed Estimate

Location: Hydro
CI# / FP#: 47432
Title: HYD Ridge Overhaul
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Hydro River Staff - Construction	day		$ 358	$ 121,596		46594
Engineering Staff	day		$ 397	$ 16,689		46594
Hydro River Staff - Removal	day		$ 358	$ 28,611		
			Sub-Total	$ 166,895		
002 Overtime Labour						
Hydro River Staff	day		$ 715	$ 35,763		
			Sub-Total	$ 35,763		
004 Term Labour						
Hydro River Staff - Construction	day		$ 358	$ 85,832		46594
Hydro River Staff - Removal	day		$ 358	$ 21,458		46594
			Sub-Total	$ 107,290		
011 Travel Expenses						
Site Visits				$ 1,000		
Temporary Report Point				$ 20,000		
			Sub-Total	$ 21,000		
012 Materials						
Links, Bushing, Bearing Material				$ 40,000		46594
Consumables				$ 5,000		46594
Runner Seals				$ 5,000		46594
New Deck Plates				$ 2,000		46594
			Sub-Total	$ 52,000		
013 Power Production Contracts						
Rotor Rewind				$ 200,000		46594
Wicket Gate Refurbishment				$ 25,000		
Machining Services				$ 30,000		46594
Exciter Balancing & Machining				$ 8,000		
Scroll Case Recoating				$ 35,000		
			Sub-Total	$ 298,000		
028 Consulting						
Inspection Services				$ 5,000		
			Sub-Total	$ 5,000		
041 Meals and Entertainment						
Site Visits				$ 500		
Temporary Report Point				$ 10,000		
			Sub-Total	$ 10,500		
094 Interest Capitalized						
AFUDC				$ 7,728		
			Sub-Total	$ 7,728		
095 Administrative Overhead						
Hydro Regular Labour AO				$ 76,972		
Hydro OT Labour AO				$ 8,247		
Hydro Term Labour AO				$ 49,482		
Thermal & Hydro Contracts AO				$ 30,426		
			Sub-Total	$ 165,127		
			Sub-Total (no AO, AFUDC)	$ 696,449		
			TOTAL (AO, AFUDC included)	$ 869,304		
Original Cost				$ 550,495		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

HYD Ridge Overhaul
Summary of Alternatives

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Hydro	**CI Number:**	47432
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Ridge Overhaul vs Replacement Energ	6.11%	-8,664,451	7,125,017	1	50.05%	3.8 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

Based on the cost of the replacement energy, it is recommneded to refurbish this unit.

Notes/Comments :

Ridge Overhaul vs Replacement Energy & Repair Costs

Option compares proactively refurbishing the unit compared to running it until an unplanned failure occurs and losing the generation from the unit on a go forward basis.

Test 2

Test 3

Test 4

HYD Ridge Overhaul
Summary of Sensitivities

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Hydro	**CI Number:**	47432
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Ridge Overhaul vs Replacement Energy & Repair	6.11%	-8,664,451	7,125,017	1	50.05%	3.8 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Ridge Overhaul vs Replacement Energy & Repair	10%	-8,599,238	7,070,500	1	46.11%	4.0 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:						
	A	65,213	-54,517	0	-3.94%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Ridge Overhaul vs Replacement Energy & Repair	-10%	-7,732,792	6,357,998	1	45.71%	4.1 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:						
	A	931,658	-767,019	0	-4.33%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	154,494	335,931	553,066	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

HYD Ridge Overhaul
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	Date :	30-Oct-15
Department :	Hydro	CI Number:	47432
Originator :		Project No. :	

Ridge Overhaul vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	30%	40%	30%	40%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	13164.0	13164.0				
Duration (Hours)	1	1				
Totals	$165,664	$239,321	$0	$0	$165,664	$239,321
Total Capital Cost of Alternative						$869,304

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

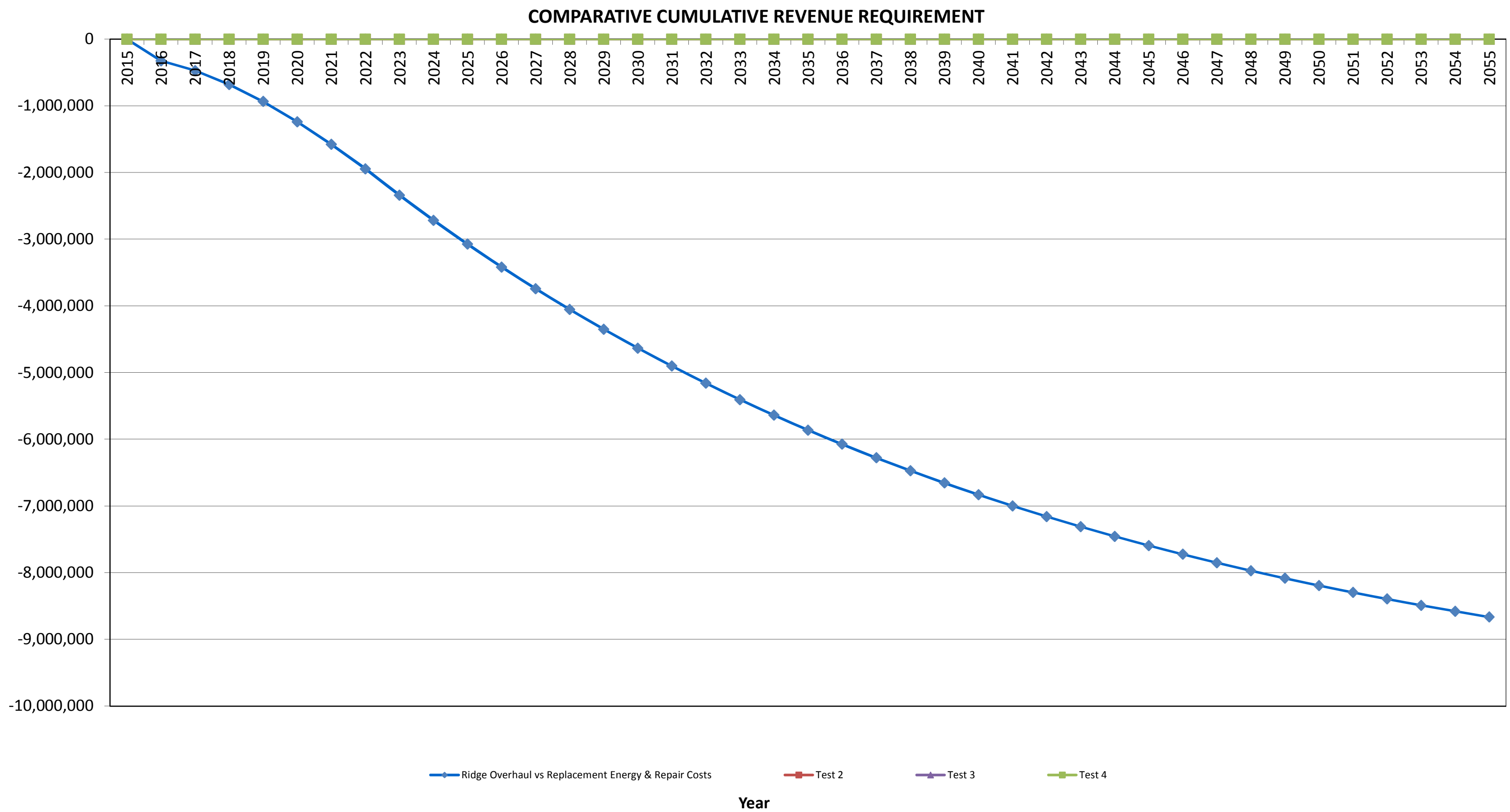
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

HYD Ridge Overhaul
Ridge Overhaul vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	165,663.8	(704,177.2)	27,858.0	714,166.1	(538,513.5)	(42,719.8)	(581,233.3)	(547,764.9)	0.94	(547,764.9)
2017	-	-	239,321.2	-	53,487.3	653,069.8	239,321.2	(57,608.5)	181,712.7	161,388.5	0.89	(386,376.3)
2018	-	-	328,554.0	-	49,208.3	596,861.1	328,554.0	(86,597.2)	241,956.8	202,520.5	0.84	(183,855.9)
2019	-	-	409,780.4	-	45,271.6	545,149.2	409,780.4	(112,997.7)	296,782.7	234,106.4	0.79	50,250.5
2020	-	-	502,843.0	-	41,649.9	497,574.2	502,843.0	(142,969.9)	359,873.1	267,527.1	0.74	317,777.7
2021	-	-	586,171.3	-	38,317.9	453,805.2	586,171.3	(169,834.5)	416,336.7	291,680.1	0.70	609,457.8
2022	-	-	672,631.5	-	35,252.5	413,537.7	672,631.5	(197,587.5)	475,044.0	313,645.9	0.66	923,103.7
2023	-	-	762,315.7	-	32,432.3	376,491.7	762,315.7	(226,263.9)	536,051.8	333,546.4	0.62	1,256,650.1
2024	-	-	777,562.0	-	29,837.7	342,409.3	777,562.0	(231,794.5)	545,767.5	320,037.5	0.59	1,576,687.6
2025	-	-	793,113.3	-	27,450.7	311,053.5	793,113.3	(237,355.4)	555,757.9	307,130.2	0.55	1,883,817.8
2026	-	-	808,975.5	-	25,254.6	282,206.2	808,975.5	(242,953.5)	566,022.1	294,790.8	0.52	2,178,608.5
2027	-	-	825,155.0	-	23,234.3	255,666.6	825,155.0	(248,595.4)	576,559.6	282,988.3	0.49	2,461,596.8
2028	-	-	841,658.1	-	21,375.5	231,250.2	841,658.1	(254,287.6)	587,370.5	271,694.0	0.46	2,733,290.8
2029	-	-	858,491.3	-	19,665.5	208,787.2	858,491.3	(260,036.0)	598,455.3	260,881.5	0.44	2,994,172.3
2030	-	-	875,661.1	-	18,092.2	188,121.1	875,661.1	(265,846.4)	609,814.8	250,526.2	0.41	3,244,698.6
2031	-	-	893,174.4	-	16,644.9	169,108.4	893,174.4	(271,724.1)	621,450.2	240,605.4	0.39	3,485,303.9
2032	-	-	911,037.8	-	15,313.3	151,616.7	911,037.8	(277,674.6)	633,363.2	231,097.6	0.36	3,716,401.6
2033	-	-	929,258.6	-	14,088.2	135,524.3	929,258.6	(283,702.8)	645,555.8	221,983.2	0.34	3,938,384.8
2034	-	-	947,843.8	-	12,961.2	120,719.3	947,843.8	(289,813.6)	658,030.2	213,243.5	0.32	4,151,628.3
2035	-	-	966,800.6	-	11,924.3	107,098.7	966,800.6	(296,011.7)	670,789.0	204,861.2	0.31	4,356,489.4
2036	-	-	986,136.7	-	10,970.3	94,567.7	986,136.7	(302,301.6)	683,835.1	196,819.8	0.29	4,553,309.2
2037	-	-	1,005,859.4	-	10,092.7	83,039.3	1,005,859.4	(308,687.7)	697,171.7	189,104.1	0.27	4,742,413.3
2038	-	-	1,025,976.6	-	9,285.3	72,433.1	1,025,976.6	(315,174.3)	710,802.3	181,699.4	0.26	4,924,112.7
2039	-	-	1,046,496.1	-	8,542.5	62,675.4	1,046,496.1	(321,765.6)	724,730.5	174,592.3	0.24	5,098,705.0
2040	-	-	1,067,426.0	-	7,859.1	53,698.3	1,067,426.0	(328,465.8)	738,960.3	167,769.6	0.23	5,266,474.6
2041	-	-	1,088,774.6	-	7,230.3	45,439.4	1,088,774.6	(335,278.7)	753,495.8	161,219.2	0.21	5,427,693.7
2042	-	-	1,110,550.0	-	6,651.9	37,841.2	1,110,550.0	(342,208.4)	768,341.6	154,929.4	0.20	5,582,623.2
2043	-	-	1,132,761.0	-	6,119.8	30,850.8	1,132,761.0	(349,258.8)	783,502.2	148,889.3	0.19	5,731,512.4
2044	-	-	1,155,416.3	-	5,630.2	24,419.7	1,155,416.3	(356,433.7)	798,982.6	143,088.3	0.18	5,874,600.8
2045	-	-	1,178,524.6	-	5,179.8	18,503.1	1,178,524.6	(363,736.9)	814,787.7	137,516.6	0.17	6,012,117.3
2046	-	-	1,202,095.1	-	4,765.4	13,059.8	1,202,095.1	(371,172.2)	830,922.9	132,164.5	0.16	6,144,281.9
2047	-	-	1,226,137.0	-	4,384.1	8,051.9	1,226,137.0	(378,743.4)	847,393.6	127,023.2	0.15	6,271,305.1
2048	-	-	1,250,659.7	-	4,033.4	3,444.7	1,250,659.7	(386,454.2)	864,205.6	122,084.0	0.14	6,393,389.1
2049	-	-	1,275,672.9	-	3,710.7	(793.9)	1,275,672.9	(394,308.3)	881,364.6	117,338.6	0.13	6,510,727.7
2050	-	-	1,301,186.4	-	3,413.9	(4,693.5)	1,301,186.4	(402,309.5)	898,876.9	112,779.3	0.13	6,623,506.9
2051	-	-	1,327,210.1	-	3,140.8	(8,281.0)	1,327,210.1	(410,461.5)	916,748.6	108,398.4	0.12	6,731,905.4
2052	-	-	1,353,754.3	-	2,889.5	(11,581.6)	1,353,754.3	(418,768.1)	934,986.2	104,188.9	0.11	6,836,094.3
2053	-	-	1,380,829.4	-	2,658.4	(14,618.1)	1,380,829.4	(427,233.0)	953,596.4	100,143.9	0.11	6,936,238.2
2054	-	-	1,408,446.0	-	2,445.7	(17,411.7)	1,408,446.0	(435,860.1)	972,585.9	96,256.9	0.10	7,032,495.1
2055	-	-	1,436,614.9	-	2,250.0	(19,981.8)	1,436,614.9	(444,653.1)	991,961.8	92,521.4	0.09	7,125,016.5
Total	**-**	**-**	**38,056,539.5**	**(704,177.2)**	**670,573.6**		**37,352,362.3**	**(11,589,649.4)**	**25,762,712.8**	**7,125,016.5**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Ridge Overhaul vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Steam

Boiler

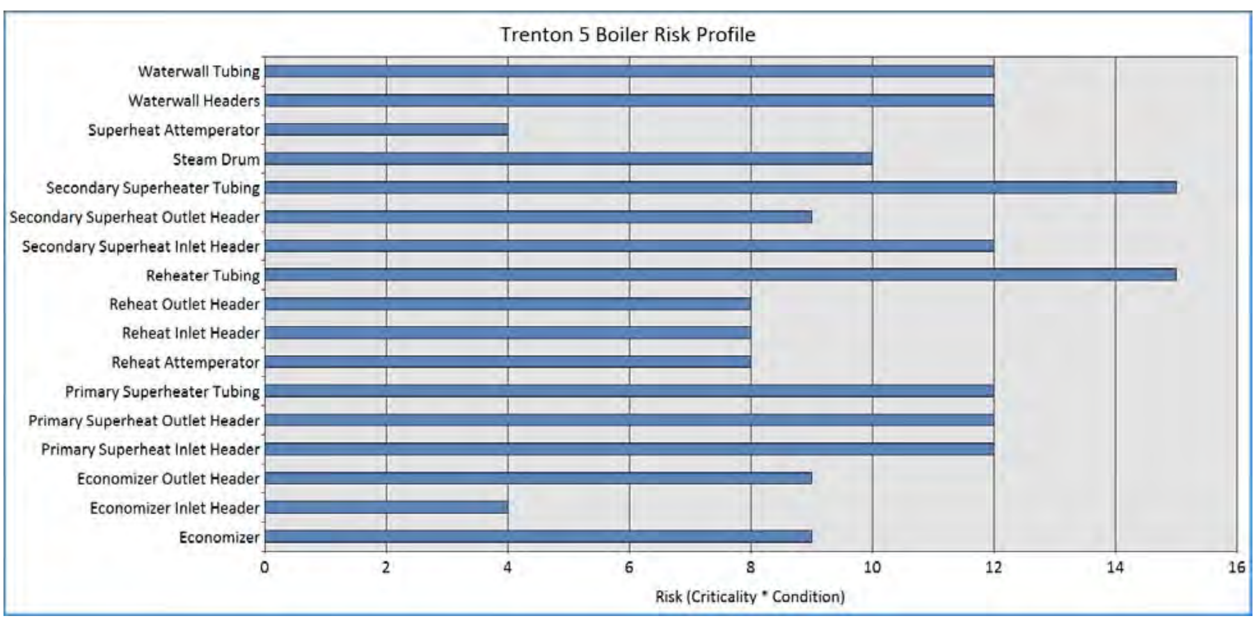
Boilers

NS Power's fleet includes 13 Boilers supplying Steam Turbine/Generator units ranging from 50MW to 185MW nominal rating. Boilers are considered complex asset classes. This asset class is generally defined by Water and Steam Circuits (Economizer, Superheaters, Reheaters, Water Walls and Division Walls, Steam Drum, Headers, Air heaters, Ash Seals, Sootblowers and Boiler Support Structures). Boilers typically include numerous other integral systems including emission controls (Baghouse and Precipitators), Burners Systems and complex control systems.

Boiler inspection and condition assessment is typically done on an annual basis during planned outages. Annual inspections typically provide early warning of impending problems and are addressed immediately or monitoring is established to project time to repair.

Boilers are composed of many sections and areas each with a different environment related to temperature, gas flow, particulate loading and resultant chemical regime. Therefore, there are different tube sizes, materials and failure mechanisms to consider across the various areas of the Boiler. Fuel also represents a key variable which effects the operating environment, failure mechanisms and repairs. Due to these complexities, and the harsh operating environments, Boilers represent the single largest source of unplanned outages in the generation industry.

NS Power has employed a rigorous Asset Management plan for Boilers for more than a decade which has resulted in excellent Boiler performance, when compared to industry norms. As the fleet continues to age, NS Power's Asset Management Plan for Boilers is evolving to project investments of a life extension nature. The following graphic illustrates the previously discussed risk profiling approach as applied to Boilers.



CI Number: 47552

Title: TRE5 – Boiler Refurbishment 2016

Start Date:	2016/06
In-Service Date:	2016/09
Final Cost Date:	2017/03
Function:	Steam
Forecast Amount:	$1,204,387

DESCRIPTION:

The scope of work for this project is to refurbish and replace deteriorated boiler tubes, tube bends and shields on the Trenton Unit 5 boiler as part of the planned outage in 2016. The scope of this project is determined as part of the annual boiler condition data collection and analysis. This effort includes evaluation and prioritization of activities to be undertaken during the annual outage. Protective erosion shields identified as missing or degraded will be replaced with new shields. Tubes and bends will be replaced in the areas where the thickness readings are below American Society of Mechanical Engineers (ASME) specifications. This tolerance maximizes the economic tube life while maintaining boiler reliability.

The increase in this project from 2015 CI 46302 is due to additional tubes in the reheat intermediate section, which is original to the plant (1969), being cut out and replaced. These replacement requirements were identified during Non-Destructive testing completed during 2015. Additionally, investment in the boiler water wall and vestibule are also being completed.

Summary of Related CIs +/- 2 years:
2014 CI 44732 TRE5 Boiler Refurbishment $626,649
2015 CI 46302 TRE5 Boiler Refurbishment $647,845
2017 CI TBD TRE5 Boiler Refurbishment $TBD
2018 CI TBD TRE5 Boiler Refurbishment $TBD

Depreciation Class: Steam Production Plant- Trenton Unit 5

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Ongoing asset management activities have identified the requirement for boiler component replacement to maintain the long term reliability of the boiler and mitigate the risk of unplanned outages due to tube leaks. Boiler Tube failures represent the industry's single largest source of outages for steam-based generation. NS Power has a long history of managing this issue with comprehensive Boiler Inspection and Investment Programs to match the various failure mechanisms.

Why do this project now?

In order to mitigate the risk of unplanned outages, annual boiler refurbishment activities are required. Some of the tubes to be inspected and replaced are difficult to access and sufficient time during a planned outage is required to complete refurbishment or replacements. The annual planned outage duration will afford the time necessary to assess, locate and repair tubes and shields.

Why do this project this way?

Replacing deteriorated boiler tubes, tube bends and shields will mitigate the risk of tube leaks and minimize the number of unplanned outages. Based on boiler assessments, these upgrades are necessary to maintain reliable operation of the boiler. Refurbishment of these components is not an option once they are outside acceptable tolerances.

CI Number : 47552 - TRE5 Boiler Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 340 - 340-Trenton Unit 5 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,892	0	2,892
095		095-Thermal Term Labour AO		1,217	0	1,217
095		095-Thermal Overtime Labour AO		730	0	730
095		095-Thermal & Hydro Contracts AO		90,542	0	90,542
095		095-Thermal Regular Labour AO		3,282	0	3,282
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	16,193	0	16,193
002	013	002 - THERMAL Overtime Labour	013 - SGP - Boiler	7,205	0	7,205
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	6,005	0	6,005
012	013	012 - Materials	013 - SGP - Boiler	89,000	0	89,000
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	886,800	0	886,800
066	013	066 - Other Goods & Services	013 - SGP - Boiler	100,520	0	100,520
			Total Cost:	1,204,387	0	1,204,387
			Original Cost:	155,305		

Capital Project Detailed Estimate

Location: **Trenton**
CI# : 47552
Title: TRE5 Boiler Refurbishment 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Engineering	PD	20	$ 405	$ 8,106		CI 46302
Maintenance Trades	PD	9	$ 365	$ 3,283		
Utilityworker	PD	20	$ 240	$ 4,804		
			Sub-Total	$ 16,193		
002 OT Labour						
Utilityworker	PD	15	$ 480	$ 7,205		
				$ -		
			Sub-Total	$ 7,205		
004 Term Labour						
Utilityworker	PD	25	$ 240	$ 6,005		
				$ -		
			Sub-Total	$ 6,005		
012 Materials						
Reheater Tubes	ea	20	$ 1,500	$ 30,000		CI 46302
Boiler Tubes	ea	8	$ 1,500	$ 12,000		CI 46302
Contractor Materials	lot	1	$ 27,000	$ 27,000		CI 46302
Shields	ea	200	$ 100	$ 20,000		CI 46302
				$ -		
			Sub-Total	$ 89,000		
013 Contracts						
Inspection	lot	1	$ 150,000	$ 150,000		CI 46302
Boiler Repairs	lot	1	$ 350,000	$ 350,000		CI 46302
Reheater Tube Replacement	lot	1	$ 150,000	$ 150,000		CI 46302
Supervision / Foreman / Quality Assurance	lot	1	$ 210,000	$ 210,000		CI 46302
Vacuum Services	lot	1	$ 26,800	$ 26,800		CI 46302
				$ -		
			Sub-Total	$ 886,800		
066 Other Goods & Services						
Contingency	%	10%	$ 1,005,203	$ 100,520		
			Sub-Total	$ 100,520		
094 Interest Capitalized						
AFUDC				$ 2,892		
			Sub-Total	$ 2,892		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 3,282		
Thermal OT Labour AO				$ 730		
Thermal Term Labour AO				$ 1,217		
Thermal / Hydro Contracts AO				$ 90,542		
			Sub-Total	$ 95,772		
			SUB-TOTAL (no AO, AFUDC)	$ 1,105,723		
			TOTAL (AO, AFUDC included)	$ 1,204,387		
Original Cost				$ 155,305		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

TRE5 Boiler Refurbishment 2016
Summary of Alternatives

Nova Scotia POWER
An Emera Company

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Trenton Generating Station	**CI Number:**	47552
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Boiler Refurbishments vs Replacement	6.07%	-4,928,956	3,790,623	1	35.02%	4.1 years
B	Test 2	6.07%	0	0	2	#NUM!	0.0 years
C	Test 3	6.07%	0	0	2	#NUM!	0.0 years
D	Test 4	6.07%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to perform planned boiler refurbishments during the 2016 TRE5 outage. This is backed by favorable economic analysis data.

Notes/Comments :

Boiler Refurbishments vs Replacement Energy & Repair Costs

This model compares the refurbishment costs to the replacement energy costs associated with unplanned outages due to tube leaks in the boiler. Assumptions are that there will be one tube leak in 2016, with increasing likelihood of failure in subsequent years. The unit would be down an average of 120 hours to perform repairs such that the unit could be returned to service. The failure rate considers the age of the boiler (1969).

Test 2

Test 3

Test 4

TRE5 Boiler Refurbishment 2016
Summary of Sensitivities

Division :	Power Production		**Date :**	**30-Oct-15**
Department :	Trenton Generating Station		**CI Number:**	47552
Originator :			**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Boiler Refurbishments vs Replacement Energy &	6.07%	-4,928,956	3,790,623	1	35.02%	4.1 years
B	Test 2	6.07%	0	0	2	#NUM!	0.0 years
C	Test 3	6.07%	0	0	2	#NUM!	0.0 years
D	Test 4	6.07%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Boiler Refurbishments vs Replacement Energy &	10%	-4,817,315	3,704,969	1	32.22%	4.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change: **A**	111,642	-85,654	0	-2.80%	0.3 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Boiler Refurbishments vs Replacement Energy &	-10%	-4,324,419	3,325,907	1	31.94%	4.4 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change: **A**	604,537	-464,716	0	-3.08%	0.3 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	134,125	376,608	561,586	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

TRE5 Boiler Refurbishment 2016
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Trenton Generating Station	**CI Number:**	47552
Originator :		**Project No. :**	

Boiler Refurbishments vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			100,000	104,024		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	160.0	160.0				
Duration (Hours)	120	120				
Totals	$43,769	$113,310	$100,000	$208,048	$143,769	$321,358

Total Capital Cost of Alternative **$1,204,387**

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

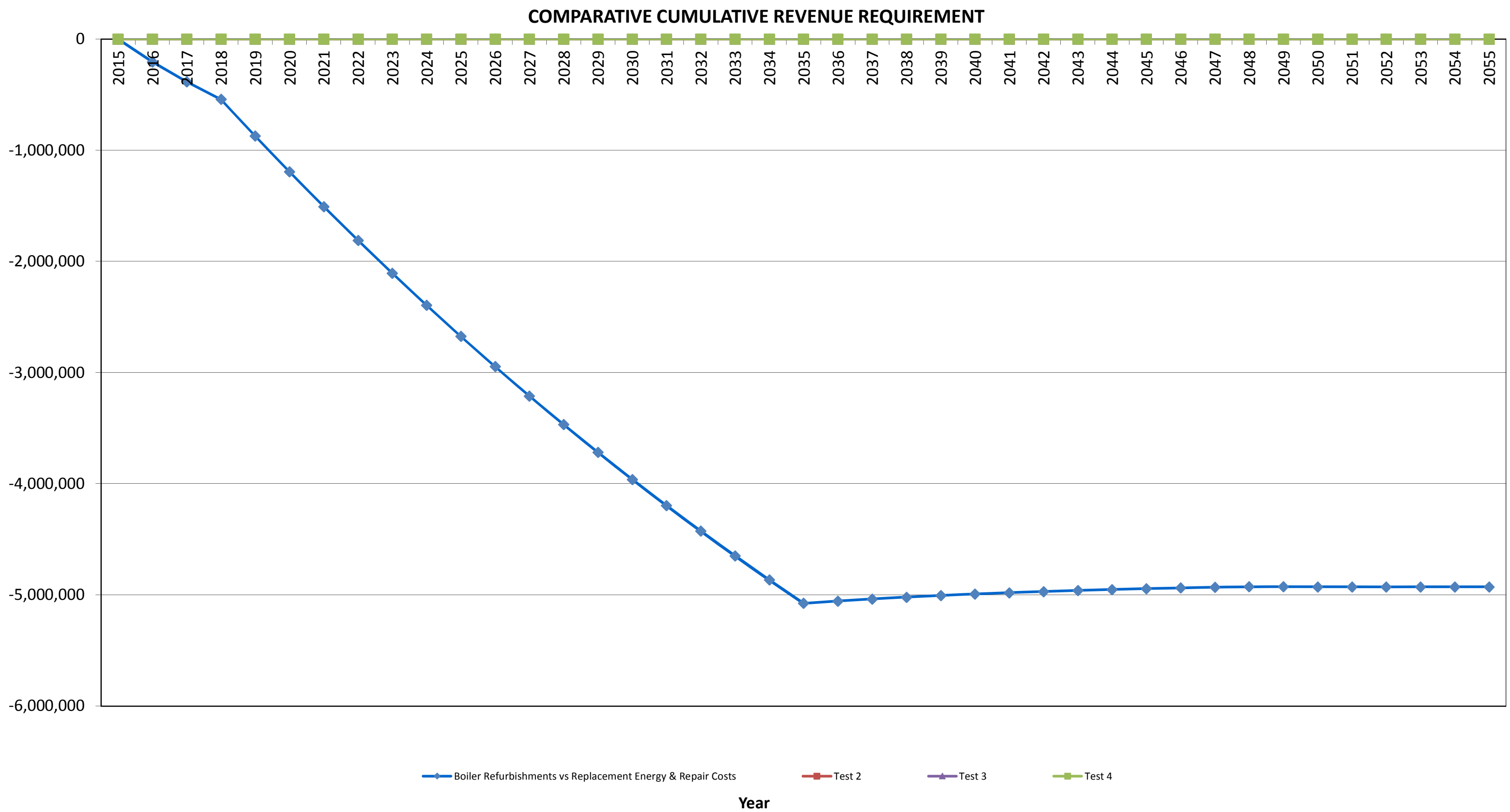
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

TRE5 Boiler Refurbishment 2016
Boiler Refurbishments vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	143,768.9	(1,108,615.0)	44,228.9	1,087,927.2	(964,846.0)	(30,857.4)	(995,703.4)	(938,722.9)	0.94	(938,722.9)
2017	-	-	321,357.8	-	84,919.5	998,594.5	321,357.8	(73,295.9)	248,061.9	220,482.9	0.89	(718,240.0)
2018	-	-	311,979.0	-	78,126.0	916,408.4	311,979.0	(72,494.4)	239,484.6	200,678.0	0.84	(517,562.0)
2019	-	-	552,890.3	-	71,875.9	840,797.2	552,890.3	(149,114.5)	403,775.8	318,984.8	0.79	(198,577.2)
2020	-	-	570,943.0	-	66,125.8	771,234.9	570,943.0	(156,493.3)	414,449.6	308,680.3	0.74	110,103.2
2021	-	-	589,471.8	-	60,835.8	707,237.6	589,471.8	(163,877.2)	425,594.6	298,841.4	0.70	408,944.5
2022	-	-	608,657.4	-	55,968.9	648,360.0	608,657.4	(171,333.4)	437,323.9	289,504.5	0.66	698,449.0
2023	-	-	628,524.3	-	51,491.4	594,192.7	628,524.3	(178,880.2)	449,644.1	280,626.3	0.62	979,075.2
2024	-	-	649,098.1	-	47,372.1	544,358.7	649,098.1	(186,535.1)	462,563.0	272,168.5	0.59	1,251,243.7
2025	-	-	670,405.5	-	43,582.3	498,511.5	670,405.5	(194,315.2)	476,090.3	264,097.1	0.55	1,515,340.8
2026	-	-	692,474.1	-	40,095.7	456,332.1	692,474.1	(202,237.3)	490,236.8	256,382.1	0.52	1,771,722.9
2027	-	-	715,332.5	-	36,888.1	417,527.0	715,332.5	(210,317.8)	505,014.8	248,996.5	0.49	2,020,719.4
2028	-	-	739,010.7	-	33,937.0	381,826.3	739,010.7	(218,572.8)	520,437.9	241,916.5	0.46	2,262,635.9
2029	-	-	763,539.6	-	31,222.1	348,981.7	763,539.6	(227,018.4)	536,521.2	235,120.7	0.44	2,497,756.6
2030	-	-	788,951.4	-	28,724.3	318,764.6	788,951.4	(235,670.4)	553,281.0	228,590.0	0.41	2,726,346.6
2031	-	-	815,279.4	-	26,426.3	290,964.9	815,279.4	(244,544.5)	570,735.0	222,307.1	0.39	2,948,653.7
2032	-	-	842,558.6	-	24,312.2	265,389.2	842,558.6	(253,656.4)	588,902.2	216,256.7	0.37	3,164,910.4
2033	-	-	870,825.0	-	22,367.3	241,859.5	870,825.0	(263,021.9)	607,803.1	210,424.7	0.35	3,375,335.1
2034	-	-	900,116.0	-	20,577.9	220,212.2	900,116.0	(272,656.8)	627,459.2	204,798.5	0.33	3,580,133.5
2035	-	-	930,470.8	-	18,931.6	200,296.7	930,470.8	(282,577.1)	647,893.7	199,366.6	0.31	3,779,500.1
2036	-	-	-	-	17,417.1	181,974.5	-	5,399.3	5,399.3	1,566.4	0.29	3,781,066.5
2037	-	-	-	-	16,023.7	165,118.0	-	4,967.4	4,967.4	1,358.6	0.27	3,782,425.1
2038	-	-	-	-	14,741.8	149,610.0	-	4,570.0	4,570.0	1,178.4	0.26	3,783,603.4
2039	-	-	-	-	13,562.5	135,342.7	-	4,204.4	4,204.4	1,022.1	0.24	3,784,625.5
2040	-	-	-	-	12,477.5	122,216.7	-	3,868.0	3,868.0	886.5	0.23	3,785,512.0
2041	-	-	-	-	11,479.3	110,140.9	-	3,558.6	3,558.6	768.9	0.22	3,786,280.9
2042	-	-	-	-	10,561.0	99,031.1	-	3,273.9	3,273.9	666.9	0.20	3,786,947.8
2043	-	-	-	-	9,716.1	88,810.1	-	3,012.0	3,012.0	578.4	0.19	3,787,526.2
2044	-	-	-	-	8,938.8	79,406.7	-	2,771.0	2,771.0	501.7	0.18	3,788,028.0
2045	-	-	-	-	8,223.7	70,755.7	-	2,549.3	2,549.3	435.2	0.17	3,788,463.1
2046	-	-	-	-	7,565.8	62,796.7	-	2,345.4	2,345.4	377.4	0.16	3,788,840.6
2047	-	-	-	-	6,960.5	55,474.4	-	2,157.8	2,157.8	327.4	0.15	3,789,167.9
2048	-	-	-	-	6,403.7	48,737.9	-	1,985.1	1,985.1	283.9	0.14	3,789,451.9
2049	-	-	-	-	5,891.4	42,540.4	-	1,826.3	1,826.3	246.3	0.13	3,789,698.2
2050	-	-	-	-	5,420.1	36,838.6	-	1,680.2	1,680.2	213.6	0.13	3,789,911.8
2051	-	-	-	-	4,986.5	31,593.0	-	1,545.8	1,545.8	185.3	0.12	3,790,097.1
2052	-	-	-	-	4,587.6	26,767.0	-	1,422.1	1,422.1	160.7	0.11	3,790,257.8
2053	-	-	-	-	4,220.6	22,327.1	-	1,308.4	1,308.4	139.4	0.11	3,790,397.1
2054	-	-	-	-	3,882.9	18,242.4	-	1,203.7	1,203.7	120.9	0.10	3,790,518.0
2055	-	-	-	-	3,572.3	14,484.5	-	1,107.4	1,107.4	104.9	0.09	3,790,622.9
Total	**-**	**-**	**13,105,654.1**	**(1,108,615.0)**	**1,064,641.8**		**11,997,039.1**	**(3,732,713.8)**	**8,264,325.3**	**3,790,622.9**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-1,000,000
-2,000,000
-3,000,000
-4,000,000
-5,000,000
-6,000,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Boiler Refurbishments vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47664

Title: LIN4 – Division Wall Replacement

Start Date:	2016/04
In-Service Date:	2016/06
Final Cost Date:	2016/12
Function:	Steam
Forecast Amount:	$619,243

DESCRIPTION:

This capital work order provides for the replacement of the division wall for Lingan Unit 4. The division walls are vertical tubes connected by membrane making up the walls around the combustor of the boiler. Similar to Unit 3 where the division wall was replaced in 2015, the section of wall requiring replacement has been pad welded to allow it to operate until the planned extended outage in 2016 when time allows for a more reliable permanent solution. This panel is 12 feet high and consists of 113 tubes.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2015 CI 46467 LIN3 Division Wall Replacement $635,747

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The division wall must be in working order, free of leaks in order for the boiler to operate. A known section of the wall is worn and if the boiler continues to run without replacing the panel past the 2016 planned outage, leaks will develop causing the unit to be taken off line.

Why do this project now?

The division wall panel on the west wall of the boiler has reached its minimum allowable wall thickness, and has been pad welded to allow the boiler to run until the planned major outage in 2016.

Why do this project this way?

Replacement of the division wall panel is the only option, as the repairs made to date are not permanent solutions and will compromise the reliability of the boiler if relied upon into the future.

CI Number : 47664 - LIN4 Division Wall Replacement **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity		Forecast Amount	Amount	Variance
094		094 - Interest Capitalized			3,781	0	3,781
095		095-Thermal Regular Labour AO			477	0	477
095		095-Thermal & Hydro Contracts AO			46,966	0	46,966
095		095-Thermal Term Labour AO			955	0	955
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler		2,355	0	2,355
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler		4,709	0	4,709
012	013	012 - Materials	013 - SGP - Boiler		100,000	0	100,000
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler		460,000	0	460,000
				Total Cost:	619,243	0	619,243
				Original Cost:	200,361		

Capital Project Detailed Estimate

Location: Steam
CI# : 47664
Title: LIN4 Division Wall Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Utilityworker	PD	10	$ 240	$ 2,355		
			Sub-Total	$ 2,355		
004 Term Labour						
Utilityworker	PD	20	$ 240	$ 4,709		
			Sub-Total	$ 4,709		
012 Materials						
Boiler Division Wall Panel	ea	1	$ 92,000	$ 92,000		CI 46467
Misc. Consumables	ea	1	$ 8,000	$ 8,000		CI 46467
			Sub-Total	$ 100,000		
013 Contracts						
Installation of Division Wall Panels	ea	1	$ 460,000	$ 460,000		CI 46467
				$ -		
			Sub-Total	$ 460,000		
094 Interest Capitalized						
				$ 3,781		
				$ -		
			Sub-Total	$ 3,781		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 477		
Thermal Term Labour AO				$ 955		
Thermal / Hydro Contracts AO				$ 46,966		
			Sub-Total	$ 48,398		
			SUB-TOTAL (no AO, AFUDC)	$ 567,064		
			TOTAL (AO, AFUDC included)	$ 619,243		
Original Cost				$ 200,361		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Division Wall Replacement
Summary of Alternatives

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47664
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Division Wall vs Replacement	6.11%	-1,680,386	1,205,296	1	38.30%	4.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid increased tube leaks in this area of the boiler.

Notes/Comments :

Replace Division Wall vs Replacement Energy & Repair Costs

The division if not replaced will continue to wear and require pad welds over pad welds at which point the predicted annual failure will increase and boiler reliability will be reduced.

Test 2

Test 3

Test 4

LIN4 Division Wall Replacement
Summary of Sensitivities

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47664
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Division Wall vs Replacement Energy & I	6.11%	-1,680,386	1,205,296	1	38.30%	4.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Division Wall vs Replacement Energy & I	10%	-1,624,854	1,161,144	1	34.99%	4.2 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	55,532	-44,152	0	-3.31%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Division Wall vs Replacement Energy & I	-10%	-1,456,815	1,040,615	1	34.65%	4.2 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	223,571	-164,682	0	-3.65%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	76,320	138,933	281,810	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 Division Wall Replacement
Avoided Cost Calculations

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47664
Originator :		**Project No. :**	

Replace Division Wall vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			69,800	72,594		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	80	80				
Totals	$12,038	$21,373	$69,800	$72,594	$81,838	$93,967
Total Capital Cost of Alternative						$619,243

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

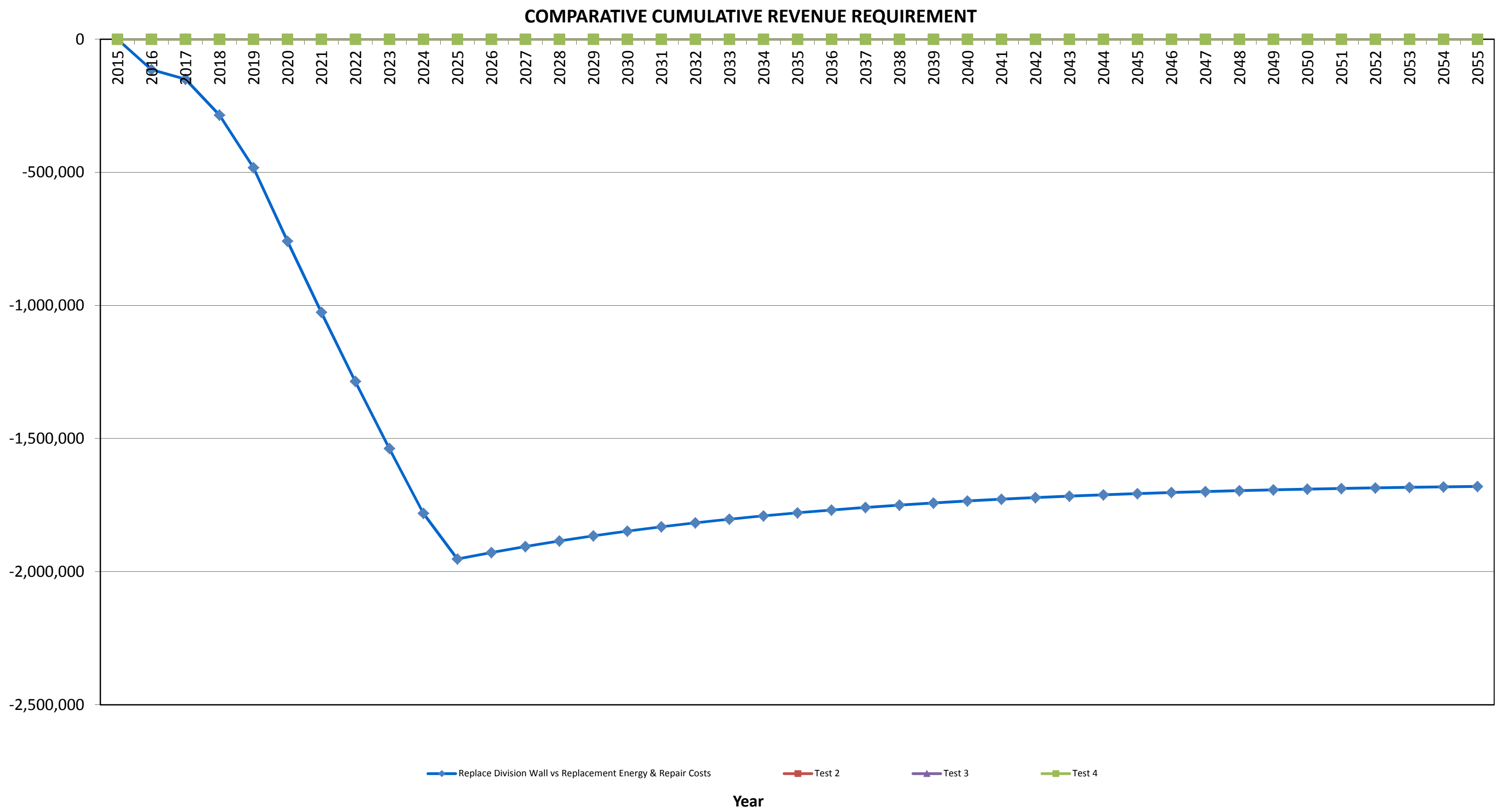
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Division Wall Replacement
Replace Division Wall vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	81,838.0	(570,844.6)	22,682.6	557,739.3	(489,006.7)	(18,338.2)	(507,344.8)	(478,131.0)	0.94	(478,131.0)
2017	-	-	93,967.2	-	43,550.5	511,958.6	93,967.2	(15,629.2)	78,338.0	69,576.1	0.89	(408,555.0)
2018	-	-	219,600.3	-	40,066.5	469,840.4	219,600.3	(55,655.5)	163,944.8	137,223.6	0.84	(271,331.4)
2019	-	-	314,444.7	-	36,861.2	431,091.6	314,444.7	(86,050.9)	228,393.8	180,160.3	0.79	(91,171.1)
2020	-	-	445,176.9	-	33,912.3	395,442.7	445,176.9	(127,492.0)	317,684.9	236,164.7	0.74	144,993.6
2021	-	-	460,622.6	-	31,199.3	362,645.8	460,622.6	(133,121.2)	327,501.4	229,443.2	0.70	374,436.8
2022	-	-	476,639.1	-	28,703.3	332,472.5	476,639.1	(138,860.1)	337,779.0	223,017.3	0.66	597,454.1
2023	-	-	493,248.3	-	26,407.1	304,713.2	493,248.3	(144,720.8)	348,527.5	216,863.6	0.62	814,317.7
2024	-	-	510,473.0	-	24,294.5	279,174.6	510,473.0	(150,715.3)	359,757.6	210,961.5	0.59	1,025,279.2
2025	-	-	397,483.4	-	22,350.9	255,679.1	397,483.4	(116,291.1)	281,192.3	155,396.2	0.55	1,180,675.3
2026	-	-	-	-	20,562.9	234,063.2	-	6,374.5	6,374.5	3,319.9	0.52	1,183,995.2
2027	-	-	-	-	18,917.8	214,176.6	-	5,864.5	5,864.5	2,878.4	0.49	1,186,873.7
2028	-	-	-	-	17,404.4	195,880.9	-	5,395.4	5,395.4	2,495.7	0.46	1,189,369.4
2029	-	-	-	-	16,012.1	179,048.9	-	4,963.7	4,963.7	2,163.8	0.44	1,191,533.2
2030	-	-	-	-	14,731.1	163,563.4	-	4,566.6	4,566.6	1,876.1	0.41	1,193,409.3
2031	-	-	-	-	13,552.6	149,316.8	-	4,201.3	4,201.3	1,626.6	0.39	1,195,035.9
2032	-	-	-	-	12,468.4	136,209.9	-	3,865.2	3,865.2	1,410.3	0.36	1,196,446.2
2033	-	-	-	-	11,470.9	124,151.6	-	3,556.0	3,556.0	1,222.8	0.34	1,197,669.0
2034	-	-	-	-	10,553.3	113,057.9	-	3,271.5	3,271.5	1,060.2	0.32	1,198,729.1
2035	-	-	-	-	9,709.0	102,851.7	-	3,009.8	3,009.8	919.2	0.31	1,199,648.3
2036	-	-	-	-	8,932.3	93,462.0	-	2,769.0	2,769.0	797.0	0.29	1,200,445.3
2037	-	-	-	-	8,217.7	84,823.5	-	2,547.5	2,547.5	691.0	0.27	1,201,136.3
2038	-	-	-	-	7,560.3	76,876.1	-	2,343.7	2,343.7	599.1	0.26	1,201,735.4
2039	-	-	-	-	6,955.5	69,564.5	-	2,156.2	2,156.2	519.4	0.24	1,202,254.9
2040	-	-	-	-	6,399.0	62,837.7	-	1,983.7	1,983.7	450.4	0.23	1,202,705.2
2041	-	-	-	-	5,887.1	56,649.2	-	1,825.0	1,825.0	390.5	0.21	1,203,095.7
2042	-	-	-	-	5,416.1	50,955.7	-	1,679.0	1,679.0	338.6	0.20	1,203,434.3
2043	-	-	-	-	4,982.8	45,717.7	-	1,544.7	1,544.7	293.5	0.19	1,203,727.8
2044	-	-	-	-	4,584.2	40,898.7	-	1,421.1	1,421.1	254.5	0.18	1,203,982.3
2045	-	-	-	-	4,217.5	36,465.3	-	1,307.4	1,307.4	220.7	0.17	1,204,203.0
2046	-	-	-	-	3,880.1	32,386.5	-	1,202.8	1,202.8	191.3	0.16	1,204,394.3
2047	-	-	-	-	3,569.7	28,634.0	-	1,106.6	1,106.6	165.9	0.15	1,204,560.2
2048	-	-	-	-	3,284.1	25,181.8	-	1,018.1	1,018.1	143.8	0.14	1,204,704.0
2049	-	-	-	-	3,021.4	22,005.7	-	936.6	936.6	124.7	0.13	1,204,828.7
2050	-	-	-	-	2,779.7	19,083.7	-	861.7	861.7	108.1	0.13	1,204,936.8
2051	-	-	-	-	2,557.3	16,395.4	-	792.8	792.8	93.7	0.12	1,205,030.5
2052	-	-	-	-	2,352.7	13,922.2	-	729.3	729.3	81.3	0.11	1,205,111.8
2053	-	-	-	-	2,164.5	11,646.9	-	671.0	671.0	70.5	0.11	1,205,182.3
2054	-	-	-	-	1,991.3	9,553.6	-	617.3	617.3	61.1	0.10	1,205,243.4
2055	-	-	-	-	1,832.0	7,627.8	-	567.9	567.9	53.0	0.09	1,205,296.3
Total	**-**	**-**	**3,493,493.5**	**(570,844.6)**	**545,995.8**		**2,922,648.9**	**(913,724.3)**	**2,008,924.6**	**1,205,296.3**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-500,000
-1,000,000
-1,500,000
-2,000,000
-2,500,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Replace Division Wall vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47613

Title: PHB Boiler Refurbishment 2016

Start Date:	2016/05
In-Service Date:	2016/05
Final Cost Date:	2016/11
Function:	Steam
Forecast Amount:	$604,194

DESCRIPTION:

Refurbishment of sections of the Port Hawkesbury Biomass (PHB) boiler is required to ensure reliable operation of the unit. Due to the significant volume of biomass fuel that passes through the boiler, it has many erosion susceptible areas including conveyors, feed screws and reciprocating grates. This project falls within the projected sustaining capital investment for the biomass plant. Similar to the boilers on coal-fired units, the biomass boiler will require refurbishment and select component replacements over its life in response to exposure to elevated temperatures, temperature cycling, erosion and corrosion.

Specifically, replacements will be made on the boiler's fuel insertion screw conveyors, boiler reciprocating grate, and pressure parts. On the electrostatic precipitator, the collecting system alignment will be improved, casing repairs to reduce air ingress will be made and the precipitator outlet expansion joints will be replaced. This scope is the result of a boiler inspection conducted in September 2015.

Summary of Related CIs +/- 2 years:
2014 CI 44888 PHB Boiler Refurbishment 2014 $742,129
2015 CI 46451 PHB Boiler Refurbishment 2015 $673,602
2017 CI TBD PHB Boiler Refurbishment 2017 $TBD
2018 CI TBD PHB Boiler Refurbishment 2018 $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Ongoing asset management activities have identified the requirement for boiler component replacement to maintain the long term reliability of the boiler and mitigate the risk of unplanned outages due to tube leaks. The Port Hawkesbury Biomass Plant is a component of NS Power's strategy to achieve required renewable energy targets in 2016 and beyond.

Why do this project now?

Some of the boiler tubes and other equipment to be inspected and replaced are difficult to access. Work must be completed during an outage of sufficient duration to complete the necessary work. The planned outage for the biomass boiler in 2014 will be of sufficient duration to complete the work.

Why do this project this way?

The work will be completed in the most cost effective manner to ensure reliable and efficient operation of the boiler. By servicing the boiler and associated components routinely and simultaneously plant uptime will be maximized and the risk of unplanned outages associated with the generating unit will be reduced.

CI Number : 47613 - PHB - Boiler Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 251 - 251-PH Biomass Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal & Hydro Contracts AO		33,387	0	33,387
095		095-Thermal Overtime Labour AO		340	0	340
095		095-Thermal Term Labour AO		362	0	362
095		095-Thermal Regular Labour AO		535	0	535
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	2,638	0	2,638
002	013	002 - THERMAL Overtime Labour	013 - SGP - Boiler	3,353	0	3,353
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	1,788	0	1,788
011	013	011 - Travel Expense	013 - SGP - Boiler	1,000	0	1,000
012	013	012 - Materials	013 - SGP - Boiler	181,875	0	181,875
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	327,000	0	327,000
014	013	014 - Overtime Meals	013 - SGP - Boiler	250	0	250
066	013	066 - Other Goods & Services	013 - SGP - Boiler	51,665	0	51,665
			Total Cost:	604,193	0	604,193
			Original Cost:	320,000		

Location: PHB
CI# / FP#: 47613
Title: PHB Boiler Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	2	$ 351	$ 703		
Maintenance Trades	PD	2	$ 358	$ 715		
Power Plant Technician	PD	2	$ 375	$ 749		
Utilityworker	PD	2	$ 235	$ 471		
			Sub-Total	$ 2,638		
002 OT Labour						
Electrician	PD	1	$ 703	$ 703		
Maintenance Trades	PD	2	$ 715	$ 1,431		
Power Plant Technician	PD	1	$ 749	$ 749		
Utilityworker	PD	1	$ 471	$ 471		
			Sub-Total	$ 3,353		
004 Term Labour						
Maintenance Trades	PD	5	$ 358	$ 1,788		
			Sub-Total	$ 1,788		
011 Travel Expense						
Travel	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 1,000		
012 Materials						
Grate castings and wear plates	lot	75	$ 745	$ 55,875		
Biomass feed conveyor screws	lot	2	$ 22,000	$ 44,000		
Biomass feed screw bearings	lot	1	$ 20,000	$ 20,000		
Expansion joint, precipitator outlet	lot	1	$ 60,000	$ 60,000		
Ash system conveyor components	lot	1	$ 2,000	$ 2,000		
			Sub-Total	$ 181,875		
013 Contracts						
Cranes, etc.	lot	1	$ 3,000	$ 3,000		
Boilermakers - Boiler Routine Repairs	lot	1	$ 324,000	$ 324,000		
			Sub-Total	$ 327,000		
041 Meals & Entertainment						
Meals and expenses	lot	1	$ 250	$ 250		
			Sub-Total	$ 250		
066 Other Goods & Services						
Contingency 10% (Materials, Contracts, Labour	%	10%	$ 516,654	$ 51,665		
			Sub-Total	$ 51,665		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 535		
Thermal OT Labour AO				$ 340		
Thermal Term Labour AO				$ 362		
Thermal / Hydro Contracts AO				$ 33,387		
			Sub-Total	$ 34,624		
			SUB-TOTAL (no AO, AFUDC)	$ 569,570		
			TOTAL (AO, AFUDC included)	$ 604,193		
Original Cost				$ 320,000		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47666

Title: LIN4 Boiler Refurbishment 2016

Start Date: 2016/04
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $571,859

DESCRIPTION:

The scope of work for this project is to refurbish and replace deteriorated boiler tubes, tube bends and shields on the Lingan Unit 4 boiler as part of the planned outage in 2016. The scope of this project is determined as part of the annual boiler condition data collection and analysis. This effort includes evaluation and prioritization of activities to be undertaken during the annual outage. Protective erosion shields identified as missing or degraded will be replaced with new shields. Tubes and bends will be replaced in the areas where the wall thickness readings are below American Society of Mechanical Engineers (ASME) specifications. This tolerance maximizes the economic tube life while maintaining boiler reliability.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2014 CI 44350 LIN4 Boiler Refurbishment 2014 $382,503
2015 CI 46469 LIN4 – Boiler Refurbishment 2015 $501,938
2017 CI TBD LIN4 Boiler Refurbishment 2017 $TBD
2018 CI TBD LIN4 Boiler Refurbishment 2018 $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Ongoing asset management activities have identified the requirement for boiler component replacement to maintain the long-term reliability of the boiler and mitigate the risk of unplanned outages due to tube leaks. Boiler Tube failures represent the industry's single largest source of outages for steam-based generation. NS Power has a long history of managing this with comprehensive Boiler Inspection and Investment Programs to match the various failure mechanisms.

Why do this project now?

In order to mitigate the risk of an unplanned outage, annual boiler refurbishment activities are required. Some of the tubes to be inspected and replaced are difficult to access and sufficient time during a planned outage is required to complete repairs or replacements. The annual planned outage duration will afford the time necessary to assess, locate and repair tubes and shields.

Why do this project this way?

Replacing deteriorated tubes, tube bends and shields will mitigate the risk of tube leaks and minimize the number of unplanned outages. Based on boiler assessments, these upgrades are necessary to maintain reliable operation of the boiler. Refurbishment of these components is not an option once they are outside acceptable tolerances.

CI Number : 47666 - LIN4 Boiler Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,440	0	3,440
095		095-Thermal & Hydro Contracts AO		46,966	0	46,966
095		095-Thermal Term Labour AO		4,773	0	4,773
095		095-Thermal Regular Labour AO		1,202	0	1,202
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	5,931	0	5,931
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	23,547	0	23,547
012	013	012 - Materials	013 - SGP - Boiler	26,000	0	26,000
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	460,000	0	460,000
			Total Cost:	571,859	0	571,859
			Original Cost:	192,602		

Capital Project Detailed Estimate

Location: **Steam**
CI# : 47666
Title: LIN4 Boiler Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	10	$ 365	$ 3,576		
Utilityworker	PD	10	$ 240	$ 2,355		
			Sub-Total	$ 5,931		
004 Term Labour						
Utilityworker	PD	98	$ 240	$ 23,547		
			Sub-Total	$ 23,547		
012 Materials						
Boiler Tube	ea	1	$ 6,000	$ 6,000		46469
Boiler Sheilds	ea	1	$ 12,000	$ 12,000		46469
Misc. Consumables	ea	1	$ 8,000	$ 8,000		
			Sub-Total	$ 26,000		
013 Contracts						
Boiler Inspection and Refurbishment	ea	1	$ 460,000	$ 460,000		46469
			Sub-Total	$ 460,000		
094 Interest Capitalized						
				$ 3,440		
			Sub-Total	$ 3,440		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 1,202		
Thermal Term Labour AO				$ 4,773		
Thermal / Hydro Contracts AO				$ 46,966		
			Sub-Total	$ 52,941		
			SUB-TOTAL (no AO, AFUDC)	$ 515,478		
			TOTAL (AO, AFUDC included)	$ 571,859		
Original Cost				$ 192,602		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Boiler Refurbishment
Summary of Alternatives

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47666
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish Boiler vs Replacement Energ	6.11%	-768,638	516,019	1	35.33%	3.5 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to maintain the reliability of LIN4.

Notes/Comments :

Refurbish Boiler vs Replacement Energy & Repair Costs

If nothing is done to the boiler, the probability and number of tube failures will increase over time.

Test 2

Test 3

Test 4

LIN4 Boiler Refurbishment
Summary of Sensitivities

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47666
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Boiler vs Replacement Energy & Repai	6.11%	-768,638	516,019	1	35.33%	3.5 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Boiler vs Replacement Energy & Repai	10%	-718,229	475,883	1	30.81%	3.7 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:					
A	50,409	-40,136	0	-4.52%	0.2 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Boiler vs Replacement Energy & Repai	-10%	-641,365	424,281	1	30.35%	3.7 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:					
A	127,273	-91,738	0	-4.97%	0.2 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**Delay?**
Yrs Delay:	1	2	3	
A	76,320	222,118	367,691	No
B	0	0	0	No
C	0	0	0	No
D	0	0	0	No

LIN4 Boiler Refurbishment
Avoided Cost Calculations

Division :	Power Production	**Date :**	30-Oct-15
Department :	Lingan Generating Station	**CI Number:**	47666
Originator :		**Project No. :**	

Refurbish Boiler vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			69,800	72,594		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	80	80				
Totals	$12,038	$42,746	$69,800	$145,188	$81,838	$187,934
Total Capital Cost of Alternative						$571,859

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

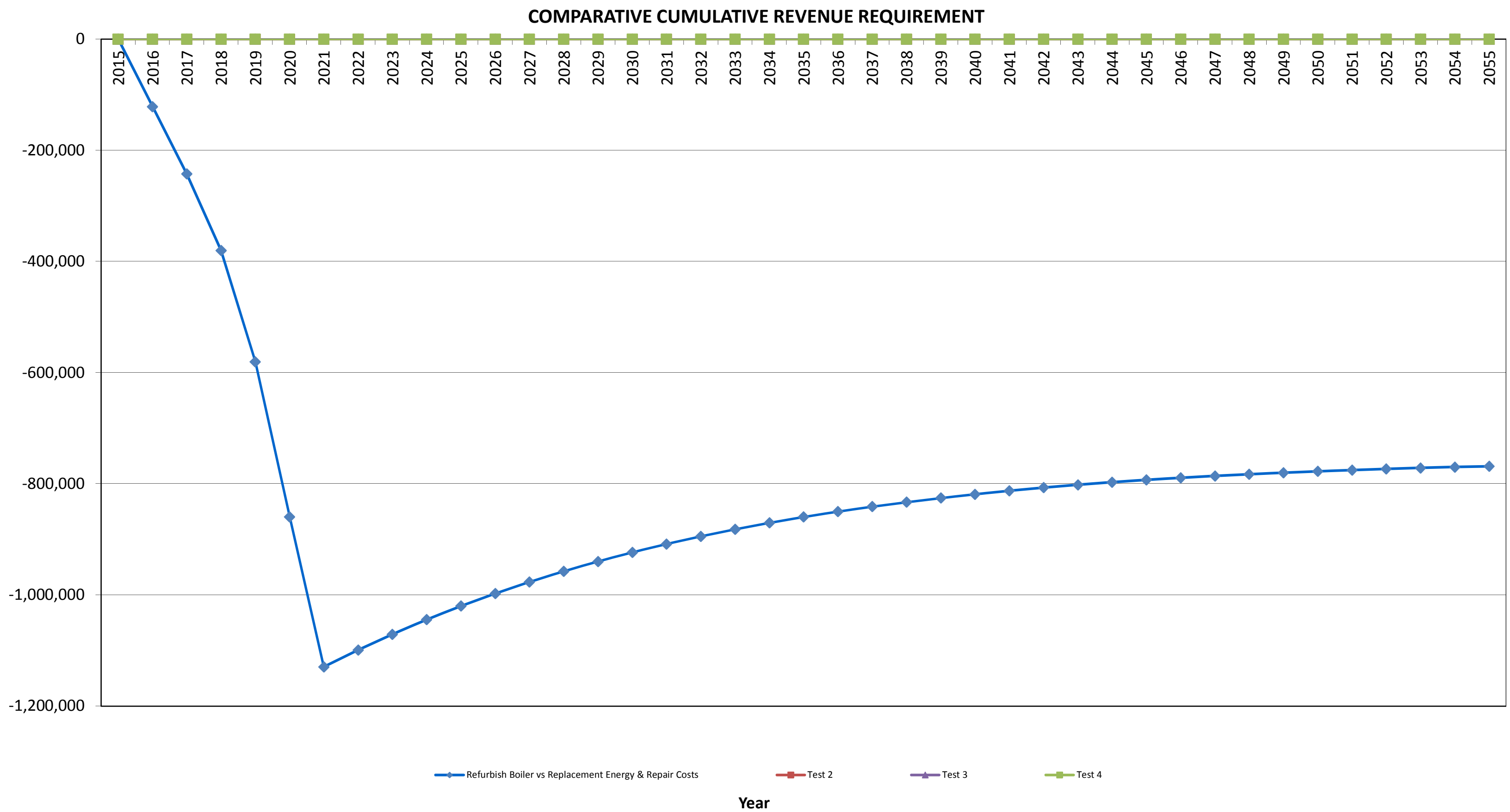
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Boiler Refurbishment

Refurbish Boiler vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	81,838.0	(518,918.3)	20,619.1	509,470.5	(437,080.3)	(18,977.8)	(456,058.2)	(429,797.6)	0.94	(429,797.6)
2017	-	-	187,934.3	-	39,588.7	467,442.3	187,934.3	(45,987.1)	141,947.2	126,070.7	0.89	(303,726.9)
2018	-	-	219,600.3	-	36,421.6	428,776.3	219,600.3	(56,785.4)	162,814.9	136,277.8	0.84	(167,449.0)
2019	-	-	314,444.7	-	33,507.9	393,203.6	314,444.7	(87,090.4)	227,354.3	179,340.3	0.79	11,891.3
2020	-	-	445,176.9	-	30,827.2	360,476.8	445,176.9	(128,448.4)	316,728.5	235,453.7	0.74	247,345.0
2021	-	-	460,622.6	-	28,361.1	330,368.0	460,622.6	(134,001.1)	326,621.6	228,826.8	0.70	476,171.9
2022	-	-	-	-	26,092.2	302,668.0	-	8,088.6	8,088.6	5,340.5	0.66	481,512.3
2023	-	-	-	-	24,004.8	277,184.0	-	7,441.5	7,441.5	4,630.3	0.62	486,142.6
2024	-	-	-	-	22,084.4	253,738.7	-	6,846.2	6,846.2	4,014.6	0.59	490,157.2
2025	-	-	-	-	20,317.7	232,169.0	-	6,298.5	6,298.5	3,480.7	0.55	493,637.9
2026	-	-	-	-	18,692.3	212,324.9	-	5,794.6	5,794.6	3,017.9	0.52	496,655.8
2027	-	-	-	-	17,196.9	194,068.3	-	5,331.0	5,331.0	2,616.6	0.49	499,272.4
2028	-	-	-	-	15,821.1	177,272.2	-	4,904.5	4,904.5	2,268.6	0.46	501,541.1
2029	-	-	-	-	14,555.4	161,819.9	-	4,512.2	4,512.2	1,967.0	0.44	503,508.0
2030	-	-	-	-	13,391.0	147,603.7	-	4,151.2	4,151.2	1,705.4	0.41	505,213.5
2031	-	-	-	-	12,319.7	134,524.8	-	3,819.1	3,819.1	1,478.6	0.39	506,692.1
2032	-	-	-	-	11,334.1	122,492.2	-	3,513.6	3,513.6	1,282.0	0.36	507,974.1
2033	-	-	-	-	10,427.4	111,422.3	-	3,232.5	3,232.5	1,111.5	0.34	509,085.6
2034	-	-	-	-	9,593.2	101,237.9	-	2,973.9	2,973.9	963.7	0.32	510,049.4
2035	-	-	-	-	8,825.8	91,868.3	-	2,736.0	2,736.0	835.6	0.31	510,885.0
2036	-	-	-	-	8,119.7	83,248.2	-	2,517.1	2,517.1	724.5	0.29	511,609.4
2037	-	-	-	-	7,470.1	75,317.8	-	2,315.7	2,315.7	628.1	0.27	512,237.6
2038	-	-	-	-	6,872.5	68,021.8	-	2,130.5	2,130.5	544.6	0.26	512,782.2
2039	-	-	-	-	6,322.7	61,309.4	-	1,960.0	1,960.0	472.2	0.24	513,254.4
2040	-	-	-	-	5,816.9	55,134.1	-	1,803.2	1,803.2	409.4	0.23	513,663.7
2041	-	-	-	-	5,351.5	49,452.8	-	1,659.0	1,659.0	355.0	0.21	514,018.7
2042	-	-	-	-	4,923.4	44,226.0	-	1,526.3	1,526.3	307.8	0.20	514,326.5
2043	-	-	-	-	4,529.5	39,417.3	-	1,404.2	1,404.2	266.8	0.19	514,593.3
2044	-	-	-	-	4,167.2	34,993.3	-	1,291.8	1,291.8	231.4	0.18	514,824.6
2045	-	-	-	-	3,833.8	30,923.3	-	1,188.5	1,188.5	200.6	0.17	515,025.2
2046	-	-	-	-	3,527.1	27,178.8	-	1,093.4	1,093.4	173.9	0.16	515,199.1
2047	-	-	-	-	3,244.9	23,733.9	-	1,005.9	1,005.9	150.8	0.15	515,349.9
2048	-	-	-	-	2,985.3	20,564.6	-	925.5	925.5	130.7	0.14	515,480.7
2049	-	-	-	-	2,746.5	17,648.9	-	851.4	851.4	113.4	0.13	515,594.0
2050	-	-	-	-	2,526.8	14,966.4	-	783.3	783.3	98.3	0.13	515,692.3
2051	-	-	-	-	2,324.6	12,498.5	-	720.6	720.6	85.2	0.12	515,777.5
2052	-	-	-	-	2,138.7	10,228.0	-	663.0	663.0	73.9	0.11	515,851.4
2053	-	-	-	-	1,967.6	8,139.2	-	610.0	610.0	64.1	0.11	515,915.4
2054	-	-	-	-	1,810.2	6,217.5	-	561.2	561.2	55.5	0.10	515,971.0
2055	-	-	-	-	1,665.4	4,449.5	-	516.3	516.3	48.2	0.09	516,019.1
Total	**-**	**-**	**1,709,616.9**	**(518,918.3)**	**496,326.2**		**1,190,698.6**	**(376,120.1)**	**814,578.5**	**516,019.1**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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-800,000
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Refurbish Boiler vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47663

Title: LIN4 SH5 Boiler Tube Replacement

Start Date: 2016/04
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $538,776

DESCRIPTION:

This project includes the replacement of 40 boiler tube cut-outs and 20 boiler tube bends in the Lingan Unit #4 Superheater #5. During 2015, the Lingan Unit #4 Superheater #5 was inspected as part of the routine boiler inspection. Ultrasonic testing showed thinning wall thickness of the tubes; a total of 40 tubes were found to be thinning and will require replacement during the planned outage in 2016.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Erosion wear on boiler tubes will lead to leaks requiring the boiler to come offline for repairs. Superheater tubes exhibiting erosion wear with tubes below the minimum wall thickness for the boiler pressure and temperature should be refurbished to mitigate unplanned outages due to tube leaks.

Why do this project now?

Ultrasonic testing in 2015 showed thinning wall thickness of the tubes. The refurbishment must be completed during the next scheduled extended outage to avoid tube leaks during operation and provide reliable unit operation during high demand periods.

Why do this project this way?

The refurbishment work is in accordance with maintenance best practices. Refurbishing the tubes through tube cut-outs is the only feasible way to allow the unit to operate without tube failures in this area.

CI Number : 47663 - LIN4 - SH5 Boiler Tube Replacement **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,750	0	2,750
095		095-Thermal & Hydro Contracts AO		42,882	0	42,882
095		095-Thermal Regular Labour AO		477	0	477
095		095-Thermal Term Labour AO		7,637	0	7,637
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	2,355	0	2,355
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	37,675	0	37,675
012	013	012 - Materials	013 - SGP - Boiler	25,000	0	25,000
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	420,000	0	420,000
			Total Cost:	538,776	0	538,776
			Original Cost:	169,525		

Capital Project Detailed Estimate

Location: Steam
CI# : 47663
Title: LIN4 SH5 Boiler Tube Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Utilityworker	PD	10	$ 235	$ 2,355		
			Sub-Total	$ 2,355		
004 Term Labour						
Utilityworker	PD	80	$ 470.94	$ 37,675		
			Sub-Total	$ 37,675		
012 Materials						
SH-5 Boiler Tube	Lot	1	$ 20,000	$ 20,000		CI 47052
Misc. Consumables	Lot	1	$ 5,000	$ 5,000		
			Sub-Total	$ 25,000		
013 Contracts						
Boiler Services Replacement of 40 tube cut-outs	ea	40	$ 10,000	$ 400,000		CI 47052
Boiler Tube Bending 20 tube bends	ea	20	$ 1,000	$ 20,000		CI 47052
				$ -		
			Sub-Total	$ 420,000		
094 Interest Capitalized						
AFUDC				$ 2,750		
				$ -		
			Sub-Total	$ 2,750		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 477		
Thermal Term Labour AO				$ 7,637		
Thermal / Hydro Contracts AO				$ 42,882		
			Sub-Total	$ 50,996		
			SUB-TOTAL (no AO, AFUDC)	$ 485,030		
			TOTAL (AO, AFUDC included)	$ 538,776		
Original Cost				$ 169,525		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 SH5 Boiler Tube Replacement
Summary of Alternatives

Division :	Power Production		**Date :**	**02-Nov-15**
Department :	Lingan Generating Station		**CI Number:**	47663
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Tube Replacement vs. Replacement Er	6.11%	-1,084,704	771,868	1	32.61%	4.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to complete this project to maintain reliability in the SH5 section of the boiler.

Notes/Comments :

Tube Replacement vs. Replacement Energy & Repair Costs

It is estimated to take approximately 80 hours to repair a tube leak in SH5. As time passes, the frequency and probability of leaks in this section of the boiler will increase.

Test 2

Test 3

Test 4

LIN4 SH5 Boiler Tube Replacement
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47663
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Tube Replacement vs. Replacement Energy & Re	6.11%	-1,084,704	771,868	1	32.61%	4.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Tube Replacement vs. Replacement Energy & Re	10%	-1,037,275	734,148	1	29.40%	4.6 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:					
A	47,429	-37,719	0	-3.21%	0.4 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Tube Replacement vs. Replacement Energy & Re	-10%	-928,805	656,962	1	29.07%	4.7 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:					
A	155,899	-114,906	0	-3.53%	0.4 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement		**PV of Revenue Requirement**	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**Delay?**
	Yrs Delay:	1	2	3	
	A	53,604	173,302	315,995	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 SH5 Boiler Tube Replacement
Avoided Cost Calculations

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan Generating Station	CI Number:	47663
Originator :		Project No. :	

Tube Replacement vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			32,200	33,491		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	168	168				
Totals	$25,280	$89,768	$32,200	$66,982	$57,480	$156,749
Total Capital Cost of Alternative						$538,776

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

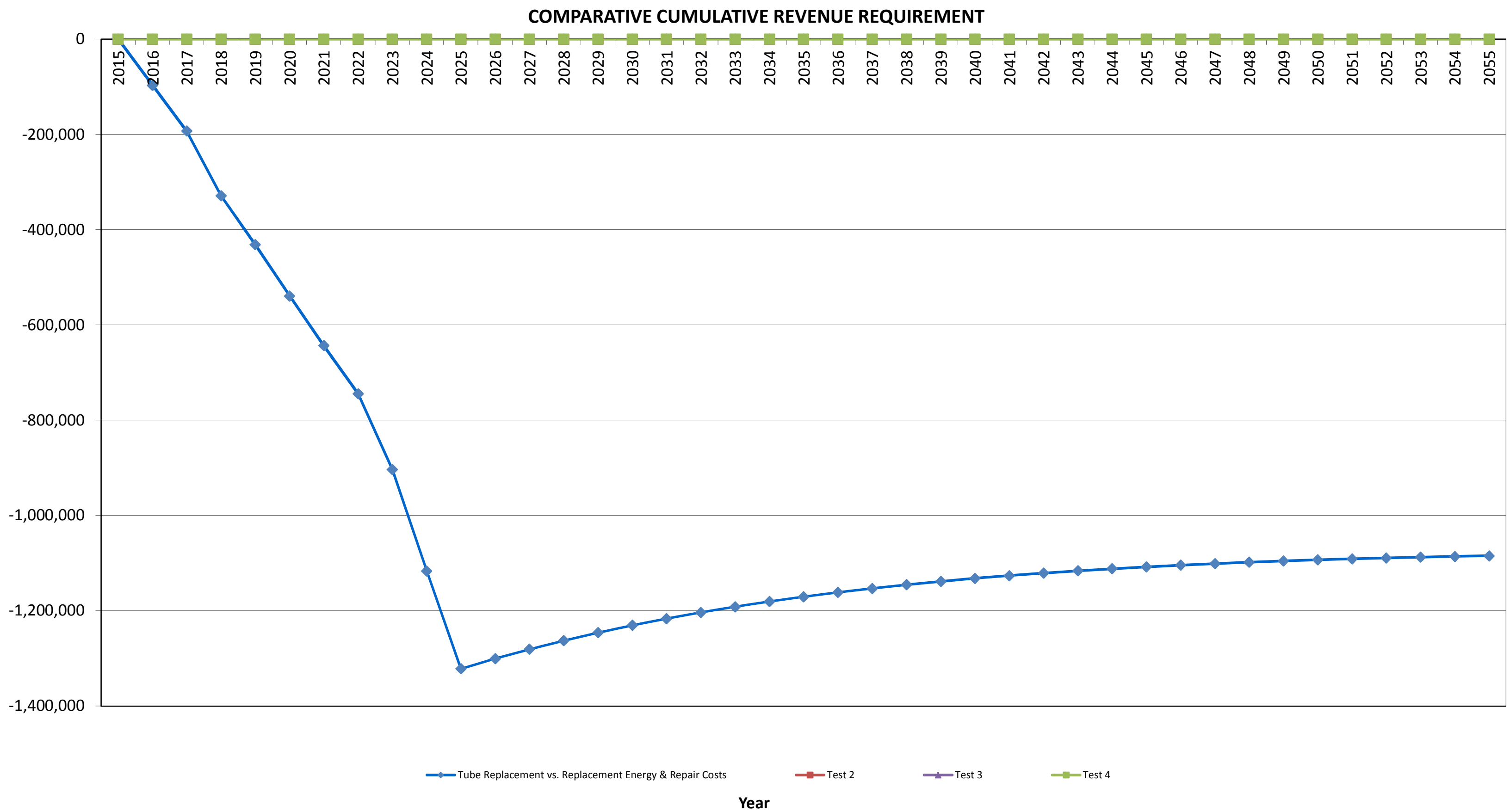
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 SH5 Boiler Tube Replacement

Tube Replacement vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	57,479.8	(487,779.8)	19,401.2	479,703.4	(430,300.0)	(11,804.4)	(442,104.4)	(416,647.2)	0.94	(416,647.2)
2017	-	-	156,749.4	-	37,250.3	440,103.2	156,749.4	(37,044.7)	119,704.6	106,315.9	0.89	(310,331.3)
2018	-	-	213,729.1	-	34,270.3	403,671.0	213,729.1	(55,632.2)	158,096.8	132,328.8	0.84	(178,002.5)
2019	-	-	182,891.2	-	31,528.6	370,153.5	182,891.2	(46,922.4)	135,968.8	107,254.1	0.79	(70,748.4)
2020	-	-	199,808.5	-	29,006.3	339,317.3	199,808.5	(52,948.7)	146,859.9	109,174.6	0.74	38,426.2
2021	-	-	205,318.8	-	26,685.8	310,948.0	205,318.8	(55,376.2)	149,942.6	105,047.8	0.70	143,474.0
2022	-	-	210,999.9	-	24,551.0	284,848.2	210,999.9	(57,799.2)	153,200.7	101,150.2	0.66	244,624.2
2023	-	-	325,286.6	-	22,586.9	260,836.5	325,286.6	(93,836.9)	231,449.7	144,014.5	0.62	388,638.6
2024	-	-	445,796.9	-	20,779.9	238,745.7	445,796.9	(131,755.3)	314,041.7	184,153.7	0.59	572,792.3
2025	-	-	458,256.5	-	19,117.5	218,422.1	458,256.5	(136,133.1)	322,123.4	178,016.1	0.55	750,808.4
2026	-	-	-	-	17,588.1	199,724.4	-	5,452.3	5,452.3	2,839.6	0.52	753,648.0
2027	-	-	-	-	16,181.1	182,522.6	-	5,016.1	5,016.1	2,462.0	0.49	756,110.0
2028	-	-	-	-	14,886.6	166,696.9	-	4,614.8	4,614.8	2,134.6	0.46	758,244.7
2029	-	-	-	-	13,695.7	152,137.2	-	4,245.7	4,245.7	1,850.8	0.44	760,095.5
2030	-	-	-	-	12,600.0	138,742.3	-	3,906.0	3,906.0	1,604.7	0.41	761,700.2
2031	-	-	-	-	11,592.0	126,419.0	-	3,593.5	3,593.5	1,391.3	0.39	763,091.5
2032	-	-	-	-	10,664.7	115,081.6	-	3,306.0	3,306.0	1,206.3	0.36	764,297.7
2033	-	-	-	-	9,811.5	104,651.2	-	3,041.6	3,041.6	1,045.9	0.34	765,343.6
2034	-	-	-	-	9,026.6	95,055.2	-	2,798.2	2,798.2	906.8	0.32	766,250.4
2035	-	-	-	-	8,304.4	86,226.9	-	2,574.4	2,574.4	786.2	0.31	767,036.7
2036	-	-	-	-	7,640.1	78,104.8	-	2,368.4	2,368.4	681.7	0.29	767,718.3
2037	-	-	-	-	7,028.9	70,632.5	-	2,179.0	2,179.0	591.0	0.27	768,309.4
2038	-	-	-	-	6,466.6	63,758.0	-	2,004.6	2,004.6	512.4	0.26	768,821.8
2039	-	-	-	-	5,949.2	57,433.5	-	1,844.3	1,844.3	444.3	0.24	769,266.1
2040	-	-	-	-	5,473.3	51,614.9	-	1,696.7	1,696.7	385.2	0.23	769,651.3
2041	-	-	-	-	5,035.4	46,261.8	-	1,561.0	1,561.0	334.0	0.21	769,985.3
2042	-	-	-	-	4,632.6	41,336.9	-	1,436.1	1,436.1	289.6	0.20	770,274.9
2043	-	-	-	-	4,262.0	36,806.1	-	1,321.2	1,321.2	251.1	0.19	770,525.9
2044	-	-	-	-	3,921.0	32,637.7	-	1,215.5	1,215.5	217.7	0.18	770,743.6
2045	-	-	-	-	3,607.4	28,802.8	-	1,118.3	1,118.3	188.7	0.17	770,932.4
2046	-	-	-	-	3,318.8	25,274.6	-	1,028.8	1,028.8	163.6	0.16	771,096.0
2047	-	-	-	-	3,053.3	22,028.8	-	946.5	946.5	141.9	0.15	771,237.9
2048	-	-	-	-	2,809.0	19,042.6	-	870.8	870.8	123.0	0.14	771,360.9
2049	-	-	-	-	2,584.3	16,295.3	-	801.1	801.1	106.7	0.13	771,467.6
2050	-	-	-	-	2,377.5	13,767.7	-	737.0	737.0	92.5	0.13	771,560.0
2051	-	-	-	-	2,187.3	11,442.4	-	678.1	678.1	80.2	0.12	771,640.2
2052	-	-	-	-	2,012.3	9,303.1	-	623.8	623.8	69.5	0.11	771,709.7
2053	-	-	-	-	1,851.4	7,335.0	-	573.9	573.9	60.3	0.11	771,770.0
2054	-	-	-	-	1,703.3	5,524.3	-	528.0	528.0	52.3	0.10	771,822.3
2055	-	-	-	-	1,567.0	3,858.4	-	485.8	485.8	45.3	0.09	771,867.6
Total	**-**	**-**	**2,456,316.7**	**(487,779.8)**	**467,009.3**		**1,968,536.9**	**(616,685.3)**	**1,351,851.6**	**771,867.6**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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-600,000
-800,000
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-1,400,000
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Tube Replacement vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 46352

Title: TRE5 Air Heater Refurbishment

Start Date:	2016/06
In-Service Date:	2016/10
Final Cost Date:	2017/04
Function:	Steam
Forecast Amount:	$530,139

DESCRIPTION:

The Trenton Unit 5 Air Heaters are part of the original unit equipment and date back to 1969. The air heaters exchange heat between the exhaust flue gas and the incoming combustion air for the unit by means of continuously rotating heat transfer elements of specially formed metal plates fabricated in bundles known as baskets. The baskets are supplied in two layers: upper (hot end) and lower (cold end). As a result of the corrosive conditions that are present in the flue gas, the baskets and their support structures deteriorate over time. Additionally, sealing components are used to keep the exhaust and combustion air streams separate as the air heater rotors turn, which must be replaced as they wear. The cold end baskets slated for replacement were installed in 2008. This project will replace the cold end baskets, their support grids and miscellaneous seals.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The cold end baskets have corroded to the point where they must be replaced. Additionally, the support grids are in very poor condition and are at risk of failure. Basket and support grid use has been extended by annual repairs, but they are at the end of their service life. In the event of related failures, the cold end basket could fall out of position and stop the air heater from rotating, resulting in a unit outage to perform a repair.

Why do this project now?

The cold end baskets have corroded to the point where they must be replaced. Additionally, the support grids are in very poor condition and are at risk of failure. Regular assessment by NS Power and the OEM indicated the condition of the cold end baskets, support structure and seals are such that replacement is required at this time to ensure the reliability and performance of the generating unit. Risk profiling (compared to similar equipment in NS Power's fleet) provides guidance on the timing of refurbishment.

Why do this project this way?

As the Air Heater is situated in the Boiler Gas Pass, this work must be completed during a unit outage. Typically, the duration of this refurbishment is greater than two weeks (depending on scope). It is not desirable to have an issue advance to critical between outage intervals. The deteriorated condition of the Air Heater components is such that they cannot be refurbished and replacement is the only option.

CI Number : 46352 - TRE5 Air Heater Refurbishments **Project Number**

Parent CI Number : -

Cost Centre : 340 - 340-Trenton Unit 5 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		5,309	0	5,309
095		095-Thermal & Hydro Contracts AO		13,401	0	13,401
095		095-Thermal Overtime Labour AO		6,384	0	6,384
095		095-Thermal Regular Labour AO		12,770	0	12,770
095		095-Thermal Term Labour AO		13,526	0	13,526
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	62,999	0	62,999
002	013	002 - THERMAL Overtime Labour	013 - SGP - Boiler	62,989	0	62,989
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	66,728	0	66,728
012	013	012 - Materials	013 - SGP - Boiler	[redacted]	0	[redacted]
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	[redacted]	0	[redacted]
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	2,000	0	2,000
			Total Cost:	530,139	0	530,139
			Original Cost:	69,493		

Capital Project Detailed Estimate

Location: Trenton Generating Station
CI# / FP#: 46352
Title: TRE5 Air Heater Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	3	$ 358	$ 1,075		
Maintenance Trades	PD	150	$ 365	$ 54,719		
Utilityworker	PD	30	$ 240	$ 7,205		
			Sub-Total	$ 62,999		
002 OT Labour						
Maintenance Trades	PD	60	$ 730	$ 43,775		
Utilityworker	PD	40	$ 480	$ 19,214		
			Sub-Total	$ 62,989		
004 Term Labour						
Maintenance Trades	PD	150	$ 365	$ 54,719		
Utilityworker	PD	50	$ 240	$ 12,009		
			Sub-Total	$ 66,728		
012 Materials						
Cold End Baskets	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Grids	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Seals	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Circumferential seal angles, misc steel	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Miscellaneous Steel	lot	1	$ 5,000	$ 5,000		
			Sub-Total	[redacted]		
013 Contracts						
Contract Labour	PD	50	[redacted]	[redacted]		
Service supervisor	Lot	1	$ 50,000	$ 50,000		
External supervision	PD	15	$ 750	$ 11,250		
Vacuum Services	lot	1	$ 20,000	$ 20,000		
			Sub-Total	[redacted]		
041 Meals & Entertainment						
Meals	Lot	1	$ 2,000	$ 2,000		
			Sub-Total	$ 2,000		
094 Interest Capitalized						
AFUDC				$ 5,309		
			Sub-Total	$ 5,309		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 12,770		
Thermal OT Labour AO				$ 6,384		
Thermal Term Labour AO				$ 13,526		
Thermal Contracts AO				$ 13,401		
			Sub-Total	$ 46,080		
			SUB-TOTAL (no AO, AFUDC)	$ 478,750		
			TOTAL (AO, AFUDC included)	$ 530,139		
Original Cost				$ 69,493		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

TRE5 Air Heater Refurbishment
Summary of Alternatives

Division :	Power Production		**Date :**	**02-Nov-15**
Department :	Trenton Generating Station		**CI Number:**	46352
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Air Heater Refurbishment vs Replacem	6.11%	-841,654	584,427	1	36.47%	3.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to perform airheater refurbishments based on favorable economic analysis results.

Notes/Comments :

Air Heater Refurbishment vs Replacement Energy & Repair Costs

This scenario measures the cost of refurbishments versus the replacement energy and repair costs associated with an unplanned outage due to airheater failure. This model assumes a 60% chance of occurrence within the first year, increasing in probability thereafter. This model also assumes that, on average, the unplanned outage would be a full unit outage (160MW) which would last one week (168 hours) in order to complete repairs so that the unit can return to service. The material costs are the costs of components assumed to return the air heater to current state.

Test 2

Test 3

Test 4

TRE5 Air Heater Refurbishment
Summary of Sensitivities

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	46352
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Air Heater Refurbishment vs Replacement Energy	6.11%	-841,654	584,427	1	36.47%	3.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Air Heater Refurbishment vs Replacement Energy	10%	-793,637	546,951	1	32.05%	3.6 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	48,017	-37,475	0	-4.41%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Air Heater Refurbishment vs Replacement Energy	-10%	-709,471	488,509	1	31.61%	3.6 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	132,183	-95,918	0	-4.85%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	116,876	242,176	358,987	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

TRE5 Air Heater Refurbishment
Avoided Cost Calculations

Nova Scotia POWER
An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	46352
Originator :		**Project No. :**	

Air Heater Refurbishment vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**147,600**	**153,527**		
Events/Outages (#)	**1**	**1**	**1**	**1**		
Probability of Occurance (%)	**60%**	**70%**	**60%**	**70%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**160.0**	**160.0**				
Duration (Hours)	**168**	**168**				
Totals	**$36,766**	**$55,522**	**$88,560**	**$107,469**	**$125,326**	**$162,991**
Total Capital Cost of Alternative						**$530,139**

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

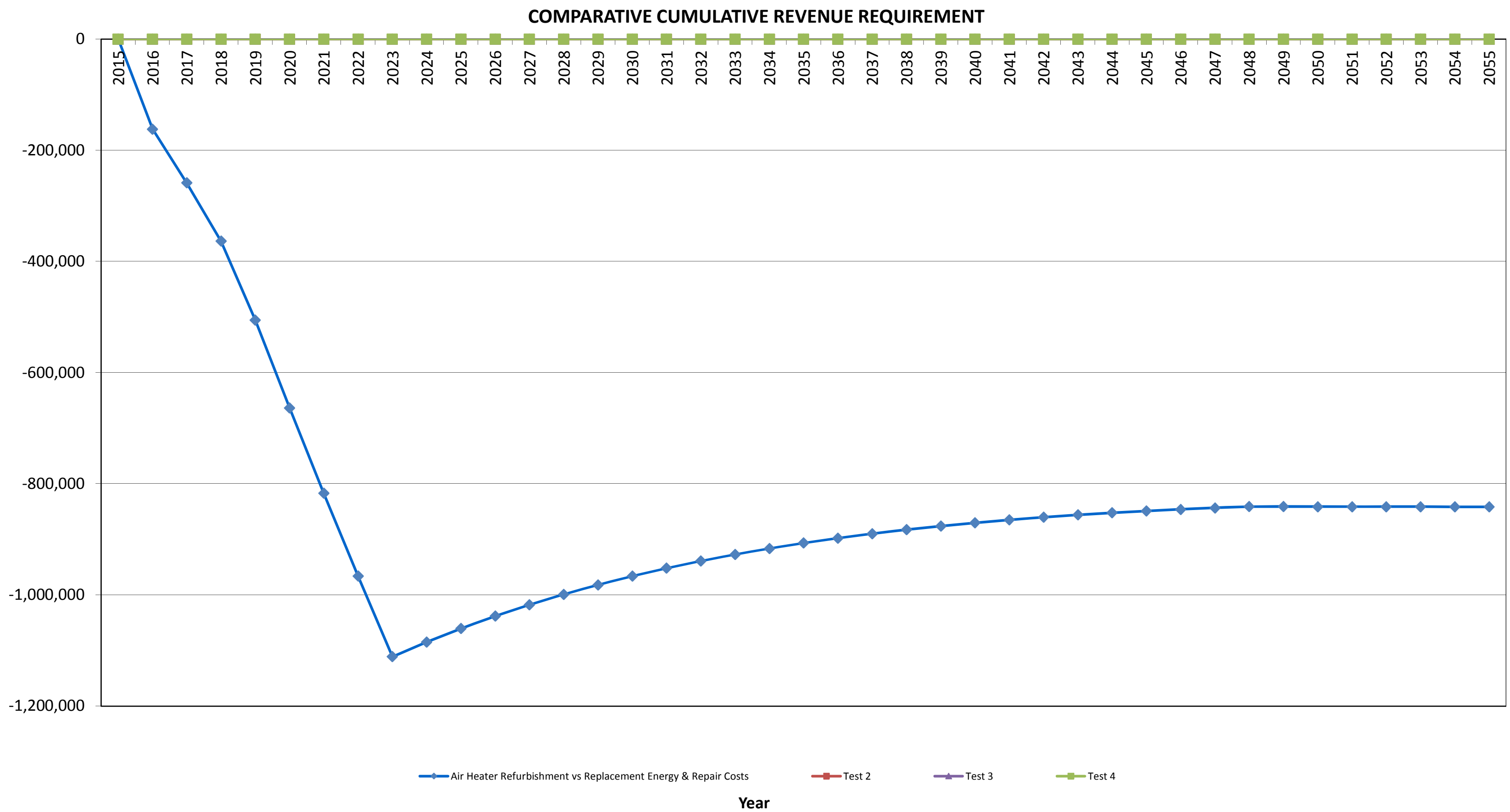
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

TRE5 Air Heater Refurbishment

Air Heater Refurbishment vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	125,325.9	(484,058.9)	19,150.0	472,318.5	(358,733.0)	(32,914.5)	(391,647.6)	(369,095.8)	0.94	(369,095.8)
2017	-	-	162,990.7	-	36,768.0	433,427.1	162,990.7	(39,129.0)	123,861.7	110,008.0	0.89	(259,087.8)
2018	-	-	181,266.8	-	33,826.6	397,647.0	181,266.8	(45,706.5)	135,560.3	113,465.5	0.84	(145,622.3)
2019	-	-	239,877.1	-	31,120.5	364,729.3	239,877.1	(64,714.6)	175,162.6	138,170.7	0.79	(7,451.6)
2020	-	-	275,283.4	-	28,630.8	334,445.1	275,283.4	(76,462.3)	198,821.1	147,802.2	0.74	140,350.6
2021	-	-	284,271.6	-	26,340.4	306,583.5	284,271.6	(79,958.7)	204,312.9	143,139.0	0.70	283,489.6
2022	-	-	293,579.4	-	24,233.1	280,950.9	293,579.4	(83,497.3)	210,082.0	138,705.8	0.66	422,195.4
2023	-	-	303,218.8	-	22,294.5	257,368.9	303,218.8	(87,086.5)	216,132.2	134,483.5	0.62	556,678.9
2024	-	-	-	-	20,510.9	235,673.5	-	6,358.4	6,358.4	3,728.6	0.59	560,407.5
2025	-	-	-	-	18,870.0	215,713.7	-	5,849.7	5,849.7	3,232.7	0.55	563,640.2
2026	-	-	-	-	17,360.4	197,350.7	-	5,381.7	5,381.7	2,802.9	0.52	566,443.1
2027	-	-	-	-	15,971.6	180,456.7	-	4,951.2	4,951.2	2,430.2	0.49	568,873.3
2028	-	-	-	-	14,693.9	164,914.3	-	4,555.1	4,555.1	2,107.0	0.46	570,980.3
2029	-	-	-	-	13,518.4	150,615.2	-	4,190.7	4,190.7	1,826.8	0.44	572,807.1
2030	-	-	-	-	12,436.9	137,460.1	-	3,855.4	3,855.4	1,583.9	0.41	574,391.0
2031	-	-	-	-	11,441.9	125,357.3	-	3,547.0	3,547.0	1,373.3	0.39	575,764.3
2032	-	-	-	-	10,526.6	114,222.8	-	3,263.2	3,263.2	1,190.7	0.36	576,955.0
2033	-	-	-	-	9,684.5	103,979.1	-	3,002.2	3,002.2	1,032.3	0.34	577,987.3
2034	-	-	-	-	8,909.7	94,554.8	-	2,762.0	2,762.0	895.1	0.32	578,882.4
2035	-	-	-	-	8,196.9	85,884.5	-	2,541.0	2,541.0	776.0	0.31	579,658.4
2036	-	-	-	-	7,541.2	77,907.8	-	2,337.8	2,337.8	672.8	0.29	580,331.3
2037	-	-	-	-	6,937.9	70,569.3	-	2,150.7	2,150.7	583.4	0.27	580,914.6
2038	-	-	-	-	6,382.9	63,817.8	-	1,978.7	1,978.7	505.8	0.26	581,420.4
2039	-	-	-	-	5,872.2	57,606.5	-	1,820.4	1,820.4	438.5	0.24	581,859.0
2040	-	-	-	-	5,402.4	51,892.0	-	1,674.8	1,674.8	380.2	0.23	582,239.2
2041	-	-	-	-	4,970.3	46,634.8	-	1,540.8	1,540.8	329.7	0.21	582,568.9
2042	-	-	-	-	4,572.6	41,798.1	-	1,417.5	1,417.5	285.8	0.20	582,854.7
2043	-	-	-	-	4,206.8	37,348.3	-	1,304.1	1,304.1	247.8	0.19	583,102.5
2044	-	-	-	-	3,870.3	33,254.5	-	1,199.8	1,199.8	214.9	0.18	583,317.4
2045	-	-	-	-	3,560.7	29,488.2	-	1,103.8	1,103.8	186.3	0.17	583,503.7
2046	-	-	-	-	3,275.8	26,023.3	-	1,015.5	1,015.5	161.5	0.16	583,665.2
2047	-	-	-	-	3,013.7	22,835.5	-	934.3	934.3	140.0	0.15	583,805.3
2048	-	-	-	-	2,772.6	19,902.7	-	859.5	859.5	121.4	0.14	583,926.7
2049	-	-	-	-	2,550.8	17,204.6	-	790.8	790.8	105.3	0.13	584,032.0
2050	-	-	-	-	2,346.8	14,722.3	-	727.5	727.5	91.3	0.13	584,123.2
2051	-	-	-	-	2,159.0	12,438.6	-	669.3	669.3	79.1	0.12	584,202.4
2052	-	-	-	-	1,986.3	10,337.6	-	615.8	615.8	68.6	0.11	584,271.0
2053	-	-	-	-	1,827.4	8,404.7	-	566.5	566.5	59.5	0.11	584,330.5
2054	-	-	-	-	1,681.2	6,626.4	-	521.2	521.2	51.6	0.10	584,382.1
2055	-	-	-	-	1,546.7	4,990.3	-	479.5	479.5	44.7	0.09	584,426.8
Total	**-**	**-**	**1,865,813.7**	**(484,058.9)**	**460,963.3**		**1,381,754.8**	**(435,503.6)**	**946,251.1**	**584,426.8**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
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Air Heater Refurbishment vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Quotation (Parts)

ISO 9001:2008 Certified

Howden

Attention:	Fred Jordan	From:	Phillip Edgerton
Company/Representative:	Trenton Thermal Generating Station	Phone:	919-324-2388
End User:	Trenton Thermal Generating Station	Email:	phillip.edgerton@howden.com
Your Reference:			
Our Reference:	25 VIT 70/82 (1124/1101)	Fax:	866-810-9419
Market:	Power	Quote #:	HNANSD.AFM.003201/B
General Assembly Drawing:		Date:	8/20/2015

Howden North America presents our offer as follows:

Item	Part Number	Description	Qty	Price Each	*Availability
1	BASE: COLD LAYER	CE Elements Air Heater BASKETS: Heater Designation: 24 VIR 54 Number of Sets: 2 Total Number Baskets: 192 Baskets Material : LACRS (EN 10025-5) Baskets Type: Full Wrapper ELEMENTS: Elements Depth: 12 inches Element Profile: NF-6 Element Thickness: 18 gauge Element Material : LACRS (EN 10025-5) Total Aprx. Shipping Weight: 73551 lbs	1	[redacted]	[redacted]
2	Seals	2 Sets - Corten Steel Hot and Cold Seals with holding strips and fasteners. Includes Radial, Rotor Post, Circumferential. (Axial Seals not required for VR Heaters)	1	[redacted]	[redacted]
3	Grating	2 Sets - Corten Steel Bottom Grating (24 Pieces Total)	1	[redacted]	[redacted]
4	Sealing Angles	2 Sets Cold and Hot End Corten Steel Sealing Angles with fasteners	1	[redacted]	[redacted]

**** PLEASE NOTE ABOVE PRICING INCLUDES TRANSPORTATION TO JOBSITE ****
Unloading of containers and site logistics is the responsibility of the customer.

Howden Field Service is available to Supervise or Assist at the jobsite, see attached Rate Sheet.

All orders are subject to credit approval by Howden's Accounting Department.

Prices are in CAD

Freight:	DDP at Plant Site. Incoterms 2010. Freight Allowed.

This quote is subject only to Howden North America's Standard Terms and Conditions of Sale, (attached). Unless otherwise negotiated and agreed to by HNA in writing, no other terms shall apply regardless of any statement on Buyer's documents to the contrary.

Howden North America does not accept Liquidated Damages or in place warranty as standard business practice.

*If quoted deliveries do not meet your requirements, please advise.

For Prepay and Charge orders, there will be a 4% charge of the net selling price applied to Buyer's invoice as a separate item to cover the standard transportation and handling expenses to the first North American destination. In addition, any expense incurred by Seller because of special delivery arrangements requested by Buyer shall be billed to Buyer. Howden does not provide copies of freight invoices.

Pricing does not include Federal, State, Local, or Export taxes or duties.

Payment terms are 20% upon drawing submittal (~February 2016), 30% upon receipt of raw materials (June/July 2016), 30% upon dispatch from Howden Spain facility (September 2016), 20% upon delivery (October 2016), payable Net 30 days.

Quote expires 30 days from noted and is subject to customer credit approval.

Minimum order value is $350.00.

Non inventory parts are not returnable; returned inventory parts are subject to restocking charges.

Quoted lead time is based upon material availability and factory loading at time of quotation, and may be subject to adjustment at order placement/acknowledgement.

If you have any questions, please contact us.

Sincerely,

Phillip Edgerton

CI Number: 47689

Title: LIN4 – Air Heater Refurbishment

Start Date: 2015/04
In-Service Date: 2015/05
Final Cost Date: 2015/11
Function: Steam
Forecast Amount: $521,951

DESCRIPTION:

This project includes the replacement of Air Heater components such as hot end baskets, cold end baskets, and seals related to the Lingan Unit #4 air heaters.

Air Heaters are directly in the Boiler gas pass and subjected to continuous use. These Air Heaters incorporate two layers of heat transferring elements referred to as hot-end baskets and cold-end baskets which act to recover energy and improve the operating efficiency of the unit. In order to efficiently operate an air heater of this design, metal seals are used to prevent air migration from the air stream to the gas stream during heat transfer. If an effective seal is not maintained, heat transfer is reduced, which yields a reduction in boiler efficiency and increased fuel consumption. As these operate within the hot flue gas flow of the boiler they are subject to the effects of heating and erosion. The frequency of repair is a function of operating hours, gas velocity and ash loading.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2015 CI 46463 LIN3 – Air Heater Refurbishment $477,566

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The air heaters are part of the original design of the plant. Their function is to recover heat (transfer from outgoing flue gas to incoming combustion air). Air Heater performance deteriorates over operating time. Air Heater baskets wear out, seal clearances and integrity deteriorate and air heater drive components wear. Refurbishment is required to maintain the Air Heater in service and to maintain its effectiveness to transfer heat and have a positive effect on efficiency.

Why do this project now?

Regular assessment by NS Power and the OEM indicated the condition of the components is such that replacement is required at this time to ensure the reliability and performance of the generating unit. Risk profiling (compared to similar equipment in NS Power's fleet) provides guidance on the timing of refurbishment.

Why do this project this way?

As the Air Heater is situated in the Boiler Gas Pass, this work must be completed during a unit outage. Typically, the duration of the work is greater than 2 weeks (depending on scope). It is not desirable to have an issue advance to critical between outage intervals. The deteriorated condition of the Air Heater components is such that they cannot be refurbished and replacement is the only option.

CI Number : 47689-SE76 - LIN4 - Air Heater Refurbishment **Project Number** SE76

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		6,490	0	6,490
095		095-Thermal Term Labour AO		16,646	0	16,646
095		095-Thermal & Hydro Contracts AO		2,757	0	2,757
095		095-Thermal Regular Labour AO		7,479	0	7,479
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	36,896	0	36,896
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	82,123	0	82,123
012	013	012 - Materials	013 - SGP - Boiler	308,964	0	308,964
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	27,000	0	27,000
066	013	066 - Other Goods & Services	013 - SGP - Boiler	33,596	0	33,596
			Total Cost:	521,951	0	521,951
			Original Cost:	359,584		

Capital Project Detailed Estimate

Location: Steam
CI# : 47689
Title: LIN4 Air Heater Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	88	$ 365	$ 32,187		
Utilityworker	PD	20	$ 240	$ 4,709		
			Sub-Total	$ 36,896		
004 Term Labour						
Maintenance Trades	PD	196	$ 365	$ 71,527		
Utilityworker	PD	44	$ 240	$ 10,596		
				$ -		
			Sub-Total	$ 82,123		
012 Materials						
Hot End Air Heater Baskets	Lot	1	[redacted]	[redacted]	Cost Support #1 - Item 3	
Cold End Air Heater Baskets	Lot	1	[redacted]	[redacted]	Cost Support #1 - Item 2	
Air Heater Seals	Lot	1	[redacted]	[redacted]		CI 46463
Misc. Consumables and Materials	Lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 308,964		
013 Contracts						
Air Heater Technical Advisor	Lot	1	$ 12,000	$ 12,000		
Welding Services	Lot	1	$ 15,000	$ 15,000		
			Sub-Total	$ 27,000		
066 Other Goods & Services						
Contingency on Contracts / Consulting	%	10%	$ 335,964	$ 33,596		
				$ -		
			Sub-Total	$ 33,596		
094 Interest Capitalized						
				$ 6,490		
				$ -		
			Sub-Total	$ 6,490		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 7,479		
Thermal Term Labour AO				$ 16,646		
Thermal / Hydro Contracts AO				$ 2,757		
			Sub-Total	$ 26,882		
			SUB-TOTAL (no AO, AFUDC)	$ 488,580		
			TOTAL (AO, AFUDC included)	$ 521,951		
Original Cost				$ 359,584		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Air Heater Refurbishment
Summary of Alternatives

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47689
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Baskets and Seals vs. Replace	6.11%	-583,449	387,875	1	25.76%	4.4 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to complete this project in order to maintain boiler efficiency and avoid lost generation required to complete repairs.

Notes/Comments :

Replace Baskets and Seals vs. Replacement Energy & Repair Costs

As time passes the probabilty of air heater failure increases. This analysis does not include efficiency losses as seals break down, considerations in this anaylsis were only made for the loss of generation and costs of completing repairs.

Test 2

Test 3

Test 4

LIN4 Air Heater Refurbishment
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47689
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Baskets and Seals vs. Replacement Ene	6.11%	-583,449	387,875	1	25.76%	4.4 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Baskets and Seals vs. Replacement Ene	10%	-535,529	349,529	1	22.33%	4.8 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:						
	A	47,920	-38,346	0	-3.43%	0.4 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Baskets and Seals vs. Replacement Ene	-10%	-477,184	310,742	1	21.99%	4.8 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:						
	A	106,265	-77,133	0	-3.77%	0.4 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	74,898	166,191	288,456	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 Air Heater Refurbishment
Avoided Cost Calculations

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47689
Originator :		**Project No. :**	

Replace Baskets and Seals vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]	[redacted]				
Repair Cost ($)			83,296	86,650		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	60%	70%	60%	70%		
Capacity Factor (%)	[redacted]	[redacted]				
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	336	336				
Totals	$30,336	$62,837	$49,978	$60,655	$80,313	$123,492

Total Capital Cost of Alternative — **$521,951**

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]	[redacted]				
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]	[redacted]				
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative — **$0**

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]	[redacted]				
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]	[redacted]				
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative — **$0**

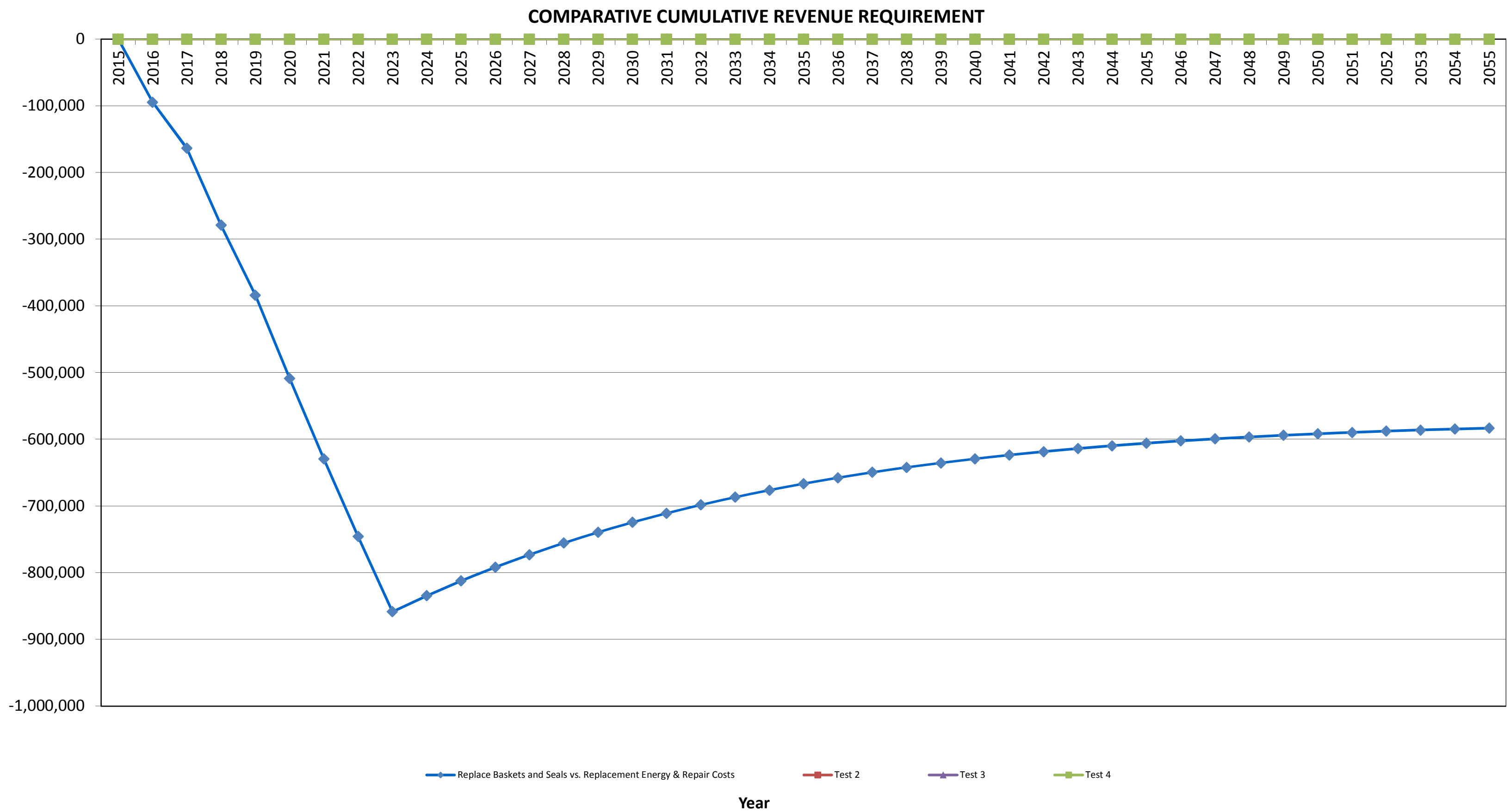
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]	[redacted]				
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]	[redacted]				
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative — **$0**

LIN4 Air Heater Refurbishment
Replace Baskets and Seals vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	80,313.3	(495,069.4)	19,543.2	476,456.0	(414,756.1)	(18,838.7)	(433,594.9)	(408,627.7)	0.94	(408,627.7)
2017	-	-	123,492.3	-	37,522.9	437,694.3	123,492.3	(26,650.5)	96,841.8	86,010.2	0.89	(322,617.5)
2018	-	-	187,360.8	-	34,521.1	402,033.6	187,360.8	(47,380.3)	139,980.5	117,165.2	0.84	(205,452.3)
2019	-	-	183,779.8	-	31,759.4	369,225.7	183,779.8	(47,126.3)	136,653.5	107,794.2	0.79	(97,658.1)
2020	-	-	221,987.8	-	29,218.7	339,042.5	221,987.8	(59,758.4)	162,229.4	120,600.2	0.74	22,942.1
2021	-	-	228,404.4	-	26,881.2	311,274.0	228,404.4	(62,472.2)	165,932.2	116,249.9	0.70	139,192.0
2022	-	-	235,028.9	-	24,730.7	285,726.9	235,028.9	(65,192.4)	169,836.4	112,133.8	0.66	251,325.9
2023	-	-	241,868.7	-	22,752.2	262,223.6	241,868.7	(67,926.1)	173,942.6	108,231.9	0.62	359,557.8
2024	-	-	-	-	20,932.0	240,600.5	-	6,488.9	6,488.9	3,805.1	0.59	363,362.9
2025	-	-	-	-	19,257.5	220,707.3	-	5,969.8	5,969.8	3,299.1	0.55	366,662.0
2026	-	-	-	-	17,716.9	202,405.5	-	5,492.2	5,492.2	2,860.4	0.52	369,522.4
2027	-	-	-	-	16,299.5	185,567.9	-	5,052.9	5,052.9	2,480.1	0.49	372,002.5
2028	-	-	-	-	14,995.6	170,077.3	-	4,648.6	4,648.6	2,150.3	0.46	374,152.7
2029	-	-	-	-	13,795.9	155,826.0	-	4,276.7	4,276.7	1,864.3	0.44	376,017.1
2030	-	-	-	-	12,692.2	142,714.7	-	3,934.6	3,934.6	1,616.4	0.41	377,633.5
2031	-	-	-	-	11,676.9	130,652.4	-	3,619.8	3,619.8	1,401.5	0.39	379,035.0
2032	-	-	-	-	10,742.7	119,555.0	-	3,330.2	3,330.2	1,215.1	0.36	380,250.1
2033	-	-	-	-	9,883.3	109,345.5	-	3,063.8	3,063.8	1,053.5	0.34	381,303.6
2034	-	-	-	-	9,092.6	99,952.7	-	2,818.7	2,818.7	913.4	0.32	382,217.1
2035	-	-	-	-	8,365.2	91,311.3	-	2,593.2	2,593.2	792.0	0.31	383,009.1
2036	-	-	-	-	7,696.0	83,361.2	-	2,385.8	2,385.8	686.7	0.29	383,695.7
2037	-	-	-	-	7,080.3	76,047.2	-	2,194.9	2,194.9	595.4	0.27	384,291.1
2038	-	-	-	-	6,513.9	69,318.2	-	2,019.3	2,019.3	516.2	0.26	384,807.3
2039	-	-	-	-	5,992.8	63,127.6	-	1,857.8	1,857.8	447.5	0.24	385,254.8
2040	-	-	-	-	5,513.4	57,432.2	-	1,709.1	1,709.1	388.0	0.23	385,642.9
2041	-	-	-	-	5,072.3	52,192.5	-	1,572.4	1,572.4	336.4	0.21	385,979.3
2042	-	-	-	-	4,666.5	47,371.9	-	1,446.6	1,446.6	291.7	0.20	386,271.0
2043	-	-	-	-	4,293.2	42,937.0	-	1,330.9	1,330.9	252.9	0.19	386,523.9
2044	-	-	-	-	3,949.7	38,856.9	-	1,224.4	1,224.4	219.3	0.18	386,743.2
2045	-	-	-	-	3,633.8	35,103.2	-	1,126.5	1,126.5	190.1	0.17	386,933.3
2046	-	-	-	-	3,343.1	31,649.7	-	1,036.3	1,036.3	164.8	0.16	387,098.1
2047	-	-	-	-	3,075.6	28,472.6	-	953.4	953.4	142.9	0.15	387,241.1
2048	-	-	-	-	2,829.6	25,549.6	-	877.2	877.2	123.9	0.14	387,365.0
2049	-	-	-	-	2,603.2	22,860.5	-	807.0	807.0	107.4	0.13	387,472.4
2050	-	-	-	-	2,394.9	20,386.5	-	742.4	742.4	93.2	0.13	387,565.6
2051	-	-	-	-	2,203.3	18,110.4	-	683.0	683.0	80.8	0.12	387,646.3
2052	-	-	-	-	2,027.1	16,016.4	-	628.4	628.4	70.0	0.11	387,716.3
2053	-	-	-	-	1,864.9	14,089.9	-	578.1	578.1	60.7	0.11	387,777.1
2054	-	-	-	-	1,715.7	12,317.6	-	531.9	531.9	52.6	0.10	387,829.7
2055	-	-	-	-	1,578.5	10,687.0	-	489.3	489.3	45.6	0.09	387,875.3
Total	**-**	**-**	**1,502,236.0**	**(495,069.4)**	**470,427.4**		**1,007,166.5**	**(319,860.7)**	**687,305.9**	**387,875.3**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-100,000
-200,000
-300,000
-400,000
-500,000
-600,000
-700,000
-800,000
-900,000
-1,000,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Replace Baskets and Seals vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Quotation (Parts)

ISO 9001:2008 Certified

Attention:	Gerald Bedecki	From:	Phillip Edgerton
Company/Representative:	Lingan Thermal Generating Station	Phone:	919-324-2388
End User:	Lingan Thermal Generating Station	Email:	phillip.edgerton@howden.com
Your Reference:			
Our Reference:	1090	Fax:	866-810-9419
Market:	Power	Quote #:	HNASEH.AFM.006578/C
General Assembly Drawing:		Date:	1/8/2015

Howden North America presents our offer as follows:

Item	Part Number	Description	Qty	Price Each	*Availability
1	BASE: HOT LAYER (HC Option)	HE Elements Air Heater BASKETS: Heater Designation: 23.5 VIR 44" Number of Sets: 2 Total Number Baskets: 168 Baskets Material : LACRS (EN 10025-5) Baskets Type: MK-IV ELEMENTS: Elements Depth: 32 inches Element Profile: HC11 Element Thickness: 24 gauge Element Material : LACRS (EN 10025-5) Total Aprx. Shipping Weight: 120866 lbs **Delivery: With a PO on or before end of December, delivery on or before mid March	1	[redacted]	0 Week(s)
2	BASE: COLD LAYER (HC Option)	CE Elements Air Heater BASKETS: Heater Designation: 23.5 VIR 44" Number of Sets: 2 Total Number Baskets: 192 Baskets Material : LACRS (EN 10025-5) Baskets Type: Full Wrapper ELEMENTS: Elements Depth: 12 inches Element Profile: HC12 Element Thickness: 18 gauge Element Material : LACRS (EN 10025-5) Total Aprx. Shipping Weight: 77702 lbs **Delivery: With a PO on or before end of December, delivery on or before mid March	1	[redacted]	0 Week(s)

3	OPTIONAL: HOT LAYER (HC Option)	HE Elements Air Heater BASKETS: Heater Designation: 23.5 VIR 44" Number of Sets: 2 Total Number Baskets: 168 Baskets Material : LACRS (EN 10025-5) Baskets Type: MK-IV ELEMENTS: Elements Depth: 32 inches Element Profile: HC11 Element Thickness: 22 gauge Element Material : LACRS (EN 10025-5) Total Aprx. Shipping Weight: 135828 lbs **Delivery: With a PO on or before end of December, delivery on or before mid March	1	[redacted]	0 Week(s)

**** PLEASE NOTE ABOVE PRICING INCLUDES TRANSPORTATION TO JOBSITE ****
Unloading of containers and site logistics is the responsibility of the customer.

Howden Field Service is available to Supervise or Assist at the jobsite, see attached Rate Sheet.

All orders are subject to credit approval by Howden's Accounting Department.

Prices are in CAD

Freight:	DDP at Port of Entry after release from customs. Incoterms 2010. Freight Allowed.

This quote is subject only to Howden North America's Standard Terms and Conditions of Sale, (attached). Unless otherwise negotiated and agreed to by HNA in writing, no other terms shall apply regardless of any statement on Buyer's documents to the contrary.

Howden North America does not accept Liquidated Damages or in place warranty as standard business practice.
*If quoted deliveries do not meet your requirements, please advise.
For Prepay and Charge orders, there will be a 4% charge of the net selling price applied to Buyer's invoice as a separate item to cover the standard transportation and handling expenses to the first North American destination. In addition, any expense incurred by Seller because of special delivery arrangements requested by Buyer shall be billed to Buyer. Howden does not provide copies of freight invoices.
Pricing does not include Federal, State, Local, or Export taxes or duties.
Payment terms are 30% with order, 70% upon shipment, payable Net 30 days.
Quote expires 30 days from noted and is subject to customer credit approval.
Minimum order value is $350.00.
Non inventory parts are not returnable; returned inventory parts are subject to restocking charges.

If you have any questions, please contact us.

Sincerely,

Phillip Edgerton

CI Number: 47761

Title: LIN1 – Boiler Refurbishment 2016

Start Date:	2016/07
In-Service Date:	2016/08
Final Cost Date:	2017/02
Function:	Steam
Forecast Amount:	$506,845

DESCRIPTION:

The scope of work for this project is to refurbish and replace deteriorated boiler tubes, tube bends and shields on the Lingan Unit 1 boiler as part of the planned outage in 2016. The scope of this project is determined as part of the annual boiler condition data collection and analysis. This effort includes evaluation and prioritization of activities to be undertaken during the annual outage. Protective erosion shields identified as missing or degraded will be replaced with new shields. Tubes and bends will be replaced in the areas where the wall thickness readings are below American Society of Mechanical Engineers (ASME) specifications. This tolerance maximizes the economic tube life while maintaining boiler reliability.

Summary of Related CIs +/- 2 years:
2014 CI 43164 LIN1 Boiler Refurbishment $224,974
2015 CI 46470 LIN1 Boiler Refurbishment 2015 $496,369
2017 CI TBD LIN1 Boiler Refurbishment 2017 $TBD
2018 CI TBD LIN1 Boiler Refurbishment 2018 $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Ongoing asset management activities have identified the requirement for boiler component replacement to maintain the long-term reliability of the boiler and mitigate the risk of unplanned outages due to tube leaks. Boiler Tube failures represent the industry's single largest source of outages for steam-based generation. NS Power has a long history of managing this with comprehensive Boiler Inspection and Investment Programs to match the various failure mechanisms.

Why do this project now?

In order to mitigate the risk of an unplanned outage, annual boiler refurbishment activities (on different components) are required. Some of the tubes to be inspected and replaced are difficult to access and sufficient time during a planned outage is required to complete repairs or replacements. The annual planned outage duration will afford the time necessary to assess, locate and repair tubes and shields.

Why do this project this way?

Replacing deteriorated tubes, tube bends and shields will mitigate the risk of tube leaks and minimize the number of unplanned outages. Based on boiler assessments, these upgrades are necessary to maintain reliable operation of the boiler. Refurbishment of these components is not an option once they are outside acceptable tolerances.

CI Number : 47761 - LIN1 Boiler Refurbishment **Project Number**

Parent CI Number : -

Cost Centre : 304 - 304-Lingan 1&2 Prod. Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		955	0	955
095		095-Thermal Term Labour AO		4,773	0	4,773
095		095-Thermal & Hydro Contracts AO		41,861	0	41,861
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	4,709	0	4,709
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	23,547	0	23,547
012	013	012 - Materials	013 - SGP - Boiler	21,000	0	21,000
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	410,000	0	410,000
			Total Cost:	506,845	0	506,845
			Original Cost:	129,772		

Capital Project Detailed Estimate

Location: Steam
CI# : 47761
Title: LIN1 Boiler Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Utilityworker	PD	20	$ 240	$ 4,709		
			Sub-Total	$ 4,709		
004 Term Labour						
Utilityworker	PD	98	$ 240	$ 23,547		
			Sub-Total	$ 23,547		
012 Materials						
Boiler Tube	ea	1	$ 6,000	$ 6,000		CI 46470
Boiler Shields	ea	1	$ 10,000	$ 10,000		CI 46470
Misc. Consumables	ea	1	$ 5,000	$ 5,000		CI 46470
			Sub-Total	$ 21,000		
013 Contracts						
Boiler Inspection & Refurbishment	ea	1	$ 410,000	$ 410,000		CI 46470
			Sub-Total	$ 410,000		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 955		
Thermal Term Labour AO				$ 4,773		
Thermal / Hydro Contracts AO				$ 41,861		
			Sub-Total	$ 47,589		
			SUB-TOTAL (no AO, AFUDC)	$ 459,256		
			TOTAL (AO, AFUDC included)	$ 506,845		
Original Cost				$ 129,772		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN1 Boiler Refurbishment
Summary of Alternatives

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47761
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish Boiler vs Replacement Energ	6.11%	-168,459	104,986	1	13.03%	4.8 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to maintain boiler reliaiblity through the winter months.

Notes/Comments :

Refurbish Boiler vs Replacement Energy & Repair Costs

It is assumed as time passes the frequency and probabilty of tube failures increases. There are extra fuel charges incurred for every tube failure; this was considered in this economic analysis.

Test 2

Test 3

Test 4

LIN1 Boiler Refurbishment
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47761
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Boiler vs Replacement Energy & Repai	6.11%	-168,459	104,986	1	13.03%	4.8 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Boiler vs Replacement Energy & Repai	10%	-121,515	69,516	1	10.25%	5.2 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years
	Change:	**A**	46,943	-35,470	0	-2.78%	0.3 years
		B	0	0	0	#NUM!	0.0 years
		C	0	0	0	#NUM!	0.0 years
		D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Boiler vs Replacement Energy & Repai	-10%	-104,670	59,018	1	9.98%	5.2 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years
	Change:	**A**	63,789	-45,968	0	-3.06%	0.4 years
		B	0	0	0	#NUM!	0.0 years
		C	0	0	0	#NUM!	0.0 years
		D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	35,824	91,783	173,282	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN1 Boiler Refurbishment
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan Generating Station	CI Number:	47761
Originator :		Project No. :	

Refurbish Boiler vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			72,200	75,091		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	50%	50%	50%	50%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	80	80				
Totals	$2,314	$7,167	$36,100	$75,091	$38,414	$82,258
Total Capital Cost of Alternative						$506,845

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

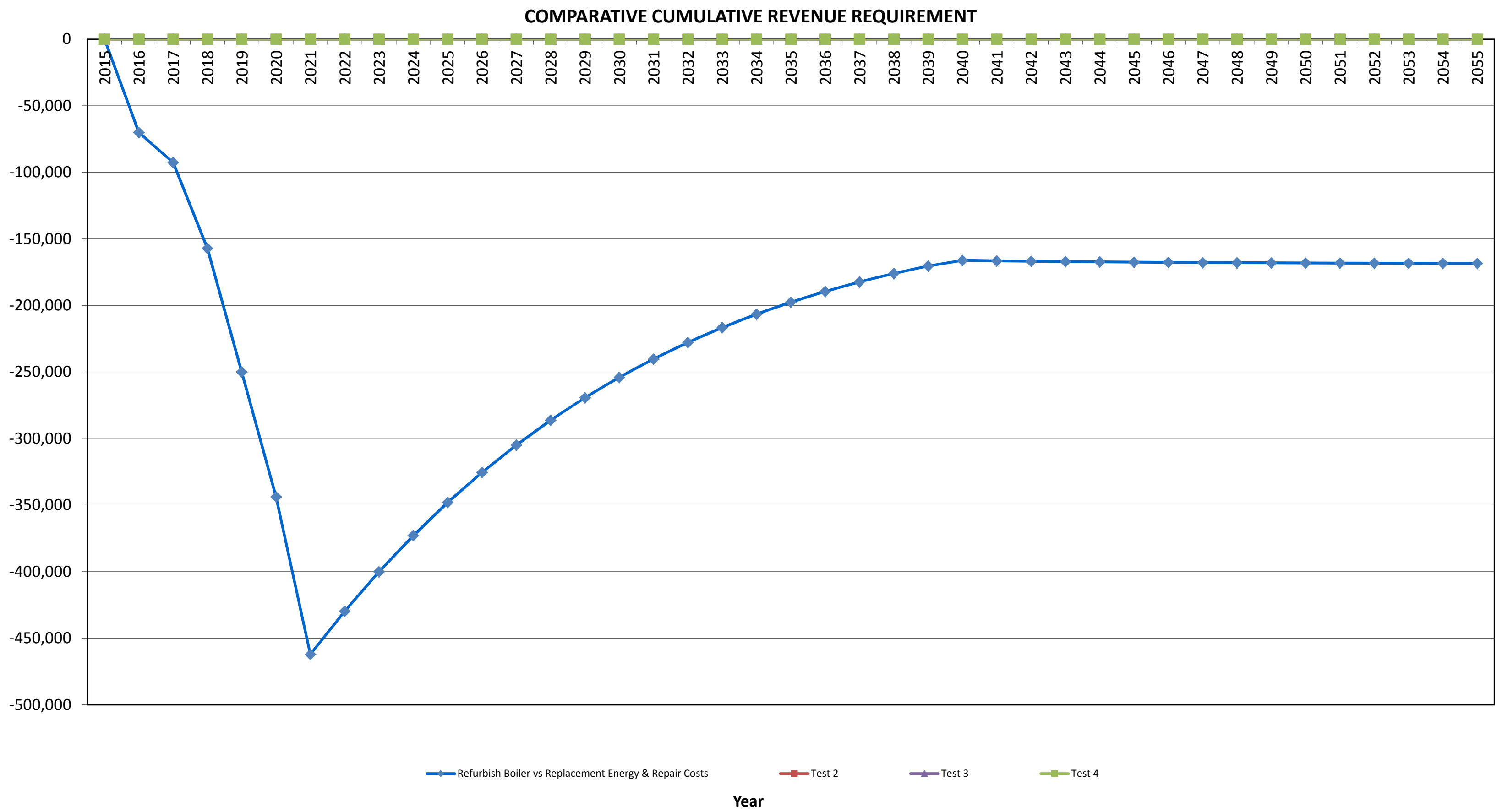
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN1 Boiler Refurbishment

Refurbish Boiler vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	38,413.6	(459,256.2)	18,370.2	454,020.4	(420,842.6)	(6,213.4)	(427,056.1)	(402,465.4)	0.94	(402,465.4)
2017	-	-	82,258.1	-	35,270.9	416,556.7	82,258.1	(14,566.1)	67,692.1	60,120.9	0.89	(342,344.6)
2018	-	-	135,562.5	-	32,449.2	382,090.0	135,562.5	(31,965.1)	103,597.4	86,712.1	0.84	(255,632.4)
2019	-	-	178,040.5	-	29,853.3	350,380.7	178,040.5	(45,938.0)	132,102.4	104,204.3	0.79	(151,428.2)
2020	-	-	187,512.3	-	27,465.0	321,208.1	187,512.3	(49,614.6)	137,897.6	102,512.1	0.74	(48,916.1)
2021	-	-	233,578.0	-	25,267.8	294,369.3	233,578.0	(64,576.2)	169,001.8	118,400.5	0.70	69,484.4
2022	-	-	-	-	23,246.4	269,677.7	-	7,206.4	7,206.4	4,758.0	0.66	74,242.4
2023	-	-	-	-	21,386.7	246,961.3	-	6,629.9	6,629.9	4,125.3	0.62	78,367.7
2024	-	-	-	-	19,675.7	226,062.3	-	6,099.5	6,099.5	3,576.7	0.59	81,944.4
2025	-	-	-	-	18,101.7	206,835.2	-	5,611.5	5,611.5	3,101.1	0.55	85,045.5
2026	-	-	-	-	16,653.5	189,146.2	-	5,162.6	5,162.6	2,688.7	0.52	87,734.3
2027	-	-	-	-	15,321.3	172,872.4	-	4,749.6	4,749.6	2,331.2	0.49	90,065.5
2028	-	-	-	-	14,095.6	157,900.5	-	4,369.6	4,369.6	2,021.2	0.46	92,086.7
2029	-	-	-	-	12,967.9	144,126.3	-	4,020.1	4,020.1	1,752.4	0.44	93,839.1
2030	-	-	-	-	11,930.5	131,454.1	-	3,698.4	3,698.4	1,519.4	0.41	95,358.5
2031	-	-	-	-	10,976.0	119,795.7	-	3,402.6	3,402.6	1,317.4	0.39	96,675.9
2032	-	-	-	-	10,098.0	109,069.9	-	3,130.4	3,130.4	1,142.2	0.36	97,818.1
2033	-	-	-	-	9,290.1	99,202.2	-	2,879.9	2,879.9	990.3	0.34	98,808.4
2034	-	-	-	-	8,546.9	90,123.9	-	2,649.5	2,649.5	858.6	0.32	99,667.0
2035	-	-	-	-	7,863.2	81,771.8	-	2,437.6	2,437.6	744.4	0.31	100,411.5
2036	-	-	-	-	7,234.1	74,088.0	-	2,242.6	2,242.6	645.5	0.29	101,056.9
2037	-	-	-	-	6,655.4	67,018.8	-	2,063.2	2,063.2	559.6	0.27	101,616.6
2038	-	-	-	-	6,122.9	60,515.2	-	1,898.1	1,898.1	485.2	0.26	102,101.8
2039	-	-	-	-	5,633.1	54,531.8	-	1,746.3	1,746.3	420.7	0.24	102,522.4
2040	-	-	-	-	5,182.5	49,027.2	-	1,606.6	1,606.6	364.7	0.23	102,887.2
2041	-	-	-	-	4,767.9	43,962.9	-	1,478.0	1,478.0	316.2	0.21	103,203.4
2042	-	-	-	-	4,386.4	39,303.7	-	1,359.8	1,359.8	274.2	0.20	103,477.6
2043	-	-	-	-	4,035.5	35,017.3	-	1,251.0	1,251.0	237.7	0.19	103,715.4
2044	-	-	-	-	3,712.7	31,073.8	-	1,150.9	1,150.9	206.1	0.18	103,921.5
2045	-	-	-	-	3,415.7	27,445.7	-	1,058.9	1,058.9	178.7	0.17	104,100.2
2046	-	-	-	-	3,142.4	24,108.0	-	974.1	974.1	154.9	0.16	104,255.1
2047	-	-	-	-	2,891.0	21,037.2	-	896.2	896.2	134.3	0.15	104,389.5
2048	-	-	-	-	2,659.7	18,212.1	-	824.5	824.5	116.5	0.14	104,505.9
2049	-	-	-	-	2,447.0	15,613.0	-	758.6	758.6	101.0	0.13	104,606.9
2050	-	-	-	-	2,251.2	13,221.8	-	697.9	697.9	87.6	0.13	104,694.5
2051	-	-	-	-	2,071.1	11,022.0	-	642.0	642.0	75.9	0.12	104,770.4
2052	-	-	-	-	1,905.4	8,998.1	-	590.7	590.7	65.8	0.11	104,836.2
2053	-	-	-	-	1,753.0	7,136.1	-	543.4	543.4	57.1	0.11	104,893.3
2054	-	-	-	-	1,612.7	5,423.1	-	500.0	500.0	49.5	0.10	104,942.8
2055	-	-	-	-	1,483.7	3,847.1	-	460.0	460.0	42.9	0.09	104,985.7
Total	**-**	**-**	**855,364.9**	**(459,256.2)**	**442,193.4**		**396,108.7**	**(128,083.2)**	**268,025.5**	**104,985.7**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-50,000
-100,000
-150,000
-200,000
-250,000
-300,000
-350,000
-400,000
-450,000
-500,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish Boiler vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47690

Title: LIN4 Burner Front Refurbishment

Start Date: 2016/04
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $480,349

DESCRIPTION:

NS Power coal fired units utilize Burner Assemblies which deliver and distribute pulverized coal and combustion air to the boiler combustion zone. These assemblies include ductwork (and support structures) Burner Assemblies (buckets), nozzles and associated pneumatic control mechanisms. The delivery elements are subjected to wear as a result of transporting a fuel/air mixture at high velocity. The components nearer the boiler front are subjected to the boiler environment and they wear due to heat and erosion.

Repair rates for Burner Assemblies are a function of operating hours, load and fuel quality. Regular assessments determine condition and guide scope of refurbishment and replacement of components.

This project covers the replacement of the burner front components on Unit #4. The burner fronts internal to the boiler have been inspected yearly and in 2015 were deemed to require replacement in 2016. The burner condition has a direct impact on unburned carbon, oxygen levels, and boiler temperatures which all have an effect on heat rate and fuel efficiency. Twelve Burner Assemblies (buckets) will be replaced in this project.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Burner performance and integrity deteriorates over operating time. Burner distribution to the combustor and fuel air mix will become less uniform as elements in the burner system deteriorate resulting in less efficient utilization of fuel. Supporting structures, seal mechanisms and the integrity of ducts and buckets will deteriorate and provide opportunity for burner fires (outside the combustor) which is a safety concern. Refurbishment is required to maintain the Burner system in a safe and effective operating condition.

Why do this project now?

Regular assessment by NS Power and the OEM indicated the condition of the components is such that replacement is required at this time to ensure the reliability and performance of the generating unit. As the Burner System is essential to Boiler Operation, this work must be completed during a unit outage.

Why do this project this way?

A combination of component refurbishment and replacement will be included in the refurbishment. Some tips, nozzles and burners will be replaced based on condition. Supporting structures are typically repaired in situ. Both replacement and refurbishment are options on the various elements to sustain burner system performance. When possible, components will be replaced if it is more cost effective.

CI Number : 47690 - LIN4 Burner Front Refurbishment **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		4,087	0	4,087
095		095-Thermal Term Labour AO		3,818	0	3,818
095		095-Thermal & Hydro Contracts AO		16,336	0	16,336
095		095-Thermal Regular Labour AO		477	0	477
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	2,355	0	2,355
004	013	004 - THERMAL Term Labour	013 - SGP - Boiler	18,837	0	18,837
012	013	012 - Materials	013 - SGP - Boiler	258,438	0	258,438
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	160,000	0	160,000
066	013	066 - Other Goods & Services	013 - SGP - Boiler	16,000	0	16,000
			Total Cost:	480,349	0	480,349
			Original Cost:	346,801		

Capital Project Detailed Estimate

Location: **Steam**
CI# : 47690
Title: LIN4 Burner Front Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Utilityworker	PD	10	$ 240	$ 2,355		
			Sub-Total	$ 2,355		
004 Term Labour						
Utilityworker	PD	78	$ 240	$ 18,837		
			Sub-Total	$ 18,837		
012 Materials						
Coal Nozzle	ea	16	$ 6,038	$ 96,608		46482
Coal Nozzle Tips	ea	16	[redacted]		Cost Support Item #1	
Air Nozzle Tips	ea	8			Cost Support Item #1	
Oil Nozzle Tips	ea	8			Cost Support Item #1	
USD to CDN Exchange	ea	25%				
Miscellaneous Consumable and Fasteners	ea	1	$ 10,000	$ 10,000		
			Sub-Total	$ 258,438		
013 Contracts						
Burner Installation	ea	1	140000	$ 140,000		46482
Burner Inspection	ea	1	20000	$ 20,000		46482
			Sub-Total	$ 160,000		
066 Other Goods & Services						
Contingency	%	10%	$ 160,000	$ 16,000		
				$ -		
			Sub-Total	$ 16,000		
094 Interest Capitalized						
AFUDC				$ 4,087		
			Sub-Total	$ 4,087		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 477		
Thermal Term Labour AO				$ 3,818		
Thermal / Hydro Contracts AO				$ 16,336		
			Sub-Total	$ 20,632		
			SUB-TOTAL (no AO, AFUDC)	$ 455,630		
			TOTAL (AO, AFUDC included)	$ 480,349		
Original Cost				$ 346,801		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Burner Front Refurbishment
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47690
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Components vs Replacement	6.11%	-421,473	267,402	1	26.52%	3.5 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid unit downtime.

Notes/Comments :

Replace Components vs Replacement Energy & Repair Costs

The burner fronts only last a set amount of time due to the environment. If the fronts are not replaced, they will fail, causing the unit to have to come offline for repair. As time passes, the number of events and probability increases.

Test 2

Test 3

Test 4

LIN4 Burner Front Refurbishment
Summary of Sensitivities

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47690
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Components vs Replacement Energy & F	6.11%	-421,473	267,402	1	26.52%	3.5 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Components vs Replacement Energy & F	10%	-376,723	231,828	1	22.20%	3.7 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:	**A**	44,751	-35,575	0	-4.32%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Components vs Replacement Energy & F	-10%	-334,575	205,087	1	21.76%	3.7 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:	**A**	86,898	-62,315	0	-4.76%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	49,746	148,746	320,060	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 Burner Front Refurbishment
Avoided Cost Calculations

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47690
Originator :		**Project No. :**	

Replace Components vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			39,800	41,394		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	90	90				
Totals	$13,543	$48,090	$39,800	$82,788	$53,343	$130,878
Total Capital Cost of Alternative						$480,349

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

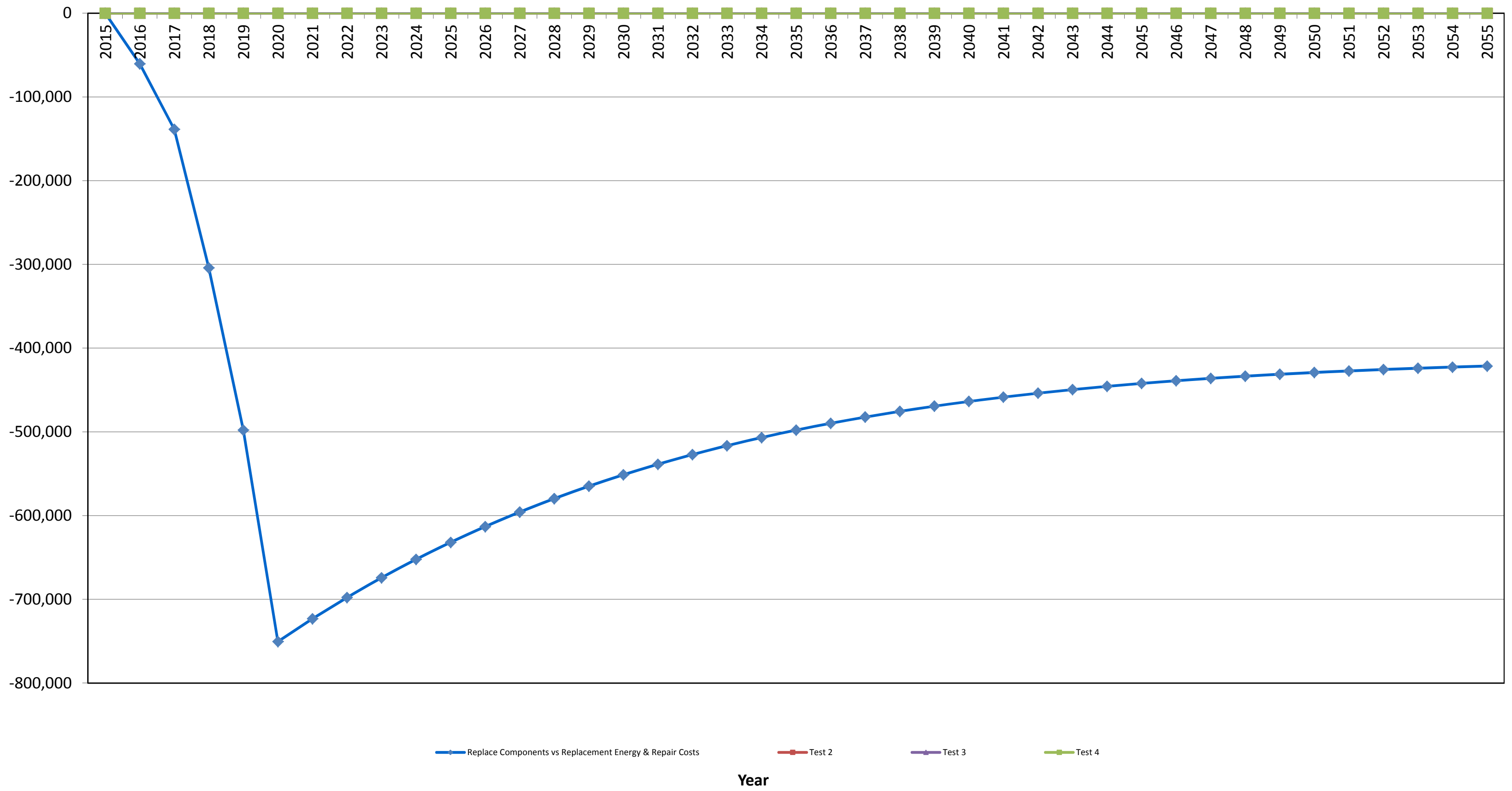
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Burner Front Refurbishment
Replace Components vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	53,342.7	(459,717.7)	18,225.2	443,099.3	(406,374.9)	(10,886.4)	(417,261.4)	(393,234.7)	0.94	(393,234.7)
2017	-	-	130,877.6	-	34,992.4	407,156.2	130,877.6	(29,724.4)	101,153.2	89,839.4	0.89	(303,395.3)
2018	-	-	244,919.2	-	32,193.0	374,088.5	244,919.2	(65,945.1)	178,974.1	149,803.2	0.84	(153,592.1)
2019	-	-	297,422.5	-	29,617.6	343,666.3	297,422.5	(83,019.5)	214,403.0	169,124.1	0.79	15,532.1
2020	-	-	399,510.8	-	27,248.2	315,677.8	399,510.8	(115,401.4)	284,109.4	211,204.9	0.74	226,736.9
2021	-	-	-	-	25,068.3	289,928.5	-	7,771.2	7,771.2	5,444.4	0.70	232,181.3
2022	-	-	-	-	23,062.8	266,239.0	-	7,149.5	7,149.5	4,720.4	0.66	236,901.7
2023	-	-	-	-	21,217.8	244,444.7	-	6,577.5	6,577.5	4,092.7	0.62	240,994.5
2024	-	-	-	-	19,520.4	224,394.0	-	6,051.3	6,051.3	3,548.5	0.59	244,543.0
2025	-	-	-	-	17,958.8	205,947.3	-	5,567.2	5,567.2	3,076.6	0.55	247,619.6
2026	-	-	-	-	16,522.1	188,976.4	-	5,121.8	5,121.8	2,667.5	0.52	250,287.1
2027	-	-	-	-	15,200.3	173,363.1	-	4,712.1	4,712.1	2,312.8	0.49	252,599.9
2028	-	-	-	-	13,984.3	158,998.9	-	4,335.1	4,335.1	2,005.3	0.46	254,605.1
2029	-	-	-	-	12,865.5	145,783.8	-	3,988.3	3,988.3	1,738.6	0.44	256,343.8
2030	-	-	-	-	11,836.3	133,626.0	-	3,669.2	3,669.2	1,507.4	0.41	257,851.2
2031	-	-	-	-	10,889.4	122,440.7	-	3,375.7	3,375.7	1,307.0	0.39	259,158.1
2032	-	-	-	-	10,018.2	112,150.3	-	3,105.7	3,105.7	1,133.2	0.36	260,291.3
2033	-	-	-	-	9,216.8	102,683.1	-	2,857.2	2,857.2	982.5	0.34	261,273.8
2034	-	-	-	-	8,479.4	93,973.3	-	2,628.6	2,628.6	851.8	0.32	262,125.6
2035	-	-	-	-	7,801.1	85,960.3	-	2,418.3	2,418.3	738.6	0.31	262,864.2
2036	-	-	-	-	7,177.0	78,588.3	-	2,224.9	2,224.9	640.4	0.29	263,504.6
2037	-	-	-	-	6,602.8	71,806.1	-	2,046.9	2,046.9	555.2	0.27	264,059.8
2038	-	-	-	-	6,074.6	65,566.4	-	1,883.1	1,883.1	481.4	0.26	264,541.1
2039	-	-	-	-	5,588.6	59,826.0	-	1,732.5	1,732.5	417.4	0.24	264,958.5
2040	-	-	-	-	5,141.5	54,544.7	-	1,593.9	1,593.9	361.9	0.23	265,320.4
2041	-	-	-	-	4,730.2	49,686.0	-	1,466.4	1,466.4	313.7	0.21	265,634.1
2042	-	-	-	-	4,351.8	45,215.9	-	1,349.1	1,349.1	272.0	0.20	265,906.1
2043	-	-	-	-	4,003.7	41,103.5	-	1,241.1	1,241.1	235.9	0.19	266,142.0
2044	-	-	-	-	3,683.4	37,320.1	-	1,141.8	1,141.8	204.5	0.18	266,346.5
2045	-	-	-	-	3,388.7	33,839.3	-	1,050.5	1,050.5	177.3	0.17	266,523.8
2046	-	-	-	-	3,117.6	30,637.0	-	966.5	966.5	153.7	0.16	266,677.5
2047	-	-	-	-	2,868.2	27,690.9	-	889.1	889.1	133.3	0.15	266,810.8
2048	-	-	-	-	2,638.7	24,980.4	-	818.0	818.0	115.6	0.14	266,926.3
2049	-	-	-	-	2,427.6	22,486.9	-	752.6	752.6	100.2	0.13	267,026.5
2050	-	-	-	-	2,233.4	20,192.7	-	692.4	692.4	86.9	0.13	267,113.4
2051	-	-	-	-	2,054.8	18,082.2	-	637.0	637.0	75.3	0.12	267,188.7
2052	-	-	-	-	1,890.4	16,140.4	-	586.0	586.0	65.3	0.11	267,254.0
2053	-	-	-	-	1,739.1	14,354.0	-	539.1	539.1	56.6	0.11	267,310.6
2054	-	-	-	-	1,600.0	12,710.6	-	496.0	496.0	49.1	0.10	267,359.7
2055	-	-	-	-	1,472.0	11,198.6	-	456.3	456.3	42.6	0.09	267,402.3
Total	**-**	**-**	**1,126,072.8**	**(459,717.7)**	**438,702.1**		**666,355.1**	**(213,084.9)**	**453,270.2**	**267,402.3**		

COMPARATIVE CUMULATIVE REVENUE REQUIREMENT



R-V INDUSTRIES INC

December 10, 2014

Nova Scotia Power
Lingan Generating Station

Re: R-V Quote # 14-1419-01, Rev #2 – Updated for December 10, 2014

Dear Sirs,

In response to your request I have listed our price below

Qty	Description	*Price Each*
16	Tip, Adjustable Coal Nozzle, 310 SS For Low NOX Burners, NSPI Ref # 148807 Ref # 8063-16476-001	[redacted]
32	Pivot Pin for Coal Nozzles, NSPI Ref # 147083 Ref# 8066-00933-004	[redacted]
16	Seal Plate for Coal Nozzle, NSPI Ref # 146426 Ref# 8063-02380-047	[redacted]
16	Link Pin for Coal Nozzle, NSPI Ref # 111347 Ref# 8066-00935-001	[redacted]
8	Tip, Adjustable Air Nozzle Assembly, 309 SS For Low NOX Burners, NSPI Ref # 138728 Ref # 8064-16500-001	[redacted]
8	Tip, Adjustable Oil Nozzle with Diffuser, 309 SS For Low NOX Burners, NSPI Ref # 145204 Ref # 8064-16560-001	[redacted]

All Prices are in U.S. Funds

F.O.B.: Honey Brook, PA, (Prices above do NOT include freight)

Lead-Time: 11-12 weeks

Payment Terms: Net 30 Days

Our price is firm for order placement within 30 days. Our standard warranty is enclosed and becomes part of this quotation. Nonconforming terms in your purchase order will not become part of the contract unless accepted by R-V Industries in writing.

We look forward to working with you in the near future. If you have any questions or if you would like to further discuss any of the above, please contact Peter Brabant at Brabtec Industrial Sales or you may contact this office.

Regards,

Turbine

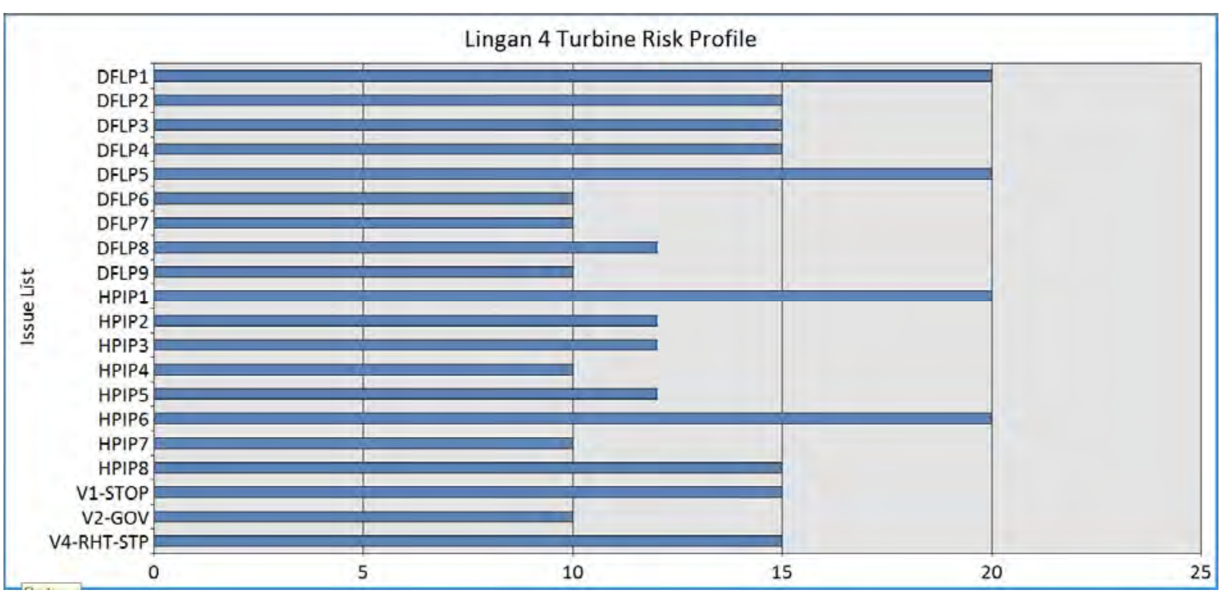
Steam Turbines

NS Power has a fleet of 13 steam turbines and electrical generators, ranging from 50MW to 185MW nominal rating. Steam turbines are considered complex asset classes, as they are composed of extremely heavy rotating elements (rotors), contain high energy steam from the boiler, include sophisticated valve and bearing systems, and are managed by state of the art supervisory systems.

NS Power engages independent industry experts to support regular health assessments and risk profiles. Approximately 60 key condition areas are assessed and rated for each turbine and generator. (Generators are considered in the same Health Assessments as turbines as their maintenance intervals need to be considered together in order to optimize planned major outage scheduling.)

The graphic below illustrates a typical Turbine risk profile (Lingan Unit #4 is illustrated as it has a planned major outage in 2016). Each unit has a similar risk profile developed on the 25 point scale from comprehensive assessments as detailed in the Generation Asset Management overview. Risks are considered for each turbine/generator set with the highest risks typically dictating the timing of the next planned major outage. Lower risk items are considered against their anticipated risk progression, compared to the next planned major outage to determine when the risk needs to be addressed.

Long term maintenance planning assumes an eight year interval between planned major outages. However, actual condition, operating history and anticipated unit utilization are used to optimize the actual planned major outage and associated capital investment.



CI Number: 47658

Title: LIN4 L-0 Turbine Blade Replacements

Start Date:	2016/02
In-Service Date:	2016/06
Final Cost Date:	2016/12
Function:	Steam
Forecast Amount:	$4,597,152

DESCRIPTION:

This project includes the replacement of the Last Pass (L-0) turbine blades. The L-0 blades are original to the turbine (1984) and are susceptible to wear due to their location in the turbine (the L-0 blades are the last blades before the steam is condensed in the condenser).

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

The increase in project cost from CI 42806 in 2015 is primarily due to the decrease in value of the Canadian dollar. CI 42806 used an exchange rate of $1.08 CDN/USD, while today's rate is $1.30 CDN/USD.

Summary of Related CIs +/- 2 years:
2015 CI 42806 LIN3 L-0 Turbine Blade Replacements $4,157,741

Depreciation Class: Lingan Unit 3&4

Estimated Useful Life: 25 Years

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Evaluation of Unit 4 L-0 turbine blade life consumption calculations and inspection by the NS Power Turbine Generator Asset Management Team indicates that the L-0 blades are now at the end of their service life and replacement is recommended. The tips of the blades have started to erode, and erosion patterns have caused stress risers which allowed a cyclic fatigue fracture to occur with increasing risk of blade separation. Completing this replacement will mitigate the risk of blade separation, and the resulting damage to both the interior and possibly exterior of the machine.

Why do this project now?

Life consumption calculations and inspection indicate that the Last Pass Blades are at the end of life and due to the reasons mentioned above are at risk of blade separation. It is necessary for safety and unit reliability to re-establish life cycle integrity of the Unit 4 L-0 blades. Extending the run beyond 2016 increases the risk of forced outages and subsequent unplanned major outages. Unit 4 has a major planned outage for 2016. This major planned outage provides sufficient time for the L-0 blades to be replaced.

Why do this project this way?

Repair of individual blades or replacement of individual blades versus replacement of the blade set is not an adequate measure to restore integrity. In certain cases, replacement of individual blades can be an option. However the failure mechanism and condition of all the last pass blades are such that full replacement is necessary.

CI Number : 47658-SE59 - LIN4 L-0 Blade Replacement **Project Number** SE59

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		64,651	0	64,651
095		095-Thermal Regular Labour AO		27,767	0	27,767
095		095-Thermal Term Labour AO		48,750	0	48,750
095		095-Thermal & Hydro Contracts AO		165,400	0	165,400
095		095-Thermal Overtime Labour AO		20,008	0	20,008
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	136,986	0	136,986
002	010	002 - THERMAL Overtime Labour	010 - SGP - Turbo Gen.Instal.	197,414	0	197,414
004	010	004 - THERMAL Term Labour	010 - SGP - Turbo Gen.Instal.	240,503	0	240,503
011	010	011 - Travel Expense	010 - SGP - Turbo Gen.Instal.	10,000	0	10,000
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	1,852,090	0	1,852,090
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	1,619,980	0	1,619,980
028	010	028 - Consulting	010 - SGP - Turbo Gen.Instal.	40,000	0	40,000
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	173,604	0	173,604
			Total Cost:	4,597,152	0	4,597,152
			Original Cost:	1,877,751		

Capital Project Detailed Estimate

Location: **Steam**
CI# : 47658
Title: LIN4 L-0 Blade Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	20	$ 358	$ 7,025		CI 42806
Engineering	PD	20	$ 405	$ 7,947		CI 42806
Maintenance Trades	PD	322	$ 365	$ 117,304		CI 42806
Utilityworker	PD	20	$ 240	$ 4,709		CI 42806
			Sub-Total	$ 136,986		
002 OT Labour						
Maintenance Trades	PD	265	$ 744.16	$ 197,414		CI 42806
			Sub-Total	$ 197,414		
004 Term Labour						
Maintenance Trades	PD	515	$ 365	$ 187,758		CI 42806
Utilityworker	PD	220	$ 240	$ 52,745		CI 42806
			Sub-Total	$ 240,503		
011 Travel Expense						
Factory Blade Inspection	ea	1	$ 10,000	$ 10,000		
			Sub-Total	$ 10,000		
012 Materials						
L-0 Replacement Blades	USD	1	[redacted]		Cost Support #1	
USD to CDN Exchange	%	30%				
Misc Fasteners and Consumables	ea	1				
			Sub-Total	$ 1,852,090		
013 Contracts						
Rotor Inspection Services	USD	1	$ 202,000	$ 202,000		CI 42806
L-0 Blade Replacement	USD	1	[redacted]		Cost Support #2 - Page 6	
Turbine Vibration Technical Advisor	USD	1				
Turbine Technical Advisor	USD	1				CI 42806
USD to CDN Exchange	%	30%	$ 1,134,600.00	$ 340,380		
Grit Blasting	ea	1	$ 50,000.00	$ 50,000		
Fastener Heaters	ea	1	$ 60,000.00	$ 60,000		
Onsite machining	ea	1	$ 35,000.00	$ 35,000		
			Sub-Total	$ 1,619,980		
028 Consulting						
Project Management	$	1	$ 40,000	$ 40,000		
			Sub-Total	$ 40,000		
066 Other Goods & Services						
Contingency	%	5%	$ 3,472,070	$ 173,604		
			Sub-Total	$ 173,604		
094 Interest Capitalized						
				$ 64,651		
			Sub-Total	$ 64,651		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 27,767		
Thermal OT Labour AO				$ 20,008		
Thermal Term Labour AO				$ 48,750		
Thermal / Hydro Contracts AO				$ 165,400		
			Sub-Total	$ 261,925		
			SUB-TOTAL (no AO, AFUDC)	$ 4,270,576		
			TOTAL (AO, AFUDC included)	$ 4,597,152		
Original Cost				$ 1,877,751		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 L-0 Blade Replacement
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47658
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Blades vs Replacement Energ	6.11%	-6,881,034	5,100,413	1	18.70%	7.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid lost generation and additional turbine damage if an L-0 blade fails.

Notes/Comments :

Replace Blades vs Replacement Energy & Repair Costs

The L-0 blades, if left in service will eventually fail. As time passes the probability increases. If a blade fails it is likely the blade row will require replacement and could damage adjacent blades and diaphragms which would take a minimum of 10 weeks, and up to 6 months (26 weeks), to procure a set and have them installed. No generation would be possible during this time. This EAM uses the an average of 18 weeks in the calcuation of replacement energy costs.

Test 2

Test 3

Test 4

LIN4 L-0 Blade Replacement
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47658
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Blades vs Replacement Energy & Repair	6.11%	-6,881,034	5,100,413	1	18.70%	7.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Blades vs Replacement Energy & Repair	10%	-6,462,499	4,764,492	1	17.03%	7.9 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:					
A	418,536	-335,920	0	-1.68%	0.7 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Blades vs Replacement Energy & Repair	-10%	-5,774,395	4,254,451	1	16.86%	8.0 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:					
A	1,106,639	-845,962	0	-1.85%	0.7 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**Delay?**
Yrs Delay:	1	2	3	
A	254,613	604,588	1,184,303	No
B	0	0	0	No
C	0	0	0	No
D	0	0	0	No

LIN4 L-0 Blade Replacement
Avoided Cost Calculations

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47658
Originator :		**Project No. :**	

Replace Blades vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**1**	**1**	**1**	**1**		
Probability of Occurance (%)	**60%**	**70%**	**60%**	**70%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**154.0**	**154.0**				
Duration (Hours)	**3024**	**3024**				
Totals	**$273,021**	**$565,536**	**$0**	**$0**	**$273,021**	**$565,536**
Total Capital Cost of Alternative						**$4,597,152**

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

Test 3

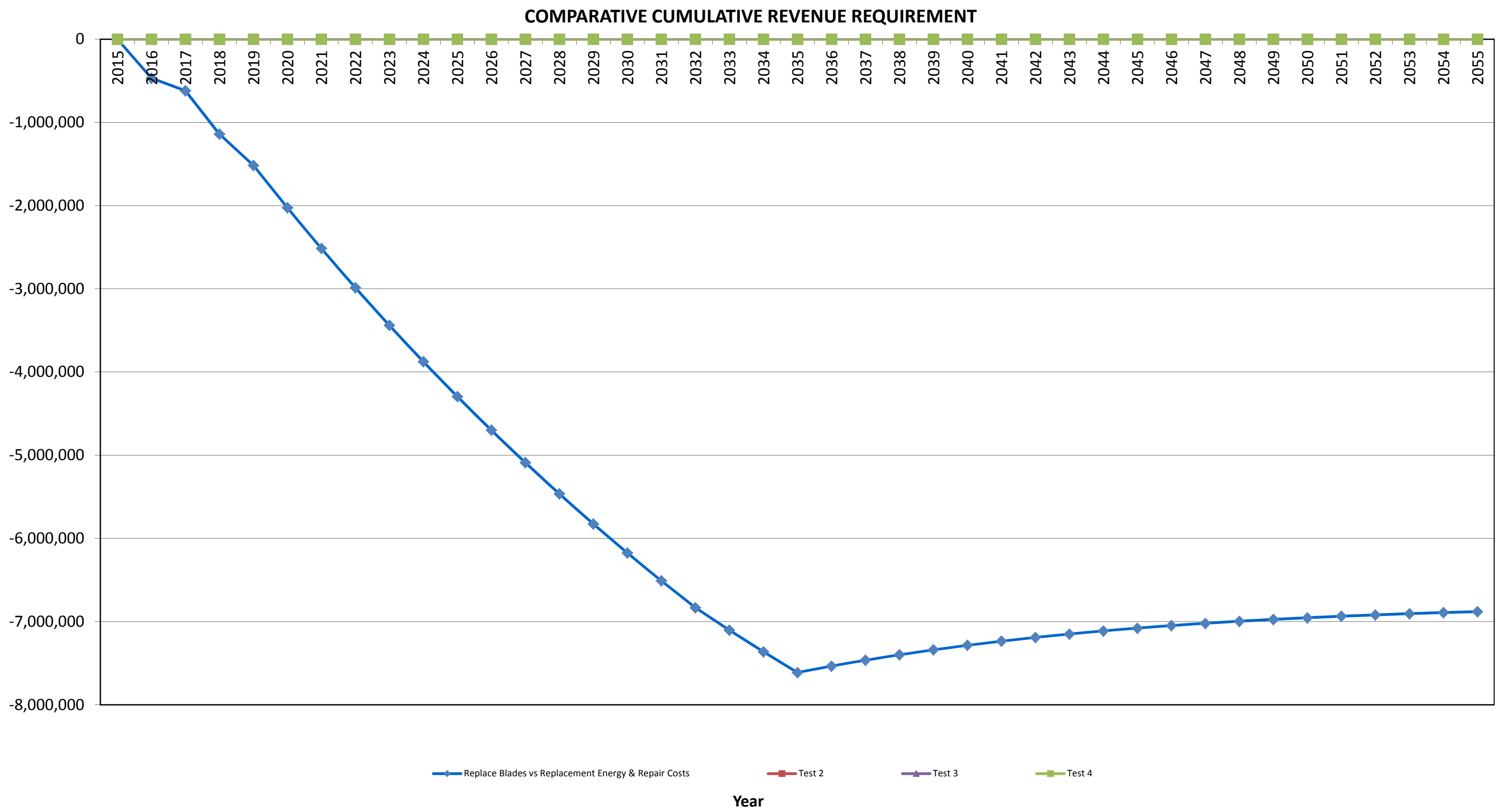
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			**0**	**0**		
Events/Outages (#)	**0**	**0**	**0**	**0**		
Probability of Occurance (%)	**0%**	**0%**	**0%**	**0%**		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	**0.0**	**0.0**				
Duration (Hours)	**0**	**0**				
Totals	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Capital Cost of Alternative						**$0**

LIN4 L-0 Blade Replacement
Replace Blades vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	273,021.4	(4,335,227.5)	170,823.0	4,172,044.2	(4,062,206.0)	(31,681.5)	(4,093,887.5)	(3,858,154.3)	0.94	(3,858,154.3)
2017	-	-	565,535.9	-	327,980.2	3,831,994.4	565,535.9	(73,642.2)	491,893.6	436,876.4	0.89	(3,421,277.9)
2018	-	-	1,037,246.8	-	301,741.8	3,519,148.7	1,037,246.8	(228,006.6)	809,240.3	677,342.9	0.84	(2,743,935.1)
2019	-	-	894,493.3	-	277,602.5	3,231,330.6	894,493.3	(191,236.2)	703,257.1	554,739.2	0.79	(2,189,195.8)
2020	-	-	1,119,993.5	-	255,394.3	2,966,538.0	1,119,993.5	(268,025.8)	851,967.8	633,346.8	0.74	(1,555,849.0)
2021	-	-	1,142,393.4	-	234,962.7	2,722,928.7	1,142,393.4	(281,303.5)	861,089.9	603,268.4	0.70	(952,580.6)
2022	-	-	1,165,241.3	-	216,165.7	2,498,808.2	1,165,241.3	(294,213.4)	871,027.8	575,092.7	0.66	(377,487.9)
2023	-	-	1,188,546.1	-	198,872.5	2,292,617.4	1,188,546.1	(306,798.8)	881,747.3	548,647.7	0.62	171,159.8
2024	-	-	1,212,317.0	-	182,962.7	2,102,921.8	1,212,317.0	(319,099.8)	893,217.2	523,781.6	0.59	694,941.4
2025	-	-	1,236,563.3	-	168,325.6	1,928,401.9	1,236,563.3	(331,153.7)	905,409.7	500,359.3	0.55	1,195,300.7
2026	-	-	1,261,294.6	-	154,859.6	1,767,843.5	1,261,294.6	(342,994.9)	918,299.8	478,261.0	0.52	1,673,561.8
2027	-	-	1,286,520.5	-	142,470.8	1,620,129.8	1,286,520.5	(354,655.4)	931,865.1	457,380.1	0.49	2,130,941.9
2028	-	-	1,312,250.9	-	131,073.2	1,484,233.3	1,312,250.9	(366,165.1)	946,085.8	437,621.3	0.46	2,568,563.2
2029	-	-	1,338,495.9	-	120,587.3	1,359,208.4	1,338,495.9	(377,551.7)	960,944.3	418,899.5	0.44	2,987,462.6
2030	-	-	1,365,265.8	-	110,940.3	1,244,185.5	1,365,265.8	(388,840.9)	976,424.9	401,138.3	0.41	3,388,600.9
2031	-	-	1,392,571.2	-	102,065.1	1,138,364.5	1,392,571.2	(400,056.9)	992,514.3	384,269.3	0.39	3,772,870.3
2032	-	-	1,420,422.6	-	93,899.9	1,041,009.1	1,420,422.6	(411,222.0)	1,009,200.6	368,230.8	0.36	4,141,101.1
2033	-	-	1,303,947.9	-	86,387.9	951,442.2	1,303,947.9	(377,443.6)	926,504.3	318,591.2	0.34	4,459,692.3
2034	-	-	1,330,026.9	-	79,476.9	869,040.6	1,330,026.9	(387,670.5)	942,356.4	305,383.2	0.32	4,765,075.5
2035	-	-	1,356,627.4	-	73,118.7	793,231.2	1,356,627.4	(397,887.7)	958,739.7	292,802.3	0.31	5,057,877.8
2036	-	-	-	-	67,269.2	723,486.5	-	20,853.5	20,853.5	6,002.0	0.29	5,063,879.8
2037	-	-	-	-	61,887.7	659,321.4	-	19,185.2	19,185.2	5,203.9	0.27	5,069,083.7
2038	-	-	-	-	56,936.7	600,289.5	-	17,650.4	17,650.4	4,511.9	0.26	5,073,595.5
2039	-	-	-	-	52,381.7	545,980.1	-	16,238.3	16,238.3	3,911.9	0.24	5,077,507.5
2040	-	-	-	-	48,191.2	496,015.5	-	14,939.3	14,939.3	3,391.7	0.23	5,080,899.2
2041	-	-	-	-	44,335.9	450,048.1	-	13,744.1	13,744.1	2,940.7	0.21	5,083,839.9
2042	-	-	-	-	40,789.0	407,758.0	-	12,644.6	12,644.6	2,549.7	0.20	5,086,389.6
2043	-	-	-	-	37,525.9	368,851.2	-	11,633.0	11,633.0	2,210.6	0.19	5,088,600.2
2044	-	-	-	-	34,523.8	333,056.9	-	10,702.4	10,702.4	1,916.7	0.18	5,090,516.9
2045	-	-	-	-	31,761.9	300,126.2	-	9,846.2	9,846.2	1,661.8	0.17	5,092,178.7
2046	-	-	-	-	29,221.0	269,829.9	-	9,058.5	9,058.5	1,440.8	0.16	5,093,619.5
2047	-	-	-	-	26,883.3	241,957.3	-	8,333.8	8,333.8	1,249.2	0.15	5,094,868.7
2048	-	-	-	-	24,732.6	216,314.5	-	7,667.1	7,667.1	1,083.1	0.14	5,095,951.9
2049	-	-	-	-	22,754.0	192,723.2	-	7,053.7	7,053.7	939.1	0.13	5,096,890.9
2050	-	-	-	-	20,933.7	171,019.1	-	6,489.4	6,489.4	814.2	0.13	5,097,705.2
2051	-	-	-	-	19,259.0	151,051.4	-	5,970.3	5,970.3	705.9	0.12	5,098,411.1
2052	-	-	-	-	17,718.3	132,681.1	-	5,492.7	5,492.7	612.1	0.11	5,099,023.2
2053	-	-	-	-	16,300.8	115,780.4	-	5,053.3	5,053.3	530.7	0.11	5,099,553.8
2054	-	-	-	-	14,996.8	100,231.8	-	4,649.0	4,649.0	460.1	0.10	5,100,013.9
2055	-	-	-	-	13,797.0	85,927.0	-	4,277.1	4,277.1	398.9	0.09	5,100,412.9
Total	**-**	**-**	**23,202,775.8**	**(4,335,227.5)**	**4,111,910.3**		**18,867,548.4**	**(5,918,168.3)**	**12,949,380.0**	**5,100,412.9**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Replace Blades vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

TOSHIBA
Leading Innovation >>>

Quotation

TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION
6623 W. Washington Street
West Allis, WI 53214 USA

Toshiba Quote Number	6708-0
Quote Date	07-JUL-15

To: NOVA SCOTIA POWER INC
PO BOX 910
LINGAN, NS B1H 5E6
Canada

Plant Code	XCL01	Plant Name	LINGAN
Customer RFQ #		Lead Time	***See Quote Remarks***
Requested Delivery Date	27-JAN-16	Ship Via	TBD-LTL-Ground
Payment Terms	Net 30	Customer Contact	
Delivery Terms	To Be Determined	Validity	30 days
Toshiba Contact	Scholze, Mr. Mark	Toshiba Contact #	

Remarks :	Items need to be ordered ASAP to have the parts on-stie by 2-1-2016. Items need to be ordered as quoted.

Line Number	Ordered Item	UOM	Quantity	Unit price (USD)	Extended Price (USD)
1.1	[redacted]	Each	88	[redacted]	[redacted]
2.1	[redacted]	Each	88	[redacted]	[redacted]
3.1	[redacted]	Each	176	[redacted]	[redacted]
4.1	[redacted]	Each	176	[redacted]	[redacted]
5.1	[redacted]	Each	176	[redacted]	[redacted]
6.1	[redacted]	Each	91	[redacted]	[redacted]
7.1	[redacted]	Each	91	[redacted]	[redacted]
8.1	[redacted]	Each	176	[redacted]	[redacted]

Subtotal	[redacted]
Total Sales Tax	0.00
Total (USD)	[redacted]

Notes:
- Quoted prices are based on volume at time of request. Toshiba America Energy Systems Corporation reserves the right to adjust pricing at time of order if volumes change.
- Lead times are estimates based on current capacity and are subject to factory loading at time of order.
- This quotation excludes any applicable taxes.
- Sales according to Toshiba America Energy Systems Corporation standard terms and conditions or mutually agreed upon terms and conditions between Toshiba America Energy Systems Corporation and customer.

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Leading Innovation >>>

TOSHIBA INTERNATIONAL CORPORATION
POWER SYSTEMS DIVISION
POWER GENERATION SERVICES
6623 WEST WASHINGTON STREET, WEST ALLIS, WI 53214
PHONE: (414) 475-2800 FAX: (414) 475-2811

January 13, 2015

Nova Scotia Power, Incorporated
1894 Barrington Street, PO BOX 910
Halifax, Nova Scotia, Canada, B3J 2W5

Attention: Hugh Kerr
Supply Chain Manager

NSPI Reference: RFP P-14-397
TIC Offer: QUO-01975-W7X3

Fixed Price Offer to Nova Scotia Power, Inc
For Last Stage Blading and Spill Strip Replacement Services At Lingan Generating Station

Dear Mr. Hugh Kerr,

Toshiba International Corporation (TIC) is pleased to submit this fixed price offer to Nova Scotia Power, Inc for on-site last stage blade replacement and last stage diaphragm spill strip replacement services at Lingan Generating Station (PLANT) during the spring 2015 outage.

1 Base Scope of Work:

1.1 Last Stage Blading Replacement – TE and GE Rows.

1.1.1 Pre-outage planning and staged mobilization of [redacted] and equipment to site.
1.1.2 Set-up equipment, one powered roller set (by PLANT), one (1) portable machine shop, one (1) portable lathe/balancer at site (approximately one week prior to start of blade removal work).
1.1.3 Inventory blade row assembly hardware supplies (e.g. blades, covers, pins) provided separately by Plant.
1.1.4 Receive rotor for blade work
1.1.5 Remove blades on Turbine End (TE) and Generator End (GE) using pneumatic gun or power actuated gun for pin removal if required.
1.1.6 Blast clean rotor (by PLANT)
1.1.7 Glass bead blast last stage blade attachment areas (by PLANT)
1.1.8 Perform Non Destructive Examination including:
1.1.8.1 [redacted]
Note: TIC intends to utilize the services of [redacted] for this work activity.
1.1.9 Demobilize NDE subcontractor.
1.1.10 Install, align, ream and pin blade row assemblies – TE and GE
1.1.11 Ream pin holes using hand drill methods

1.1.12 Install pins and stake to secure
1.1.13 Caulk bucket cover tenons
1.1.14 Mobilize [redacted] to site for low speed balance work.
1.1.15 Record LSB row assembly documentation and final dimensional inspection
1.1.16 Low speed balance assembled LP rotor
- 1.1.16.1 Note: [redacted]
- 1.1.16.2 If balance weights cannot be removed by normal hand methods and must be destructively removed by machining methods (drilling, grinding, etc) then this work would be considered an extra to the contract.
- 1.1.16.3 Balance weights shall be provided by PLANT.

1.1.17 Clean work areas and demobilize from site
1.1.18 Prepare final report

1.2 Last Stage Diaphragm Spill Strip Replacement.
1.2.1 Receive and inventory replacement parts provided.
1.2.2 Stage diaphragms halves as required for work scope. (by PLANT).
1.2.3 Remove existing spill strips.
1.2.4 Clean and prepare spill strip grooves.
1.2.5 Install replacement spill strips.
1.2.6 Record final dimensions.

2 Optional Scope of Work

2.1 Destructive Removal of 10% of Total Axial Pin Count.
2.1.1 Provide labor use rate for the destructive removal of LSB axial pins on an hourly rate basis.
2.1.2 Provide tooling and consumables consumption rate for the destructive removal of LSB axial pins on a per hole rate basis.

3 Division of Responsibilities (DOR)

3.1 TIC's offer is based upon the following division of responsibilities. Any changes will subject this offer to pricing adjustments accordingly.

	Site Preparation	PLANT	TIC
1	Remote Office Trailer and Communication Services, including the following items listed below: *Remote office trailer with desks, chairs and tables. *Long distance and overseas capable telephone for remote office trailer. *Four (4) high speed internet connection (s) for remote office trailer.	X	
2	Set up staging area for tooling and materials within 100 feet of work area	X	
3	Set up laydown space within 100 feet of work area	X	
4	Timbers, Skids, Pallets, Floor protection, Two (2) 4' x 8' Work Benches, etc	X	
5	Lunch and Break Facilities: Customer will provide a suitable area near the Work area for	X	

	Contractor's employees to use as a break and lunch facility.		
6	Wash Station: Customer will provide a suitable area near the Work area for Contractor's employees to use as a wash facility.	X	
7	Stage replacement parts in accessible location for TIC	X	
8	Remove/reinstall insulation as needed	X	
9	Temp. Power: Provide temp. power as needed to perform the Work. It is the responsibility of Customer to provide the necessary transformers, distribution panels, wiring, connections and disconnections. The temp. power requirements have been listed below: *Machine Tool Container will require electrical connection on a separate 480V/3P/30 Amp line, Input amperage not to exceed 30 amp service. *Power distribution center will require electrical connection connected on a separate 480V/3P/200 Amp line, Input amperage not to exceed 300 amp service. *Low Speed Balance machine will require electrical connection on a separate 480V/3P/40 Amp line, Input amperage not to exceed 30 amp service.	X	
10	Provide lighting for laydown and work areas	X	
11	Non-potable water: For construction use will be furnished by Customer at no charge. The connection will be at hose bibs near the construction area. Customer shall provide all piping, valves, and hoses as required to distribute the water for their contractor use.	X	
12	Drinking Water: Drinking water will be furnished by Customer at no charge. The connection will be at hose bibs near the construction area.	X	
13	Compressed Air: Provide compressed air at existing service locations. Hoses for distribution and use are the responsibility of Contractor.	X	
14	Sanitary Facilities: Customer will provide sanitary facilities for Contractor in the area of the LP turbine work scope and maintain them during the construction period.	X	
15	Trash Containers & Collection: Customer will provide a truck-mounted trash receptacle for use by Contractor and will empty the trash container as needed. Customer shall also supply and maintain all other trash containers necessary to maintain a clean and safe work area.	X	
16	Disconnect/reconnect instrumentation lines as needed	X	
17	Disconnect/reconnect hydraulic lines as needed	X	
18	Removal of the LP Rotors, Final installation of same	X	
19	Record disassembly LP Rotor runout checks with LP Rotor in bearings.	X	
20	Record "Pre" Low Speed Balance LP Rotor Journal dimensions.	X	
21	Blast cleaning of LP Rotor periphery. Blast cleaning media for Rotor periphery shall be aluminum oxide.	X	
22	Glass Bead cleaning of TE & GE L-0 Blade attachments.	X	
23	NDE (VT & MT) inspections of the following *LP Rotor periphery. *TE & GE L-0 Blade attachments. *TE & GE L-0 Blade attachments.		X
24	Sufficient Lay-down area and workspace for the following items: *One (1) Client provided LP Rotor skid. *One (1) Lathe/Low Speed Balance machine. *One (1) portable machine shop. *One (1) twenty foot conex. *Two (2), 4' x 8' work benches	X	

	*Safe working platforms.		
25	Scaffolding, Platforms & Staging: Customer will provide all scaffolding, platforms and staging needed to perform the Work.	X	
26	Duck Ponds/Basins: Customer will need to erect and place Duck ponds or catch basins under the LP Rotor for the collection of excess fluids from the LSB Replacement project	X	
27	Receive, unload and store new buckets and installation materials.	X	
28	Transport materials from plant storage areas to the assembly area.	X	
	Tools, Equipment and Labor		
1	[redacted]		X
2	[redacted]		X
3	[redacted]		X
4	Combined Lathe/Low Speed Balance Machine		X
5	Portable Machine Shop		X
6	All Tooling and Fixtures *Temporary Pins *Shim stock *Hand tools *Power Tools *Hilti Guns and supplies *LSB Pin Removal - Bushings, Guides & Drills *LSB Pin Installation - Reamers, Bushings & Guides		X
7	LSB Replacement Project Inspection & Test Plan Submittal		X
8	LSB Replacement Project Installation Drawings and Specifications		X
9	Overall LSB Replacement Project management, Technical Direction and customer interface		X
10	Detailed LSB Replacement Project Schedule submittal		X
11	LSB Replacement Project Laydown Requirement submittal, [redacted] after award		X
12	LSB Replacement Project Site Safety Plan submittal, [redacted] after award		X
13	LSB Replacement Project Organization Chart submittal, [redacted] prior to mobilization date.		X
14	Daily progress reports for work completed and planned		X
15	Replacement parts	X	
16	Data sheets and documentation		X
17	All overhead crane, rigging technician, crane operator and rigging hardware support during mobilization, outage execution and demobilization.	X	
18	Fork trucks, Electric pallet jack, Mobile Crane and associated certified operators	X	
19	Plant special tools (lifting devices, cable, slings, slugging wrenches, etc.)	X	
20	Solvent and appropriate rags	X	
21	Necessary oxygen, acetylene gas, hydrogen, carbon dioxide, argon and lubricants as necessary	X	
22	Welding and stress relief equipment and service	X	
23	Expendables and consumables	X	
24	Powered rolls set for rotor rotation during blading work	X	
25	LP Rotor stands	X	

26	Disposal of used Blades and Other Materials: Customer shall provide disposal plan and containers for all Blades and Other materials.	X	
	Administration, Facilities and Safety		
1	Personal Protective Equipment *C.S.A. Class G hard hats *C.S.A. Class A Hearing Protection *C.S. A. Approved Safety Footwear *Eye and face Protection		X
2	Daily briefing to PLANT personnel		X
3	One point contact per shift	X	X
4	Lockout-Tagout	X	
5	Contractor two (2) hour site specific safety orientation	X	
6	<u>Site Security and Access:</u> Customer will provide instructions for Contractor personnel to obtain site access security badges. Customer will provide inside the plant fence perimeter parking of Contractor vehicle.	X	
7	Admin of plant safety policy	X	
8	First aid supplies, facility and ambulance service	X	
9	Site Outage Organization chart	X	X
10	Emergency Contact numbers	X	
11	Plant security requirements (background checks, orientation, etc.)	X	
12	<u>Hazardous Waste Disposal:</u> Customer shall provide designated containers for hazardous waste. Customer will be responsible for final disposal.	X	
13	All asbestos insulation or asbestos bearing material identification, removal and disposal	X	
14	Removal and disposal of lead paint	X	
	Workspace, Transport and Utilities		
1	<u>Snow Removal:</u> Customer will provide snow removal service for all on-site roads, parking areas, and around all permanent and temporary construction facilities.	X	
2	Provide contractor parking in near proximity to work area	X	
3	Work area cleanliness		X
4	Return shipment of Toshiba equipment and tooling		X

4 Schedule

4.1 Please reference the draft schedule submitted as Attachment 4.

4.2 TIC's schedule (Attachment 4) is based on the following on-site resources:

4.2.1 One (1) Site Manager.

The site manager will be responsible for the management of the project; including but not limited to pre-outage planning, site management, periodic schedule updates, single point of contact, daily reports, final report, maintaining quality documents and safety administration.

4.2.2 Two (2) Lead Technicians.

4.2.3 Six (6) Technicians.

4.3 TIC schedule is also based on uninterrupted access to the work items with the exception of an allotted total [redacted] for NSPI to fully alum-oxide blast clean the LP rotor periphery (

after LSB removal) and glass bead blast clean the exposed LSB blade attachment areas. Durations beyond this allotment, at no fault of TIC, will be considered as a delay.

5 Pricing, Delivery and Validity

5.1 Price.

5.1.1 **Base Scope of Supply – Section 1 – Subsections 1.1 and 1.2**
USD [redacted] FIXED PRICE

5.1.2 **Optional Scope of Supply – Section 2 – Subsection 2.1.**
5.1.2.1 Labor Rate – USD [redacted]
5.1.2.2 Consumables Rate - [redacted]

5.2 Delivery

5.2.1 Base Scope of Supply Delivery.
TIC intends to complete the base scope of supply in [redacted]. This delivery period commences upon TIC's receipt of rotor at site. This delivery period includes a [redacted] period for NSPI to blast clean rotor and glass bead last stage wheel blade attachment areas.

5.2.2 Optional Scope of Supply Delivery.
TIC anticipates that a total of [redacted] extension should be anticipated for destructive removal of 10% total pin count (53).

5.3 Progress Payments.

Progress payments shall apply for the Base Scope of Supply as follows:

- [redacted] Upon receipt of order.
- [redacted] Upon mobilization of equipment to site.
- [redacted] Upon completion of base scope of supply work.

5.4 Validity.

Pricing stated shall be valid for a period of 90 calendar days.

6 Terms and Clarifications

6.1 All work will be performed in accordance with *TIC Parts and Equipment Service Terms and Conditions Rev 06.15.12* (Attachment 1) or to a mutually agreed to a version of the recent *Products & Services Agreement Between Nova Scotia Power Incorporated and Toshiba International Corporation, effective November 25, 2013* terms which is to be amended to reflect the scope and pricing information of this offer document.

6.2 Payments shall be due net 30 days after issuance of invoice.

6.2.1 A late payment service charge of 1½% per month shall apply.

6.3 Pricing is based upon all site work occurring during non-holidays or holiday weekends.

6.4 Work required beyond what is defined in Section 1 shall be considered extra work.

6.4.1 A signed authorization must be received prior to performing extra work.

6.4.2 Extra work will be billed in accordance with Attachments 2 and 3.

6.5 Additional time or delays (including standby time) outside the direct control of TIC will also be billed in accordance with Attachments 2 and 3.

6.6 Sales and use taxes, VAT, gross receipts, excise taxes and other local and state taxes, fees and any security instrument costs are not included in above price.

6.7 Replacement parts are not included in the above price, except as specifically identified herein.

6.8 The above pricing is subject to prior sale at time of award.

6.9 A minimum lead time of 60 calendar days is required to support the scope. Order award received within 60 calendar days of the project start date may subject pricing to expediting fees.

6.10 Additional methods of blade removal, including machining, may be required for consideration should the quantity of stuck pins as initially assessed or as determined during the course of the work increase considerably beyond 10% total quantity which would then adversely impact schedule and budget comparatively.

7 Confidentiality

7.1 This offer contains information proprietary to TIC; it is submitted in confidence and is to be used solely for the purpose for which it is furnished and returned upon request.

8 Attachments

8.1 Attachment 1: TIC Parts and Equipment Services Terms and Conditions 120615.

8.2 Attachment 2: 2015 Time and Material Rates for Field Service Engineers, Specialists and Site Management Services 141121.

8.3 Attachment 3: 2014 Milwaukee Service Center and Field Technician Rate Sheet 140101.

8.4 Attachment 4: Project Schedule – Draft.

We hope this proposal is of interest to you and look forward to discussing it with you in detail in the very near future.

Sincerely,

James Fanning

James Fanning, P.E.
Key Accounts Manager
TOSHIBA INTERNATIONAL CORPORATION
Power System Division
Mobile Telephone: 804-316-5251
James.Fanning@psd.toshiba.com

cc. James Radish. Manager, OEM Service Projects.

CI Number: 47755

Title: LIN4 High Temperature Fasteners Replacement

Start Date: 2016/02
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $1,073,877

DESCRIPTION:

This project is to replace steam turbine high temperature fasteners (bolts and studs) to maintain the integrity of the Lingan Unit 4 steam turbine for continued safe and efficient operation. The basic criteria for evaluating the consumed life for steam turbine high-temperature bolts are the material, number of times the bolts have been tightened, number of unit start/stop cycles, running hours, bolt operating temperature and critical maintenance data. Evaluation of LIN4 high temperature fasteners using Original Equipment Manufacturer (OEM) criteria indicates that these fasteners are now at the end of their service life and must be replaced.

High Temperature Fasteners are monitored for life cycle maintenance as described in NS Power's TMP (Thermal Maintenance Practice) - Steam Turbine - High Temperature Bolting Maintenance Practice. The Practice applies to the high-pressure outer casing, high-pressure inner casing, intermediate-pressure outer casing, intermediate-pressure inner casing, main stop valve cover, control valves, reheat stop valve covers, intercept valve covers, combined reheat valve covers, main and reheat steam leads.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

The increase in project cost from CI 42806 in 2015 is primarily due to the decrease in value of the Canadian dollar. CI 42806 used an exchange rate of $1.08 CDN/USD, while today's rate is $1.30 CDN/USD.

Summary of Related CIs +/- 2 years:
2015 CI 43094 LIN3 High Temperature Fastener Replacement $868,348

Depreciation Class: Steam Production Plant - Lingan Unit 3 and 4

Estimated Useful Life: 30 Years

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The function of the steam turbine high temperature bolting is to maintain a tight joint with no steam leakage into other sections of the turbine or into the plant. High pressure steam leaking from high-pressure joints is a critical safety issue and may require maintenance outages and costly repairs. Leaking joints within the steam turbine can result in steam bypassing portions of the intended steam path and a resultant loss of efficiency.

Why do this project now?

Based on the criteria mentioned above, these bolts are at the end of their service life and should be replaced during the planned major outage in 2016. Waiting until the next planned major outage would greatly increase the probability of fastener failure and the associated safety concerns.

Why do this project this way?

Replacing the bolts and studs is the only option to maintain the integrity of the steam turbine. Refurbishing these bolts and studs is not feasible as the integrity of the material cannot be re-established. Replacement with non-OEM parts is considered, but at this time, OEM parts are the most reliable and cost-effective option.

CI Number : 47755 - LIN4 Turbine High Temperature Fastners Replacement **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		12,397	0	12,397
095		095-Thermal Overtime Labour AO		2,984	0	2,984
095		095-Thermal Term Labour AO		11,961	0	11,961
095		095-Thermal Regular Labour AO		14,833	0	14,833
095		095-Thermal & Hydro Contracts AO		34,204	0	34,204
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	73,177	0	73,177
002	010	002 - THERMAL Overtime Labour	010 - SGP - Turbo Gen.Instal.	29,446	0	29,446
004	010	004 - THERMAL Term Labour	010 - SGP - Turbo Gen.Instal.	59,010	0	59,010
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	[redacted]	0	[redacted]
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	335,000	0	335,000
028	010	028 - Consulting	010 - SGP - Turbo Gen.Instal.	[redacted]	0	[redacted]
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	70,260	0	70,260
			Total Cost:	1,073,877	0	1,073,877
			Original Cost:	364,745		

Capital Project Detailed Estimate

Location: Steam
CI# : 47755
Title: LIN4 Turbine HT Fasteners Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Engineering	PD	10	$ 405	$ 3,974		
Maintenance Trades	PD	151	$ 365	$ 55,076		
Utilityworker	PD	59	$ 240	$ 14,128		
			Sub-Total	$ 73,177		
002 OT Labour						
Maintenance Trades	PD	27	$ 730	$ 20,028		
Utilityworker	PD	20	$ 480	$ 9,419		
			Sub-Total	$ 29,446		
004 Term Labour						
Maintenance Trades	PD	162	$ 365	$ 59,010		
			Sub-Total	$ 59,010		
012 Materials						
Replacement Fasteners	Lot	1	[redacted]		Cost Support #1	
Miscellaneous Materials & Consumables	Lot	1	15,000	$ 15,000		43094
Hydraulic Positioners	Lot	1	8,000	$ 8,000		
UH Taps and Thread Chasers	Lot	1	15,000	$ 15,000		
			Sub-Total	[redacted]		
013 Contracts						
OEM Tech. Advisor Support	Lot	1	100,000	$ 100,000		43094
USD to CDN Exchange	%	25%	100,000	$ 25,000		
Fastener Removal	Lot	1	150,000	$ 150,000		43094
Bolting Heating	Lot	1	60,000	$ 60,000		43094
			Sub-Total	$ 335,000		
028 Consulting						
Project Management	Lot	1	[redacted]			
			Sub-Total	[redacted]		
066 Other Goods & Services						
Contingency	%	10%	$ 702,604	$ 70,260		
			Sub-Total	$ 70,260		
094 Interest Capitalized						
				$ 12,397		
			Sub-Total	$ 12,397		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 14,833		
Thermal OT Labour AO				$ 2,984		
Thermal Term Labour AO				$ 11,961		
Thermal / Hydro Contracts AO				$ 34,204		
			Sub-Total	$ 63,982		
			SUB-TOTAL (no AO, AFUDC)	$ 997,498		
			TOTAL (AO, AFUDC included)	$ 1,073,877		
Original Cost				$ 364,745		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Turbine HT Fasteners Replacement
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan GS	**CI Number:**	47755
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Fasteners vs Replacement En	6.11%	-2,498,566	1,791,229	1	31.68%	5.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to maintain integrity of the HT fastners on the turbine.

Notes/Comments :

Replace Fasteners vs Replacement Energy & Repair Costs

If a high temperature fastener fails the unit will have to come offline to replace that fastener. It is estimated that if a fastener fails it would take approximately 3 weeks to get a replacement bolt and remove the old and install the new one.

Test 2

Test 3

Test 4

LIN4 Turbine HT Fasteners Replacement
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan GS	**CI Number:**	47755
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Fasteners vs Replacement Energy & Re	6.11%	-2,498,566	1,791,229	1	31.68%	5.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Fasteners vs Replacement Energy & Re	10%	-2,400,792	1,713,021	1	28.88%	5.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:						
	A	97,774	-78,208	0	-2.79%	0.4 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace Fasteners vs Replacement Energy & Re	-10%	-2,150,935	1,533,898	1	28.60%	5.5 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:						
	A	347,631	-257,331	0	-3.08%	0.4 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	131,418	280,369	468,531	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 Turbine HT Fasteners Replacement
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan GS	CI Number:	47755
Originator :		Project No. :	

Replace Fasteners vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			206,000	214,304		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	60%	50%	60%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	504	504				
Totals	$37,920	$80,791	$103,000	$128,583	$140,920	$209,373
Total Capital Cost of Alternative						$1,073,877

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

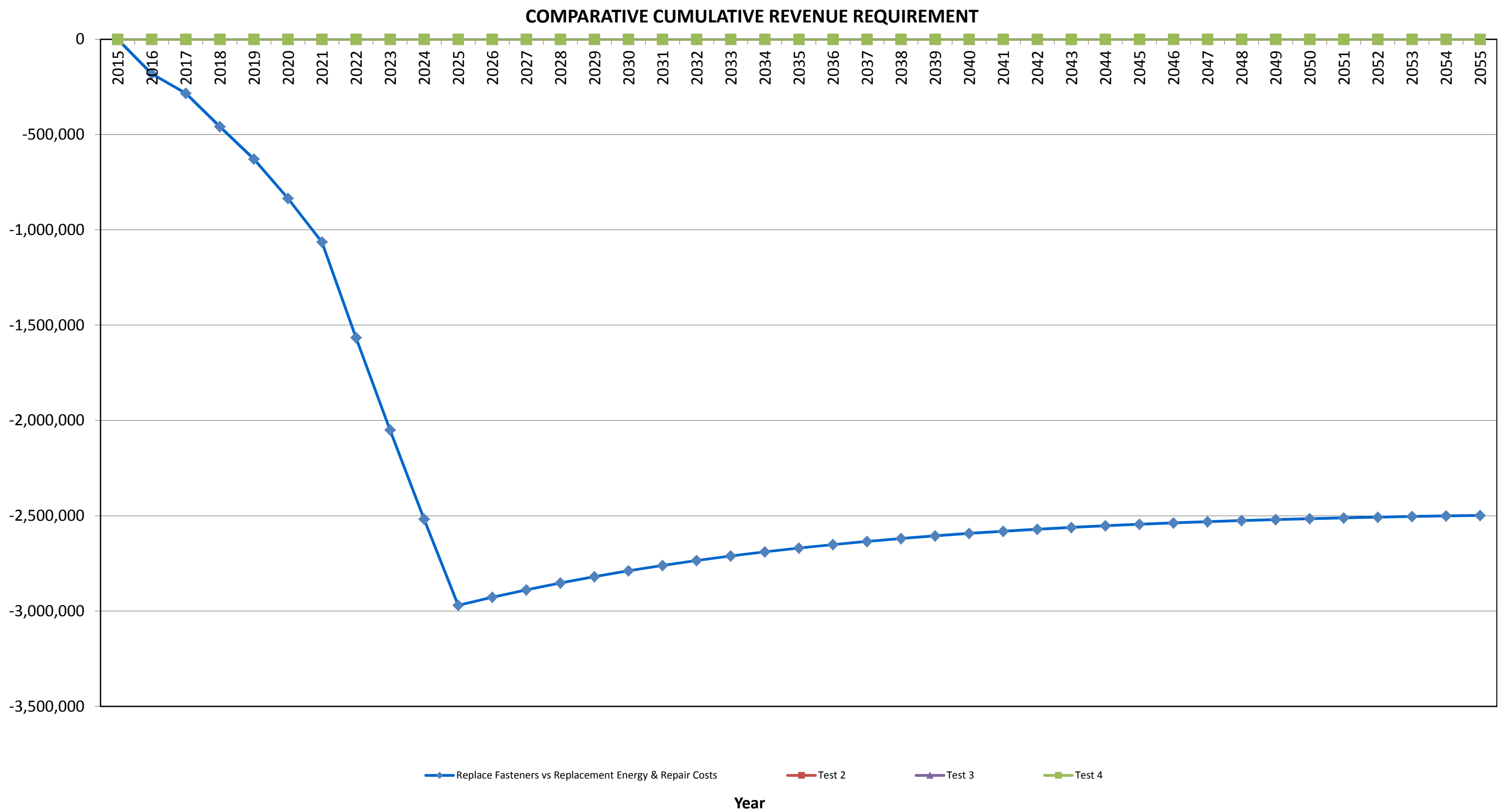
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Turbine HT Fasteners Replacement
Replace Fasteners vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	140,919.6	(1,009,894.6)	39,899.9	975,256.8	(868,974.9)	(31,316.1)	(900,291.1)	(848,450.7)	0.94	(848,450.7)
2017	-	-	209,373.5	-	76,607.8	895,700.7	209,373.5	(41,157.4)	168,216.1	149,401.5	0.89	(699,049.2)
2018	-	-	307,325.7	-	70,479.2	822,509.0	307,325.7	(73,422.4)	233,903.3	195,779.6	0.84	(503,269.7)
2019	-	-	318,062.3	-	64,840.9	755,172.7	318,062.3	(78,498.7)	239,563.7	188,971.2	0.79	(314,298.4)
2020	-	-	385,151.7	-	59,653.6	693,223.4	385,151.7	(100,904.4)	284,247.3	211,307.4	0.74	(102,991.0)
2021	-	-	441,406.4	-	54,881.3	636,229.9	441,406.4	(119,822.8)	321,583.6	225,297.3	0.70	122,306.4
2022	-	-	910,666.3	-	50,490.8	583,796.0	910,666.3	(266,654.4)	644,011.9	425,206.3	0.66	547,512.7
2023	-	-	939,488.0	-	46,451.5	535,556.7	939,488.0	(276,841.3)	662,646.7	412,317.3	0.62	959,829.9
2024	-	-	969,313.9	-	42,735.4	491,176.6	969,313.9	(287,239.3)	682,074.6	399,967.8	0.59	1,359,797.7
2025	-	-	1,000,181.1	-	39,316.6	450,346.9	1,000,181.1	(297,868.0)	702,313.1	388,121.4	0.55	1,747,919.2
2026	-	-	-	-	36,171.3	412,783.6	-	11,213.1	11,213.1	5,839.9	0.52	1,753,759.1
2027	-	-	-	-	33,277.6	378,225.3	-	10,316.0	10,316.0	5,063.3	0.49	1,758,822.4
2028	-	-	-	-	30,615.3	346,431.7	-	9,490.8	9,490.8	4,390.0	0.46	1,763,212.5
2029	-	-	-	-	28,166.1	317,181.6	-	8,731.5	8,731.5	3,806.3	0.44	1,767,018.7
2030	-	-	-	-	25,912.8	290,271.5	-	8,033.0	8,033.0	3,300.1	0.41	1,770,318.9
2031	-	-	-	-	23,839.8	265,514.2	-	7,390.3	7,390.3	2,861.3	0.39	1,773,180.2
2032	-	-	-	-	21,932.6	242,737.5	-	6,799.1	6,799.1	2,480.8	0.36	1,775,661.0
2033	-	-	-	-	20,178.0	221,782.9	-	6,255.2	6,255.2	2,150.9	0.34	1,777,811.9
2034	-	-	-	-	18,563.8	202,504.7	-	5,754.8	5,754.8	1,864.9	0.32	1,779,676.8
2035	-	-	-	-	17,078.7	184,768.8	-	5,294.4	5,294.4	1,616.9	0.31	1,781,293.8
2036	-	-	-	-	15,712.4	168,451.7	-	4,870.8	4,870.8	1,401.9	0.29	1,782,695.7
2037	-	-	-	-	14,455.4	153,440.0	-	4,481.2	4,481.2	1,215.5	0.27	1,783,911.2
2038	-	-	-	-	13,299.0	139,629.2	-	4,122.7	4,122.7	1,053.9	0.26	1,784,965.0
2039	-	-	-	-	12,235.0	126,923.3	-	3,792.9	3,792.9	913.7	0.24	1,785,878.7
2040	-	-	-	-	11,256.2	115,233.9	-	3,489.4	3,489.4	792.2	0.23	1,786,671.0
2041	-	-	-	-	10,355.7	104,479.6	-	3,210.3	3,210.3	686.9	0.21	1,787,357.8
2042	-	-	-	-	9,527.3	94,585.7	-	2,953.5	2,953.5	595.5	0.20	1,787,953.4
2043	-	-	-	-	8,765.1	85,483.2	-	2,717.2	2,717.2	516.3	0.19	1,788,469.7
2044	-	-	-	-	8,063.9	77,109.0	-	2,499.8	2,499.8	447.7	0.18	1,788,917.4
2045	-	-	-	-	7,418.8	69,404.7	-	2,299.8	2,299.8	388.2	0.17	1,789,305.6
2046	-	-	-	-	6,825.3	62,316.8	-	2,115.8	2,115.8	336.5	0.16	1,789,642.1
2047	-	-	-	-	6,279.3	55,795.8	-	1,946.6	1,946.6	291.8	0.15	1,789,933.9
2048	-	-	-	-	5,776.9	49,796.6	-	1,790.8	1,790.8	253.0	0.14	1,790,186.9
2049	-	-	-	-	5,314.8	44,277.3	-	1,647.6	1,647.6	219.3	0.13	1,790,406.2
2050	-	-	-	-	4,889.6	39,199.5	-	1,515.8	1,515.8	190.2	0.13	1,790,596.4
2051	-	-	-	-	4,498.4	34,528.0	-	1,394.5	1,394.5	164.9	0.12	1,790,761.3
2052	-	-	-	-	4,138.5	30,230.2	-	1,282.9	1,282.9	143.0	0.11	1,790,904.3
2053	-	-	-	-	3,807.5	26,276.2	-	1,180.3	1,180.3	124.0	0.11	1,791,028.2
2054	-	-	-	-	3,502.9	22,638.5	-	1,085.9	1,085.9	107.5	0.10	1,791,135.7
2055	-	-	-	-	3,222.6	19,291.9	-	999.0	999.0	93.2	0.09	1,791,228.9
Total	**-**	**-**	**5,621,888.6**	**(1,009,894.6)**	**960,437.4**		**4,611,994.1**	**(1,445,049.9)**	**3,166,944.2**	**1,791,228.9**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Replace Fasteners vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

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Hitachi Canada Ltd.
Power & Industry Division
Suite 460, 10655 Southport Road S.W.
Calgary, Alberta. T2W 4Y1
Tel: (403) 278-1881
Fax: (403) 278-1810

February 24, 2010

Nova Scotia Power Inc
Lingan Generating Station
1599 Hinchey Avenue
Lingan, Nova Scotia
B1H 5E6

Attention: Anita Clark

Subject: Your Request for Quotation: Turbine HT Fastners
Hitachi Canada Ltd. Quotation No: 10-0017-01 – Rev 1

Anita,

We thank you for allowing us this opportunity to provide our quotation in response to the above referenced Request for Quotation. Our offered prices are as shown on the attached sheet. We ask that you please take note of the remarks section that forms part of our quotation.

We trust that this will meet your requirements and look forward to receiving your purchase order for the quoted items. In the meantime should you wish to discuss any technical or commercial aspects of our quotation or if we may be of assistance to you in any other way please don't hesitate to contact our office.

Best regards,

Brad Kuhne
Plant Services Manager
Hitachi Canada Ltd.
Power & Industrial Division

Encl:

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Hitachi Canada Ltd.

Spare Parts and/or Services for Nova Scotia Power Inc. Lingan Generating Station
Hitachi Canada Ltd. Quotation 10-0017-01 – Rev 1

Item No.	Qty	U/M	Part Description	Assembly Description	Part No.	DDP Site Unit Price	DDP Site Total Price
1	24	EA	Stud, 2", L=411	Main Steam Flange	[redacted]	[redacted]	[redacted]
2	48	EA	Nut, 2"	Main Steam Flange	[redacted]	[redacted]	[redacted]
3	48	EA	Washer, 2"	Main Steam Flange	[redacted]	[redacted]	[redacted]
4	48	EA	Stud, 1 3/4", L=214	Control Valve	[redacted]	[redacted]	[redacted]
5	48	EA	Nut, 1 3/4"	Control Valve	[redacted]	[redacted]	[redacted]
6	16	EA	Stud, 3 1/2", L=505	Main Stop Valve	[redacted]	[redacted]	[redacted]
7	16	EA	Nut, 3 1/2", Copper Plated	Main Stop Valve	[redacted]	[redacted]	[redacted]
8	44	EA	Stud, 3", L=425	Combined Reheat Valve	[redacted]	[redacted]	[redacted]
9	44	EA	Nut, 3", Copper Plated	Combined Reheat Valve	[redacted]	[redacted]	[redacted]
10	44	EA	Washer, 3"	Combined Reheat Valve	[redacted]	[redacted]	[redacted]
11	8	EA	Stud, #65-72, 4", L=671	HPIC	[redacted]	[redacted]	[redacted]
12	8	EA	Nut, 4", Copper Plated	HPIC	[redacted]	[redacted]	[redacted]
13	8	EA	Washer, 4"	HPIC	[redacted]	[redacted]	[redacted]
14	4	EA	Stud, #73-76, 3 1/2", L=651	HPIC	[redacted]	[redacted]	[redacted]
15	4	EA	Nut, 3 1/2", Copper Plated	HPIC	[redacted]	[redacted]	[redacted]
16	4	EA	Washer, 3 1/2"	HPIC	[redacted]	[redacted]	[redacted]
17	2	EA	Stud, #77-78, 2", L=351	IPIC	[redacted]	[redacted]	[redacted]
18	2	EA	Nut, 2"	IPIC	[redacted]	[redacted]	[redacted]
19	2	EA	Washer, 2"	IPIC	[redacted]	[redacted]	[redacted]
20	1	Lot	Reverse Engineering Fee	Turbine HT Fasteners		[redacted]	[redacted]
21	5	EA	Stud, #19,21-24, 5", L=1091	HIPOC	[redacted]	[redacted]	[redacted]
22	10	EA	Nut, 5", Copper Plated	HIPOC	[redacted]	[redacted]	[redacted]
23	10	EA	Washer, 5"	HIPOC	[redacted]	[redacted]	[redacted]
24	1	EA	Stud, #20, 5", L=1091	HIPOC	[redacted]	[redacted]	[redacted]
25	2	EA	Nut, 5", Copper Plated	HIPOC	[redacted]	[redacted]	[redacted]
26	2	EA	Washer, 5"	HIPOC	[redacted]	[redacted]	[redacted]
						Total	[redacted]

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Hitachi Canada Ltd.

Please take note of the following remarks that form part of our offer.

1) G.S.T. and any applicable Provincial Sales tax not included.
2) Terms: Net 30 days.
3) Validity: This quotation is valid until May 17, 2010
4) Delivery/Schedule: Delivery is estimated at 10 Weeks after receipt of acceptable purchase order and receipt of parts to be reverse engineered.
   Delivery is subject to availability of material and resources at time of order.
   Delivery is to be confirmed after receipt of order.
5) Packing will be standard export packing suitable for ocean/ground/air transportation.
6) Inspection: Manufacturer's inspection prior to shipment shall be final.
7) In the event of placement of a partial order only, prices quoted may be subject to change.
8) Items to be manufactured to customer instruction, reverse engineering information, and approved drawings with the indicated materials.
9) Customer must accept the terms provided as attached. The customer and Hitachi negotiate mutually acceptable terms at a later date.
10) [redacted]
11) This revision 1 was created to provide revised pricing for items 20 ~ 26 and to add the note in the part description of items 22, 23, and 24.

CI Number: 47911

Title: TUC1 High Temperature Fasteners Replacement

Start Date: 2016/03
In-Service Date: 2016/04
Final Cost Date: 2016/10
Function: Steam
Forecast Amount: $828,968

DESCRIPTION:

This project is to replace steam turbine high temperature fasteners (bolts and studs) to maintain the integrity of the Tufts Cove Unit 1 steam turbine for continued safe and efficient operation. These fasteners provide the clamping force to hold turbine covers tightly in place during operation. The basic criteria for evaluating the consumed life for steam turbine high-temperature bolts are the material, number of times the bolts have been tightened, number of unit start/stop cycles, running hours, bolt operating temperature and critical maintenance data. Evaluation of TUC1 high temperature fasteners using Original Equipment Manufacturer (OEM) criteria indicates that these fasteners are now at the end of their service life and must be replaced.

Tufts Cove Unit1 has accumulated approximately 255,000 hours and 440 starts since commissioning in 1965.

High Temperature Fasteners are monitored for life cycle maintenance as described in NS Power's Thermal Maintenance Practice (TMP) #034 - Steam Turbine - High Temperature Bolting Maintenance Practice. The Practice applies to the high-pressure outer casing, high-pressure inner casing, intermediate-pressure outer casing, intermediate-pressure inner casing, main stop valve cover, control valves, reheat stop valve covers, intercept valve covers, combined reheat valve covers, main and reheat steam leads.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The function of the steam turbine high temperature bolting is to maintain a tight joint with no steam leakage into other sections of the turbine or into the plant. High pressure steam (up to 12.41 MPa at 538 degrees Celsius) leaking from high-pressure joints is a critical safety risk and may require maintenance outages and costly repairs. Leaking joints within the steam turbine can result in steam bypassing portions of the intended steam path and a resultant loss of efficiency.

Why do this project now?

Based on the criteria mentioned above, these bolts are at the end of their service life and should be replaced during the planned outage in 2016. Waiting until the next planned major outage would increase the probability of fastener failure and the associated safety concerns.

Why do this project this way?

Replacing the bolts and studs is the only option to maintain the integrity of the steam turbine. Refurbishing these bolts and studs is not feasible as the integrity of the material cannot be re-established. Replacement with non-OEM parts was considered, but at this time, OEM parts are the most reliable.

CI Number : 47911 - TUC1 High Temperature Fastener Replacement **Project Number**

Parent CI Number : -

Cost Centre : 317 - 317-TC Unit 1 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Overtime Labour AO		2,462	0	2,462
095		095-Thermal & Hydro Contracts AO		41,735	0	41,735
095		095-Thermal Regular Labour AO		4,923	0	4,923
001	013	001 - THERMAL Regular Labour	013 - SGP - Boiler	24,289	0	24,289
002	013	002 - THERMAL Overtime Labour	013 - SGP - Boiler	24,289	0	24,289
012	013	012 - Materials	013 - SGP - Boiler	322,500	0	322,500
013	013	013 - POWER PRODUCTION Contracts	013 - SGP - Boiler	408,770	0	408,770
			Total Cost:	828,968	0	828,968
			Original Cost:	391,686		

Capital Project Detailed Estimate

Location: Steam
CI# : 47911
Title: TUC1 Turbine High Temperature Fasteners
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	60	$ 365	$ 21,887		
Utilityworker	PD	10	$ 240	$ 2,402		
			Sub-Total	$ 24,289		
002 OT Labour						
Maintenance Trades	PD	60	$ 365	$ 21,887		
Utilityworker	PD	10	$ 240	$ 2,402		
			Sub-Total	$ 24,289		
012 Materials						
High Pressure Inner Cylinder Hardware	Lot	1	$ 275,000	$ 275,000		43094
Int. Pressure Inner Cylinder Hardware	Lot	1	$ 37,500	$ 37,500		
Misc. Consumables	Lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 322,500		
013 Contracts						
Technical Field Advisor	lot	1	$ 90,000	$ 90,000		
Millwrights	lot	1	$ 218,400	$ 218,400		43094
Trade Supervision	lot	1	$ 29,820	$ 29,820		
Machinest	lot	1	$ 2,730	$ 2,730		
Site Supervision	lot	1	$ 29,820	$ 29,820		
Insulation	lot	1	$ 26,000	$ 26,000		
Scaffolding	lot	1	$ 12,000	$ 12,000		
			Sub-Total	$ 408,770		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 4,923		
Thermal OT Labour AO				$ 2,462		
Thermal / Hydro Contracts AO				$ 41,735		
			Sub-Total	$ 49,120		
			SUB-TOTAL (no AO, AFUDC)	$ 779,848		
			TOTAL (AO, AFUDC included)	$ 828,968		
Original Cost				$ 391,686		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

NOVA SCOTIA POWER INC. THERMAL PLANT MAINTENANCE PRACTICES	Practice No.:	TMP - 034
	Issue Date:	December 2008
STEAM TURBINE- HIGH TEMPERATURE BOLTING MAINTENANCE	Revision Date:	
	Revision No.:	0
Related Practices:	File No:	

INTRODUCTION:

The inspection, testing and replacement of Steam Turbine High Temperature Bolting (bolts and studs) ensure the integrity of the Steam Turbine for continued safe operation. It is essential to know the condition of the existing bolting and to anticipate the replacement of bolting that do not meet criteria for continued service. To accomplish the condition assessment the recording of each High Temperature Bolt's effective operating hours and maintenance history is required.

There are many bolts and studs used in a Steam Turbine. The function of the bolting is to maintain a tight

WORK DESCRIPTION:

This practice is the basis for managing the replacement of Steam Turbine High Temperature Bolting due to material age degradation and consumption of service life.

This practice applies to High Temperature Bolting, with an operating temperature greater than 345C, used on the Steam Turbine.
Locations of the bolting covered include: High Pressure Outer Casing, High Pressure Inner Casing, Intermediate Pressure Outer Casing, Intermediate Pressure Inner Casing, Main Stop Valve Cover, Control Valves, Reheat Stop Valve Covers, Intercept Valve Covers, Combined Reheat Valve Covers, Main and Reheat Steam Leads
joint with no steam leakage into the plant. Steam leaking from high-pressure joints may require maintenance outages and costly repairs. Unlike many plant applications, bolting used in Steam Turbine applications is often required to be slackened and retightened after periods of service to allow for component maintenance.

Steam Turbine High Temperature Bolting Maintenance Requirement:

The basic requirements for tracking Steam Turbine High Temperature Bolt consumed life are the number of tightenings, number of unit start/ stop cycles, running hours, bolt operating temperature and critical maintenance data.

The station maintenance personnel facilitate the information management required to track the operating hours, start-stop cycles, tightening events and other critical data that make up the running history of each individual High Temperature Bolt.

The maintenance crews are to report all activities, including stripped threads, bolts removed, damaged bolts, tightening events, application of thermocouples, etc.

Each individual High Temperature Bolt is identified and is returned to its original location at assembly.

	APPROVED:				
PREPARED BY: Greg Carlin	Phil Zinck	Mark Sidebottom	Mark Savory		

Supplementary Maintenance Activities:

The Actual life achieved will depend on the tightening procedure, the operating conditions, the quality of the original bolt material and the fabrication procedures used. Although the highest operating lives will be obtained with careful checks of all the important variables, in practice there will always be some uncertainty regarding actual performance. In many cases, bolts will be subjected to some non-destructive/ destructive inspections during scheduled maintenance outages to check for evidence of distress.
These supplementary inspections will typically consist of the following:

- Hammer test before disassembly (always)
- Inspection for evidence of steam leakage after disassembly of component joint (always)
- Visual inspection for defects of the bolt (always)
- Non Destructive Testing of bolt for cracks (Ultrasonic,Magnetic Particle, or Dye Penetrant)
- Hardness measurement of bolt
- Dimensional Inspection of outside diameters of shank, thread.
- Dimensional inspection of Inside diameters of nut or tapped hole
- Dimensional Stud wobble/Lean inspection
- Dimensional Inspection of Stud length
- Metallurgical inspection (Hardness and Replication)
- Destructive testing for Material Property examination (Tensile strength, yield strength, expansion, reduction of area, impact value

CI Number: 46465

Title: TUC2 Turbine Valve Refurbishments

Start Date: 2016/10
In-Service Date: 2016/11
Final Cost Date: 2017/05
Function: Steam
Forecast Amount: $651,362

DESCRIPTION:

This project is for the component replacement on the Turbine Main Steam Emergency Stop and Governor valves and the Reheat Steam Emergency Stop and Governor valves. Scope will include replacement/refurbishment of valve stems and bushings, hydraulic valves and control oil pressure regulator.

Summary of Related CIs +/- 2 years:
2015 CI 46473 Tufts Cove Unit3 Turbine Valve Refurbishments 2015 $609,870
2015 CI 46464 Tufts Cove Unit1 Turbine Valve Refurbishments 2015 $541,162

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The primary function of the Governor Valves is to regulate the steam flow to the turbine, and thus control the power output of the steam turbine generator. The Emergency Stop Valves (ESVs) interrupt the steam flow promptly during an emergency trip and cut off the steam supply when the unit is shut down. All these valves are critical components of the steam turbine. Their functionality and reliability are crucial to the safe operation of the unit. Preventative Maintenance Inspections, as part of Fleet Equipment reliability strategies, have identified components that are out of tolerance and recommended for replacement by the OEM.

Why do this project now?

Completing this project as part of the 2016 planned outage will mitigate the risk of unplanned outages to address possible valve failures, likely to occur by operating the unit with the out of tolerance (physical dimensions have worn past OEM standards) components. A valve failure could include a small component failure that could be repaired in an approximately one week outage. Further to this type of failure, a failure of the turbine valves could also lead to a potential over-speed event which NS Power does not consider an acceptable outcome. An over-speed event would include significant damage to the turbine and possible other plant equipment. It also would put NS Power personnel's safety at risk.

Why do this project this way?

The refurbishment work is recommended by the Original Equipment Manufacturer (OEM), and is in accordance with their best practices and consistent with NS Power practice. Total valve replacement is another alternative, but is a much more costly option and not considered necessary at this time.

CI Number : 46465 - TUC2 Turbine Valve Refurbishment **Project Number**

Parent CI Number : -

Cost Centre : 318 - 318-TC Unit 2 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		6,034	0	6,034
095		095-Thermal & Hydro Contracts AO		24,767	0	24,767
095		095-Thermal Overtime Labour AO		739	0	739
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	29,768	0	29,768
002	010	002 - THERMAL Overtime Labour	010 - SGP - Turbo Gen.Instal.	7,296	0	7,296
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	291,564	0	291,564
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	242,580	0	242,580
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	48,614	0	48,614
			Total Cost:	651,362	0	651,362
			Original Cost:	582,753		

Capital Project Detailed Estimate

Location: Steam
CI# : 46465
Title: TUC2 Turbine Valve Refurbishments
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	3	$ 358	$ 1,075		
Engineering	PD	20	$ 405	$ 8,106		
Maintenance Trades	PD	50	$ 365	$ 18,239		
Power Plant Technician	PD	3	$ 382	$ 1,146		
Utilityworker	PD	5	$ 240	$ 1,201		
			Sub-Total	$ 29,767		46473
002 OT Labour						
Maintenance Trades	PD	20	$ 365	$ 7,296		
			Sub-Total	$ 7,296		
012 Materials						
Valve Components	lot	1	$ 276,564	$ 276,564		46473
Misc Materials/Consumables	lot	1	$ 15,000	$ 15,000		
			Sub-Total	$ 291,564		
013 Contracts						
Technical Field Advisor & Report	lot	1	$ 111,200	$ 111,200		46473
Millwright Support	lot	1	$ 98,380	$ 98,380		
Valve NDE Services	lot	1	$ 15,000	$ 15,000		
Scaffolding Services	lot	1	$ 8,000	$ 8,000		
Insulation Services	lot	1	$ 10,000	$ 10,000		
				$ -		
				$ -		
			Sub-Total	$ 242,580		
066 Other Goods & Services						
Contingency - Valve Components	%	10%	$ 276,564	$ 27,656		
Contingency - Tech Advisor / Millwright	%	10%	$ 209,580	$ 20,958		
			Sub-Total	$ 48,614		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 6,034		
Thermal OT Labour AO				$ 739		
Thermal / Hydro Contracts AO				$ 24,767		
			Sub-Total	$ 31,541		
			SUB-TOTAL (no AO, AFUDC)	$ 619,822		
			TOTAL (AO, AFUDC included)	$ 651,362		
Original Cost				$ 582,753		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48018

Title: TUC1 HP/IP Turbine Blading Replacement

Start Date:	2016/03
In-Service Date:	2016/04
Final Cost Date:	2016/10
Function:	Steam
Forecast Amount:	$1,137,208

DESCRIPTION:

This project includes the replacement of Tuft's Cove Unit #1 high pressure (HP) and intermediate pressure (IP) turbine blades. Based on hours of operation and health assessment supported by independent industry experts, Row4R of the HP turbine and Row2R of the IP turbine has been identified for replacement. These blades are subject to creep, shroud lifting and solid particle erosion, an industry phenomenon, originating from spalling metallic oxide deposits that travel in the steam path at high velocities to the higher pressure sections of the turbine. These are typical aging mechanisms for Turbine Blades that need to be monitored to forecast plan blade replacement. As an example, Tuft's Cove Unit #1 has accumulated approximately 255,000 hours and 440 starts since commissioning in 1965.

Summary of Related CIs +/- 2 years:
2014 CI 45816 TUC3 U&U Turbine Blade Replace Ph2 $1,150,115

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Estimated Useful Life: 25 years

Depreciation Class: Tuft's Cove Unit #1

Why do this project?

The risks identified with this row of IP Turbine Blades were through NS Power's Turbine Health Assessment process which is a feature of NS Power's Asset Management practices. Replacing this row of blades is required for ongoing reliable operation of Tuft's Cove Unit #1 and will mitigate the risk of an unplanned outage due to blade failure and the associated component damage. Tuft's Cove Unit #1 is expected to continue operation well into the future, and this project will support its operation.

Why do this project now?

Tufts Cove Unit #1 has accumulated approximately 255,000 hours and 440 starts since commissioning in 1965. Risk assessments suggest that the condition of the blades has deteriorated to the point where replacement is necessary.

Why do this project this way?

Replacement of these blades is considered the only feasible option as refurbishment would not provide the same level of reliability and could lead to replacement being required in the near future regardless of refurbishment being completed in 2016. Replacement of these blades, as opposed to refurbishment, is standard industry practice.

CI Number : 48018 - TUC1 IP HP Turbine Blading Refurbishments **Project Number**

Parent CI Number : -

Cost Centre : 317 - 317-TC Unit 1 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		5,328	0	5,328
095		095-Thermal Overtime Labour AO		2,359	0	2,359
095		095-Thermal & Hydro Contracts AO		56,625	0	56,625
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	26,283	0	26,283
002	010	002 - THERMAL Overtime Labour	010 - SGP - Turbo Gen.Instal.	23,274	0	23,274
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	420,000	0	420,000
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	554,608	0	554,608
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	48,730	0	48,730
			Total Cost:	1,137,208	0	1,137,208
			Original Cost:	453,643		

Capital Project Detailed Estimate

Location: Tufts Cove
CI# : 48018
Title: TUC1 HP / IP Blading Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	2	$ 358	$ 717		
Maintenance Trades	PD	36	$ 365	$ 13,132		
Maintenance Trades (Crane Operator)	PD	12	$ 365	$ 4,377		
Power Plant Technician	PD	6	$ 382	$ 2,293		
Utilityworker	PD	24	$ 240	$ 5,764		
			Sub-Total	$ 26,283		
002 OT Labour						
Maintenance Trades	PD	18	$ 730	$ 13,132		
Utilityworker	PD	12	$ 480	$ 5,764		
Maintenance Trades (Crane Operator)	PD	6	$ 730	$ 4,377		
				$ -		
			Sub-Total	$ 23,274		
012 Materials						
Blading & Fixings	LOT	2	$ 200,000	$ 400,000	Quantity of 2 represents one for HP and one for IP Turbine	45816
Misc. Consumables	LOT	2	$ 10,000	$ 20,000		
				$ -		
			Sub-Total	$ 420,000		
013 Contracts						
Technical Advisor During Construction	LOT	2	$ 56,000	$ 112,000		
Engineering Support	LOT	2	$ 14,000	$ 28,000		
Grinding Trade Support	LOT	2	$ 65,520	$ 131,040		
Trade Supervision	LOT	2	$ 8,946	$ 17,892		
Grinding - Machinest	LOT	2	$ 1,092	$ 2,184		
Construction Management	LOT	2	$ 8,946	$ 17,892		
Scaffolding	LOT	2	$ 4,800	$ 9,600		
Bladers / Specialty Service	LOT	2	$ 80,000	$ 160,000		
Enclosure for Sandblasting	LOT	2	$ 2,000	$ 4,000		
Sandblasting Services	LOT	2	$ 10,000	$ 20,000		
Remote Inspections	LOT	2	$ 2,000	$ 4,000		
Balance Engineer & Equipment	LOT	2	$ 24,000	$ 48,000		
				$ -		
			Sub-Total	$ 554,608		
066 Other Goods & Services						
Contingency	%	5%	$ 974,608	$ 48,730		
				$ -		
			Sub-Total	$ 48,730		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 5,328		
Thermal OT Labour AO				$ 2,359		
Thermal / Hydro Contracts AO				$ 56,625		
			Sub-Total	$ 64,312		
			SUB-TOTAL (no AO, AFUDC)	$ 1,072,896		
			TOTAL (AO, AFUDC included)	$ 1,137,208		
Original Cost				$ 453,643		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Generator

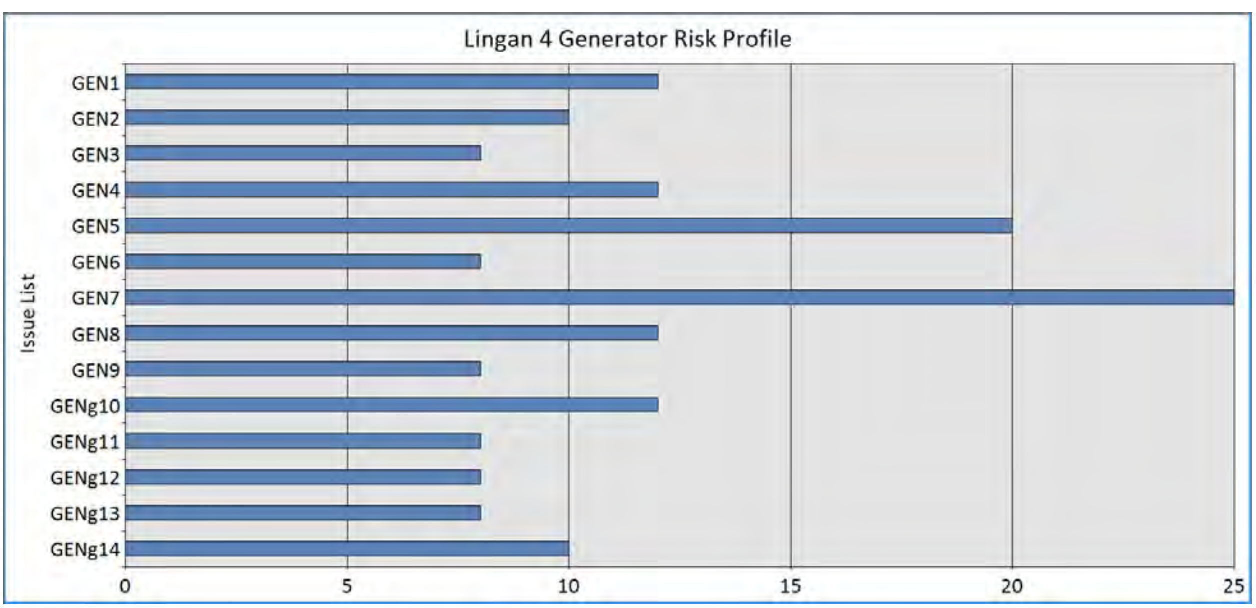
Electrical Generators

NS Power has a fleet of 13 electrical generators, ranging from 50MW to 185MW nominal rating. Generators are considered complex asset classes, as they are composed of an extremely heavy field rotor, both field and stator windings have insulation systems which are exposed to electromechanical and/or centrifugal stresses, are hydrogen cooled, and include bearing and lube systems

NS Power engages independent industry experts to support regular health assessments and risk profiles. Approximately 60 key condition areas are assessed and rated for each turbine and generator. (Generators are considered in the same Health Assessments as turbines as their maintenance intervals need to be considered together in order to optimize planned major outage scheduling.)

The graphic below illustrates a typical Generator risk profile (Lingan Unit #4 is illustrated as it has a planned major outage in 2016). Each unit has a similar risk profile developed on the 25 point scale from comprehensive assessments as detailed in the Generation Asset Management overview. Risks are considered for each turbine/generator set with the highest risks typically dictating the timing of the next planned major outage. Lower risk items are considered against their anticipated risk progression, compared to the next planned major outage to determine when the risk needs to be addressed.

Long term maintenance planning assumes an eight year interval between planned major outages. However, actual condition, operating history and anticipated unit utilization are used to optimize the actual planned major outage and associated capital investment.



CI Number: 47673

Title: LIN4 Generator Rotor Rewind

Start Date: 2015/12
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $2,602,159

DESCRIPTION:

This project includes rewinding the generator rotor, replacement of retaining rings, as well as repair of other generator inspection findings related to the generator rotor. Based on Generator Health Assessment and knowledge from previous refurbishments on Lingan Unit #1and Unit #3, Lingan Unit #4 rotor needs to be refurbished to remediate known failure mechanisms and provide reliable service to the next planned major outage.

A generator rotor failure would result in damage to the generator and an extended unplanned outage.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

The increase in project cost from CI 43088 in 2015 is primarily due to the decrease in value of the Canadian dollar. CI 42806 used an exchange rate of $1.08 CDN/USD, while today's rate is $1.30 CDN/USD. Rotor Rewind materials, before currency exchange, were higher than originally budgeted in CI 43088 and are forecasted as such in this project.

Summary of Related CIs +/- 2 years:
2015 CI 43088 LIN3 Generator Rotor Rewind $1,901,480

Depreciation Class: Steam Production Plant - Lingan Unit 3 and 4

Estimated Useful Life: 30 Years

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Rewinding the rotor will reduce the risk of a ground fault due to insulation and copper dusting migration. A generator outage due to a ground fault can create an unplanned outage of approximately 10 weeks. The rotor rewind will alleviate future copper dust formation and migration of mylar insulation.

Why do this project now?

A rotor rewind requires extraction of the rotor for factory refurbishment and testing. An outage window of 7-8 weeks is required. A major Unit 4 outage is planned for spring 2016 to allow the rewind work to occur as a planned activity, therefore avoiding unplanned forced outages due to equipment failure.

Why do this project this way?

Rewinding is common practice and has been completed successfully on Unit 1 in 2010 and Unit 3 in 2015. Rewinding will restore the rotor to full capability and mitigate mylar insulation migration and copper dusting issues. The refurbished rotor is expected to operate without further rewinds for more than 15 years. A new rotor is approximately twice the cost of a rewind and requires extensive lead time.

CI Number : 47673-SE63 - LIN4 Generator Rotor Rewind **Project Number** SE63

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		23,623	0	23,623
095		095-Thermal Overtime Labour AO		2,900	0	2,900
095		095-Thermal & Hydro Contracts AO		103,058	0	103,058
095		095-Thermal Term Labour AO		4,350	0	4,350
095		095-Thermal Regular Labour AO		21,419	0	21,419
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	105,671	0	105,671
002	010	002 - THERMAL Overtime Labour	010 - SGP - Turbo Gen.Instal.	28,611	0	28,611
004	010	004 - THERMAL Term Labour	010 - SGP - Turbo Gen.Instal.	21,458	0	21,458
011	010	011 - Travel Expense	010 - SGP - Turbo Gen.Instal.	16,000	0	16,000
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	[redacted]	0	[redacted]
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	[redacted]	0	[redacted]
015	010	015 - Frt, Post & Delivery	010 - SGP - Turbo Gen.Instal.	20,000	0	20,000
028	010	028 - Consulting	010 - SGP - Turbo Gen.Instal.	15,000	0	15,000
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	106,670	0	106,670
			Total Cost:	2,602,159	0	2,602,159
			Original Cost:	856,824		

Capital Project Detailed Estimate

Location: **Steam**
CI# : 47673
Title: LIN4 Generator Rotor Rewind
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	118	$ 358	$ 42,151		
Engineering	PD	39	$ 405	$ 15,894		
Maintenance Trades	PD	118	$ 365	$ 42,916		
Utilityworker	PD	20	$ 240	$ 4,709		
			Sub-Total	$ 105,671		CI 43088
002 OT Labour						
Maintenance Trades	PD	38	$ 744.16	$ 28,611		
				$ -		
			Sub-Total	$ 28,611		CI 43088
004 Term Labour						
Maintenance Trades	PD	59	$ 365	$ 21,458		
				$ -		
			Sub-Total	$ 21,458		CI 43088
011 Travel Expense						
Rotor Rewind Witness	$	2	$ 8,000	$ 16,000		
				$ -		
			Sub-Total	$ 16,000		
012 Materials						
1 Set of Retaining Rings	USD	1	[redacted]		Cost Support #3	
Rewind Materials	USD	1			Cost Support #2 - Page 4 - Item 5.1.1 - 5.1.3	
USD to CDN Exchange	%	30%				
Miscellaneous Materials	Lot	1	$ 15,000	$ 15,000		
			Sub-Total	[redacted]		
013 Contracts						
Rewind Services	USD	1	[redacted]		Cost Support #1 - Page 3 - Item 4.1.1	
OEM Technical Advisor	USD	1				
USD to CDN Exchange	%	30%				
			Sub-Total	[redacted]		
028 Consulting						
Project Management	$	1	$ 15,000	$ 15,000		
				$ -		
				$ -		
			Sub-Total	$ 15,000		
015 Freight						
Shipping	$	1	$ 20,000	$ 20,000		
				$ -		
			Sub-Total	$ 20,000		
066 Other Goods & Services						
Contingency	%	5%	$ 2,133,399	$ 106,670		
			Sub-Total	$ 106,670		
094 Interest Capitalized						
				$ 23,623		
				$ -		
			Sub-Total	$ 23,623		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 21,419		
Thermal OT Labour AO				$ 2,900		
Thermal Term Labour AO				$ 4,350		
Thermal / Hydro Contracts AO				$ 103,058		
			Sub-Total	$ 131,727		
			SUB-TOTAL (no AO, AFUDC)	$ 2,446,809		
			TOTAL (AO, AFUDC included)	$ 2,602,159		
Original Cost				$ 856,824		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Generator Rotor Rewind
Summary of Alternatives

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47673
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Rotor Rewind vs. Replacement Energy	6.11%	-1,421,790	861,947	1	15.16%	5.9 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to maintain reliaiblity of the unit and avoid a long unplanned outage in the case of a winding failure.

Notes/Comments :

Rotor Rewind vs. Replacement Energy & Repair Costs

If the rotor rewind isn't completed there is the potential for a winding failure, which could potentially damage more than the generating rotor, including the stator. This option assumes if a winding fails and the unit can be repaired, return to service would take 8 to 10 weeks.

Test 2

Test 3

Test 4

LIN4 Generator Rotor Rewind
Summary of Sensitivities

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47673
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Rotor Rewind vs. Replacement Energy & Repair (	6.11%	-1,421,790	861,947	1	15.16%	5.9 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Rotor Rewind vs. Replacement Energy & Repair (	10%	-1,181,662	670,747	1	12.53%	6.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	240,128	-191,200	0	-2.63%	0.5 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Rotor Rewind vs. Replacement Energy & Repair (	-10%	-1,039,483	584,553	1	12.27%	6.4 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	382,307	-277,394	0	-2.90%	0.5 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	282,950	617,501	1,051,294	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 Generator Rotor Rewind
Avoided Cost Calculations

Nova Scotia POWER
An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47673
Originator :		**Project No. :**	

Rotor Rewind vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			809,120	833,455		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	30%	40%	30%	40%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	1344	1344				
Totals	$60,671	$143,628	$242,736	$333,382	$303,407	$477,010
Total Capital Cost of Alternative						$2,602,159

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

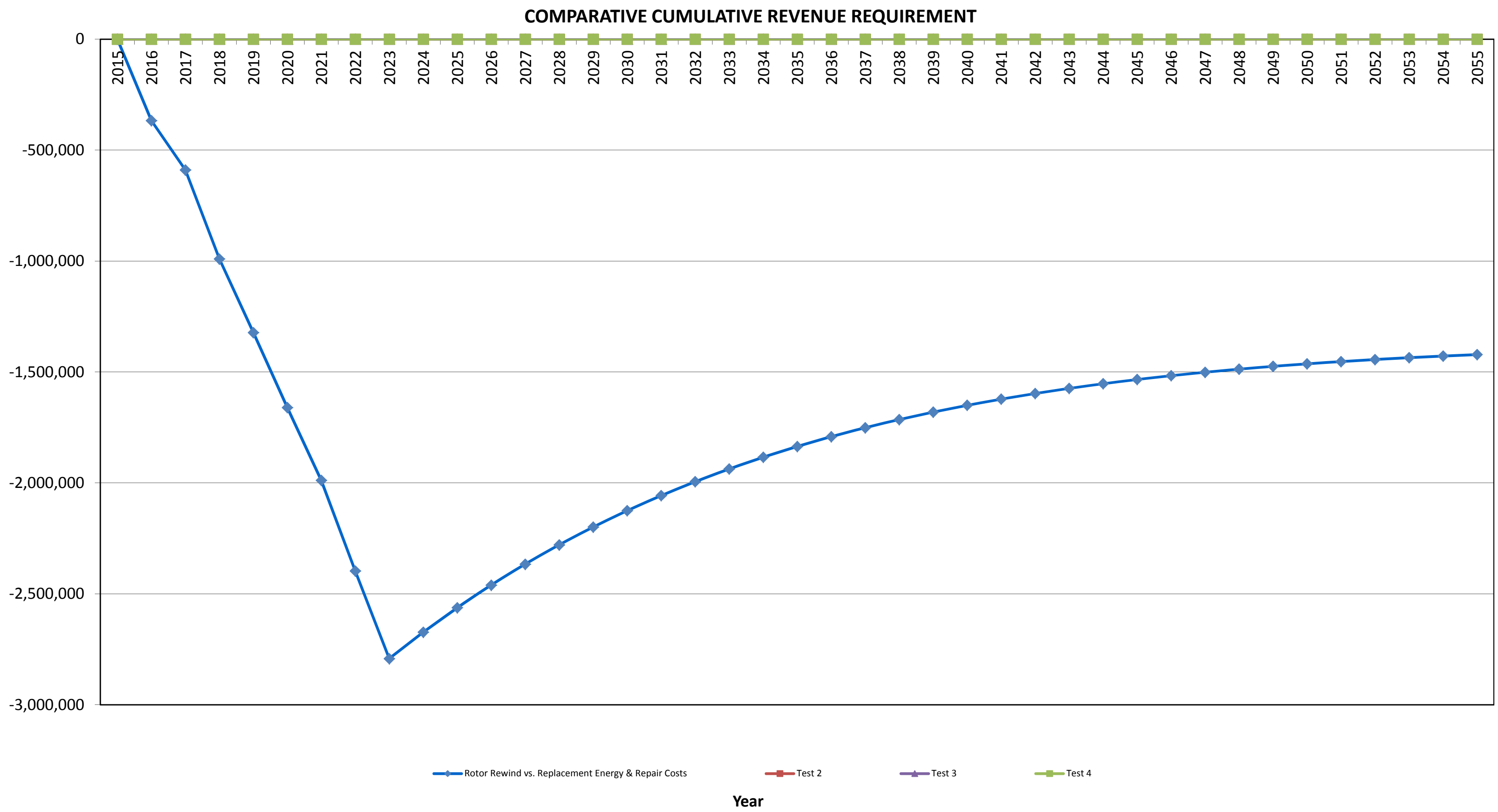
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Generator Rotor Rewind
Rotor Rewind vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	303,407.4	(2,470,431.9)	97,872.3	2,385,293.0	(2,167,024.5)	(63,715.9)	(2,230,740.4)	(2,102,290.4)	0.94	(2,102,290.4)
2017	-	-	477,010.3	-	187,914.9	2,191,308.1	477,010.3	(89,619.6)	387,390.7	344,061.9	0.89	(1,758,228.5)
2018	-	-	717,385.5	-	172,881.7	2,012,842.0	717,385.5	(168,796.2)	548,589.3	459,175.2	0.84	(1,299,053.3)
2019	-	-	663,034.6	-	159,051.2	1,848,653.2	663,034.6	(156,234.9)	506,799.7	399,770.8	0.79	(899,282.5)
2020	-	-	704,358.4	-	146,327.1	1,697,599.5	704,358.4	(172,989.7)	531,368.7	395,015.8	0.74	(504,266.7)
2021	-	-	723,035.1	-	134,620.9	1,558,630.1	723,035.1	(182,408.4)	540,626.7	378,756.1	0.70	(125,510.6)
2022	-	-	890,668.1	-	123,851.2	1,430,778.2	890,668.1	(237,713.2)	652,954.9	431,110.9	0.66	305,600.2
2023	-	-	914,325.2	-	113,943.1	1,313,154.5	914,325.2	(248,118.4)	666,206.7	414,532.4	0.62	720,132.7
2024	-	-	-	-	104,827.7	1,204,940.7	-	32,496.6	32,496.6	19,056.0	0.59	739,188.6
2025	-	-	-	-	96,441.5	1,105,384.0	-	29,896.9	29,896.9	16,522.0	0.55	755,710.6
2026	-	-	-	-	88,726.2	1,013,791.9	-	27,505.1	27,505.1	14,325.0	0.52	770,035.6
2027	-	-	-	-	81,628.1	929,527.1	-	25,304.7	25,304.7	12,420.1	0.49	782,455.7
2028	-	-	-	-	75,097.8	852,003.5	-	23,280.3	23,280.3	10,768.5	0.46	793,224.3
2029	-	-	-	-	69,090.0	780,681.7	-	21,417.9	21,417.9	9,336.6	0.44	802,560.8
2030	-	-	-	-	63,562.8	715,065.8	-	19,704.5	19,704.5	8,095.1	0.41	810,655.9
2031	-	-	-	-	58,477.8	654,699.0	-	18,128.1	18,128.1	7,018.6	0.39	817,674.5
2032	-	-	-	-	53,799.6	599,161.7	-	16,677.9	16,677.9	6,085.3	0.36	823,759.8
2033	-	-	-	-	49,495.6	548,067.3	-	15,343.6	15,343.6	5,276.1	0.34	829,036.0
2034	-	-	-	-	45,535.9	501,060.5	-	14,116.1	14,116.1	4,574.5	0.32	833,610.5
2035	-	-	-	-	41,893.1	457,814.2	-	12,986.9	12,986.9	3,966.2	0.31	837,576.7
2036	-	-	-	-	38,541.6	418,027.6	-	11,947.9	11,947.9	3,438.8	0.29	841,015.5
2037	-	-	-	-	35,458.3	381,424.0	-	10,992.1	10,992.1	2,981.5	0.27	843,997.1
2038	-	-	-	-	32,621.6	347,748.6	-	10,112.7	10,112.7	2,585.1	0.26	846,582.1
2039	-	-	-	-	30,011.9	316,767.3	-	9,303.7	9,303.7	2,241.3	0.24	848,823.4
2040	-	-	-	-	27,610.9	288,264.4	-	8,559.4	8,559.4	1,943.3	0.23	850,766.7
2041	-	-	-	-	25,402.1	262,041.8	-	7,874.6	7,874.6	1,684.9	0.21	852,451.6
2042	-	-	-	-	23,369.9	237,917.0	-	7,244.7	7,244.7	1,460.8	0.20	853,912.4
2043	-	-	-	-	21,500.3	215,722.2	-	6,665.1	6,665.1	1,266.6	0.19	855,179.0
2044	-	-	-	-	19,780.3	195,303.0	-	6,131.9	6,131.9	1,098.1	0.18	856,277.1
2045	-	-	-	-	18,197.9	176,517.3	-	5,641.3	5,641.3	952.1	0.17	857,229.3
2046	-	-	-	-	16,742.0	159,234.5	-	5,190.0	5,190.0	825.5	0.16	858,054.8
2047	-	-	-	-	15,402.7	143,334.3	-	4,774.8	4,774.8	715.7	0.15	858,770.5
2048	-	-	-	-	14,170.5	128,706.1	-	4,392.8	4,392.8	620.6	0.14	859,391.1
2049	-	-	-	-	13,036.8	115,248.2	-	4,041.4	4,041.4	538.0	0.13	859,929.1
2050	-	-	-	-	11,993.9	102,866.9	-	3,718.1	3,718.1	466.5	0.13	860,395.6
2051	-	-	-	-	11,034.4	91,476.1	-	3,420.7	3,420.7	404.5	0.12	860,800.1
2052	-	-	-	-	10,151.6	80,996.5	-	3,147.0	3,147.0	350.7	0.11	861,150.8
2053	-	-	-	-	9,339.5	71,355.4	-	2,895.2	2,895.2	304.0	0.11	861,454.8
2054	-	-	-	-	8,592.3	62,485.5	-	2,663.6	2,663.6	263.6	0.10	861,718.4
2055	-	-	-	-	7,904.9	54,325.2	-	2,450.5	2,450.5	228.6	0.09	861,947.0
Total	**-**	**-**	**5,393,224.7**	**(2,470,431.9)**	**2,355,901.9**		**2,922,792.8**	**(941,570.1)**	**1,981,222.7**	**861,947.0**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Rotor Rewind vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

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TOSHIBA INTERNATIONAL CORPORATION
POWER SYSTEMS DIVISION
POWER GENERATION SERVICES
6623 WEST WASHINGTON STREET, WEST ALLIS, WI 53214
PHONE: (414) 475-2800 FAX: (414) 475-2811

December 29, 2014

Nova Scotia Power Incorporated
1894 Barrington Street, PO Box 910
Halifax, Nova Scotia, Canada B3J 2W5
Attn: Ms. Karen King.

TIC Reference: QUO-01907-J5W8

Fixed Price Offer to Nova Scotia Power, Inc
For Lingan Generating Station Unit 3 Generator Rotor Rewind Services

Dear Ms. King.
Toshiba International Corporation (TIC) is pleased to submit this fixed price offer to Nova Scotia Power, Inc for generator rotor rewind services for Lingan Generating Station (PLANT) unit G3 during the spring 2015 outage.

1 Scope of Work

1.1 Generator Rotor Rewind Services

1.1.1 Provide transportation from the PLANT to TIC's Milwaukee Service Center.

1.2.2 Perform incoming visual inspection and electrical testing including:

1.2.2.1 [redacted]

1.2.2.2 [redacted]

1.2.2.3 [redacted]

1.2.2.4 [redacted]

1.2.2.5 [redacted]

1.2.3 Set up rotor in lathe and record [redacted]

1.2.4 Match mark and remove shaft components.

1.2.5 Clean and perform NDE inspection of shaft components.

1.2.6 Remove exciter end retaining ring and electrical test including:

1.2.6.1 [redacted]

1.2.6.2 [redacted]

1.2.6.3 [redacted]

1.2.5.4 [redacted]

1.2.6.5 [redacted]

1.2.7 Remove turbine end retaining ring and electrical test including:

1.2.7.1 [redacted]

1.2.7.2 [redacted]

1.2.7.3 [redacted]

1.2.7.4 [redacted]

1.2.7.5 [redacted]

1.2.8 Visually inspect winding end turns and report findings

1.2.9 Remove rotor slot wedges
1.2.10 Map and remove existing balance weights
1.2.11 Clean and NDE inspect rotor slot wedges that will be re-installed, if applicable.
1.2.12 Set up rotor in an asbestos abatement enclosure
1.2.13 Remove and clean existing rotor winding
1.2.14 Abate asbestos while removing existing rotor winding if needed (this is added scope and price)
1.2.15 Remove external lead assemblies; main terminals and collector leads
1.2.16 Remove internal lead assemblies; bore copper with insulating tube
1.2.17 Clean rotor windings and visually inspect brazed joints in rotor windings
1.2.18 Clean and dimensional inspect rotor windings and shaft components
1.2.19 Clean and dimensional inspect fit areas, coupling and collector rings
1.2.20 Clean and dimensional inspect retaining rings
1.2.21 Blast and hand clean generator rotor forging
1.2.22 Perform NDE inspection; visual and magnetic particle, of complete rotor body
1.2.23 Recondition and reinstall bore copper lead assembly; new insulator tube and separators
1.2.24 Recondition and reinstall main lead assemblies; new insulating materials
1.2.25 Recondition and reinstall collector lead assemblies; new insulating sleeves, spacers, washers and seals.
1.2.26 Pressure and vacuum test rotor bore as assembled
1.2.27 Braze common turns of rotor winding
1.2.28 Assemble winding head for coil end support during coil installation work.
1.2.29 Install rotor winding, slot armor, bottom filler, top filler, end turn and slot turn insulation and adhesives
1.2.30 Install rotor slot wedges
1.2.31 Install temporary blocking
1.2.32 Cure rotor turn insulation adhesive
1.2.33 Install end turn blocking; new blocking
1.2.34 Install amortisseur to end windings; new amortisseur
1.2.35 Install turbine end retaining ring and test including:
  1.2.35.1 [redacted]
  1.2.35.2 [redacted]
  1.2.35.3 [redacted]
  1.2.35.4 [redacted]
  1.2.35.5 [redacted]
1.2.36 Install exciter end retaining ring and test including:
  1.2.35.1 [redacted]
  1.2.35.2 [redacted]
  1.2.35.3 [redacted]
  1.2.35.4 [redacted]
  1.2.35.5 [redacted]
1.2.37 Set rotor in lathe and polish journals and collector rings
1.2.38 Set up and perform high speed balance, over speed testing and at speed electrical tests including
  1.2.38.1 [redacted]
  1.2.38.2 [redacted]
  1.2.38.3 [redacted]
1.2.39 Perform final high pot testing

TIC Reference: QUO-01907-J5W8

1.2.40 Paint rotor body and shaft ends
1.2.41 Perform final electrical testing including:
- 1.2.41.1 [redacted]
- 1.2.41.2 [redacted]
- 1.2.41.3 [redacted]
- 1.2.41.4 [redacted]
- 1.2.41.5 [redacted]

1.2.42 Prepare generator rotor for shipment including:
- 1.2.42.1 Wrapping rotor
- 1.2.42.2 Installing protective covering

1.2.43 Ship generator rotor on truck transport from the Milwaukee Service Center to the PLANT.

2 Technical Comments and Clarifications

2.1 Rotor Condition

2.1.1 This offer assumes the rotor is in serviceable condition and that the indicated rotor run-outs are within normal criteria.

2.2 Rotor Balancing Operation

2.2.1 The ability to balance to a stated level depends upon eccentricity conditions of each specific rotor. If rotor body eccentricity is sufficiently large, this eccentricity can predominate and may limit the best achievable final balance condition. [redacted]

2.2.2 Balancing operation is concluded upon successful completion of electrical and balancing testing. Additional runs from [redacted] are not included in scope.

3 Schedule

3.1 Scope of Work

3.1.1 [redacted] are estimated for completion of the shop work as described in Section 1.

3.1.2 A [redacted] lead time is required after receipt of purchase order for materials to be completed prior to rewind services.

3.1.2 [redacted] are estimated for shipment each way for a total of [redacted] between PLANT and TIC subject to local and federal permit requirements.

4 Price, Terms and Clarifications

4.1 Price Data

4.1.1 Generator Rotor Rewind Service…………….. **USD $** [redacted]

4.1.2 Optional Pricing Data.
The Generator Rotor Rewind Service price includes generator rotor round trip freight and [redacted] transport insurance services for a combined total amount of [redacted]. In the event, NSPI would elect to arrange for these freight and insurance services a price deduct in the amount of [redacted] would apply.

4.1.3 Price does not include:

4.1.3.1 Generator rotor rewind parts or materials.
4.1.3.2 Truck loading and unloading at PLANT
4.1.3.3 Preventative machining for the rotor wedge dovetail grooves
4.1.3.4 Rebuilding (re-insulating) of the collector rings
4.1.3.5 Additional machining of rotor forging or assembly to provide satisfactory operation
4.1.3.6 Any special transportation requirement beyond standard industry methods
4.1.3.7 Any special packing requirement beyond standard industry methods
4.1.3.8 Brokerage and NAFTA (to be arranged by NSPI) for rotor transport.
4.1.3.9 Work related to asbestos or lead abatement.
4.1.3.10 Sales and use taxes, VAT, gross receipts, excise taxes and other local and state taxes and any security instruments costs.

4.2 Terms and Clarifications

4.2.1 Progress Payments.
Invoices will be due and payable Net 30 per the following milestones:

4.2.1.1 20% upon receipt of purchase order
4.2.1.2 70% upon completion of base work scope at TIC, West Allis
4.2.1.3 10% upon delivery of generator rotor to Lingan Generating Station.

4.2.2 Terms and Conditions.
TIC offers to perform the work in accordance with TIC Parts and Equipment Services Terms and Conditions (Rev 6.15.12) unless otherwise agreed to in writing.

4.2.3 Warranty.
The warranty period shall be [redacted] years from completion of the work.

4.2.4 Transport Insurance.
Pricing includes transport insurance which will be provided in the amount [redacted].

4.2.5 Delivery Terms.
Delivery terms are DAP Lingan Power Station (INCOTERMS 2010) except that Export Clearance/ Handling is to be paid by NSPI.

4.2.6 Hazardous Materials.
This proposal is based on asbestos and lead free parts. Asbestos or lead abatement is considered extra work and will be quoted at that time.

4.2.7 Delays.
Additional time or delays (including standby time) outside the direct control of TIC or its subcontractors, any repair work, or added scope will be invoiced at T&M rates.

4.2.8 Destructive Removal.
This offer excludes all destructive removal (including, but not limited to, cutting, grinding and drilling) of any components (fasteners, pins, etc). If such actions are required then they will be quoted as extra work.

4.2.9 Related Offer.
This offer is contingent upon award of TIC Offer QUO-02023 Generator Rotor Rewind Materials.

TOSHIBA

5 Confidentiality

5.1 This offer contains information proprietary to TIC; it is submitted in confidence and is to be used solely for the purpose for which it is furnished and returned upon request.

6 Attachments

6.1 **Attachment 1:** TIC Milwaukee Service Center Time and Material Rates 2014. [redacted]

6.2 **Attachment 2**: TIC Parts and Equipment Services Terms and Conditions (Rev 6.15.12).

7 Validity.

7.1 Prices and rates offered remain valid for 30 days. Pending orders are subject to prior sales.

We hope this proposal is of interest to you and look forward to discussing it with you in detail in the very near future.

Sincerely,

James Fanning

James Fanning, P.E.
Key Accounts Manager
TOSHIBA INTERNATIONAL CORPORATION
Power System Division
Mobile Telephone: 804 316-5251
James.Fanning@psd.toshiba.com

cc: James Radish. Mgr, OEM Service Projects.

TIC Reference: QUO-01907-J5W8

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TOSHIBA INTERNATIONAL CORPORATION
POWER SYSTEMS DIVISION
6623 WEST WASHINGTON STREET, WEST ALLIS, WI 53213
PHONE: (414) 475-2800 FACSIMILE: (414) 475-2811

December 19, 2014

Nova Scotia Power Inc.
Lingan Generating Station
Lingan, Nova Scotia B1H 5E6
Attention: Karen King

TIC Reference: QUO-02023-T8P4

Fixed Price Offer to Nova Scotia Power, Inc
For Lingan Generating Station Unit 3 Generator Rotor Rewind Materials

Dear Ms. King,

Toshiba International Corporation (TIC) is pleased to submit this fixed price offer to Nova Scotia Power, Inc for generator rotor rewind materials for Lingan Generating Station (PLANT) unit G3 for the spring 2015 outage. This parts procurement offer also contains optional pricing for upgraded rotor slot coil wedges and in-kind replacement creepage blocks that were discussed and identified in previous offers (Ref: TIC Offer P12-06404 Rev. 00 thru Rev. 03).

1 Base Scope of Supply

1.1 Provide Generator Rotor Rewind Materials.

Note i). Items prefixed with an asterisk (*) have expiration limitations (ie: shelf lives) and/or require environmental controls for preservation. Timing of the procurement of these items will be determined by TIC to support generator outage schedule.

Note ii). Items prefixed with a double-asterisk (**) require rotor dimensional inspection for confirmation to complete the manufacturing process.

Parts List

No.	Item	New/Reuse	Remarks
1	[redacted]	New	
2	[redacted]	New	
3	[redacted]	New	
4	[redacted]	-	
5	[redacted]	Reuse	Included in Base Scope Pricing.
		New	If required – See Optional Pricing Item 5.1.3
6	[redacted]	New	
7	[redacted]	Reuse	
8	[redacted]	Reuse	
9	[redacted]	New	
10a	[redacted]	New	Included in Base Scope Pricing

10b	[redacted]	Reuse	Included in Base Scope Pricing
		New	If elected – See Optional Pricing Item 5.1.2
10c	[redacted]	Reuse	Included in Base Scope Pricing
		New	If elected – See Optional Pricing Item 5.1.2
11	[redacted]	Reuse	
12	[redacted]	New	
13	[redacted]	New	
14	[redacted]	New	
15	[redacted]	New	
16	[redacted]	-	
17	[redacted]	Reuse	
18	[redacted]	New	
19	[redacted]	Reuse	
20	[redacted]	Reuse	Slip rings are to remain on rotor unless incoming visual and diagnostic electrical testing warrants removal and replacement of insulation.
21	[redacted]	New	
22	[redacted]	Reuse	
23	[redacted]	-	
24	[redacted]	-	
25	[redacted]	Reuse	
26	[redacted]	New	
27	[redacted]	New	
28	[redacted]	New	Replacement retaining rings are to be provided under separate contract. In-kind installation of these new rings is included in this offer's work scope.
29	[redacted]	Reuse	
30	[redacted]	Reuse	
31	[redacted]	Reuse	
32	[redacted]	Reuse	
33	[redacted]	Reuse	
34	[redacted]	-	
35	[redacted]	-	
36	[redacted]	New	
37	[redacted]	Reuse	
38	[redacted]	Reuse	
39	[redacted]	New	

[redacted]

PARTS Location Map – Typical Rotor Shown (Not Lingan).

2 <u>Optional Scope of Supply.</u>

2.1 Rotor Slot Wedge Replacement – Upgraded Rotor Capability Design.

2.1.1 Engineering design for Unit 3 and Unit 4.

2.1.2 Manufacture [redacted] replacement aluminum upgraded rotor slot coil wedges for Unit 3.

2.1.3 Manufacture [redacted] non-magnetic steel rotor slot coil end wedges for Unit 3.

2.2 Creepage Block Replacement.

2.2.1 Manufacture complete set of replacement ventilated [redacted] creepage blocks (top fillers).

3 Scope Clarifications

3.1 Parts Retention at TIC-MSC.

The generator rotor rewind parts are to be retained at TIC Milwaukee Service Center upon completion for subsequent installation into the subject generator rotor. The generator rotor rewind is currently scheduled to commence on or about March 24, 2015.

3.2 Hold Point - Upgraded Rotor Coil Slot Wedges Manufacturing.

Rotor coil slot wedge manufacture shall require [redacted] of mating rotor slot before final machining. Therefore the rotor coil slot wedge manufacturing process will be completed up to a predetermined process hold point at which further manufacturing will be dependent upon rotor [redacted] and subsequent TIC engineering review and analysis during the rotor rewind schedule.

4 Schedule

4.1 Base and Optional Scope of Work

4.1.1 A [redacted] time is required after receipt of purchase order for materials to be completed prior to rewind services under normal delivery terms.

4.1.2 Uprated coil wedges will be considered complete when manufacturing reaches the hold-point status.

5 Price.

5.1 Pricing Data.

5.1.1 Generator Rotor Rewind Materials.

Price: USD [redacted] FIXED PRICE.
Lead Time: [redacted]

5.1.2. Optional Scope – Rotor Slot Wedge Replacement – Upgraded Rotor Capability Design.

Price: USD [redacted] FIXED PRICE.
Lead Time: [redacted]
Note i). Also, refer to Scope Clarifications Article 3.2.

5.1.3. Optional Scope – Creepage Block Replacement – Complete.

Price: USD [redacted] FIXED PRICE.
Lead Time: [redacted]

Note i). The [redacted] lead time accounts for material procurement and manufacture of the creepage blocks during the generator rotor rewind work since the condition of the blocks will be known until rotor disassembly is performed.

Note ii). In the event it is determined upon rotor disassembly that only a portion of the creepage blocks require replacement, TIC will provide additional pricing options based on the actual quantity needed as an extra work item.

5.2 Pricing Terms and Clarifications

5.2.1 Related Offer.

This offer is contingent upon TIC receiving the related Lingan Unit 3 generator rotor rewind order. (Refer to TIC Offer QUO-1907-J5W8).

5.2.2 Payment.

Payment terms for Base and Optional Scope of Supply invoicing will be:

- 25% Upon Receipt of Order; Net 30 Days.
- 75% Upon Completion of Work, Net 30 Days

5.2.3 Exclusions.
Pricing does not include; sales and use taxes, VAT, gross receipts, excise taxes and other local and state taxes and any security instruments costs.

5.2.4 Proprietary Information.
This offer contains information proprietary to TIC. It is submitted in confidence and is to be used solely for the purpose for which it is furnished and returned upon request.

6 Terms and Conditions.

6.1 Terms and Conditions.

TIC Parts and Equipment Services Terms and Conditions shall apply unless otherwise agreed to in writing. See Attachment A in this offer.

7 TIC Representative

Questions regarding the contents of this offer document can be directed to:

Name: Jim Fanning
Email: james.fanning@psd.toshiba.com

8 Validity

The pricing and delivery data provided in this offer will remain valid until January 15, 2015. Orders are subject to prior sales at time of order receipt and acknowledgement.

We trust this offer is complete in the intended scope of supply. TIC looks forward to discussing it with you in detail in the near future.

Sincerely,

TOSHIBA INTERNATIONAL CORPORATION
Key Account Manager

Jim Fanning.

ATTACHMENT:

- Attachment A - TIC Parts and Equipment Services Terms and Conditions.

cc: James Radish. Manager - OEM Service Projects.

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Quotation

Page: 1

TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION
6623 W. Washington Street
West Allis, WI 53214 USA

Toshiba Quote Number	6835-0
Quote Date	16-JUL-15

To: NOVA SCOTIA POWER INC
PO BOX 910
LINGAN, NS B1H 5E6
Canada

Plant Code	XCL04	Plant Name	LINGAN
Customer RFQ #		Lead Time	Please see comments in Customer Quote Remarks
Requested Delivery Date	16-DEC-15	Ship Via	TBD-LTL-Ground
Payment Terms	Net 30	Customer Contact	
Delivery Terms	To Be Determined	Validity	30 days
Toshiba Contact	Scholze, Mr. Mark	Toshiba Contact #	

Remarks :	Forgings are in-stock and are available on a first come, first serve basis. We recommend ordering ASAP to have in time for the outage. Pricing is for finished machined rings. Final sizing will be made once the rotor work is complete.

Line Number	Ordered Item	UOM	Quantity	Unit price (USD)	Extended Price (USD)
1.1	[redacted]	Each	1	[redacted]	[redacted]
2.1	[redacted]	Each	1	[redacted]	[redacted]

Subtotal	[redacted]
Total Sales Tax	0.00
Total (USD)	[redacted]

Notes:
- Quoted prices are based on volume at time of request. Toshiba America Energy Systems Corporation reserves the right to adjust pricing at time of order if volumes change.
- Lead times are estimates based on current capacity and are subject to factory loading at time of order.
- This quotation excludes any applicable taxes.
- Sales according to Toshiba America Energy Systems Corporation standard terms and conditions or mutually agreed upon terms and conditions between Toshiba America Energy Systems Corporation and customer.

CI Number: 43170

Title: LIN4 AVR Replacement

Start Date: 2016/01
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $842,207

DESCRIPTION:

This project includes the replacement of existing Auto Voltage Regulation (AVR) devices on Unit 4 at the Lingan Generating Station. The existing AVR devices are obsolete and are no longer supported by the Original Equipment Manufacturer (OEM). The existing excitation system will be completely replaced with modern digital static excitation system equipment, excluding the existing exciter transformer. This project is well aligned with NS Power's overall AVR program.

The excitation system for a synchronous generator provides the DC field current to the generator rotor. The DC field current is derived from rectifying an AC supply. The excitation system includes the thyristor rectifier bridges, AVR, field circuit breaker, monitoring and control. The AVR automatically controls the generator voltage via field current regulation and is integral to the excitation system.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2015 – CI 37611 LIN3 AVR Replacement $829,422

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The excitation system for the Lingan Unit #4 generator is now obsolete. The Original Equipment Manufacturer (OEM) no longer supports this equipment and it is no longer possible to source spare parts or receive technical support service. A dependable excitation system is required for reliable operation of this unit.

Why do this project now?

The spare parts originally supplied with the system have been depleted and replacement parts are no longer available. Replacing the excitation system now will mitigate the risk of an unplanned outage and associated replacement energy costs.

Why do this project this way?

Replacement of the obsolete excitation system and AVR is the only option. The existing AVR equipment removed from Unit #4 will be salvaged where possible and used for spares to support potential repairs that may be required for Lingan Units #1 and #2, as significant investment in these two units may not be warranted due to their limited remaining life/operation.

CI Number : 43170-SE64 - LIN4 AVR Replacement **Project Number** SE64

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		17,852	0	17,852
095		095-Thermal Regular Labour AO		11,876	0	11,876
095		095-Thermal & Hydro Contracts AO		10,721	0	10,721
095		095-Thermal Term Labour AO		8,544	0	8,544
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	58,588	0	58,588
004	010	004 - THERMAL Term Labour	010 - SGP - Turbo Gen.Instal.	42,151	0	42,151
011	010	011 - Travel Expense	010 - SGP - Turbo Gen.Instal.	15,000	0	15,000
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	497,250	0	497,250
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	105,000	0	105,000
028	010	028 - Consulting	010 - SGP - Turbo Gen.Instal.	15,000	0	15,000
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	60,225	0	60,225
			Total Cost:	842,207	0	842,207
			Original Cost:	322,652		

Capital Project Detailed Estimate

Location: **Lingan Generating Station**
CI# : 43170
Title: LIN4 AVR Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	78	$ 358	$ 28,101		
Engineering	PD	59	$ 405	$ 23,842		
Maintenance Trades	PD	12	$ 365	$ 4,292		
Utilityworker	PD	10	$ 240	$ 2,355		
			Sub-Total	$ 58,588		
004 Term Labour						
Electrician	PD	118	$ 358	$ 42,151		
			Sub-Total	$ 42,151		
011 Travel Expense						
Factory Acceptance Test	Lot	3	$ 5,000	$ 15,000		
				$ -		
			Sub-Total	$ 15,000		
012 Materials						
Excitation / AVR System Replacement	Lot	1	[redacted]		Cost Support Item #1	
AVR Commissioning Spares	Lot	1				CI 37611
USD to CDN Exchange	Lot	25%				
Assembly for remote IDP 1200	Lot	1	$ 6,500	$ 6,500		
Tools and Rigging - Misc	Lot	1	$ 2,000	$ 2,000		
Cable Tray - new wire runs	Lot	1	$ 10,000	$ 10,000		
DC Cables	Lot	1	$ 10,000	$ 10,000		
Control , AC Cable and misc matl	Lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 497,250		
013 Contracts						
Concrete Floor Cutting	Lot	1	$ 10,000	$ 10,000		
Shipping	Lot	1	$ 15,000	$ 15,000		
AVR TA Supervision / commission	Lot	2	$ 20,000	$ 40,000		
USD to CDN Exchange	Lot	25%	$ 40,000	$ 10,000		
Generator OEM TA Debug	Lot	1	$ 20,000	$ 20,000		
Training	Lot	1	$ 10,000	$ 10,000		
				$ -		
			Sub-Total	$ 105,000		CI 37611
028 Consulting						
Project Management	Lot	1	$ 15,000	$ 15,000		
			Sub-Total	$ 15,000		
066 Other Goods & Services						
Contingency	%	10%	$ 602,250	$ 60,225		
				$ -		
			Sub-Total	$ 60,225		
094 Interest Capitalized						
AFUDC				$ 17,852		
				$ -		
			Sub-Total	$ 17,852		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 11,876		
Thermal Term Labour AO				$ 8,544		
Thermal / Hydro Contracts AO				$ 10,721		
			Sub-Total	$ 31,140		
			SUB-TOTAL (no AO, AFUDC)	$ 793,214		
			TOTAL (AO, AFUDC included)	$ 842,207		
Original Cost				$ 322,652		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 AVR Replacement
Summary of Alternatives

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	43170
Originator :	J.March	**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace AVR vs Replacement Energy/I	6.11%	-4,542,810	3,496,496	1	34.07%	4.9 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to replace the AVR. The economics are positive even when conservatively not including the potential for generator damage from an AVR failure.

Notes/Comments :

Replace AVR vs Replacement Energy/Repair Costs

The AVR is required to allow the generator to operate. If the AVR fails, part orders will have a long delivery if they are available and the unit would not be able to run until replacement parts are installed. The repair costs are conservative as they are solely related to the AVR, as no consideration has been included for damage that is possible to the generator in the case of an AVR failure, which could occur.

Test 2

Test 3

Test 4

LIN4 AVR Replacement
Summary of Sensitivities

Nova Scotia POWE
An Emera Compa

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	43170
Originator :	J.March	**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace AVR vs Replacement Energy/Repair Cos	6.11%	-4,542,810	3,496,496	1	34.07%	4.9 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace AVR vs Replacement Energy/Repair Cos	10%	-4,465,012	3,433,552	1	31.78%	5.2 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	**A**	77,798	-62,944	0	-2.28%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Replace AVR vs Replacement Energy/Repair Cos	-10%	-4,010,731	3,083,902	1	31.55%	5.2 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	**A**	532,079	-412,594	0	-2.51%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	58,088	155,414	332,765	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 AVR Replacement
Avoided Cost Calculations

Division :	Power Production	Date :	03-Nov-15
Department :	Lingan Generating Station	CI Number:	43170
Originator :	J.March	Project No. :	

Replace AVR vs Replacement Energy/Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			109,200	113,572		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	20%	30%	20%	30%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	1344	1344				
Totals	$40,448	$107,721	$21,840	$34,072	$62,288	$141,793
Total Capital Cost of Alternative						$842,207

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

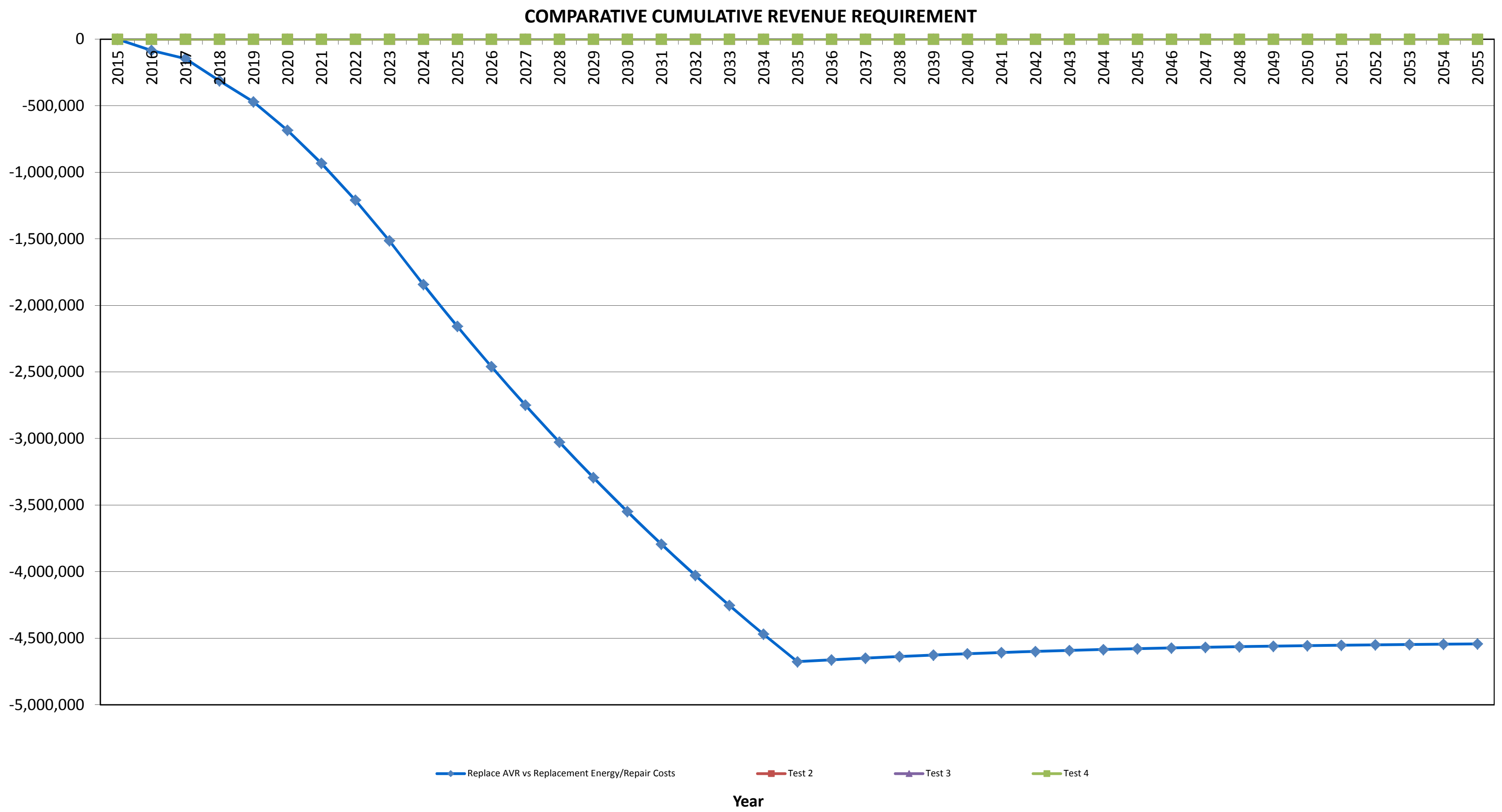
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 AVR Replacement
Replace AVR vs Replacement Energy/Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	62,287.6	(811,066.6)	31,728.6	770,080.3	(748,779.0)	(9,473.3)	(758,252.3)	(714,590.8)	0.94	(714,590.8)
2017	-	-	141,792.6	-	60,918.8	707,726.5	141,792.6	(25,070.9)	116,721.8	103,666.7	0.89	(610,924.1)
2018	-	-	277,746.7	-	56,045.3	650,361.0	277,746.7	(68,727.4)	209,019.2	174,951.4	0.84	(435,972.7)
2019	-	-	282,286.1	-	51,561.7	597,584.8	282,286.1	(71,524.6)	210,761.5	166,251.7	0.79	(269,721.0)
2020	-	-	375,324.0	-	47,436.8	549,030.6	375,324.0	(101,645.0)	273,679.0	203,451.0	0.74	(66,270.0)
2021	-	-	448,427.3	-	43,641.8	504,360.8	448,427.3	(125,483.5)	322,943.8	226,250.3	0.70	159,980.2
2022	-	-	524,867.8	-	40,150.5	463,264.6	524,867.8	(150,262.4)	374,605.4	247,331.7	0.66	407,312.0
2023	-	-	604,777.6	-	36,938.4	425,456.0	604,777.6	(176,030.1)	428,747.4	266,778.6	0.62	674,090.6
2024	-	-	688,294.1	-	33,983.4	390,672.2	688,294.1	(202,836.3)	485,457.8	284,671.9	0.59	958,762.5
2025	-	-	705,054.8	-	31,264.7	358,671.0	705,054.8	(208,874.9)	496,179.8	274,205.4	0.55	1,232,967.9
2026	-	-	722,270.5	-	28,763.5	329,230.0	722,270.5	(214,987.2)	507,283.4	264,199.0	0.52	1,497,166.9
2027	-	-	739,955.3	-	26,462.4	302,144.2	739,955.3	(221,182.8)	518,772.5	254,625.1	0.49	1,751,792.0
2028	-	-	758,123.5	-	24,345.4	277,225.3	758,123.5	(227,471.2)	530,652.3	245,458.4	0.46	1,997,250.4
2029	-	-	776,789.9	-	22,397.8	254,299.9	776,789.9	(233,861.5)	542,928.3	236,675.9	0.44	2,233,926.3
2030	-	-	795,969.9	-	20,606.0	233,208.6	795,969.9	(240,362.8)	555,607.1	228,256.4	0.41	2,462,182.8
2031	-	-	815,679.4	-	18,957.5	213,804.5	815,679.4	(246,983.8)	568,695.6	220,180.5	0.39	2,682,363.3
2032	-	-	835,934.8	-	17,440.9	195,952.8	835,934.8	(253,733.1)	582,201.7	212,430.1	0.36	2,894,793.4
2033	-	-	856,753.2	-	16,045.6	179,529.2	856,753.2	(260,619.3)	596,133.8	204,988.8	0.34	3,099,782.2
2034	-	-	878,152.0	-	14,762.0	164,419.5	878,152.0	(267,650.9)	610,501.1	197,841.1	0.32	3,297,623.3
2035	-	-	900,149.5	-	13,581.0	150,518.6	900,149.5	(274,836.2)	625,313.3	190,972.7	0.31	3,488,596.0
2036	-	-	-	-	12,494.5	137,729.7	-	3,873.3	3,873.3	1,114.8	0.29	3,489,710.8
2037	-	-	-	-	11,495.0	125,964.0	-	3,563.4	3,563.4	966.6	0.27	3,490,677.4
2038	-	-	-	-	10,575.4	115,139.5	-	3,278.4	3,278.4	838.0	0.26	3,491,515.4
2039	-	-	-	-	9,729.4	105,181.0	-	3,016.1	3,016.1	726.6	0.24	3,492,242.0
2040	-	-	-	-	8,951.0	96,019.1	-	2,774.8	2,774.8	630.0	0.23	3,492,872.0
2041	-	-	-	-	8,234.9	87,590.2	-	2,552.8	2,552.8	546.2	0.21	3,493,418.2
2042	-	-	-	-	7,576.1	79,835.6	-	2,348.6	2,348.6	473.6	0.20	3,493,891.8
2043	-	-	-	-	6,970.0	72,701.4	-	2,160.7	2,160.7	410.6	0.19	3,494,302.4
2044	-	-	-	-	6,412.4	66,137.9	-	1,987.9	1,987.9	356.0	0.18	3,494,658.4
2045	-	-	-	-	5,899.4	60,099.5	-	1,828.8	1,828.8	308.7	0.17	3,494,967.0
2046	-	-	-	-	5,427.5	54,544.2	-	1,682.5	1,682.5	267.6	0.16	3,495,234.7
2047	-	-	-	-	4,993.3	49,433.3	-	1,547.9	1,547.9	232.0	0.15	3,495,466.7
2048	-	-	-	-	4,593.8	44,731.3	-	1,424.1	1,424.1	201.2	0.14	3,495,667.9
2049	-	-	-	-	4,226.3	40,405.4	-	1,310.2	1,310.2	174.4	0.13	3,495,842.3
2050	-	-	-	-	3,888.2	36,425.6	-	1,205.3	1,205.3	151.2	0.13	3,495,993.5
2051	-	-	-	-	3,577.2	32,764.2	-	1,108.9	1,108.9	131.1	0.12	3,496,124.7
2052	-	-	-	-	3,291.0	29,395.7	-	1,020.2	1,020.2	113.7	0.11	3,496,238.3
2053	-	-	-	-	3,027.7	26,296.7	-	938.6	938.6	98.6	0.11	3,496,336.9
2054	-	-	-	-	2,785.5	23,445.6	-	863.5	863.5	85.5	0.10	3,496,422.4
2055	-	-	-	-	2,562.6	20,822.5	-	794.4	794.4	74.1	0.09	3,496,496.5
Total	**-**	**-**	**12,190,636.5**	**(811,066.6)**	**763,743.7**		**11,379,569.9**	**(3,542,336.8)**	**7,837,233.2**	**3,496,496.5**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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Replace AVR vs Replacement Energy/Repair Costs
Test 2
Test 3
Test 4
Year

Basler Electric®
12570 STATE ROUTE 143
HIGHLAND IL 62249-1074 USA
http://www.basler.com, info@basler.com
PHONE 618/654-2341 Operator-assisted Fax 618/654-2341, ext 248 **FAX 618/654-2351**

Power System Control and Protection for the Electric Power Industry

QUOTATION

TO:	**Nova Scotia Power Inc.** **315 Windmill Road** **Dartmouth, Nova Scotia** **Canada B3A 1H3**	**QUOTATION (SQ) No.:** **DATE of QUOTE:**	[redacted] **July 22, 2015**

ATTN: Charles Hooper

REF: request via Roger Labbe and Andrew Branch

Item	Qty	Description	Price Each

DECS-2100 Static Exciter for Lingan G.S. Unit 4

1	**1**	**DECS-2100**	**US**[redacted]

Supply of a Fully Static Exciter – to be installed by *others.* The fully static exciter, consisting of digital excitation control and rectifier bridge assemblies cooled with redundant fans, complete with accessories listed below, mounted and wired and tested in a NEMA 1 Control/Rectifying cabinet – for use with a brush-type synchronous generator with main field requirements of **2200 Amperes at 283 Volts** at rated load and power factor. **The static exciter includes a multi-bridge design that provides a minimum of N+1 bridge redundancy,** with

[redacted]

Excitation Power Potential Transformer (PPT) – re-used existing:

Three-Phase, 60 Hz, **1430** kVA
Primary**: 13800** (WYE) Volts
Secondary**: 412** (Δ) Volts (line currents ≈ 2004 Amperes RMS)

The quoted system includes:

NEMA Type 1 - indoor - Excitation Control/Rectifying Enclosure

Exterior ANSI Gray #61 (light gray)
Cabinet Line-Up,
144″W × 90″/102″H × 60½″D
weighing approximately 4.1 tons (*avoirdupois*)
Front and Rear Access Required

Dual-Control Channel

With automatic voltage regulator, manual control, excitation limiters and integrated protection systems

Item Qty Description Price Each

DECS-2100 Excitation Control Features – continued

Regulation

Automatic Voltage Regulation Mode
Paralleling Compensation
Reactive Current / Line Drop Compensation
Adjuster Follower Circuits for Bumpless Transfer (auto-manual)
[redacted]
Manual Control, field *current* regulator (*FCR*)
available as field *voltage* regulator (*FVR*) for testing
Auto-Manual Control Transfer – operator action

Sensing

Inputs for two sets of PTs, Regulating and Metering sets
Inputs for three CTs from the machine under control

Power System Stabilizer (PSS),

Type: Two input; utilizing compensated frequency and power
(IEEE 421.5 Model PSS-2B)

Limiting Functions including:

Under Excitation Limiter (*UEL*)
Over (Maximum) Excitation Limiter (*OEL*)
Instantaneous Field Current Limiter (*INST_CUR*)
separate on-line and off-line pickups
Volts/Hertz Limiter (*HXL*)
Generator Overvoltage Limiter (OVL)

Protective Functions including:

Loss of Field (*40Q*), Alarm/Transfer/Trip with delay
Over Excitation Protection (*OEP*)
Instantaneous Field Over-Current Protection (*INST_CUR*)
separate on-line and off-line pick-ups
[redacted]
Loss of PT sensing (*LOS_SENS*)
Loss of Voltage Sensing automatic transfer to metering PTs
Automatic Transfer to Manual – on failure of sensing potential
Field Ground Detector (*64F*), integrated in excitation control

Monitoring Functions:

Conduction of Current into Power Converter
[redacted]

Item	Qty	Description	Price Each

Item 1: DECS-2100 Static Excitation System – continued

Interactive Display Panel (IDP-1201)

high-resolution TFT color LCD touchscreen Human Machine Interface (HMI) capable of displaying generator system parameters.
Generator operation overview screen acts as operator's interface to monitor status and to view metering of excitation inputs to the generator and metering of the outputs of the generator.
Password-protected control screen offers the user access to control operation, to adjust setpoints, etc.
Ethernet, USB and CompactFlash™ interface ports
Please see product bulletin *SVU.*

[redacted]

Item Qty Description Price Each

Item 1: DECS-2100 Static Excitation System – continued

Excitation PPT Protection

[redacted]

Transformer Overcurrent (50/51)
Transformer Differential Current (87)
door-mounted and wired in the DECS-2100 logic cubicle
Current Differential Relay, with additional 12 Outputs, 6 Inputs,
Conventional Terminal Blocks
Configured Part Number: [redacted]

Inputs for discrete contact alarms from the Owner's PPT

Contact for transformer overtemperature
Contact for transformer low oil
Contact for High pressure alarm

CTs for differential (87) protection

[redacted]

Four (N+1) Power Converters, drawout, *power drawers*

cooled by forced air – redundant fans

[redacted]

Incoming AC Line surge suppression

Incoming AC Line Voltage Filters

De-Excitation module – for field discharge for shutdown

[redacted]

Crowbar module – for protection during pole slip

Field Discharge Resistor (FDR)

Shaft Voltage Suppression Network

Field Build-Up Circuit, flashing from 125 Volt DC source
Field Build-Up Circuit, flashing from 600-Volt AC source

AC Field Breaker – "41A" Device

[redacted]

Item Qty Description Price Each

Item 1: DECS-2100 Static Excitation System – continued

DC Field Disconnect – isolating switch (41S)

non-load break, 2-pole, rated 1500V, 2000Aac/2400Adc

Test Transformer & Switching –

[redacted]

Technical Notes

Machine Data: as reported on the schematic 9465300910, for Lingan Unit 3

150 MVA, 0.85 power factor, three-phase, 60 Hz, 14400 Volts

Field Ratings

No-Load: 870 Amperes at 95 Volts

Full-Load: 2200 Amperes at **283** Volts

The data, repeated above, for the field requirements of the generator are based on matching the values recorded for Lingan Unit 3. The same is true for the re-used PPT ratings repeated herein. During the design process, these values should be confirmed. The nominal secondary voltage – the expected power feed to the proposed exciter – of the PPT should be confirmed and shared with BASLER's project coordinator.

Item	Qty	Description	Price Each

Technical & Schedule Notes

[redacted]

Example Schedule – BASED ON ORDER BY AUGUST 3	
Order Acceptance:	**Monday, August 03, 2015**
Estimated Drawings Schedule	[redacted]
submittal of drawings:	[redacted]
Drawings Review for Approval	[redacted]
receipt of approval	[redacted]
Estimated Production in Work Shop	[redacted]
Preliminary Ship Date:	[redacted]

[redacted]

Item	Qty	Description	Price Each
	Commercial Notes		

Delivery: [redacted]

International Packaging Requirements: [redacted]

PSS Tuning: [redacted]

Field Service: [redacted]

Terms and Conditions: [redacted]

[redacted]

Invoices for services will be issued at the time the indicated service is completed.

Your Basler Sales Rep is:

Mr. Roger Labbe

Henery & Sons, Inc.
87 Aurora
Pointe-Claire, Quebec
Canada H9R 3G5
Office: 450-378-5038
FAX: 450-378-8228
E-Mail: rlabbe@henery.ca

Andrew Branch

Applications Engineer
Southwestern U.S.A. & Eastern Canada
Power Systems Group
Basler Electric Company

Mobile: 618-301-6134
E-Mail: andrewbranch@basler.com

CI Number: 47657

Title: LIN4 High Voltage Bushings Refurbishment

Start Date: 2016/02
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $822,570

DESCRIPTION:

The scope of this project is to refurbish the high voltage generator bushings on Lingan Generating Unit 4 in order to reduce the risk of a failure. This project will be completed during a planned major outage in 2016.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2015 CI 40363 LIN3 High Voltage Bushings Refurbishment $628,531

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

High voltage bushings are installed on the three phases of the generator primary electrical connections to seal hydrogen gas in the generator. Each phase requires two bushings for phase connections. Hydrogen gas is a highly effective cooling medium commonly used in large utility generators. Over time, and through normal operating wear, hydrogen leaks can occur around the generator bushings. The Original Equipment Manufacturer (OEM) is recommending refurbishment of the generator bushings and O-ring gaskets to ensure the long term integrity of the bushings.

Why do this project now?

A minimum of a 4 week generator outage is required for this project to be completed. The Unit 4 planned major outage in 2016 provides the opportunity for the bushings to be refurbished. Without this work, the probability of bushing failures and related hydrogen leaks will increase.

Why do this project this way?

Refurbishing and re-using the bushings with new gaskets and sealing components is the most cost effective approach to restore reliability of the bushings. OEM factory refurbished bushings cost approximately $21,000 per bushing, while new bushings cost $33,328. The expected life of new or refurbished bushings is the same.

CI Number : 47657-SE71 - LIN4 High Voltage Bushing Refurbishment **Project Number** SE71

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		8,544	0	8,544
095		095-Thermal Regular Labour AO		4,533	0	4,533
095		095-Thermal & Hydro Contracts AO		53,654	0	53,654
001	010	001 - THERMAL Regular Labour	010 - SGP - Turbo Gen.Instal.	22,365	0	22,365
012	010	012 - Materials	010 - SGP - Turbo Gen.Instal.	115,000	0	115,000
013	010	013 - POWER PRODUCTION Contracts	010 - SGP - Turbo Gen.Instal.	535,875	0	535,875
015	010	015 - Frt, Post & Delivery	010 - SGP - Turbo Gen.Instal.	5,178	0	5,178
028	010	028 - Consulting	010 - SGP - Turbo Gen.Instal.	25,000	0	25,000
066	010	066 - Other Goods & Services	010 - SGP - Turbo Gen.Instal.	52,421	0	52,421
			Total Cost:	822,570	0	822,570
			Original Cost:	282,909		

Capital Project Detailed Estimate

Location: **Steam**
CI# : 47657
Title: LIN4 High Voltage Bushings Refurbishment
Execution Year: 2015

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	39	$ 358	$ 14,050		
Engineering	PD	15	$ 405	$ 5,960		
Utilityworker	PD	10	$ 240	$ 2,355		
			Sub-Total	$ 22,365		
012 Materials						
HVB Insulator and Consumables	Lot	1	$ 80,000	$ 80,000		CI 40363
Misc. Wiring and Connectors	Lot	1	$ 5,000	$ 5,000		CI 40363
Rigging	Lot	1	$ 5,000	$ 5,000		CI 40363
Replacement Standoff Insulators	Lot	1	$ 25,000	$ 25,000		CI 40363
			Sub-Total	$ 115,000		
013 Contracts						
HVB Refurbishment	USD	1	[redacted]		Cost Support #2 - Page 3 - Item 5	
HVB Installation	USD	1			Cost Support #1 - Page 5 - Item 5	
OEM Evaluation	USD	1	$ 20,000	$ 20,000		
USD Exchange	%	25%	[redacted]			
Silver Plate Contacts	Lot	1	$ 10,000.00	$ 10,000		
Scaffolding Services	Lot	1	$ 25,000	$ 25,000		
			Sub-Total	$ 535,875		
015 Freight						
Freight	Lot	1	$ 5,178	$ 5,178		
			Sub-Total	$ 5,178		
028 Consulting						
Project Coordination	Lot	1	$ 25,000	$ 25,000		
			Sub-Total	$ 25,000		
066 Other Goods & Services						
Contingency	%	10%	$ 535,875	$ 52,421		
				$ -		
			Sub-Total	$ 52,421		
094 Interest Capitalized						
				$ 8,544		
				$ -		
			Sub-Total	$ 8,544		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 4,533		
Thermal / Hydro Contracts AO				$ 53,654		
			Sub-Total	$ 58,188		
			SUB-TOTAL (no AO, AFUDC)	$ 755,838		
			TOTAL (AO, AFUDC included)	$ 822,570		
Original Cost				$ 282,909		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 HVB Refurbishment
Summary of Alternatives

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47657
Originator :	J. March	**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish HVB vs Replacement Energy	6.11%	-3,055,346	2,207,026	1	48.32%	3.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid an extended outage related to a HVB failure.

Notes/Comments :

Refurbish HVB vs Replacement Energy & Repair Costs

This option compares the refurbishment of the High Voltage Bushings versus the do nothing option and incurring the replacement energy costs in the event of an unplanned outage due to component failure.

Test 2

Test 3

Test 4

LIN4 HVB Refurbishment
Summary of Sensitivities

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47657
Originator :	J. March	**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish HVB vs Replacement Energy & Repair	6.11%	-3,055,346	2,207,026	1	48.32%	3.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish HVB vs Replacement Energy & Repair	10%	-2,981,325	2,147,846	1	44.14%	3.6 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	**A**	74,021	-59,181	0	-4.18%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish HVB vs Replacement Energy & Repair	-10%	-2,675,790	1,927,143	1	43.72%	3.6 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	**A**	379,556	-279,883	0	-4.60%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	131,067	326,928	630,614	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN4 HVB Refurbishment
Avoided Cost Calculations

Nova Scotia POWER
An Emera Company

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan Generating Station	CI Number:	47657
Originator :	J. March	Project No. :	

Refurbish HVB vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			266,240	276,916		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	30%	40%	30%	40%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	1344	1344				
Totals	$60,671	$143,628	$79,872	$110,766	$140,543	$254,395
Total Capital Cost of Alternative						$822,570

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

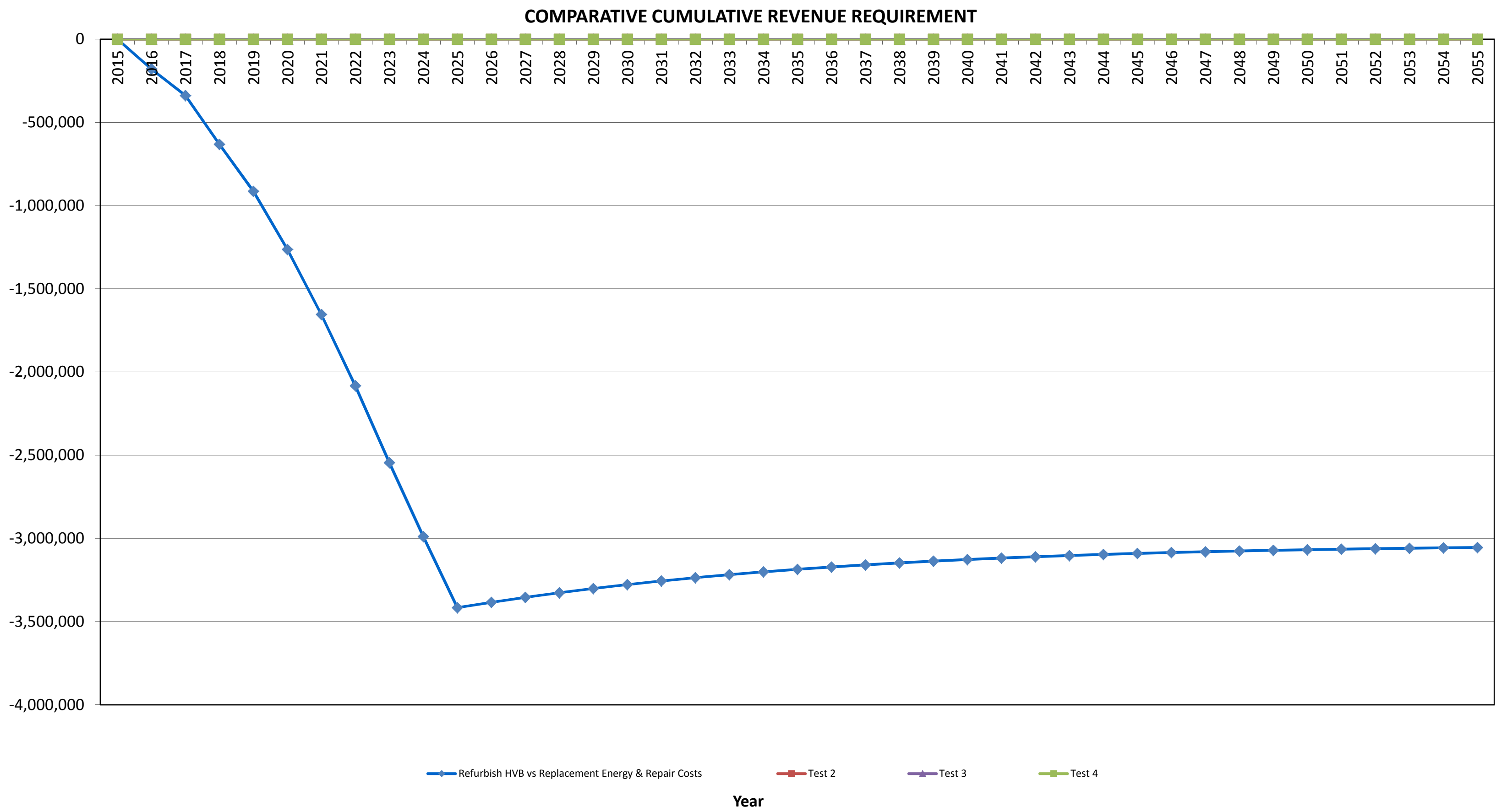
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 HVB Refurbishment

Refurbish HVB vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	140,543.4	(764,382.5)	30,233.5	741,664.7	(623,839.1)	(34,196.1)	(658,035.2)	(620,144.3)	0.94	(620,144.3)
2017	-	-	254,394.6	-	58,048.4	680,935.0	254,394.6	(60,867.3)	193,527.3	171,881.7	0.89	(448,262.7)
2018	-	-	432,134.3	-	53,404.5	625,063.7	432,134.3	(117,406.2)	314,728.1	263,430.8	0.84	(184,831.9)
2019	-	-	444,776.9	-	49,132.2	573,662.1	444,776.9	(122,649.9)	322,127.1	254,098.4	0.79	69,266.5
2020	-	-	566,550.1	-	45,201.6	526,372.6	566,550.1	(161,618.0)	404,932.1	301,023.6	0.74	370,290.1
2021	-	-	665,445.7	-	41,585.5	482,866.3	665,445.7	(193,396.7)	472,049.0	330,711.5	0.70	701,001.6
2022	-	-	769,461.4	-	38,258.6	442,840.5	769,461.4	(226,672.9)	542,788.6	358,374.0	0.66	1,059,375.6
2023	-	-	878,831.3	-	35,197.9	406,016.8	878,831.3	(261,526.4)	617,305.0	384,104.4	0.62	1,443,480.0
2024	-	-	903,454.7	-	32,382.1	372,138.9	903,454.7	(270,032.5)	633,422.2	371,438.1	0.59	1,814,918.1
2025	-	-	928,853.1	-	29,791.5	340,971.3	928,853.1	(278,709.1)	650,144.0	359,291.1	0.55	2,174,209.1
2026	-	-	-	-	27,408.2	312,297.1	-	8,496.5	8,496.5	4,425.1	0.52	2,178,634.2
2027	-	-	-	-	25,215.6	285,916.8	-	7,816.8	7,816.8	3,836.7	0.49	2,182,470.9
2028	-	-	-	-	23,198.3	261,647.0	-	7,191.5	7,191.5	3,326.5	0.46	2,185,797.4
2029	-	-	-	-	21,342.4	239,318.7	-	6,616.2	6,616.2	2,884.1	0.44	2,188,681.5
2030	-	-	-	-	19,635.0	218,776.7	-	6,086.9	6,086.9	2,500.6	0.41	2,191,182.2
2031	-	-	-	-	18,064.2	199,878.1	-	5,599.9	5,599.9	2,168.1	0.39	2,193,350.3
2032	-	-	-	-	16,619.1	182,491.3	-	5,151.9	5,151.9	1,879.8	0.36	2,195,230.1
2033	-	-	-	-	15,289.6	166,495.5	-	4,739.8	4,739.8	1,629.8	0.34	2,196,859.9
2034	-	-	-	-	14,066.4	151,779.4	-	4,360.6	4,360.6	1,413.1	0.32	2,198,273.0
2035	-	-	-	-	12,941.1	138,240.5	-	4,011.7	4,011.7	1,225.2	0.31	2,199,498.2
2036	-	-	-	-	11,905.8	125,784.8	-	3,690.8	3,690.8	1,062.3	0.29	2,200,560.5
2037	-	-	-	-	10,953.3	114,325.5	-	3,395.5	3,395.5	921.0	0.27	2,201,481.5
2038	-	-	-	-	10,077.1	103,783.0	-	3,123.9	3,123.9	798.5	0.26	2,202,280.1
2039	-	-	-	-	9,270.9	94,083.8	-	2,874.0	2,874.0	692.4	0.24	2,202,972.4
2040	-	-	-	-	8,529.2	85,160.6	-	2,644.1	2,644.1	600.3	0.23	2,203,572.7
2041	-	-	-	-	7,846.9	76,951.3	-	2,432.5	2,432.5	520.5	0.21	2,204,093.2
2042	-	-	-	-	7,219.1	69,398.7	-	2,237.9	2,237.9	451.3	0.20	2,204,544.4
2043	-	-	-	-	6,641.6	62,450.3	-	2,058.9	2,058.9	391.3	0.19	2,204,935.7
2044	-	-	-	-	6,110.3	56,057.8	-	1,894.2	1,894.2	339.2	0.18	2,205,274.9
2045	-	-	-	-	5,621.5	50,176.6	-	1,742.7	1,742.7	294.1	0.17	2,205,569.0
2046	-	-	-	-	5,171.7	44,766.0	-	1,603.2	1,603.2	255.0	0.16	2,205,824.0
2047	-	-	-	-	4,758.0	39,788.2	-	1,475.0	1,475.0	221.1	0.15	2,206,045.1
2048	-	-	-	-	4,377.4	35,208.7	-	1,357.0	1,357.0	191.7	0.14	2,206,236.8
2049	-	-	-	-	4,027.2	30,995.5	-	1,248.4	1,248.4	166.2	0.13	2,206,403.1
2050	-	-	-	-	3,705.0	27,119.3	-	1,148.6	1,148.6	144.1	0.13	2,206,547.2
2051	-	-	-	-	3,408.6	23,553.3	-	1,056.7	1,056.7	124.9	0.12	2,206,672.1
2052	-	-	-	-	3,135.9	20,272.5	-	972.1	972.1	108.3	0.11	2,206,780.4
2053	-	-	-	-	2,885.0	17,254.2	-	894.4	894.4	93.9	0.11	2,206,874.4
2054	-	-	-	-	2,654.2	14,477.4	-	822.8	822.8	81.4	0.10	2,206,955.8
2055	-	-	-	-	2,441.9	11,922.7	-	757.0	757.0	70.6	0.09	2,207,026.4
Total	**-**	**-**	**5,984,445.6**	**(764,382.5)**	**727,756.6**		**5,220,063.1**	**(1,629,573.6)**	**3,590,489.5**	**2,207,026.4**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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-500,000
-1,000,000
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-3,500,000
-4,000,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish HVB vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

TOSHIBA
Leading Innovation >>>

TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION

6623 W. WASHINGTON STREET, WEST ALLIS, WI 53214
PHONE: (414) 475-2800
FACSIMILE: (414) 475-2858

June 29, 2015

Mary Louise Mills
Procurement Manager
Nova Scotia Power, Inc.
1894 Barrington Street, PO Box 910
Halifax, Nova Scotia, Canada, B3J 2W5

TAES Reference: QUO-02299-V0M4 Rev 00

Dear Ms. Mills:

Pursuant to your request, Toshiba America Energy Systems Corporation (TAES) is pleased to offer this proposal for turnkey high-voltage bushing installation services at the Lingan Generating Station Unit 4 for Nova Scotia Power, Inc. Attached, please find TAES' proposal that consists of the following sections:

Section 1 – Base Scope of Services
Section 2 – Division of Responsibility
Section 3 – Technical Clarifications
Section 4 – Schedule
Section 5 – Price
Section 6 – Commercial Clarifications
Section 7 – Attachments

I hope this proposal is of interest to you and look forward to discussing it with you in the very near future. In the meantime, should you require additional information, please feel free to call me.

Regards,

James Fanning

James Fanning, PE
Field Sales Manager - North
TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION
(804) 316-5251
James.Fanning@.toshiba.com

Cc: James Radish, Manager, OEM Service Projects
Julie Kulzick, Proposal Specialist

1 Base Scope of Services

1.1 Set up scaffolding as necessary (PLANT).

1.2 Mobilize [redacted]

1.2 Mobilize [redacted] to the site.

1.4 Establish PLANT contact interface

1.5 Complete safety training required by PLANT

1.6 Review plans with PLANT personnel

1.7 Turnkey installation of high-voltage bushings (HVB):

1.7.1 Verify that the hydrogen gas in the generator has been completely evacuated.

1.7.3 Remove the existing HVB.

1.7.3.1 [redacted]

1.7.3.1.1 [redacted]

1.7.3.1.2 [redacted]

1.7.3.1.3 [redacted]

1.7.3.1.4 [redacted]

1.7.3.1.5 [redacted]

Figure 1

1.7.3.1.6 [redacted]

1.7.3.1.7 [redacted]

1.7.3.1.8 [redacted]

1.7.3.1.9 [redacted]

1.7.3.2 [redacted]

1.7.3.2.1 [redacted]

1.7.3.2.2 [redacted]

1.7.3.2.3 [redacted]

1.7.3.2.4 [redacted]

1.7.3.2.5 [redacted]

1.7.3.2.6 [redacted]

1.7.3.3 [redacted]

1.7.3.3.1 [redacted]

1.7.3.3.2 [redacted]

1.7.3.3.3 [redacted]

1.7.3.3.4 [redacted]

1.7.3.3.5 [redacted]

1.7.3.3.6 [redacted]

1.7.3.3.7 [redacted]

1.7.4 [redacted]

1.7.5 [redacted]

1.7.5.1 [redacted]

1.7.5.2 [redacted]

1.7.5.3 [redacted]

1.7.5.4 [redacted]

1.7.5.5 [redacted]

[redacted]

1.7.5.6 [redacted]

1.7.5.7 [redacted]

TOSHIBA

1.7.6 [redacted]
1.7.7 [redacted]
1.7.8 [redacted]
1.7.9 [redacted]
1.7.10 [redacted]

2 Division of Responsibility (DOR)

		Lingan	TAES
	Pre-Outage Site Preparation	X	
1	Set up staging area for tooling and materials with 100 feet of work area.	X	
2	Provide parking for TAES personnel near the work site.	X	
3	Receive, off-load, and stage Toshiba tools and equipment.	X	
4	Provide electrical service to the work area and make connections as needed	X	
5	Provide and connect temporary lighting for the laydown and work area.		X
6	Route service water to work area as needed.	X	
7	Provide compressed air to work area as needed.	X	
8	Fitness for Duty (drug and alcohol testing) program and implementation for TAES labor.		X
	Outage Support Functions		
9	Provide, install, and remove approved scaffolding, as needed. TAES to provide direction as needed to PLANT.	X	
10	Provide mobile crane(s) as necessary for work during the time TAES is on site.	X	
11	Provide a trained crane operator and rigging personnel as needed by TAES.	X	
12	Provide pre-inspection of overhead crane.	X	
13	Provide replacement parts.	X	
	Work Scope Specific Responsibilities		
14	Manage FME program and associated equipment.	X	
15	Manage confined space program, equipment, and personnel.	X	
16	Provide expendables and consumables.		X
17	Provide fork trucks and electric pallet jack and operators, if needed	X	
18	Provide site outage organization chart and emergency numbers.	X	X
19	Purge Generator hydrogen gas and refill after work is complete.	X	
20	Provide personal protective equipment for Toshiba personnel.		X
21	Provide access to Toshiba design engineering support and drawings to PLANT.		X
22	Provide one point contact per shift.	X	X
23	Manage and provide data sheets and documentation		X
24	Adhere to the Site safety plan.		X
25	Complete Lockout/Tagout.	X	
26	Review Lockout/Tagout.		X
27	Approve Extra Work Authorizations (EWA's), if necessary.	X	
28	Provide first aid supplies and facility	X	
29	Provide access to an ambulance service	X	
	Waste Removal and Control		
30	Keep work area clean.	X	X
31	Provide hazardous waste storage and removal, if needed.	X	

32	Responsible for all asbestos insulation or asbestos material identification, removal, and disposal.	X	
33	Responsible for removal and disposal of all lead paint.	X	
34	Disposal of scrap parts.	X	
	Demobilization		
35	Arrange for the return shipping of all Toshiba tools and equipment.		X

3 Technical Clarifications

3.1 This proposal assumes that the existing mounting holes for the HVBs will be reused as is.

3.1.1 If new mounting holes are required, this will be considered extra work and quoted separately.

3.2 This proposal assumes that the area directly below the HVBs will be clear and that adequate space and accessibility is available for the removal and installation activities.

3.3 Lead/Asbestos

3.3.1 This proposal assumes that the HVBs are lead carbonate and asbestos free. If asbestos or lead is encountered, abatement of the hazardous material will be required and this will be quoted separately at the time of discovery.

3.3.2 Required abatement activities may impact the project schedule. TAES will not be responsible for any schedule delays associated with unforeseen abatement activities.

3.4 Proprietary Information/Intellectual Property

3.4.1 Drawings, data sheets, specifications, procedures, etc. will be made available for review by authorized Nova Scotia Power representatives at TAES. This information will not be directly supplied to Nova Scotia Power.

3.5 Preliminary Schedule

3.5.1 Preliminary schedule details for the various tasks associated with this proposal will be supplied upon contract award.

3.6 Parts

3.6.1 Replacement parts are not included in the price of this proposal.

4 Schedule

4.1 TAES will work with NSPI and Lingan to schedule this work during the planned Spring 2016 outage.

4.2 TAES estimates [redacted] from start to completion.

5 Price

5.1 Base Scope: [redacted] USD Fixed Price

6 Commercial Clarifications

6.1 Work shall be performed in accordance TAES Parts and Equipment Services Terms and Conditions, Attachment 1.

6.2 Sales and use taxes, VAT, gross receipts, excise taxes and other local and state taxes, fees and any security instrument cost are not included unless specifically identified above.

6.3 Any work required beyond what is outlined in Section 1, Scope of Services, shall be considered extra work.

6.3.1 This includes additional time or delays, including standby time, outside the direct control of TAES or added scope.

6.3.2 A written authorization from the Owner must be received prior to performing extra work.

6.3.3 Extra work shall be billed in accordance with the *Milwaukee Service Center and Field Technician Rate Sheet for 2016 (*Attachment 2*)* and *TAES 2016 Time and Material*

Rates for Field Service Engineers, Specialists and Site Management Services (Attachment 3) *.*

6.4 This offer shall remain valid for thirty (30) calendar days from the date of the proposal.
6.5 The above price and delivery is subject to prior sale.
6.6 TAES proposes the following milestone payment schedule for this proposal:
  6.6.1 10% upon receipt of purchase order.
  6.6.2 90% upon completion of work
6.7 Payment shall be net thirty (30) days.
  6.7.1 A late payment service charge of 1- 1½% per month shall apply.
6.8 This document and information are not to be reproduced, transmitted, disclosed, or used otherwise in whole or in part without the written authorization of TAES.
6.9 Pricing is based upon all site work occurring during the non-holidays or holiday weekends.
6.10 A minimum lead time of 60 calendar days is required to support the scope. Order award received within 60 calendar days of the project start date may subject pricing to expediting fees.
6.11 TAES will require the assistance of NSPI in obtaining and completing all certifications and permissions associated with US citizens performing work in Canada.

7 Attachments

7.1 **Attachment 1**: TAES Parts and Equipment Services Terms and Conditions
7.2 **Attachment 2**: Milwaukee Service Center and Field Technician Rate Sheet for 2015
7.3 **Attachment 3**: TAES 2016 Time and Material Rates for Field Service Engineers, Specialists and Site Management Services

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Leading Innovation >>>

TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION

6623 W. WASHINGTON STREET, WEST ALLIS, WI 53214
PHONE: (414) 475-2800
FACSIMILE: (414) 475-2858

June 18, 2015

Nova Scotia Power, Inc.
Hugh Kerr, Supply Chain Manager
1894 Barrington Street, PO Box 910
Halifax, Nova Scotia, Canada, B3J 2W5

RE: TAES Proposal QUO-02271-J9G1 Rev.00
Lingan Unit 4 – High Voltage Bushing Refurbishment

Dear Mr. Kerr,

Toshiba America Energy Systems Corporation (TAES) is pleased to offer this fixed price proposal for the refurbishment service of six (6) High Voltage Bushings for Lingan Unit 4. The TAES proposal consists of the following sections:

Section 1 – Base Scope of Work
Section 2 – Optional Scope
Section 3 – Technical Clarifications
Section 4 – Schedule
Section 5 - Pricing
Section 6 – Commercial Clarifications
Section 7 – Attachments

I hope this proposal is of interest to you and look forward to discussing it with you in detail in the very near future. In the meantime, should you require additional information, please feel free to call me.

Regards,

James Fanning

James Fanning, P.E.
Field Sales Manager - North
TOSHIBA AMERICA ENERGY SYSTEMS CORPORATION
804-316-5251
James.Fanning@.toshiba.com

Cc: James Radish. Manager, OEM Service Projects.
Julie Kulzick, Proposal Specialist

TOSHIBA

Reference generator information

Manufacturer	Toshiba
Rated Output	150 MW
Generator Capacity	177 KVA
RPM	3600
Power Factor	95
Frequency (Hz)	60

1 Base Scope of Work – Refurbishment of six (6) high voltage bushings (HVBs)

1.1 Receive and offload HVBs at TAES Milwaukee Service Center.

1.2 Incoming dimensional and visual inspections

1.2.1 Check to see if porcelain bushing shell or cementing is cracked.
1.2.2 Check threaded part of HVB tubular copper conductor for damage.
1.2.3 Protect the porcelain from breaking if it is to be reused.
1.2.4 Dimensionally inspect and record the gap between the [redacted]
1.2.5 Dimensionally inspect and record gap between [redacted]

1.3 Disassemble, clean, and inspect

1.3.1 Clean and NDE gasket contact surfaces.
1.3.2 Check core insulation and reuse if no abnormalities are found.
1.3.3 Check all parts for damage [redacted] plate as needed.

1.4 Assembly

1.4.1 Install hydrogen end seal plate.
1.4.2 Install tubular copper.
1.4.3 Install new gasket.
1.4.4 Assemble spring and porcelain shell.
1.4.5 Install spanner nut.
1.4.6 Measure new gaps between spring supports and retainer.
1.4.7 Tighten nuts until specified dimension is reached.
1.4.8 Machine as needed to obtain required clearances.

1.5 Leakage test

1.5.1 [redacted]
1.5.2 Slowly fill up to 6 kg/cm (85psi) with air.
1.5.3 Check to see if any leakage around porcelain shell and O-ring.

1.6 AC Hi-pot (DI-Electric) test

1.6.1 37.5 Kv/1 minute.

1.7 Prep for shipping and load

1.7.1 Shipping is not provided as part of the Base Scope of Work.

2 Optional Scope

2.1 TAES can arrange shipping at an additional cost

2.1.1 Shipping containers to be provided by Customer.
2.1.2 Plant personnel or others will be responsible for packaging and the loading and unloading of the HVBs on/off the truck at the plant.

3 Technical Clarifications

3.1 Work Location

3.1.1 TAES will be performing the High Voltage Bushing (HVB) refurbishment and testing in their Milwaukee Service Center, located in West Allis, Wisconsin

3.2 Shipping Details

3.2.1 HVBs are to be received in reusable shipping containers. TAES strongly recommends NSPI inspect and reuse the packaging container(s) utilized for the previous set of refurbished HVBs.

3.2.2 Shipping is the responsibility of NSPI (unless the option listed in 5.1.2. is chosen).

3.3 Lead/Asbestos

3.3.1 This proposal assumes that the HVBs are lead carbonate and asbestos free. If asbestos or lead is encountered, abatement of the hazardous material will be required and this will be quoted separately at the time of discovery.

3.3.2 Required abatement activities may impact the project schedule. TAES will not be responsible for any schedule delays associated with unforeseen abatement activities.

3.4 Proprietary Information/Intellectual Property

3.4.1 Drawings, data sheets, specifications, procedures, etc. will be made available for review by authorized Nova Scotia Power representatives at TAES. This information will not be directly supplied to Nova Scotia Power.

3.5 Preliminary Schedule

3.5.1 Preliminary schedule details for the various tasks associated with this proposal will be supplied upon contract award.

3.6 TAES Shop Access

3.6.1 During the performance of the work outlined by this proposal, authorized Nova Scotia Power representatives are welcome to visit TAES to review job progress. Such visits shall be coordinated through TAES' designated project manager. Visits in TAES' shop require escorted access and shall be scheduled as far in advance as possible. TAES typically performs repair work on a 2-shift basis and requests for visits should be limited to times during 1st shift when possible.

3.7 Additional Work

3.7.1 Any work required outside of the above outlined Section 1 – Base Scope of Supply will be considered extra work and will be quoted separately.

3.7.1.1 This includes additional time or delays outside the direct control of TAES or added scope

3.7.1.2 A written authorization from NSPI must be received prior to performing such extra work.

3.7.1.3 Extra work shall be performed in accordance with Milwaukee Service Center and Field Technician Rate Sheet for 2015 (Attachment 2).

3.8 Parts

3.8.1 Replacement parts are not included in the price of this proposal.

4 <u>Schedule</u>

4.1 TAES requests a minimum of [redacted] duration to perform this work at the Milwaukee Service Center which will allow for the disassembly, inspections and reassembly to occur during non-peak time periods.

4.2 TAES requests [redacted] time notice before arrival at MSC.

4.3 Return shipment from TAES to PLANT must occur within [redacted] of completion of work.

5 <u>Price</u>

5.1 Price

5.1.1 Base Scope of Work: [redacted] USD Fixed Price for the refurbishment of six (6) high voltage bushings.

5.1.2 Optional Scope: [redacted] USD T&M for the roundtrip shipping of six (6) HVB to the Milwaukee Service Center from the Lingan Plant.

6 Commercial Clarifications

6.1 Work to be performed in accordance with TAES Parts and Equipment Services Terms and Conditions, Attachment 1.

6.2 Sales and use taxes, VAT, gross receipts, excise taxes and other local and state taxes, fees, and any security instrument costs are not included unless specifically identified above.

6.3 This offer shall remain valid for thirty (30) calendar days from the date of the proposal.

6.4 The above price and delivery is subject to prior sale.

6.5 TAES proposes the following milestone payment schedule for this proposal.

6.5.1 10% upon receipt of purchase order

6.5.2 90% upon completion of base work scope

6.6 Payment shall be net thirty (30) days.

6.6.1 A late payment service charge of 1½% per month shall apply.

6.7 This document and information are not to be reproduced, transmitted, disclosed, or used otherwise in whole or in part without the written authorization of TAES.

6.8 The importer of record is Nova Scotia Power, Inc. Documentation required for border crossing is NSPI scope.

7 Attachments

7.1 **Attachment 1:** TAES Parts and Equipment Services Terms and Conditions

7.2 **Attachment 2:** Milwaukee Service Center and Field Technician Rate Sheet for 2015

Chemical

Chemical Systems

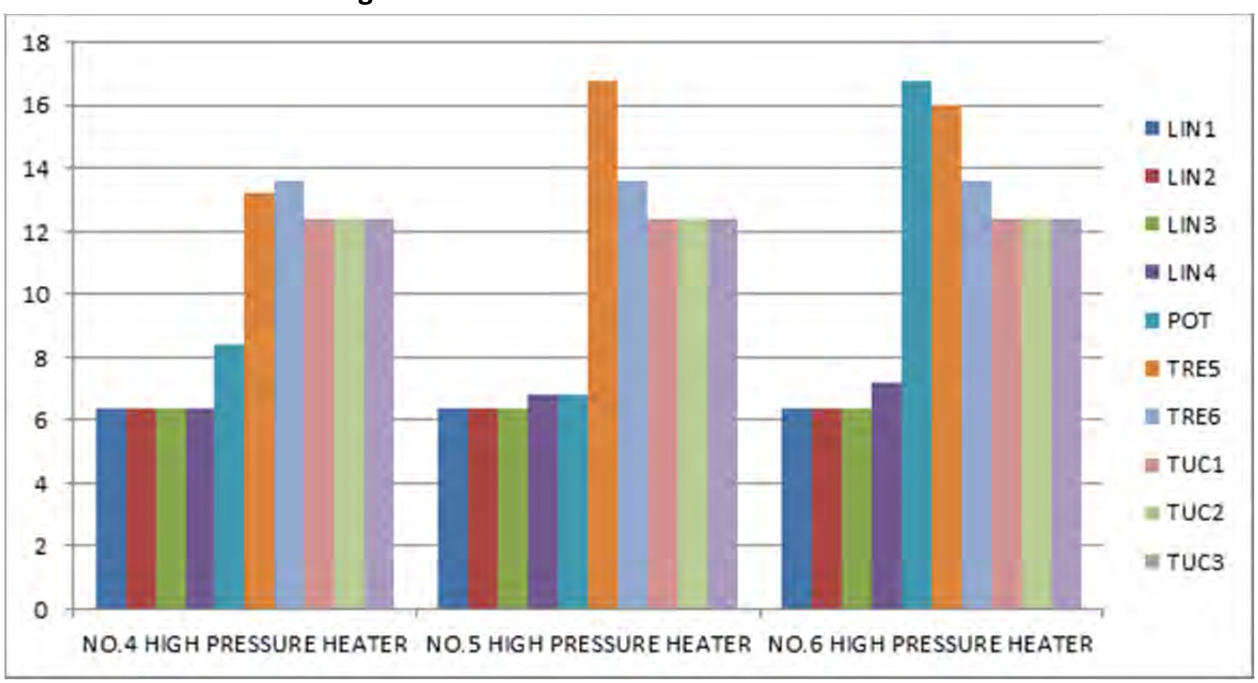
NS Power has a fleet of chemical systems that include water treatment plants and boiler feed water conditioning and controls.

Each Generating Station includes a Water Treatment Plant with associated treatment systems. Equipment includes: Chemical Injection Facilities, Clarifiers, Water Filtrations, Demineralizers, Reverse Osmosis units and all associated pumping, holding, controls and electrical systems. These plants receive locally supplied domestic quality water and produce boiler grade water as boiler make up and reserve water supply. Each generating station also includes Polishing Systems (Demineralizers, dosing and monitoring) which treat boiler feedwater before returning it to the Boiler.

The equipment types across these systems is diverse. The internal Chemical Reliability Team rates the criticality of the key equipment in this asset class and assesses condition to produce comparative risk analysis for the fleet.

As in other asset classes, this risk rating provides a comparative view of risk across the fleet and enables the development of the capital investment plan. The picture below shows calculated risk on three different High Pressure Feedwater Heaters across the thermal fleet of generating units.

High Pressure Feedwater Heater Risk Profiles



CI Number: 47762

Title: LIN4 Analytical Panel Replacement

Start Date: 2016/01
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $401,658

DESCRIPTION:

This project is for the replacement of the Analytical Panel on Unit 4 of the Lingan Generating Station that monitors the boiler feedwater chemistry. Quality feedwater chemistry is crucial to preventing corrosion and deposition in the boiler and steam turbine systems.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power's capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Reliable operation of Steam Generating Units requires online monitoring of Cycle Chemistry Key Performance Indicators. Analytical Panels are used to monitor water quality parameters that prevent corrosion mechanisms, enabling long operating life of the steam generator, turbine and auxiliary equipment. The Lingan Unit #4 analytical panel is original to the plant and its functionality is becoming less reliable at a time when feedwater chemistry analytics are becoming more critical. Flexible unit operation and asset management rely on accurate measurement and analysis to assist in decision making related to boiler components. In addition, industry standards continue to evolve in support of cycle chemistry measurements. Maintaining industry standard in steam cycle chemistry is important to monitoring operation practice and optimizing boiler life. In the event of not replacing this analytical panel, the likelihood of a chemistry upset with extensive damage to the steam generating equipment would be greatly increased.

Why do this project now?

As Lingan Unit #4 moves to more flexible and low load operations, online monitoring of cycle chemistry parameters is crucial for an effective asset protection program. Furthermore, the existing panel is no longer reliable and must be replaced. Additionally, it no longer meets Electric Power Research Institute (EPRI) standards.

Why do this project this way?

Replacement of the analytical panel and sample cooling system is the only method to provide reliable analysis of water and steam chemistry. Developments in online ion analysis will improve asset protection by providing unit operators real time data to proactively mitigate chemistry upsets.

CI Number : 47762 - LIN4 Analytical Panel Replacement **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		5,618	0	5,618
095		095-Thermal Regular Labour AO		12,720	0	12,720
095		095-Thermal Term Labour AO		5,074	0	5,074
095		095-Thermal & Hydro Contracts AO		6,509	0	6,509
001	016	001 - THERMAL Regular Labour	016 - SGP - Feed Water Sys.	62,751	0	62,751
004	016	004 - THERMAL Term Labour	016 - SGP - Feed Water Sys.	25,034	0	25,034
011	016	011 - Travel Expense	016 - SGP - Feed Water Sys.	10,000	0	10,000
012	016	012 - Materials	016 - SGP - Feed Water Sys.	203,826	0	203,826
013	016	013 - POWER PRODUCTION Contracts	016 - SGP - Feed Water Sys.	63,750	0	63,750
066	016	066 - Other Goods & Services	016 - SGP - Feed Water Sys.	6,375	0	6,375
			Total Cost:	401,658	0	401,658
			Original Cost:	167,383		

Capital Project Detailed Estimate

Location: Steam
CI# : 47762
Title: LIN4 Analytical Panel Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	20.00	$ 351	$ 7,025		
Engineering	PD	20.00	$ 397	$ 7,947		
Power Plant Technician	PD	120.00	$ 375	$ 44,954		
Utilityworker	PD	12.00	$ 235	$ 2,826		
			Sub-Total	$ 62,751		CI 46496
004 Term Labour						
Maintenance Trade	PD	35	$ 715.27	$ 25,034		
			Sub-Total	$ 25,034		CI 46496
011 Travel Expense						
Factory Acceptance Testing	$	1	$ 10,000	$ 10,000		
			Sub-Total	$ 10,000		
012 Materials						
Analytical Panel	USD	1	[redacted]		Cost Support Item #1	
Isokinetic Nozzle	USD	1				
USD to CDN Exchange	%	25%				
Tubing	Lot	1	$ 5,000	$ 5,000		
Misc. Consumable	Lot	1	$ 5,000	$ 5,000		
			Sub-Total	$ 203,826		
013 Contracts						
Installation services for Main Steam Isokinetic Nozzles	$	1	$ 25,000	$ 25,000		
Heat Treatment for Main Steam Isokinetic Nozzle Connection	$	1	$ 20,000	$ 20,000		
Commissioning	USD	1	$ 15,000	$ 15,000		
USD to CDN Exchange	$	25%	$ 15,000	$ 3,750		
			Sub-Total	$ 63,750		
066 Other Goods & Services						
Contingency	%	10%	$ 63,750	$ 6,375		
			Sub-Total	$ 6,375		
094 Interest Capitalized						
AFUDC				$ 5,618		
			Sub-Total	$ 5,618		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 12,720		
Thermal Term Labour AO				$ 5,074		
Thermal / Hydro Contracts AO				$ 6,509		
			Sub-Total	$ 24,303		
			SUB-TOTAL (no AO, AFUDC)	$ 371,737		
			TOTAL (AO, AFUDC included)	$ 401,658		
Original Cost				$ 167,383		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

NOVA SCOTIA POWER

for

Lingan

Proposal for

Steam and Water Sample Panel

Sentry Equipment Corp.

Proposal No. 140912A - R1

November 13, 2014

Sentry Contact: Joe Kreinus
Phone (262) 560-8196
E-mail: JoeK@Sentry-equip.com

A. Introduction

Sentry Equipment Corp. is an employee owned company with over 85 years of sampling equipment experience. We have equipment in 50 states, as well as 55 countries. [redacted]

Our Sampling Rack consists of modular stainless steel front conditioning rack and includes a concealed wiring trough on the front of the conditioning section for routing sensor cables back to the monitor panel. [redacted]

Another unique feature of the Sentry Equipment Sampling & Analysis Panel is the use of a combination back pressure regulator/relief valve. (BPR/RV) [redacted]

[redacted]

B. Price

Sentry proposes the following equipment as described in the Technical Proposal:

- *One (1) 5-line Water and Steam Sample & Analysis Panel consisting of a Sample Conditioning Rack (SCR), Wet Analyzer Rack (AR), and a Control/Monitor Panel (CMP). The overall design of the sample system will be similar to the sample panel previously supplied* [redacted]

  Note: The sample system proposed will be shipped complete as one skid with sample conditioning on the left and the CMP on the right with the wet analyzer rack in the middle. [redacted] *Please contact us if a different configuration is required.*

- *One (1)* [redacted] *air-cooled Temperature Control Unit (TCU) for secondary cooling of the samples to the EPRI recommended 77°F $\pm$ 1°F. The chiller unit will be shipped loose. Interconnect piping and wiring between the chiller unit and the sample system is to be supplied by* [redacted] *The chiller unit requires a* [redacted] *power supply and is suitable for* [redacted] *location.*

[redacted]

D. Options

- Technical assistance during installation, start-up, training, etc. is proposed on a time and material basis [redacted]

E. Delivery

- *Submit Mechanical Drawings.............. [redacted]
- *Submit Electrical Drawings .... [redacted]
- Begin Procurement .... [redacted]
- Submit Preliminary O&M manual .... [redacted]
- Ship .... [redacted]
- Submit Final O&M manual .... [redacted]

[redacted]

F. Technical Clarifications/Exceptions

1. [redacted]

A. General

Each piece of equipment is completely assembled, piped and wired at the factory, ready for installation when received at the site.

[redacted]

Drawings will be provided for review and approval. [redacted]

Unless otherwise specified, Sentry will provide [redacted] of the Installation, Operation and Maintenance manuals and [redacted].

B. System Overview

1. Sample Tubing

   The Supplier's responsibility for tubing begins with and includes the bulkhead fitting at the inlet of the conditioning rack. Tubing material is [redacted] welded stainless steel. All fitting connections internal to the rack comply with [redacted]

2. Materials & Components

   All tubing and system components wetted by the sample stream are [redacted] or [redacted] or as supplied as part of purchased instrumentation. All parts subject to high pressure or temperatures or other severe duty shall be of materials suitable for the service.

   The sample conditioning section panel face is made of [redacted]. The sink is made of [redacted] and is mounted across the entire conditioning section. The sink dimensions are [redacted]

   There are many variables associated with determining materials of construction. Any recommendations that seller makes herein are based on published literature available in text books and/or user recommendations. Any references are based on empirical study, and may not correlate directly with the end user's process (i.e. concentrations, temperatures, etc.).

   Sentry does not warrant against erosion, corrosion, and more specifically, the material compatibility of elastomers in specific services.

   Pressure reduction of high pressure samples (greater than 500 psig) is performed by using the Sentry VREL® (variable rod-in-tube) pressure reducing valve. [redacted]

   [redacted]

Our design includes a Sentry BPR/RV, which functions as both a Back Pressure Regulator and a Relief Valve. [redacted]

3. Sample Coolers and Cooling Water System

   Sample temperature is reduced using "primary" full counterflow sample coolers to achieve close approach temperature to the primary cooling water.

   All coolers are of the coil-in-shell type design, with counterflow of sample and cooling water. [redacted]

   For maintenance, the sample coolers have removable shells. All coolers have [redacted] The headers and coolers are protected from over pressurization [redacted]

4. Mounting

   The equipment is designed to be bolted to the purchaser supplied foundation. It is recommended that shims and non-shrinking grout be used to ensure that the equipment is level. All valves and accessories are mounted so that they are within the dimensional confine of the rack/panel.

5. Welding

   All welding done by Sentry Equipment Corp. or their immediate sub-contractors for structural, pressure vessel, and pressure retaining piping is done by welders qualified in accordance with Weld Procedure Specifications meeting the requirements of [redacted]. Weld Procedure Specifications, Procedure Qualification Records, and Welder Performance Records complying with [redacted] are maintained by Sentry's Quality Assurance department and are available, upon request. Visual weld inspection performed by Sentry Equipment Corp. inspectors meet the requirements of [redacted]

6. Electrical

   Distribution of power to the panel is centralized from a circuit breaker.

   Our standard terminal blocks are [redacted]

[redacted]

7. Storage

   We recommend storing the sample panel in an indoor temperature controlled environment until installation.

C. Factory Tests

Sentry will perform the following tests on the equipment before it is shipped. All test data is recorded and maintained in Sentry's files and is available for inspection by NOVA SCOTIA POWER.

- [redacted]
- [redacted]
- [redacted]
- [redacted]

D. Warranty

Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship for [redacted] from the substantial completion date, not to exceed [redacted] from date of shipment. If, within such a period, any such products shall be proved to Seller's satisfaction to be defective, such products shall be repaired or replaced at Seller's option.

Sellers' obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within [redacted] days after its discovery to Seller.

The foregoing warranties are exclusive and in lieu of all other express and implied warranties except in title, including but limited to, implied warranties of merchantability and fitness for purpose. Seller shall not be subject to any other obligations or liabilities whatsoever with respect to products manufactured or furnished by it, or any undertakings, acts or omissions relating thereto.

CI Number: 47961

Title: LIN1 Condenser Tube Sheet Protective Coating

Start Date: 2016/07
In-Service Date: 2016/08
Final Cost Date: 2017/02
Function: Steam
Forecast Amount: $333,944

DESCRIPTION:

This project includes the installation of a protective polymer coating on the condenser tube sheet on Lingan Unit #1.

Lingan Generating Station utilizes a once through surface condenser cooled by sea water to condense the steam from the turbine. The condenser is critical to the steam cycle as it acts as a heat sink to create vacuum that drives the turbine. The integrity of the condenser is crucial to protecting both the boiler and the turbine. A leak in the condenser can allow cooling seawater to enter the steam cycle which would cause significant damage to the unit's components. This protective coating has been installed and used on Lingan Units 2, 3 & 4 and has prevented inlet tube erosion and subsequent failures. Lingan Unit #1 is the only unit at the station without a protective coating on the tube sheet.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Utilizing a protective polymer coating on Lingan Units 2, 3, and 4 condenser tube sheets has resulted in improved integrity of the condenser, resulting in reduced outages and polishing costs. In 2014, Unit #1 experienced 37 tube leaks, over three unit outages, in the condenser. Condenser integrity is approximately 25 percent greater on the units with tube sheet coatings. A higher integrity leads to fewer forced outages, which avoids replacement energy and repair costs.

While Lingan Unit #1 is anticipated to be one of the first coal units to be retired in the future, the economic payback period of this investment is 3.7 years, which is well within the life expectancy of Lingan Unit #1.

Why do this project now?

The condenser at Lingan Unit #1 has seen reduced performance in relation to condenser mechanical integrity. As the unit ages the condenser tube failure frequency will increase negatively affecting unit reliability and operating costs.

Why do this project this way?

Utilizing protective coatings on condenser tube sheets has been proven to improve condenser tube failures at the other three units at Lingan Generating Station.

CI Number : 47961 - LIN1 Condenser Tube Sheet Protective Coating **Project Number**

Parent CI Number : -

Cost Centre : 304 - 304-Lingan 1&2 Prod. Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		3,931	0	3,931
095		095-Thermal & Hydro Contracts AO		23,891	0	23,891
095		095-Thermal Term Labour AO		3,931	0	3,931
001	014	001 - THERMAL Regular Labour	014 - SGP - Circ.Water Sys.	19,395	0	19,395
004	014	004 - THERMAL Term Labour	014 - SGP - Circ.Water Sys.	19,395	0	19,395
012	014	012 - Materials	014 - SGP - Circ.Water Sys.	6,000	0	6,000
013	014	013 - POWER PRODUCTION Contracts	014 - SGP - Circ.Water Sys.	[redacted]	0	[redacted]
066	014	066 - Other Goods & Services	014 - SGP - Circ.Water Sys.	[redacted]	0	[redacted]
			Total Cost:	333,944	0	333,944
			Original Cost:	67,895		

Capital Project Detailed Estimate

Location: Steam
CI# : 47961
Title: LIN1 Condenser Tube Sheet Protective Coating
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	40	$ 365	$ 14,591		
Utilityworker	PD	20	$ 240	$ 4,804		
			Sub-Total	$ 19,395		
004 Term Labour						
Maintenance Trades	PD	40	$ 365	$ 14,591		
Utilityworker	PD	20	$ 240	$ 4,804		
				$ -		
			Sub-Total	$ 19,395		
012 Materials						
Misc. Consumables	ea	1	$ 6,000	$ 6,000		
				$ -		
			Sub-Total	$ 6,000		
013 Contracts						
Protective Coating Service	Lot	1	[redacted]	[redacted]	Cost Support Item #1	
CDN to USD Exchange	%	30%	[redacted]	[redacted]		
			Sub-Total	[redacted]		
066 Other Goods & Services						
Contingency	%	10%	[redacted]	[redacted]		
				$ -		
			Sub-Total	[redacted]		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 3,931		
Thermal Term Labour AO				$ 3,931		
Thermal / Hydro Contracts AO				$ 23,891		
			Sub-Total	$ 31,754		
			SUB-TOTAL (no AO, AFUDC)	$ 302,190		
			TOTAL (AO, AFUDC included)	$ 333,944		
Original Cost				$ 67,895		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN1 Condenser Tube Productive Coating
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production		**Date :**	**02-Nov-15**
Department :	Lingan Generating Station		**CI Number:**	47961
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Install Coating vs. Replacement Energy	6.11%	-1,117,372	821,365	1	43.71%	3.7 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to install the protective coating to mitigate the risk of condenser tube leaks.

Notes/Comments :

Install Coating vs. Replacement Energy & Repair Costs

It is assumed that the longer the condenser runs with no protective coating, tube leak probability will increase. The analysis includes two possible failure types, a tube leak and a boiler gross salt contamination that is possible from an extreme condenser leak. In the event of a tube leak, a 5 day outage would be expected. In the case of an extreme condenser leak, a 3 week (21 day) outage would be expected. The outage duration used is 8 days, which represents a higher likelihood of a tube leak compared to the extreme condenser leak.

Test 2

Test 3

Test 4

LIN1 Condenser Tube Productive Coating
Summary of Sensitivities

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47961
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Install Coating vs. Replacement Energy & Repair	6.11%	-1,117,372	821,365	1	43.71%	3.7 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Install Coating vs. Replacement Energy & Repair	10%	-1,086,485	798,026	1	39.98%	3.9 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years
	Change:	**A**	30,887	-23,339	0	-3.73%	0.2 years
		B	0	0	0	#NUM!	0.0 years
		C	0	0	0	#NUM!	0.0 years
		D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Install Coating vs. Replacement Energy & Repair	-10%	-974,748	715,889	1	39.61%	3.9 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years
	Change:	**A**	142,624	-105,475	0	-4.10%	0.2 years
		B	0	0	0	#NUM!	0.0 years
		C	0	0	0	#NUM!	0.0 years
		D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	63,678	127,929	198,943	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN1 Condenser Tube Productive Coating
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan Generating Station	CI Number:	47961
Originator :		Project No. :	

Install Coating vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			86,440	89,900		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	70%	80%	70%	80%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	154.0	154.0				
Duration (Hours)	192	192				
Totals	$7,774	$13,761	$60,508	$71,920	$68,282	$85,681
Total Capital Cost of Alternative						$333,944

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

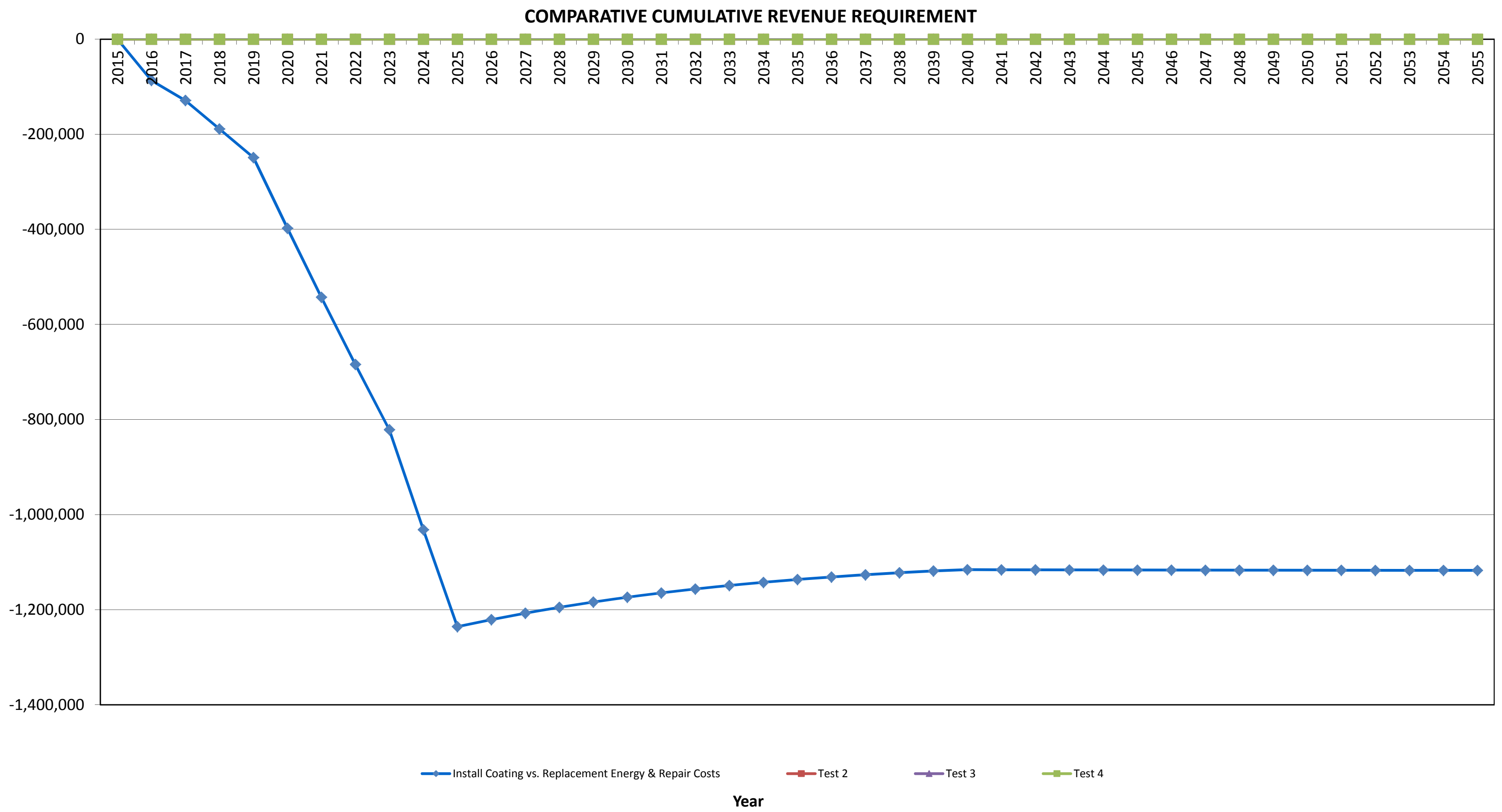
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN1 Condenser Tube Productive Coating
Install Coating vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	68,281.7	(302,190.1)	12,087.6	298,866.6	(233,908.4)	(17,420.2)	(251,328.5)	(236,856.6)	0.94	(236,856.6)
2017	-	-	85,681.3	-	23,208.2	274,195.2	85,681.3	(19,366.7)	66,314.6	58,897.5	0.89	(177,959.1)
2018	-	-	110,668.3	-	21,351.5	251,497.5	110,668.3	(27,688.2)	82,980.1	69,455.3	0.84	(108,503.9)
2019	-	-	115,951.3	-	19,643.4	230,615.6	115,951.3	(29,855.4)	86,095.8	67,913.6	0.79	(40,590.2)
2020	-	-	246,809.3	-	18,071.9	211,404.2	246,809.3	(70,908.6)	175,900.7	130,763.4	0.74	90,173.1
2021	-	-	255,796.9	-	16,626.2	193,729.8	255,796.9	(74,142.9)	181,654.0	127,264.4	0.70	217,437.6
2022	-	-	265,126.4	-	15,296.1	177,469.3	265,126.4	(77,447.4)	187,679.0	123,914.3	0.66	341,351.9
2023	-	-	274,811.2	-	14,072.4	162,509.7	274,811.2	(80,829.0)	193,982.2	120,701.1	0.62	462,053.0
2024	-	-	427,297.7	-	12,946.6	148,746.8	427,297.7	(128,448.8)	298,848.9	175,244.6	0.59	637,297.7
2025	-	-	442,953.8	-	11,910.9	136,084.9	442,953.8	(133,623.3)	309,330.5	170,946.3	0.55	808,243.9
2026	-	-	-	-	10,958.0	124,436.0	-	3,397.0	3,397.0	1,769.2	0.52	810,013.1
2027	-	-	-	-	10,081.4	113,719.1	-	3,125.2	3,125.2	1,533.9	0.49	811,547.1
2028	-	-	-	-	9,274.9	103,859.4	-	2,875.2	2,875.2	1,330.0	0.46	812,877.0
2029	-	-	-	-	8,532.9	94,788.6	-	2,645.2	2,645.2	1,153.1	0.44	814,030.1
2030	-	-	-	-	7,850.2	86,443.4	-	2,433.6	2,433.6	999.8	0.41	815,029.9
2031	-	-	-	-	7,222.2	78,765.8	-	2,238.9	2,238.9	866.8	0.39	815,896.7
2032	-	-	-	-	6,644.4	71,702.5	-	2,059.8	2,059.8	751.6	0.36	816,648.3
2033	-	-	-	-	6,112.9	65,204.2	-	1,895.0	1,895.0	651.6	0.34	817,299.9
2034	-	-	-	-	5,623.9	59,225.7	-	1,743.4	1,743.4	565.0	0.32	817,864.9
2035	-	-	-	-	5,174.0	53,725.6	-	1,603.9	1,603.9	489.8	0.31	818,354.7
2036	-	-	-	-	4,760.0	48,665.4	-	1,475.6	1,475.6	424.7	0.29	818,779.4
2037	-	-	-	-	4,379.2	44,010.1	-	1,357.6	1,357.6	368.2	0.27	819,147.7
2038	-	-	-	-	4,028.9	39,727.2	-	1,249.0	1,249.0	319.3	0.26	819,466.9
2039	-	-	-	-	3,706.6	35,786.9	-	1,149.0	1,149.0	276.8	0.24	819,743.7
2040	-	-	-	-	3,410.1	32,161.9	-	1,057.1	1,057.1	240.0	0.23	819,983.7
2041	-	-	-	-	3,137.3	28,826.8	-	972.5	972.5	208.1	0.21	820,191.8
2042	-	-	-	-	2,886.3	25,758.6	-	894.7	894.7	180.4	0.20	820,372.2
2043	-	-	-	-	2,655.4	22,935.8	-	823.2	823.2	156.4	0.19	820,528.7
2044	-	-	-	-	2,442.9	20,338.8	-	757.3	757.3	135.6	0.18	820,664.3
2045	-	-	-	-	2,247.5	17,949.6	-	696.7	696.7	117.6	0.17	820,781.9
2046	-	-	-	-	2,067.7	15,751.5	-	641.0	641.0	102.0	0.16	820,883.8
2047	-	-	-	-	1,902.3	13,729.3	-	589.7	589.7	88.4	0.15	820,972.2
2048	-	-	-	-	1,750.1	11,868.9	-	542.5	542.5	76.6	0.14	821,048.9
2049	-	-	-	-	1,610.1	10,157.3	-	499.1	499.1	66.5	0.13	821,115.3
2050	-	-	-	-	1,481.3	8,582.6	-	459.2	459.2	57.6	0.13	821,172.9
2051	-	-	-	-	1,362.8	7,133.9	-	422.5	422.5	50.0	0.12	821,222.9
2052	-	-	-	-	1,253.8	5,801.1	-	388.7	388.7	43.3	0.11	821,266.2
2053	-	-	-	-	1,153.5	4,574.9	-	357.6	357.6	37.6	0.11	821,303.8
2054	-	-	-	-	1,061.2	3,446.8	-	329.0	329.0	32.6	0.10	821,336.3
2055	-	-	-	-	976.3	2,409.0	-	302.6	302.6	28.2	0.09	821,364.5
Total	**-**	**-**	**2,293,378.0**	**(302,190.1)**	**290,962.7**		**1,991,187.9**	**(620,748.7)**	**1,370,439.2**	**821,364.5**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
-1,400,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Install Coating vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

NOVA SCOTIA POWER

LINGAN UNIT #3 CONDENSER COATING PROJECT

PLASTOCOR QUOTE # 141110-JM-1

November 10, 2014

Plastocor, Inc., is pleased to submit to our budgetary proposal for the turnkey application of our tubesheet cladding with tube-end coating and the patented tube lining process (US Patent: 7,270,847 B2; 7,717,056 B2).

CONTACTS:

Gavin Kibble, 902-428-6363, gavin.kibble@nspower.ca
Jim Mitchell, 724-942-0582, jem@plastocor.com

SCOPE OF WORK:

Clad two (2) primary inlet and two (2) return pass inlet Muntz metal tubesheets and coat 11,912, 1 inch, 18 BWG aluminum brass tube-ends to a depth of eight (8) inches.

Clad two (2) primary inlet and two (2) return pass inlet Muntz metal tubesheets and coat the full length of 11,912, 1 inch, 18 BWG aluminum brass tubes 30ôlong.

SPECIFICATION:

For tubesheets, we specify the full Plastocor Cladding System which results in the precise application of 180 mils (+/- 40 mils) of high performance, 100% solids (non-solvent emitting) epoxy materials. The Plastocor supplied materials will consist of the P-400U as our prime coat, P-2000U as our build coat and the P-400U as the top coat.

Inside the waterbox at the tubesheet-to-waterbox flanged area, we will apply DuroCaulk caulking material. The elastomeric caulking material remains flexible in service to protect the tubesheet-to-waterbox gasket area.

For tube-end coating, we specify three (3) coats of the P-400U. The coating is applied in three (3) different colors (white, gray and red). The different colors aids in quality control during application and with monitoring coating performance over time. The coating will be applied to a depth of eight (8) inches at two (2) to three (3) mils per coat. Each tube-end coat is applied to the tubesheet to anchor the tube-end coating. The termination of the coating inside the tube is a "feathered" termination with each coat going 1/4 inch further down tube than the previous coat, thus precluding "step" erosion concerns at coating termination. The coating does not puddle in the tube and has excellent adhesion characteristics to the tube wall.

The full length of the condenser tubes will be coated using Versite Technology. Versites V-200, will be applied to the full length of the tube at approximately .25 to 1 mil nominal thickness. Total film thickness will be accomplished by a single (1) pass using our shot method and proprietary applicator. No tube recovery will be attempted with the Unit on-line. The thin film approach will provide tube ID protection for coated tubes, while not interfering substantially with heat transfer.

MATERIALS:

Plastocor's P-400U, P-2000U, DuroCaulk and V-200 are 100% solids high performance epoxy. The materials offer a solvent free (zero VOC/no toxic fumes) work area for personnel safety.

APPLICATION RESPONSIBILITIES:

Plastocor performs all projects on a turnkey, non-union basis, which includes labor, equipment, tools, supplies, and materials for all phases of the project including:

- high pressure water wash with Chlor-Rid and demineralized water to decontaminate the substrate;
- dry the condenser tubesheets and tubes;
- environmental control - desiccant bed dehumidifier with in-line heater, and a dust collector;
- supply compressor providing 100% oil free air;
- surface preparation - abrasive blast using Starblast and aluminum oxide to achieve cleanliness and a 3 mil profile to SSPS-SP-5 for tubesheets and abrasive blast tube-ends;
- surface preparation - abrasive blasting the full length of tube IDôs with garnet from the inlet and outlet waterboxes to achieve ñwhite metalò appearance and profile;
- install rigging for catching squeegee pigs;
- coat tubesheets, tube-ends and the full length of the condenser tubes using our Proprietary Applicator;
- complete quality control, including random inspection of full length coated tubes using a video image scope;

From others we require:

- ALL craft labor support required by the Plant, including, but not limited to, operating engineers, boiler makers, fitters, painters, escorts, hole, safety and fire watches, etc.;
- supply security background checks, in-process training and safety training to obtain unescorted access;
- any on-site permit requirements;
- fork truck assistance;
- staging/scaffolding as required to access condenser manways and interior waterbox access to inlet and outlet condenser tubesheets;
- remove tube inserts, existing tube plugs and reinstall new Plant supplied tube plugs, if necessary;
- clean condenser tube IDôs and clear tubes of obstructions/debris;
- supply diesel fuel, demineralized water, containers or vac truck for grit and disposal of spent abrasive, waste water and other debris;
- supply electricity service and hook-up of same service within 50' of work area - 110v/single phase and 480v/three phase at 200 amps.;

APPLICATION RESPONSIBILITIES (CONőT):

- free and clear access to the condenser tubesheets;

QUOTATION:

For the scope of work performed on a turnkey/non-union basis, with a single (1) mobilization/ demobilization and a project start date of 2015, we ask:

Clad two (2) primary inlet and two (2) return pass inlet Muntz metal tubesheets and coat 11,912, 1 inch, 18 BWG aluminum brass tube-ends to a depth of eight (8) inches. . . . . [redacted] US Dollars

Clad two (2) primary inlet and two (2) return pass inlet Muntz metal tubesheets and coat the full length of 11,912, 1 inch, 18 BWG aluminum brass tubes 30ôlong . . . . [redacted] US Dollars

Any delays, standby time, turnover time between Units or additional work outside the scope of work, will be completed on a T&M basis. Please refer to our T&M rate sheet dated January15, 2014 Rev2.

No governmental, state, local, license, privilege, excise, gross receipts, value added, or similar tax or duty imposed now or in the future have (NOT) been included in the price.

SAFETY PROGRAM AND EXPERIENCE RATING MODIFICATION:

Plastocor has an industry reviewed safety program and our experience rating modification (ERM) is .77 through March 31, 2015.

SCHEDULE:

The tubesheet cladding with tube-end coating can be completed in in ten (10) consecutive days working a single (1) shift basis.

The tubesheet cladding and full length condenser tube coating can be completed in seventeen (17) days on a single (1) shift basis.

WARRANTY:

Plastocor warrants to **supply labor and material for a period of FIVE (5) YEARS** for the tubesheet cladding and **TWO (2) YEARS** for the tube-end coating and full length tube coating**,** in order to bring the coating and cladding systems up to contract conditions. Providing the condenser is operated under normal design parameters; that is, the system is not subject to workman damage, failure of Lingan Equipment or other intrusions into the circulating water system.

In no event shall Plastocor be responsible for consequential damages of any kind, downtime costs, increased expense of operation, or reconstruction of the work beyond the repair of the coating system.

CI Number: 47704

Title: POT – Replace Polisher Chemical Skid

Start Date: 2016/06
In-Service Date: 2016/08
Final Cost Date: 2017/02
Function: Steam
Forecast Amount: $321,950

DESCRIPTION:

This project includes the replacement of the polisher acid skid at the Point Tupper Generating Station. The polishing plant is part of the unit water system and provides cleaning of condensed water from the condenser to return it to the feedwater system. Chemicals are used to regenerate resin in the polishing tanks. One of the chemicals used in regeneration is sulfuric acid which is pumped into the polishers from a pumping skid. The polisher acid skid is required to regenerate condensate polishers used to control feedwater quality during start-ups, condenser leaks and normal plant operation.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Replacement of the polisher acid skid will provide reliable and safe sulfuric acid injection during polisher regenerations. The plant requires 100 percent condensate polishing during start-ups and condenser leaks. Regeneration of polisher resin is essential to maintain plant operations.

Why do this project now?

The condition of the existing equipment has deteriorated to the point where the existing polisher acid skid has experienced an increased frequency of leaks and pump maintenance. Piping does not meet current requirements set out in NS Power's internal standard QP-G033 Chemical Tanks - Piping Inspections and Repairs. Completing this replacement in 2016 will allow for reliable service.

Why do this project this way?

The condition of the acid skid does not lend itself to refurbishment. Replacement of the existing equipment is the only option that will ensure reliability, improve safety and reduce maintenance requirements.

CI Number : 47704 - POT - Replace Polisher Chemical Skid **Project Number**

Parent CI Number : -

Cost Centre : 351 - 351-Pt.Tupper Admin./Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		1,568	0	1,568
095		095-Thermal Regular Labour AO		1,953	0	1,953
095		095 - Proj Supp Regular Labour AO		4,924	0	4,924
095		095-Thermal Overtime Labour AO		390	0	390
095		095-Thermal & Hydro Contracts AO		1,536	0	1,536
095		095-Thermal Term Labour AO		1,953	0	1,953
001	016	001 - Proj Supp Regular Labour	016 - SGP - Feed Water Sys.	8,106	0	8,106
001	016	001 - THERMAL Regular Labour	016 - SGP - Feed Water Sys.	9,632	0	9,632
002	016	002 - THERMAL Overtime Labour	016 - SGP - Feed Water Sys.	3,853	0	3,853
004	016	004 - THERMAL Term Labour	016 - SGP - Feed Water Sys.	9,632	0	9,632
012	016	012 - Materials	016 - SGP - Feed Water Sys.	233,209	0	233,209
013	016	013 - POWER PRODUCTION Contracts	016 - SGP - Feed Water Sys.	7,046	0	7,046
014	016	014 - Overtime Meals	016 - SGP - Feed Water Sys.	500	0	500
066	016	066 - Other Goods & Services	016 - SGP - Feed Water Sys.	28,148	0	28,148
011	085	011 - Travel Expense	085 Design	1,000	0	1,000
041	085	041 - Meals & Entertainment	085 Design	500	0	500
013	087	013 - POWER PRODUCTION Contracts	087 Field Super.& Ops.	8,000	0	8,000
			Total Cost:	321,950	0	321,950
			Original Cost:	166,296		

Capital Project Detailed Estimate

Location: Pt. Tupper
CI# : 47704
Title: POT - Polisher Chemical Skid Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	10	$ 358	$ 3,583		
Engineering	PD	20	$ 405	$ 8,106		
Maintenance Trades	PD	10	$ 365	$ 3,648		
Utilityworker	PD	10	$ 240	$ 2,402		
			Sub-Total	$ 17,739		
002 OT Labour						
Electrician	PD	2	$ 717	$ 1,433		
Maintenance Trades	PD	2	$ 730	$ 1,459		
Utilityworker	PD	2	$ 480	$ 961		
			Sub-Total	$ 3,853		
004 Term Labour						
Electrician	PD	10	$ 358	$ 3,583		
Maintenance Trades	PD	10	$ 365	$ 3,648		
Utilityworker	PD	10	$ 240	$ 2,402		
			Sub-Total	$ 9,632		
011 Travel Expense						
Travel	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 1,000		
012 Materials						
Chemical skid with alloy 20 components and options	lot	1	[redacted]		Cost support Item #1 - Page 6 - Option 2A	
Back Pressure Valve	lot	1			Cost support Item #1 - Page 7 - Sec. 3	
Misc. and consumables	lot	1	$ 5,000	$ 5,000		
			Sub-Total	$ 233,209		
013 Contracts						
Startup and training	lot	1	$ 7,046	$ 7,046		
			Sub-Total	$ 7,046		
014 Overtime Meals						
OT meals	lot	1	$ 500	$ 500		
			Sub-Total	$ 500		
028 Consulting						
Supervision	lot	1	$ 8,000	$ 8,000		
			Sub-Total	$ 8,000		
041 Meals & Entertainment						
Meals and expenses	lot	1	$ 500	$ 500		
			Sub-Total	$ 500		
066 Other Goods & Services						
Contingency	%	10%	$ 281,479	$ 28,148		
			Sub-Total	$ 28,148		
094 Interest Capitalized						
AFUDC				$ 1,568		
			Sub-Total	$ 1,568		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 1,953		
Thermal OT Labour AO				$ 390		
Thermal Term Labour AO				$ 1,953		
Thermal / Hydro Contracts AO				$ 1,536		
Project Support Regular AO				$ 4,924		
			Sub-Total	$ 10,755		
			SUB-TOTAL (no AO, AFUDC)	$ 309,627		
			TOTAL (AO, AFUDC included)	$ 321,950		
Original Cost				$ 166,296		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

POT - Replace Polisher Chemical Skid
Summary of Alternatives

Division :	Poer Production	**Date :**	**02-Nov-15**
Department :	Point Tupper Generating Station	**CI Number:**	47704
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace Skid vs Replacement Energy &	6.11%	-4,058,077	2,976,661	1	208.81%	1.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

This project is recommended to proceed due to strong economics and reliability of the unit.

Notes/Comments :

Replace Skid vs Replacement Energy & Repair Costs

This option considers replacing the skid versus the option of doing nothing, and dealing with the replacement energy costs and added fuel costs from extra start ups from unplanned outages due to failure.

Test 2

Test 3

Test 4

POT - Replace Polisher Chemical Skid
Summary of Sensitivities

Division :	Poer Production	**Date :**	**02-Nov-15**
Department :	Point Tupper Generating Station	**CI Number:**	47704
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Skid vs Replacement Energy & Repair C	6.11%	-4,058,077	2,976,661	1	208.81%	1.0 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Skid vs Replacement Energy & Repair C	10%	-4,027,030	2,952,600	1	173.99%	1.1 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:						
	A	31,048	-24,061	0	-34.82%	0.1 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Replace Skid vs Replacement Energy & Repair C	-10%	-3,621,222	2,654,934	1	170.89%	1.1 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:						
	A	436,856	-321,727	0	-37.92%	0.1 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	234,360	527,171	877,895	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

POT - Replace Polisher Chemical Skid
Avoided Cost Calculations

Division :	Poer Production	**Date :**	**02-Nov-15**
Department :	Point Tupper Generating Station	**CI Number:**	47704
Originator :		**Project No. :**	

Replace Skid vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			45,320	46,226		
Events/Outages (#)	4	5	4	5		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	150.0	150.0				
Duration (Hours)	20	20				
Totals	$70,024	$116,993	$181,280	$231,132	$251,304	$348,125
Total Capital Cost of Alternative						$321,950

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

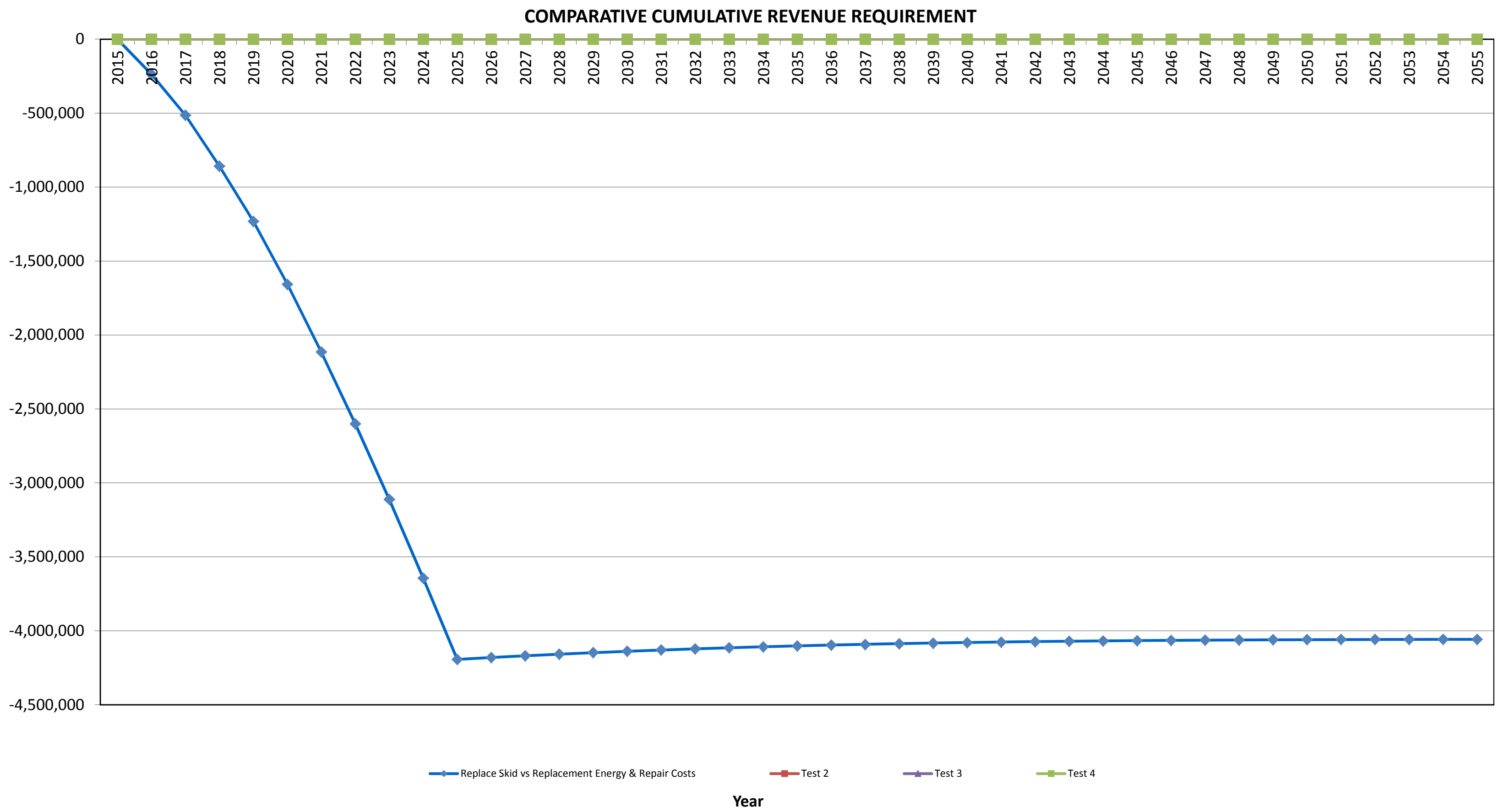
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

POT - Replace Polisher Chemical Skid

Replace Skid vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	251,303.8	(311,195.1)	12,385.1	300,210.8	(59,891.3)	(74,064.8)	(133,956.1)	(126,242.7)	0.94	(126,242.7)
2017	-	-	348,124.6	-	23,779.4	275,935.8	348,124.6	(100,547.0)	247,577.6	219,886.5	0.89	93,643.9
2018	-	-	454,985.8	-	21,877.0	253,602.8	454,985.8	(134,263.7)	320,722.1	268,447.8	0.84	362,091.7
2019	-	-	523,472.4	-	20,126.9	233,056.4	523,472.4	(156,037.1)	367,435.3	289,838.2	0.79	651,929.9
2020	-	-	632,038.5	-	18,516.7	214,153.8	632,038.5	(190,191.7)	441,846.7	328,465.7	0.74	980,395.6
2021	-	-	725,264.2	-	17,035.4	196,763.4	725,264.2	(219,550.9)	505,713.2	354,296.1	0.70	1,334,691.8
2022	-	-	821,966.0	-	15,672.6	180,764.2	821,966.0	(249,951.0)	572,015.1	377,670.7	0.66	1,712,362.5
2023	-	-	922,245.9	-	14,418.7	166,044.9	922,245.9	(281,426.4)	640,819.5	398,735.8	0.62	2,111,098.2
2024	-	-	1,026,208.2	-	13,265.2	152,503.2	1,026,208.2	(314,012.3)	712,195.9	417,630.9	0.59	2,528,729.1
2025	-	-	1,133,960.0	-	12,204.0	140,044.8	1,133,960.0	(347,744.4)	786,215.7	434,488.8	0.55	2,963,217.9
2026	-	-	-	-	11,227.7	128,583.1	-	3,480.6	3,480.6	1,812.7	0.52	2,965,030.6
2027	-	-	-	-	10,329.5	118,038.3	-	3,202.1	3,202.1	1,571.7	0.49	2,966,602.3
2028	-	-	-	-	9,503.1	108,337.1	-	2,946.0	2,946.0	1,362.7	0.46	2,967,965.0
2029	-	-	-	-	8,742.9	99,412.0	-	2,710.3	2,710.3	1,181.5	0.44	2,969,146.4
2030	-	-	-	-	8,043.4	91,200.9	-	2,493.5	2,493.5	1,024.4	0.41	2,970,170.8
2031	-	-	-	-	7,400.0	83,646.7	-	2,294.0	2,294.0	888.2	0.39	2,971,059.0
2032	-	-	-	-	6,808.0	76,696.9	-	2,110.5	2,110.5	770.1	0.36	2,971,829.0
2033	-	-	-	-	6,263.3	70,303.0	-	1,941.6	1,941.6	667.7	0.34	2,972,496.7
2034	-	-	-	-	5,762.3	64,420.6	-	1,786.3	1,786.3	578.9	0.32	2,973,075.6
2035	-	-	-	-	5,301.3	59,008.8	-	1,643.4	1,643.4	501.9	0.31	2,973,577.5
2036	-	-	-	-	4,877.2	54,030.0	-	1,511.9	1,511.9	435.2	0.29	2,974,012.6
2037	-	-	-	-	4,487.0	49,449.5	-	1,391.0	1,391.0	377.3	0.27	2,974,389.9
2038	-	-	-	-	4,128.1	45,235.4	-	1,279.7	1,279.7	327.1	0.26	2,974,717.0
2039	-	-	-	-	3,797.8	41,358.4	-	1,177.3	1,177.3	283.6	0.24	2,975,000.7
2040	-	-	-	-	3,494.0	37,791.6	-	1,083.1	1,083.1	245.9	0.23	2,975,246.6
2041	-	-	-	-	3,214.5	34,510.2	-	996.5	996.5	213.2	0.21	2,975,459.8
2042	-	-	-	-	2,957.3	31,491.2	-	916.8	916.8	184.9	0.20	2,975,644.6
2043	-	-	-	-	2,720.7	28,713.8	-	843.4	843.4	160.3	0.19	2,975,804.9
2044	-	-	-	-	2,503.1	26,158.6	-	775.9	775.9	139.0	0.18	2,975,943.9
2045	-	-	-	-	2,302.8	23,807.7	-	713.9	713.9	120.5	0.17	2,976,064.4
2046	-	-	-	-	2,118.6	21,645.0	-	656.8	656.8	104.5	0.16	2,976,168.8
2047	-	-	-	-	1,949.1	19,655.3	-	604.2	604.2	90.6	0.15	2,976,259.4
2048	-	-	-	-	1,793.2	17,824.7	-	555.9	555.9	78.5	0.14	2,976,337.9
2049	-	-	-	-	1,649.7	16,140.6	-	511.4	511.4	68.1	0.13	2,976,406.0
2050	-	-	-	-	1,517.7	14,591.2	-	470.5	470.5	59.0	0.13	2,976,465.0
2051	-	-	-	-	1,396.3	13,165.8	-	432.9	432.9	51.2	0.12	2,976,516.2
2052	-	-	-	-	1,284.6	11,854.4	-	398.2	398.2	44.4	0.11	2,976,560.6
2053	-	-	-	-	1,181.9	10,647.9	-	366.4	366.4	38.5	0.11	2,976,599.1
2054	-	-	-	-	1,087.3	9,538.0	-	337.1	337.1	33.4	0.10	2,976,632.4
2055	-	-	-	-	1,000.3	8,516.8	-	310.1	310.1	28.9	0.09	2,976,661.4
Total	**-**	**-**	**6,839,569.3**	**(311,195.1)**	**298,123.7**		**6,528,374.2**	**(2,027,848.1)**	**4,500,526.1**	**2,976,661.4**		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Replace Skid vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Quote ID: aib-150304-A-Rev-0 **Quote Date: Mar. 10, 2015.**

TO: Samsom Equipment Ltd.,
Truro, N.S.

QUOTER: **Amit**
Application: Chemical Dosing Systems,
Project: Nova Scotia Power

ATTN: Gary Chew
Gary.Chew@sansom.ca;

ProMinent®

Dear Mr. Chew,

As per your request, Prominent Fluid Controls Ltd. is pleased to submit the enclosed proposal for your favourable consideration and approval.

Please note that this proposal provides section wise pricing for the equipment as described.

Should you have any additional questions, please do not hesitate to contact us immediately.

Sincerely,

Amit Bhatt
Applications Engineering Specialist

cc: Marc Szuszkiewicz, Eng. (PFC)

Terms & Conditions

Payment Terms :	100 % Net 30 days – OR - As mentioned herein for progressive payment / TBA;
Delivery:	Drawings: 4-6 week(s) after acknowledgment of an order[1] Equipment: Section 1: 316 SS: 9 – 12 weeks / Section 2: Alloy-20: 26-32 weeks after receipt of approved drawings (ARAD)[1]
Offer Validity:	60 days

NOTES:

1. Delivery times are based on engineering schedules at time of quoting and are applicable for the validity period of the quote
2. Scope of supply is limited to this proposal and is for supply only. It does not include installation or commissioning.
3. On-site start-up support is available through a ProMinent trained Technical person, as per charges shown.
4. Custom Items are not returnable.

Table of Contents:

Payment Terms:

Payment: 100% Net 30 days, on Approved Credit, OR Progressive Payments as per following Milestones
Price: Quoted NET in Canadian funds, F.C.A. our plant in Guelph, Ontario
GST & PST: Extra (if applicable)

Milestone	% of Purchase Order Total
First submission of drawings	15%
On receipt of material	30%
On final inspection release	45%
On receipt of final documentation	10%

Cancellation Charges:

The following is a schedule of cancellation charges. In the event of an order resulting from this bid being cancelled, the following charges will apply:

Milestone	% of Purchase Order Total
Issue of Purchase Order	10%
First issue of Drawings	35%
Order of materials	85%
Start of Fabrication	100%

Section 1: Chemical Dosing System in 316 SS:

Sizing and Equipment Selection Notes:

Customer Supplied Information:

- **Project: Nova Scotia Power,**
- **Tender specifications: NO Specifications at this stage;**
- **Dosing System to be in 316 SS piping, Welded and/or flanged connections, Threaded joints to be avoided as much as possible. Chemical is to be considered as compatible with 316 SS, elastomer is Viton/PVDF/PTFE.**

Dosing Pump Capacities and other features required:

1. The Customer has requested for the Dosing Pump capacity of 230 USGPH (870 L/h); the Max. Discharge Pressure at the Dosing System is 75 psig (5.2 barg).
2. The Dosing Skid, to be installed on a Carbon Steel Welded (Non-CWB) skid frame, coated with acid resistant paint/coating.
3. The dosing system piping is to be in 316 SS welded piping with some flanged components where applicable. The system is to be fabricated to meet ASME B 31.3. No requirement of CRNs or TSSA/similar agency registration.

4. **The Chemical Dosing System is Proposed as per the Quote stage PID: AIB-150304A-100-R0, attached herewith.**

Chemical Dosing System, in 316 SS, welded piping:

Proposed is a Dual Pump Dosing Systems with Two ProMinent Hydro series, motorized, diaphragm type metering pumps, installed in a duty and stand-by configuration. The suction side includes isolation & drain valves, common calibration column and Y-strainer. The discharge side components, for each pump side include a Pressure Relief Valve, associated isolation valves, drain valves, check valves and Pressure gauges. The common single discharge line includes an isolation valve at the end connection. As an option: a Back Pressure Valve and/or a Pulsation Dampener could be included (at extra price) if required. The dosing system is not registered with ABSA/TSSA or any such agency and does not have all components with CRN. The Dosing System is designed, fabricated and tested to meet the requirements of ASME B 31.3. The dosing system is factory assembled and tested as per ProMinent standards for such dosing systems as per the Quote stage P&ID DRg. No.: AIB-150304A-100-R0, attached. The major components of each dosing system are as under:

QUANTITY:		COMPONENT DESCRIPTION:		MANUFACTURER
1	(One)	Skid Frame:	Custom skid frame for 2x Hydro 4 series pumps, in Carbon Steel welded (Non-CWB) construction, with a drip tray and painted with suitable corrosion resistant paint. The skid is suitable for floor mounting and flooded suction.	PFC

Quote ID: aib-150304-A-Rev-0 **Quote Date: Mar. 10, 2015.**

QUANTITY		COMPONENT DESCRIPTION		MANUFACTURER
2	(Two)	Dosing Pump:	**ProMinent Dosing Pumps: HYDRO-4aH, motorized, diaphragm type metering pump: Capacity: 1,070 L/h; Max. discharge pressure: 100 psig; Liquid End: PVDF; Seals: PTFE; Multi-Layer Diaphragm (PTFE);** Flanged, # 150, 1.5" suction/discharge ends; Motor: 1.5 HP; 3ph / 575 VAC/ 60 Hz; Inverter duty, TEFC Motor (WEG/Baldor), installed.	ProMinent
7	(Seven)	Isolation Valves:	1.5" Ball Valves, 316 SS, 3-pc, socket weld ends, API-607, ASME B 16.5, 1500 WOG	Velan
7	(Seven)	Isolation Valves:	1/2" Ball Valves, 316 SS, 3-pc, socket weld ends, API-607, ASME B 16.5, 1500 WOG	Velan
2	(Two)	Pressure Safety Valves:	Pr. Safety (Relief) Valve, 316SS, Sr. 2700, ASME VIII, flanged # 150 ends, ½" x 1",	Farris
2	(Two)	Pressure Gauge:	4.5", Process Pressure gauge, With 316SS Gauge Isolator.	Wika
2	(Two)	Check Valve	Check Valve, 1.5" , 316 SS, socket weld ends, 1500 WOG,	Velan
1	(One)	In-line Strainer	In-line strainer in 2" 316 SS SW construction	Colton/Equivalent
1	(One)	Calibration Pot	Calibration pot, 10 L approx.. 316 SS/Glass	Kenco/Equivalent
1	(One)	Lot Piping	Suction and Discharge piping in 1.5" 316 SS welded construction. Inlet TP to dosing skid is in 2" # 150 Flange and 2" header. Dosing System piping is to ASME B 31.3, Tested as per ProMinent standard procedures.	Pinacle/PFC
1	(One)	Electrical Control Panel	Electrical Control Panel in 304 SS, NEMA 4 construction, complete with power supply, VFDs: 2x, WEG VFD, for Dosing pump speed control; HOA, Status lights; Fault Lights; for 3ph / 575 VAC / 60Hz; complete with CSA Special Inspection Label.	PFC design / VFD: WEG;

Section 1: Chemical Dosing System in 316 SS welded piping, as per above description:

Material	Qty	Net Price	Ext Price
DO-00024-1: 316 SS, welded, 1.5", ASME B 31.3 Dosing System as per above:	1	$[redacted]	$[redacted]

Section 1: Total Net: $[redacted](CAD)

OPTION: 1A: Dosing System in 316 SS, with ProMinent HYDRO pump in ALLOY-20 Liquid End:

Material	Qty	Net Price	Ext Price
DO-00024-1A: ProMinent Hydro Pumps (2x) in Liquid end: ALLOY-20 / PTFE, [instead of PVDF/PTFE], Dosing system in 316 SS piping, all other things are same as above:	1	$[redacted]	$[redacted]

OPTION 1A : Total Net: $[redacted](CAD)

Section 2: Chemical Dosing System in ALLOY-20:

Sizing and Equipment Selection Notes:

Customer Supplied Information:

- **Project: Nova Scotia Power,**
- **Tender specifications: NO Specifications at this stage;**
- **Dosing System to be in Alloy-20 piping, Welded and/or flanged connections, Threaded joints to be avoided as much as possible. Chemical is to be considered as compatible with Alloy-20, elastomer is Viton/PVDF/PTFE.**
- **Additonal clarifications provided per Email dtd. Mar. 5, 2015.**

Dosing Pump Capacities and other features required:

1. The Customer has requested for the Dosing Pump capacity of 230 USGPH (870 L/h); the Max. Discharge Pressure at the Dosing System is 75 psig (5.2 barg).
2. The Dosing Skid, to be installed on a Carbon Steel Welded (Non-CWB) skid frame, coated with acid resistant paint/coating.
3. The dosing system piping is to be in Alloy-20 welded piping with some flanged components where applicable. The system is to be fabricated to meet ASME B 31.3. No requirement of CRNs or TSSA/similar agency registration.

4. **The Chemical Dosing System is Proposed as per the Quote stage PID: AIB-150304A-100-R0, attached herewith.**

Chemical Dosing System, in ALLOY-20, welded piping:

Proposed is a Dual Pump Dosing Systems with Two ProMinent Hydro series, motorized, diaphragm type metering pumps, installed in a duty and stand-by configuration. The suction side includes isolation & drain valves, common calibration column and Y-strainer. The discharge side components, for each pump side include a Pressure Relief Valve, associated isolation valves, drain valves, check valves and Pressure gauges. The common single discharge line includes an isolation valve at the end connection. As an option: a Back Pressure Valve and/or a Pulsation Dampener could be included (at extra price) if required. The dosing system is not registered with ABSA/TSSA or any such agency and does not have all components with CRN. The Dosing System is designed, fabricated and tested to meet the requirements of ASME B 31.3. The dosing system is factory assembled and tested as per ProMinent standards for such dosing systems as per the Quote stage P&ID DRg. No.: AIB-150304A-100-R0, attached. The major components of each dosing system are as under:

QUANTITY:		COMPONENT DESCRIPTION:		MANUFACTURER
1	(One)	Skid Frame:	Custom skid frame for 2x Hydro 4 series pumps, in Carbon Steel welded (Non-CWB) construction, with a drip tray and painted with suitable corrosion resistant paint. The skid is suitable for floor mounting and flooded suction.	**PFC**

Quote ID: aib-150304-A-Rev-0 **Quote Date: Mar. 10, 2015.**

QUANTITY		COMPONENT DESCRIPTION		MANUFACTURER
2	(Two)	Dosing Pump:	**ProMinent Dosing Pumps: HYDRO-4aH, motorized, diaphragm type metering pump: Capacity: 1,070 L/h; Max. discharge pressure: 100 psig; Liquid End: PVDF; Seals: PTFE; Multi-Layer Diaphragm (PTFE);** Flanged, # 150, 1.5" suction/discharge ends; Motor: 1.5 HP; 3ph / 575 VAC/ 60 Hz; Inverter duty, TEFC Motor (WEG/Baldor), installed.	ProMinent
7	(Seven)	Isolation Valves:	1.5" Ball Valves, Alloy-20, 3-pc, socket weld ends, 1500 WOG	Velan/Equivalent
7	(Seven)	Isolation Valves:	1/2" Ball Valves, Alloy-20, 3-pc, socket weld ends, 1500 WOG	Velan/Equivalent
2	(Two)	Pressure Safety Valves:	Pr. Safety (Relief) Valve, Alloy-20, Sr. 2700, ASME VIII, flanged # 150 ends, ½" x 1",	Farris
2	(Two)	Pressure Gauge:	4.5", Process Pressure gauge, With Alloy-20 Gauge Isolator.	Wika
2	(Two)	Check Valve	Check Valve, 1.5", Alloy-20, socket weld ends, 1500 WOG,	Velan
1	(One)	In-line Strainer	In-line strainer in 2" PVDF / 316 SS SW construction [alloy-20 not offered]	Colton/Equivalent
1	(One)	Calibration Pot	Calibration pot, 10 L approx.. PVDF/ 316 SS/Glass	Kenco/Equivalent
1	(One)	Electrical Control Panel	Electrical Control Panel in 304 SS, NEMA 4 construction, complete with power supply, VFDs: 2x, WEG VFD, for Dosing pump speed control; HOA, Status lights; Fault Lights; for 3ph / 575 VAC / 60Hz; complete with CSA Special Inspection Label.	PFC design / VFD: WEG;

Section 2: Chemical Dosing System in Alloy-20 welded piping, as per above description:

Material	Qty	Net Price	Ext Price
DO-00024-2: Alloy-20 welded, 1.5", ASME B 31.3 Dosing System, as per above	1	$[redacted]	$[redacted]

Section 2: Total Net: $[redacted](CAD)

NOTE: THE PRICE FOR THE ALLOY-20 DOSING SYSTEM IS BUDGETARY AT THIS STAGE. THE DELIVERY IS APPROX.[redacted] AS SOME COMPONENTS IN [redacted]DELVERY.

OPTION: 2A: Dosing System in Alloy-20, with ProMinent HYDRO pump in ALLOY-20 Liquid End:

Material	Qty	Net Price	Ext Price
DO-00024-2A: ProMinent Hydro Pumps (2x) in Liquid end: ALLOY-20 / PTFE, [instead of PVDF/PTFE], Dosing system in Alloy-20 piping, all other things are same as above:	1	$[redacted]	$[redacted]

OPTION 2A : Total Net: $[redacted](CAD)

SECTION 3: OPTIONAL ITEMS :

Material	Qty	Net Price	Ext Price
DO-00024-3-1: Back Pressure Valve, 1.5", 316 SS, Flanged # 150, make: TopValve; as a ship loose component, or could be installed on the dosing system	1	$[redacted]	$[redacted]
DO-00024-3-1: Back Pressure Valve, 1.5", ALLOY-20, Flanged # 150, make: TopValve; as a ship loose component, or could be installed on the dosing system.	1	$[redacted]	$[redacted]

Section : 4 : Start Up and Training Assistance Rates (On-Site) :

Start-Up & On-site Training Assistance Will Be Provided By A Qualified Prominent Technical Representative, as per the following rates:

- Standard Rate: [redacted] – Per day, based on an 8 hour working day (Monday - Friday)
– Per day, based on an 8 hour working day (Saturday - Sunday)

- Over Time Rate: – Per hour for week days (Monday - Friday) in excess of eight (8) Hours per day

- Over Time Rate: – Per hour for Saturdays, Sundays and statuary holidays in excess of eight (8) Hours per day

- Out of Pocket Expenses: – Includes (but is not limited to) flights, Car Rental, Subsistence, Hotel etc. Original receipts will be provided if requested.

Notes:

- Daily/hourly rates includes travel times
- A two day minimum time is required for any requested start-up and/or training.
- Stationary and other training items specific to the ProMinent standard training session will be provided. Any other items requested will be provided by the buyer.
- Commissioning is not within the scope of ProMinents supply.
- Pricing is valid as of 01/01/14 and is liable to change without notice. Please contact ProMinent for current pricing.

ESTIMATED ON-Site Start-up and Training Times: Please consider the following On-site start-up and training times for all of the equipment offered at Sections 1 or 2 as : Approx. ONE (1x) Day, plus travel and other expenses, as per the above rates.

Section : 5 : Notes, Deviations & Exceptions:

1. Specific Exceptions are listed before each section.

Standard Exceptions:

The following exceptions are taken, in their entirety, to any related requests within the provided specification and any accompanying documentation.

QUALITY PRACTICE

Title	Chemical Tanks / Piping Inspections & Repairs	
Applicability	POWER PRODUCTION CHEMICAL ASSET MANAGEMENT	
Issue Date		
Quality Lead	Jonathan MacIntosh – Senior Engineer, Chemical Assets	
Owner	Perry Mason – Sr. Manager, Generation Services	

Valid Until	July 12, 2018

File Ref:	QP-G033
Revision	A2

Quality Practice

QP/E033	Chemical Tanks / Piping Inspections & Repairs	Revision A1
Issued	July 12, 2015	

Revision History		
Revision A1	14-July-2012	Issued for use
Revision A2	12-July-2015	Issued for use

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1.0 PURPOSE

NSPI stores and utilizes several hazardous chemicals in the daily production of power in the existing generating stations throughout power production. The storage tanks, day tanks and piping used in the transportation of these chemicals are subject to harsh internal as well as external environmental conditions which necessitate proper choice of materials of construction as well as periodic inspections and repair to reduce the risk of chemical injury or environmental spills due to corrosion failure.

The purpose of this Quality Practice (QP) is to identify current industry recommended minimum guidelines for materials of construction, and practices for inspection and maintenance of chemical tanks and piping. This practice will focus primarily on Sulphuric Acid and Caustic Soda storage tanks and piping.

This QP supersedes the former Thermal Maintenance Practice TMP-30

2.0 SCOPE

The scope of this Quality Practice includes a safety element when working around these hazardous chemicals.
The practice also includes a description of general information on design and materials of construction primarily for sulphuric acid and caustic soda storage tanks and piping but in addition, does describe suitable materials for Aqua Ammonia and Hydrazine Hydrate tanks and piping. This includes reference to industry standards.

The practice describes the recommended types of inspections for these chemical tanks and associated piping. It also includes the recommended intervals between inspections and the required documentation for record keeping. Relevant standards are referenced in this practice as applicable.

A chemical tank inspection checklist is included in Appendix "A", as a guideline in conjunction with the API-653 checklist for tanks designed and built to the acceptable industry standards.

Although chemical day tanks are not strictly designed to any standard they must meet the minimum requirements for materials of construction and inspection frequency.

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3.0 PROCESS

3.1 Safety Considerations

Personnel working around any type of chemical should familiarize themselves with the hazards created by the chemical and must consult the MSDS for the particular product prior to working on tanks or piping systems, (i.e. Hydrogen gas is generated during the corrosion of steel by sulphuric acid). Proper containment dykes are required to retain any chemical release and should be sufficient to retain at least 120 % of the volumetric content of the storage tank. The dyke should be made of or lined with chemical resistant material and sloped to a sump. Chemical tanks must be cleaned neutralised and purged as required prior to entry for internal inspections. See Safe Work Practice SWP 22T.

3.2 Bulk Tanks: General Information on Design and Materials of Construction.

Bulk chemical tanks are generally designed to API standards 12F, API 620 or API 650 for metallic vertical cylindrical tanks, and ASME BPV-VIII, Division 1, for metallic horizontal tanks. ASME RPT –1 (7.3.1) is an appropriate design standard for reinforced thermoset plastic vessels. See also NACE Recommended Practice RP0294-2006, (Latest revision), “Design, Fabrication, and Inspection of Tanks for the Storage of Concentrated Sulfuric acid (93%), and Oleum at Ambient Temperatures”. References for design and materials of construction for 50 % caustic soda can be found in Pamphlet 94 in the Chlorine Institute document, “Sodium Hydroxide Solution and Potassium Hydroxide Solution (caustic) Storage Equipment and piping Systems”.

3.2.1 (Sulfuric Acid Tanks, 93 % 66 ^{0} BE)

The basic material of construction for concentrated sulfuric acid storage tanks is (ASTM A516 Gr. 70) carbon steel. Tanks should have a minimum corrosion allowance of 6.0 mm (0.25 in) over the design thickness. Tanks design is for specific gravity of 1.9, at ambient temperatures (< 40 C) and low velocity conditions (< 3 ft/s). High velocity and temperatures significantly increases the corrosion rate. Stainless steel 304 or 316 are also acceptable if iron is a problem. Anodic protection or phenolic coatings such as “Heresite” are also used to minimize iron pickup. See NACE standard RP0391 or RP0294 and RP0178 for lined tanks. At sulfuric acid strength’s below 70%, the corrosion of carbon steel increases significantly with a rapid evolution of hydrogen gas. All efforts must be made to prevent water from entering the tank.

3.2.2 (Caustic Soda Tanks 50%)

Carbon steel is also the most common material of construction for bulk caustic soda tanks at concentrations of 50% or less and temperatures < 120 ^{0}F (48.9 ^{0} C) where iron contamination is not a concern. At higher concentrations and temperatures over 120 ^{0} F (48.9 ^{0}C), carbon steel will experience accelerated corrosion and stress corrosion cracking .Austenitic stainless steels such as 304L and 316 L are also acceptable up to 70 ^{0} C. Where iron contamination is a concern, the tanks may be lined with a

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suitable caustic soda-resistant lining. Storage tanks should be heated and/or insulated if ambient temperatures are below 65 ^{0} F (18 ^{0} C). A temperature controller should be installed to maintain a caustic solution temperature of 85-100 ^{0} F (29 $^{0-}$ 38 ^{0} C). Tank should be designed for specific gravity 1.6. A minimum corrosion allowance of 1/8 ", (3 mm) is typical for carbon steel for floors and walls of the tank.

3.3 Chemical Piping (General Information on Design and Materials of Construction)

Design and construction of chemical piping should generally follow ANSI/ASME B31.3 "Process Piping," ASME Code for Pressure Piping".

3.3.1 Sulfuric Acid Piping

Materials of construction are dependent of fluid flow velocities, temperature, pipe size, desired life and dilution potential. Seamless carbon steel can be used for ambient temperatures and low flow (max 3 ft./sec).For small diameter piping, (e.g. 75 to 100 mm, [3 to 4 in]), the use of austenitic steel is recommended at ambient temperature and velocities up to 1.8 m/sec (5, 8 ft./sec).UNS 316 is recommended for 90-100 % sulfuric acid and flows (0-8 ft. /sec). Alloy 20 works for flows (0-20 ft. /sec). Teflon/Kynar lined piping can be used for flows (0-50 ft. /sec).
Stainless steel or lined piping is recommended for sulfuric acid < 20%. All metal piping should be welded per ANSI B31.3- "Normal Service" specifications. Multi-pass welds are recommended for metal piping. Threaded piping is not recommended for sulfuric acid service. ***NSPI will ensure that no threaded piping is used on new or replacement installations.***

The preferred material for chemical hose is reinforced ultra- high molecular weight polyethylene. Other suitable materials are Teflon, PTFE lined hose, cross-linked polyethylene (XPLE) and Viton for gaskets. All fittings should be stainless steel.
Metal piping that holds concentrated sulfuric acid should not be "blocked in" nor have valves closed tightly without a properly designed pressure- relief device in the line. Recommended material for gaskets polytetrafluroethylene (PTFE-Teflon), silica or aluminum silicate-filled PTFE, or stainless steel spiral-wound PTFE and fluoroelastomers. See also NACE RP0391-2001, standard recommended practice for "Materials and Handling and Storage of Concentrated Sulfuric Acid at Ambient Temperatures".

3.3.2 Caustic Soda Piping

Schedule 80 seamless carbon steel with butt welds is the recommended material for 50 % caustic piping (1-1.5") for temperatures < 49 ^{0} C. For piping (2''-10"), schedule 40 carbon steel, butt-welded is recommended. Where iron contamination is a problem, austenitic stainless steels 304L and 316L are acceptable. Caustic piping should be heat traced and insulated to maintain liquid temperatures (29 ^{0}- 38 ^{0} C), 85-100 ^{0} F. Polypropylene lined piping is acceptable for temperatures to 79 ^{0} C where iron contamination is a problem.

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3.4 ADDITIONAL CHEMICAL TANKS AND PIPING: Materials of Construction

3.4.1 (Hydrazine Hydrate 35- 55 % & Diethylhydroxylamine (DEHA) 30 %)

Materials considered satisfactory for all concentrations of hydrazine hydrate are type 304 L and 347 stainless steels. These materials are suitable for all piping and valves associated with the storage system. Teflon, polypropylene and the above stainless steels are suitable for DEHA use.

3.4.2 (Aqua Ammonia 10-30 %, 18-26 ^{0} Baume)

Carbon Steel or stainless steel is recommended for storage tank construction. Aluminum is also acceptable. Tanks should have a 30 psi pressure rating. The storage area should be cool and dry and ventilation provided when located in a closed building. Copper, brass or zinc must be avoided. Some elastomers, such as neoprene, ethylene propylene and teflon are acceptable for aqua ammonia use.

3.5 CHEMICAL TANK INSPECTION

Inspections of chemical tanks should use API 653 as a guideline for documented external and internal inspections. (*See attached external inspection checklist*).An additional reference NACE SP0294-2006 , is an industry recommended practice document for “Design, Fabrication, and Inspection of Storage Tank Systems for Concentrated Fresh and Process Sulphuric Acid and Oleum at Ambient Temperatures”.

The following types of inspection are required for Chemical Tanks:

3.5.1 Regular External Visual Examination.

This is normally carried out by personnel who are knowledgeable of the storage facility operations, the tank and the characteristics of the product stored. The purpose is to check for any visible change in the condition of the tank, foundation, containment, or associated piping and equipment, or any visible corrosion of these components. Overflow /vent lines should be checked to ensure there is no blockage.

3.5.2 Scheduled External Inspection.

This consists of a visual examination combined with ultrasonic thickness readings. The purpose is to monitor the corrosion rates of the tank, and associated piping and fittings, while the tank is in service. Corrective actions should be noted.

3.5.3 Internal Inspection

This is the complete examination of a tank that has been emptied out and cleaned. The purpose is to employ appropriate inspection and non-destructive testing procedures to ascertain the tank condition

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and any remedial measures necessary. Serious problems such as hydrogen grooving and floor corrosion can only be determined by internal inspection. API 653 requires internal inspections at half of the remaining corrosion life. Precautions must be taken to ensure the tank has been cleaned, neutralized and purged as required for safe entry.

3.5.4 Inclusions For In-service and Out of Service Inspections

An in-service visual inspection of the total exterior shell, roof and all associated nozzles and attachments to check for obvious deterioration of paint or coatings, bowing, weld defects, erosion/corrosion, settlement, etc... An ultrasonic thickness survey of the shell and roof should also be completed. It is also recommended that tank level sensing devices be calibrated and regularly tested to ensure proper operation.

A variety of N.D.T. methods are available for out of service inspections, since the entire tank including the interior floor plate and shell surfaces, structural supports, and steam coils, etc. can be inspected. The common inspection techniques include visual magnetic particle testing, ultrasonics and eddy current (for floor, roof and shell thickness checks) radiography (shell and floor plate welds), dye penetrant and magnetic flux scanning.

The results of these inspections when evaluated, will determine the re-inspection frequency. Detailed inspection reports including photographs of problem areas are to be prepared.

3.6 RECOMMENDED CHEMICAL TANK INSPECTION INTERVALS

Visual inspections from the ground should be completed at a minimum weekly frequency, by means of a PM with a checklist attached.

A documented visual in-service external inspection should be done every two years, and where designs permit, ultrasonic thickness measurements should be done to determine wall thickness and corrosion rate.

Documented internal inspections should be done every six years or alternate frequency determined by risk-based assessment and corrosion rates. Data to determine the integrity of the tank bottom and to determine the re-inspection criteria is required.

In all cases, it is good practice to maintain complete inspection and repair records to support scheduled maintenance programs. Construction and commissioning data will be useful in this regard as well.

API-653 uses (Tact- Tmin) /Corr. Rate to determine the next inspection date. The corrosion rate is established by previous inspection thickness testing data.

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3.7 RECOMMENDED CHEMICAL PIPING INSPECTIONS

In general, industry follows the requirements contained in ANSI/ASME B31.3, “Process Piping”, for examination and inspection of chemical piping. ANSI/ASME B31.1, “Power Piping”, is also used as a reference standard for power industry piping. See NACE Std. RP0391 (Latest edition), for information regarding piping for sulphuric acid use.

Because of the history of leaks and failures using carbon steel piping for sulphuric acid use it is recommended that all carbon steel piping still in use with concentrated sulphuric acid, be inspected and thickness tested to determine the corrosion rate and corrosion allowance to predict the remaining life of the pipe. If the thickness testing indicates loss of metal greater than 50% of the original pipe thickness then the pipe must be replaced. The minimum frequency of thickness testing is every two years unless the corrosion rate indicates a need for more frequent testing.

For all other chemical piping, it is recommended that documented chemical piping inspections be done every five to ten years. Ultrasonic thickness testing should be done after two years use to determine corrosion rates for metal piping.
The frequency of thickness testing may be reduced depending on the corrosion rate. Specific areas should include, elbows and other places where flow induced erosion/corrosion could occur such as poor fit-ups, uneven welds and changes in diameter. Factors which influence corrosion rates are temperature, velocity, chemical strength, moisture ingress, dead legs, quality of welding, corrosion under insulation, and time of use.

API-570 (pipe), also uses the (Tact-Tmin) /Corrosion Rate, formula but schedules inspection at HALF the remaining life based on previous thickness testing data and history.

Pipe inspection documentation should include API-570 recommendations:

- Original Date of Installation
- Specif ca. ons and strength levels of materials used.
- Original thickness measurements.
- Locations and dates of all subsequent thickness measurements.
- Calculated retirement thickness.
- Previous repairs or replacements.
- Pertinent operational changes or change in service.

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4.0 ACCOUNTABILITY

The primary accountability for development and revision of this practice is with the Generation Services Manager with execution support from the General Manager, Power Production, Plant Managers and other internal or external resources as required.

The Chemical Asset Specialist is responsible for authoring and revising the practice with assistance from senior technical advisors and thermal plant staff, under the guidance of the Manager, Generation Services.

Thermal Plant Managers or designate(s) are responsible for documentation and adherence to the practice at the plant level.

5.0 AUDIT

TMP-30 audits and reviews will generally follow the process described in the following document approved by senior management:

"Thermal Maintenance Practice Development and Change Management Process", Section 4, Compliance Reviews, and Appendix C, - TMP Compliance Review/Audit Process.

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6.0 APPENDIX- A CHEMICAL TANKS INSPECTION CHECKLISTS

External Inspection Checklist

Foundations

- o Check for settlement around perimeter of tank, shell, edge, and bottom
- o Check for Chemical leaks or spills.
- o Ice or Snow build-up.
- o Check that runoff rainwater from the shell drains away from tank.
- o Cavities under tank bottom
- o Check for mechanical damage.
- o Visible corrosion of tank bottom due to type of sand or rock.
- o Check operating condition of dike drains.
- o Corrosion of I-beam supports.

Housekeeping

- o Inspect the area for build-up of trash, vegetation and other inflammable

SHELLS

External Visual Inspection

- o Visually inspect for paint failures, pitting and corrosion.
- o Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.
- o Inspect the bottom-to-foundation seal, if any.
- o Inspect for cracks or signs of leakage on weld joints at nozzles, manways and reinforcing plates.
- o Chemical leaks or spills.
- o Inspect for flange leaks and leaks around bolting.
- o Overflow blockage.
- o Corrosion at stairway attachments.
- o Check condition of containment system.

SHELLS (Insulated)

- o Failure of cladding, weather proofing.
- o Failure of caulking, seals at nozzles.
- o Failure of caulking, seals at stairs, platforms and other attachments.
- o Chemical spills into insulation.
- o Accelerated corrosion adjacent to external heating coils or pads.
- o Wet insulation at shell to bottom joint.
- o Check for damage and test the accuracy of temperature indicators.
- o Wet insulation at nozzles supports or other attachments.

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ROOFS

Deck Plate Internal Corrosion

- For safety, before accessing the roof, check with ultrasonic instrument or lightly use a ball peen hammer to test the deck plate near the edge of the roof for thinning. (Corrosion normally attacks the deck plate at the edge of a fixed roof and at the rafters in the center of the roof first.)

Deck Plate External Corrosion

- Visually inspect for paint failure, holes, pitting of plate or welds, and corrosion product on the roof deck.

Roof Deck Drainage

- Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure. Large standing water areas on a floating roof indicate inadequate drainage design or, if to one side, an uneven roof with possible leaking pontoons.)

Roof Appurtenances

- Inspect condition and functioning of sample hatch cover.
- Chemical leaks or spills.
- Corrosion at stairway /platform attachments.
- Corrosion at roof to shell joint due to wet dirt or debris.
- Corrosion of nozzles and flange sealing faces.
- Vent blockage.
- Corrosion under vent exit.
- Corrosion of nuts, bolts, gaskets.
- Corrosion of safety rails, stairs, platforms.
- Ultrasonic testing of piping, especially in areas with a potential for hydrogen grooving.

Internal Inspection Checklist

Overview

- Ensure that a confined space permit is in place prior to entry.
- Check that tank has been cleaned, neutralized and is gas free and safe for entry. NACE RP0294 5.3.
- Check that the tank is completely isolated from product lines, all electrical power and steam lines.
- Check that roof is adequately supported, including fixed roof structure and floating roof legs.
- Check for any sign of acid/caustic contacting roof. This must be reported and preventive measures taken.
- Inspect structural welds on access ways and clips.
- Verify that vapour phase conditions are not explosive before doing any hot work. Hydrogen gas can be trapped in acid sludge.

Tank Exterior

- Check for obvious external corrosion as detected by MFE.
- Hammer test or ultrasonically test the roof.

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- o Enter and inspect the floating roof pontoon compartments.

Bottom Interior Surface

- o Hydrogen blisters (Sulphuric Acid)
- o Attack on cut edges of nozzles or plates.
- o Attack on welds (cracks, porosity, pitting, slag, lack of penetration)
- o Undercut at welds.
- o Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.
- o cracking of plate near shell to bottom joint.
- o Pits under sludge or deposits.
- o Deformation of bottom plate.
- o Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required.
- o Sulphate under roof column support plates or wear plate. (Sulphuric Acid).
- o Hammer test or ultrasonically examine any slightly discoloured spots or damp areas.
- o Check for reinforcing pads under all bottom attached clips, brackets and supports.
- o Galvanic corrosion at welds or dissimilar metals.
- o Surface gouges, laminations, arc strikes.
- o Corrosion in crevices.
- o Corrosion of nuts, bolts, gaskets.
- o Corrosion of flange sealing faces.
- o Erosion of outlet elbow, nozzle, piping, reducer valve.

Shell Outlet Nozzles

- o Weak acid attack (Horizontal Grooves), sulphuric acid only.
- o Hydrogen grooving, (vertical grooves with a severe horizontal groove at 12 o'clock), sulphuric acid only.
- o Attack on cut edges of nozzles or plates.
- o Attack on welds (cracks, porosity, pitting, slag, lack of penetration)
- o Inspect for vertical grooving damage from seal assembly protrusions.
- o Inspect shell nozzles for thinning and pitting.
- o Additional loads on outlet nozzle piping due to tank settlement.

Shell Internal Inspection

- o Weak acid attack (horizontal grooves) sulphuric acid.
- o Weak acid attack at shell to bottom joint. Sulphuric acid.
- o Hydrogen grooving, (vertical grooves), sulphuric acid.
- o Attack on cut edges of nozzle or plates.
- o Attack on welds (cracks, porosity, pitting, slag, lack of penetration)
- o Deformation of shell plate and reinforcing pads.
- o Corrosion of anodic protection components.
- o Surface gouges, laminations, arc strikes.
- o Pitting of plates.
- o Check manhole for above erosion/corrosion conditions, nuts, bolts gaskets.
- o Corrosion in crevices.

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SHELL-MOUNTED OVERFLOWS

- Inspect overflow for corrosion and adequate screening.
- Check location of overflow that it is not above any tank valves or equipment.

ROOF INTERIOR SURFACE

General

- Acid contacting the roof. (Any sign that acid has contacted the roof must be reported and preventative measures taken).
- Build-up of sulphate. Sulphuric acid.
- Hammer test or ultrasonically examine to check for thin areas, particularly in the vapour space of floating roofs and at edge of roof on cone roof tank.
- Movement or deformation of roof structure.
- Corrosion of roof structure/support columns.
- Evidence of water ingress.
- Corrosion of inlet nozzle /piping.
- Spark test the interior surface coating if recoating is not planned.
- Inspect the hatches for corrosion, paint and coating failures, and holes and cover sealing.
- Inspect the condition of the gaskets on bolted or latched down hatch covers.

Overflow/Vent systems.

- Check Vents for blockage.
- Check condition of overflow piping.

For Nozzles Extended Into the Tank

- Inspect pipe support pads welded to tank bottom.
- Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate.
- Inspect nozzle valves for packing leaks and damaged flange faces.
- Inspect heater steam nozzle flanges and valves for wire cutting.
- Report which nozzles have thermal pressure relief bosses and valves.
- In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom.
- On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapour space. Inspect impact area for erosion.

ACCESS STRUCTURES

Platform Frame

- Inspect frame for corrosion and paint failure.
- Inspect the attachment of frame to supports and supports to tank: for corrosion and weld failure.
- Check reinforcing pads where supports are attached to shell or roof.

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- o Inspect the surface that deck plate or grating rests on, for thinning and holes.
- o Check that flat-surface to flat-surface junctures are seal welded.

Deck Plate and Grating

- o Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure.
- o Inspect plate-to-frame weld for rust scale build-up.
- o Inspect grating for corrosion-caused thinning of bars and failure of welds.
- o Check grating tie down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway.

Stairway Stringers

- o Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer.
- o Inspect stairway supports to shell welds and reinforcing pads.
- o Inspect steel support attachment to concrete base for corrosion.

Roller Ladder

- o Inspect rolling ladder stringers for corrosion.
- o Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers.
- o Check for wear and corrosion where rolling ladder attaches to gagging platform.
- o Inspect pivot bar for wear and secureness.
- o Inspect operation of self-levelling stairway treads.
- o Inspect for corrosion and wear on moving parts.
- o Inspect rolling ladder wheels for freedom of movement, flat spots and wear on axle.
- o Inspect alignment of rolling ladder with roof rack.
- o Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough).
- o Inspect rolling ladder track welds for corrosion.
- o Inspect track supports on roof for reinforcing pads seal welded to deck plate.
- o Check by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs.
- o If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side.

CI Number: 47945

Title: TUC Electrode-ionization (EDI) Unit Replacement

Start Date: 2016/07
In-Service Date: 2016/08
Final Cost Date: 2017/02
Function: Steam
Forecast Amount: $275,154

DESCRIPTION:

This project includes the replacement of an Electrode-ionization (EDI) unit. The EDI is the final unit operation in the water treatment plant that produces demineralized water acceptable for boiler water feed and steam attemperation. Without this EDI unit in operation, the three Tufts Cove steam units cannot run at full capacity, and Tufts Cove Unit #6 will not be able to generate any energy.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The EDI unit at Tufts Cove has reached end of life. The unit is no longer supported by the vendor and the consumable parts are not available. If the unit is not replaced, Tufts Cove will not be able to produce enough demineralized water for the units, resulting in de-rates and unit unavailability.

Why do this project now?

The consumables for the existing EDI unit are no longer supported or available. The system is required to be upgraded to the new technology to maintain unit reliability and availability.

Why do this project this way?

Electrode-ionization technology outperforms traditional ion exchange technology in relation to water quality and overall cost of ownership. The technology has been proven at Tufts Cove with the first generation EDI cells.

CI Number : 47945-SE82 - TUC Electrode-ionization (EDI) Unit Replacement **Project Number** SE82

Parent CI Number : -

Cost Centre : 311 - 311-Tufts Cove Admin./Common Capita **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		3,169	0	3,169
095		095-Thermal & Hydro Contracts AO		1,787	0	1,787
001	016	001 - THERMAL Regular Labour	016 - SGP - Feed Water Sys.	15,635	0	15,635
011	016	011 - Travel Expense	016 - SGP - Feed Water Sys.	5,000	0	5,000
012	016	012 - Materials	016 - SGP - Feed Water Sys.	207,500	0	207,500
013	016	013 - POWER PRODUCTION Contracts	016 - SGP - Feed Water Sys.	17,500	0	17,500
066	016	066 - Other Goods & Services	016 - SGP - Feed Water Sys.	24,563	0	24,563
			Total Cost:	275,154	0	275,154
			Original Cost:	216,262		

Capital Project Detailed Estimate

Location: Steam
CI# : 47945
Title: TUC Electrode-ionization (EDI) Unit Replacement
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	14	$ 358	$ 5,016		
Engineering	PD	7	$ 405	$ 2,837		
Maintenance Trades	PD	14	$ 365	$ 5,107		
Power Plant Technician	PD	7	$ 382	$ 2,675		
			Sub-Total	$ 15,635		
011 Travel Expense						
Quality Control Visit		1	$ 5,000	$ 5,000		
				$ -		
			Sub-Total	$ 5,000		
012 Materials						
EDI Skid		1	[redacted]	[redacted]	Cost Support Item #1	
Piping		1	[redacted]	[redacted]		
I/O Cards - Control Wiring		1	$ 10,000	$ 10,000		
				$ -		
			Sub-Total	$ 207,500		
013 Contracts						
Commissioning Support	PD	7	$ 2,000	$ 14,000		
Electrician	PD	7	$ 500	$ 3,500		
				$ -		
			Sub-Total	$ 17,500		
066 Other Goods & Services						
Contingency	%	10%	$ 245,635	$ 24,563		
				$ -		
			Sub-Total	$ 24,563		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 3,169		
Thermal / Hydro Contracts AO				$ 1,787		
			Sub-Total	$ 4,956		
			SUB-TOTAL (no AO, AFUDC)	$ 270,198		
			TOTAL (AO, AFUDC included)	$ 275,154		
Original Cost				$ 216,262		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

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NS Power Tufts Cove EDI

NOVA SCOTIA POWER INCORPORATED

315 WINDMILL RD
DARTMOUTH, NS B3A 1H3
Canada

08/18/2015

For the Attention of: Jonathan MacIntosh

Our Reference: 173213.0

Jonathan,

Attached you will find the technical and commercial details for the requested replacement EDI system for installation at your Tufts Cove Generating Station. This proposal should have all of the information required for your budgeting work.

We will want to confirm the RO performance prior to completing the detail design and manufacture of the system. This can be done anytime between now and when NS Power is closer to making a decision to move forward with this project.

Please let me know if you have any additional questions on the attached. I will be calling you to discuss our proposal and provide any additional information that may help your evaluation. Until then, please contact me if you have any questions.

Yours sincerely,

Aaron Nelson

aaron.nelson@ge.com

cc: Daryl Black

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Proposal for

NOVA SCOTIA POWER INCORPORATED

NS Power Tufts Cove EDI
DARTMOUTH, NS Canada

Proposal #173213, Revision 0

Aaron Nelson

aaron.nelson@ge.com

Daryl Black
daryl.black@ge.com

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Confidential and Proprietary Information

GE submits the information contained in this document for evaluation by Customer only. Customer agrees not to reveal its contents except to those in Customer's organization necessary for evaluation. Copies of this document may not be made without the prior written consent of GE Management. If the preceding is not acceptable to Customer, this document shall be returned to GE.

Validity

This proposal is for budgetary purposes and does not constitute a binding offer of sale.

Trademark Notification

The following are trademarks of General Electric Company and may be registered in one or more countries: ABMet, Absolute.Z, Absolute.Za, AccuSensor, AccuTrak, AccuTrak PLUS, ActNow, Acufeed, Apogee, AmmCycle, APPLICATIONS ATLAS, AquaFloc, AquaMax, Aquamite, Aquaplex, Aquatrex, Argo Analyzer, AutoSDI, Betz, BetzDearborn, BEV Rite, BioHealth, BioMate, BioPlus, BIOSCAN, Bio-Trol, Butaclean, Certified Plus, CheckPoint, ChemSensor, ChemSure, CHEX, CleanBlade, CLOROMAT, CoalPlus, COMP-METER, COMP-RATE, Continuum, CorrPro, CorrShield, CorTrol, Custom Clean, Custom Flo, Cyto3, DataGuard, DataPlus, DataPro, DELTAFLOW, De:Odor, DEOX, DeposiTrol, Desal, Dianodic, Durasan, DuraSlick, Durasolv, Duratherm, DusTreat, E-Cell, E-Cellerator, ELECTROMAT, Embreak, EndCor, EXACT, FACT-FINDER, Ferrameen, Ferroquest, FloGard, Flotrex, Flotronics, FoamTrol, FoodPro, FRONTIER, FS CLEAN FLOW, FuelSolv, Full-Fit, G.T.M., GenGard, GEWaterSource, Glegg, Heat-Rate Pro, High Flow Z, HPC, HPD Process, Hydrecycle, HyperSperse, Hypure, Hytrex, iDeal, InfoCalc, InfoScan, InfoTrac, InnovOx, InSight, IONICS, IONICS EDR 2020, iService, JelCleer, KlarAid, Kleen, Leak Trac, Leakwise, LEAPprimary, Learning Source, LOGIX, LoSALT, M-PAK, MACarrier, Mace, Max-Amine, MegaFlo, Membrex, Memtrex, MerCURxE, MetClear, MiniWizard, MK-3, MOBILEFLOW, MobileRO, Modular Pro, ModuleTrac, MonitAll, Monitor, Monitor Plus, Monsal, MULTIFLOW, Muni.Z, Novus, OptiGuard, OptiSperse, OptiTherm, Osmo Osmo PRO, Osmo Titan, Osmonics, Pacesetter, PaceSetter, Petroflo, Petromeen, pHlimPLUS, PICOPORE, PlantGuard, PolyFloc, POWERTREAT, Predator, PRO E-Cell, Pro Elite, ProCare, Procera, ProChem, Proof Not Promises, ProPAK, ProShield, ProSweet, Purtrex, Quality System Optimization, QuickShip, QSO, RCC, Rec-Oil, Recurrent, RediFeed, Renewell, RE:Sep, ROE, ROSave.Z, SalesEdge, ScaleTrol, SeaPAK, SeaPRO, SeaSMART, Seasoft, SeaTECH, Selex, Sensicore, Sentinel, Sepa, SIDTECH, SIEVERS, SmartScan, SoliSep, SolSet, Solus, Spec-Aid, Spectrus, SPLASH, Steamate, SteriSafe, StormFX, Styrex, SUCROSOFT, SUCROTEST, Super Westchar, SuperStar, TFM, Therminator, Thermoflo, TLC, Tonkaflo, Trend, TrueSense, TurboFlo, Turboline, Ultrafilic, Vape-Sorber, VeriFeed, VersaFlo, Versamate, V-Star, WasteWizard, WATER FOR THE WORLD, Water-Energy Nexus Game, WaterGenie, WaterNODE, WaterNOW, WaterPOINT, WellPro.Z, XPleat, YieldUp, Z-BOX, Z-MOD, Z-PAK, Z-POD, ZCore, ZeeWeed, ZENON, and Z.Plex.

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Water & Process Technologies

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1 GE Water & Process Technologies

1.1 Company Overview

GE Water & Process Technologies is a leading global solutions provider of water, wastewater, desalination and process systems. GE delivers customer value by improving performance and product quality, by reducing operating costs and by extending equipment life. A broad range of products and services are used to optimize total water/process system performance, safeguard customer assets from corrosion, fouling and scaling, and protect the environment through water and energy conservation. With over 2500 field engineers bringing onsite expertise, we are able to deliver value by solving our customers' most challenging problems and improving the bottom line.

Headquartered in Trevose, Pennsylvania, Water & Process Technologies employs over 6500 people worldwide. Global Centers Of Excellence conduct leading edge research in our fields of expertise. Sites include Minnetonka, Minnesota; Burlington, Massachusetts; Norfolk, Virginia; The Woodlands, Texas; Guelph, Ontario; Oakville, Ontario; Heverlee, Belgium; Sao Paulo, Brazil and the GE Global Research Centers in Niskayuna, New York, Bangalore, India and Shanghai, China.

1.2 Fields of Expertise

GE is unique in the industry, bringing a full array of products and service offerings to our customers. Our core competencies include:

- Reverse Osmosis, Nanofiltration, Ultrafiltration and Microfiltration membrane systems for removing suspended and dissolved solids from fresh water, waste water and sea water, or to separate and concentrate product, improving yield and quantity
- Electrodeionization (EDI) for producing ultrapure water without chemical regenerants
- Electrodialysis reversal (EDR), widely used to treat water supplies which are challenging for other technologies to process and where water recovery up to 95% is required
- Mobile water treatment solutions for short-term and emergency use including deionization, filtration, reverse osmosis and EDI trailers in the industry's largest fleet
- Anaerobic Digestion (AD) technologies for treatment of sludge and organic wastes
- Electrodialysis (ED) to demineralize cheese whey
- Bipolar Electrodialysis (BPED) to produce acid and caustic from salt solutions
- Service agreements to Design, Build, Own, Operate and Maintain water treatment systems, allowing customers to focus their resources on their key operations
- Water treatment chemicals and application engineering for raw and wastewater clarification, process water and industrial boiler and cooling water
- Process chemicals and additives for improved performance in refining, pulp & paper, and metals processing applications

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1.3 We don’t just promise value. We prove it.

With GE, you know precisely how our water and process technologies help your bottom line. A Value Generation Plan quantifies how we enhance your key business results. To create your Value Generation Plan, we discuss your strategic objectives and suggest projects that can help you meet them. Then we monitor and manage all projects and report in detail how each one helped to:

- Improve productivity
- Optimize critical equipment life and performance
- Increase process uptime
- Drive out costs
- Reduce waste
- Improve regulatory compliance
- Ensure performance through continuous monitoring and preventative diagnostics
- Preserve your capital and protect your cash flow with flexible financing

1.4 Global Leadership

A comprehensive portfolio, innovative technology, application expertise and personal service are what made GE Water & Process Technologies a leader in water and process treatment. A passion for solving the world’s most challenging water and process problems, being environmentally responsible and most importantly, ***helping our customers win*** guides our roadmap for the future.

Part of that future is ecomagination, (www.ecomagination.com) an aggressive, long-term initiative from GE to bring to market new technologies that address the world’s biggest environmental challenges. As part of ecomagination, GE pledges to double its investment in cleaner technologies, introduce more products that provide significant environmental performance advantages to customers, and offer more products and services that help customers meet their pure water and wastewater demands, improve their product quality and yield, reduce greenhouse gas emissions, offset their energy demand through waste reuse, and improve efficiency.

2 Technical & Engineering Details

2.1 Basis of Design

This proposal is offered based on the following estimated water design values. These values must be confirmed.

Unless otherwise specified, the equipment has been designed to operate indoors, at ambient temperatures between 4°C and 40°C and elevations less than 1000 meters. If a VFD is included in the scope of supply, it must be located within 38 meters of the pump motor.

2.2 Influent Quality

The design solution proposed is based on the values below. All values are as mg/l as ion unless otherwise stated. This is the predicted RO permeate values and will require confirmation prior to manufacture of the proposed EDI system.

Conductivity	< 5 µS/cm @ 25 deg C.
Alkalinity	< 1 ppm as CaCO3
Hardness	<0.2 ppm as CaCO3
Silica	< 100 ppb
Total Exchangeable Cations (TEC)	< 2 ppm as CaCO3
Total Exchangeable Anions (TEA)	< 8 ppm as CaCO3

Notes:

1. All Parameters have been assumed. Please confirm these values.

2.3 Influent Flow Data

Flow rate, pressure and temperature required at inlet to the equipment.

	Minimum
Inlet Flow Rate	140 gpm (31.8 m^3/hr)
Pressure	60 – 100 psi (4.1 – 6.9 bar)
Temperature (°C)	4.4 – 20 °C

2.4 Operation Basis

The system is designed with a single process train, 1 x 100%.

2.5 Product Water / Effluent Quality

The following performance parameters are expected upon equipment start-up, based on the data listed in the influent quality table and design sections above.

Product Flow Rate	126 gpm (28.6 m^3/hr)
Conductivity	<0.1 µS/cm @ 25 deg C.
Silica	< 10 ppb
Na	< 5 ppb
Cl	< 5 ppb
SO4	< 5 ppb

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2.6 Inlet Water Variability

In the event that the influent water exceeds the specifications used in engineering this proposal or the water source changes, the ability of the water treatment system to produce the designed treated water quality and/or quantity may be impaired. Customer may continue to operate the system, but assumes the risk of damage to the system and/or additional costs due to increased membrane cleanings and consumable usage. Additional supplemental equipment can be purchased from GE, which in certain cases can restore normal production rates and minimize system damage. With the largest portfolio of Mobile Water solutions, GE can respond faster and more effectively than anyone to system upsets.

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3 GE Scope of Supply

3.1 Water Treatment System

The proposed treatment system consists of the components described in this section.

3.1.1 E- Cell EDI

	Description	Part Number
Model	ECell3X-8,6,STD,PLC,575,DV,-	CONFIGURE TO ORDER
DC Drive Voltage/Phase/Frequency	575VAC, 3-phase, 60hz	Included
Number of Stacks	6 E-Cell-3X Stacks	Included
Instrumentation	Standard – Burkert	Included
Inlet Divert Valve	Inlet Divert Valve - Burkert	Included
System Control	Allen-Bradley	Included
ANSI Flange to DIN Adapters	No ANSI To DIN Adapters	N/A

Design Data

Recovery %	90%
Feed Flow Rate	140 gpm (31.8 m3/hr)
Product Flow Rate	126 gpm (28.6 m3/hr)
Concentrate Outlet Flow Rate	12.6 gpm (2.85 m3/hr)
Electrode Outlet Flow Rate	2.11 gpm (0.48 m3/hr)
Minimum Product Flow Rate	89.8 gpm (20.4 m3/hr)
Operating Pressure	60 - 100psi (4.1 – 6.9 bar)
Pressure Drop	20 - 40 psi (1.4 – 2.8 bar)
Max Operating Temperature	104°F (40 °C)
Min Operating Temperature	40°F (4.4 °C)
Current Range	39 amp maximum

EDI Feedwater Specifications

Total Exchangeable Anion:	<25 ppm as CaCO3	Conductivity:	<43 µS/cm
pH:	4-11	Hardness:	<1.0 ppm as CaCO3
Silica:	<1.0 ppm	TOC:	<0.5 ppm
Chlorine (total):	<0.05 ppm	Iron:	<0.01 ppm
SDI15	<1	NTU:	<0.5

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Materials of Construction & Controls

Piping – External/Internal	PVC piping
EDI Stacks	E-Cell-3X
Frame	Epoxy painted carbon steel
Resistivity Meter	Feed Inlet & Product Outlet (Burkert)
Flow Meters	Meter for Product Outlet(Burkert), Electrode Outlet(Burkert), Concentrate Outlet (Burkert)
Pressure Gauges/Meters	Pressure Transmitter(Burkert) for: Feed Inlet, Product Outlet, Concentrate Inlet, Concentrate Outlet, Electrode Outlet

Installation and Utility Requirements

Overall Height	90.1 inches (229 cm)
Width	103.1 inches (262 cm)
Depth	64.2 9inches (163 cm)
Feed Pipe Size	4.0" with 150lbs flange
Concentrate Outlet Pipe Size	1.5" with 150lbs flange
Electrode Outlet Pipe Size	0.5" with 150lbs flange
Air Pressure Required	100 psig [6.9 Barg], oil-free
Power Connection Required	36 kVA
Shipping Weight Estimate	4,650 lbs (2,109 kg)
Operating Weight Estimate	5099 lbs (2,313 kg)

Features Included

- NEMA 4 Control Enclosure
- Allen-Bradley Micrologix 1400 PLC with Ethernet
- GE 6" QuickPanel View Color
- NEMA 4 Rectifier Enclosure
- Automatic Divert to Drain Valves for Inlet and Product Outlet
- Concentrate Flow Counter-Current to Dilute Flow

Documentation Included

- Operation and Maintenance manual included, and also available online at http://www.gewater.com
- Drawings: Piping and Instrumentation, Electrical, and General Dimensional, FAT report

Note: The feed water to the E-Cell must be RO permeate or equivalent. Suitable system operating conditions must be verified by E-Calc prior to acceptance of sale.

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3.3 Quality Basis

For the purposes of establishing a quality basis for equipment supply, reference is made herein to particular equipment manufactured by certain suppliers. The term "or equal" where used herein shall be deemed to mean "GE Approved Equivalent." GE reserves the right to substitute equipment that GE considers to be of equal quality and suitability for the intended application from alternative suppliers to those named herein. With regard to determining the suitability or otherwise of any particular manufacturer's equipment for inclusion as part of water treatment systems, GE's decision shall be final.

3.4 Equipment Startup Services

The proposed equipment is provided with 5 days of service as specified below:

DAYS Water Treatment System	
0	**Phase 1 – Equipment Installation Technical Advisory Services:** In support of unloading the equipment, rigging the equipment into place, installing interconnecting piping, installing interconnecting wiring, installing power wiring, installing pneumatic lines, verifying adequate drainage, testing for adequate water and air pressure, testing power supply, and testing interconnecting wire circuitry. All actual labor is provided by others.
0	**Phase 2 – Pre-start-up Inspection Visit:** Includes time to inspect installation work, address questions, develop punch list of completion items necessary prior to return visit.
0	**Phase 3 – Filter Media Loading / RO Membrane Loading:** Includes technical advisory services in support of loading media (activated carbon, sand, resin, support gravel) and loading membrane elements (if not loaded in factory).
5	**Phase 4 – Equipment Start-up:** Includes preparing the equipment to operate (flush, backwash, steam, regenerate, etc.), operating the equipment manually, operating the equipment automatically, testing control system, flushing preservative, and system sanitization (applies only to drinking water systems). Also includes informal, hands-on training conducted by the service technician in the water treatment room, in front of the equipment.
0	**Phase 5 – Initial Production Run:** Includes time to be present for special owner testing such as a time period free of alarms, production run of specific product, etc.
0	**Phase 6 – Formal Training:** This includes formal training that typically takes place after the equipment has been started up. This does not include informal training that takes place during Phase 4 with an operator being present and assisting the technicians performing start-up. Training materials are GE standard and available in English. Consult with sales representative if there are additional requirements.
TOTAL 5	This total assumes no weekends or a holiday are required and is based on an eight-hour workday. Travel time to and from the job site for GE Field Service personnel is included in this estimate. Travel/living (T&L) expenses are also included where the field service representative is based within the country or region. For job sites in remote areas where additional T&L costs may be incurred to deliver the service, expenses such as airfare may be added as additional costs. To ensure personnel availability, GE requires a minimum of two weeks' advance notice to schedule equipment start-ups.

The commissioning plan also allows for up to 2 hours of site safety training.

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On-time completion of GE's startup and commissioning services requires satisfactory installation of all equipment by Customer. If additional service time is required for GE's commissioning scope due to Customer's changes in scope or delays in completion of installation, additional charges will apply, billed at GE's Field Service Labor Rates.

3.5 Factory Acceptance Test

As applicable, all components as defined above are factory tested as per GE standards before leaving our facility. The ITP (Inspection and Test Plan) includes a test and / or inspection as defined in the ITP procedure for platform skids, prefabricated pipe (all assembled pipe, not loose supplied pipe), machinery (pumps, blowers, etc.), tanks, valves, instruments ,electrical panels / junction boxes, electrical instruments, loose materials (cables, cable trays, etc.), and VFDs, as applicable.

If applicable, an FAT report (Factory Acceptance Test) is provided to the customer. It includes certificates, test reports, and CE declaration of conformity, as applicable.

Should any testing different from the testing described above be required, please consult with your GE Sales Representative.

3.6 Documentation Package

Drawing and Data Package Schedule
AOA = After Order Acceptance
ADA = After Drawing Approval

CATEGORY	DESCRIPTION	ESTIMATED DATE	COMMENTS	SUBMITTAL TYPE
PROCESS	P & I Diagram	4-6 weeks AOA	P&I diagram for GE manufactured major components	Information Only
	Process Flow Diagram	4-6 weeks AOA	System overview drawing	Information Only
	Tank Design Data	1 week ADA	UF System membrane tank dimensions to allow civil design by others	Information Only
	Bill of Material and Component Data	6-8 weeks AOA	A tag list following the P&ID's, with vendor name, model number, and attached catalogue cut sheet	Information Only
	Control Philosophy with Sequence Chart	12-14 weeks AOA	In place of logic diagrams. Sequence charts show all valves & pump status for each operating step.	Information Only
	Operation and Maintenance Manual	Two weeks after shipment	Includes the following components: ❑ Operation and maintenance procedures ❑ Spare parts list ❑ Trouble shooting procedure ❑ MSDS sheets (if applicable) ❑ Subcomponent O&M manuals ❑ Control narrative* ❑ Control logic summary chart* ❑ Operation sequence chart*	Information Only

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	Vendor Data / CE Equipment Technical File *EU only	1 week after final shipment	Includes technical data and operating manuals of major sub components	Information Only
LAYOUT	Plot Plan	8-12 weeks AOA Optional – See Note 1	Shows 2-D overhead view of equipment layout position in water room. Includes the following components: ❑ Operating loads ❑ Anchor bolt locations ❑ Aisles, interface points for customer supplied services ❑ Trenching requirements *Note 1: Requires draft submitted by customer when order is placed.*	Information Only
MECHANICAL	General Arrangements	8-12 weeks AOA	Drawings of each individual piece of equipment manufactured by GE, showing piping & valves but excluding interconnecting pipe work	Information Only
ELECTRICAL	Electrical Drawing	8-12 weeks AOA	Includes the following components: ❑ PLC & control panel layouts ❑ Electrical schematic diagrams ❑ I/O list ❑ Electrical & instrument bill of material ❑ Motor HP listing* ❑ Terminal block layouts*	Information Only
	Power Drop Drawing (One-Line)	4-6 weeks AOA	Shows power drop points and power requirements	Information Only
	PLC Software Ladder Logic	After customer acceptance	Fully annotated program ladder logic. Includes copy of program. Customer is responsible to purchase a licensed copy of software.	Information Only
QUALITY ASSURANCE	Factory Acceptance Test Documentation	2 weeks after shipment	Includes the following: ❑ Test data ❑ P&ID verification ❑ General arrangement verification ❑ Electrical panel verification ❑ Wiring verification ❑ Electrical drawing verification ❑ I/O check ❑ Software verification Alarm verification	
PROVING PERIOD	Testing Plan	Will be confirmed in project schedule	The plan will detail routine activities to be carried out and milestones with respect to customer operation and defines points at which system performance will be reviewed	
MISCEL-LANEOUS	Project Schedule	4 weeks AOA	Detailing engineering, procurement and manufacturing schedule. (Updated and issued to client monthly.)	

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PROJECT HANDOVER	Final Documentation	1 year after preliminary handover **for municipal deals only*	As-built documentation

* Not included for all equipment types

GE submits drawing or document to provide information to the customer consistent with the text in the proposal and related contract documents. GE's remaining engineering, sourcing, and manufacturing activities will proceed uninterrupted in order to meet GE's delivery commitments **without** waiting for an approval by the customer of the drawing or document. If the customer requests changes to the submitted drawing or document, GE will issue a change order proposal for the customer's consideration reflecting the added costs and delays necessary to implement the changes.

Note: Drawings, Operation and Maintenance manuals, HMI screens, Control Philosophy, Ladder Logic, and Factory Acceptance Test Documentation are all provided in English. Contact GE if you require any of these items to be translated into another language.

4 Commercial Offer

4.1 Pricing Table

Pricing for the proposed equipment, consumables, and / or services is summarized in the table below. All pricing is based on the operating conditions and influent water analysis that are detailed in the Basis of Design section of this proposal.

Base Price

Qty	Description	Unit Price	Extended Price
1	Electrodeionization System EDI (ECell3X-8,6,STD,PLC,460,DV,-)		
5	Days of Commissioning Field Service		
Total System Price			[redacted] **CAD**

4.2 Freight

All pricing is FCA (INCOTERMS 2010) from designated factory.

4.3 Bonds

Performance or Payment Bonds are not included in the system price. These bonds can be purchased on request but will be at additional cost.

4.4 Invoicing and Payment Terms

Terms are 40% invoiced with order, 55% invoiced at shipment or delivery (depending on freight terms), 5% invoiced upon completion of start-up or net 60 days from shipment, whichever occurs first, with credit approval. Equipment shipment is contingent on receipt of initial milestone payment.

Invoices are due upon receipt.

4.5 Equipment Shipment and Delivery

If an equipment shipment estimate is required, please contact Application Engineering. The Buyer and Seller will arrange a kick-off meeting after contract acceptance to develop firm shipment schedule. Title and risk of loss will transfer upon delivery in accordance with FCA (INCOTERMS 2010) designated factory.

4.6 Pricing Notes

- All prices quoted are in CAD.
- Any sales or value added tax is not included.
- The customer will pay all applicable local, state, provincial, or federal taxes and duties as provided in GE Standard Terms and Conditions of Sale.
- The equipment delivery date, start date, and date of commencement of operations are to be negotiated.

- Commercial terms and conditions shall be in accordance with GE's Standard Terms and Conditions of Sale.
- This proposal and the rates provided herein are subject to final site, environmental, GE compliance check, and financial due diligence by GE.
- This proposal supersedes all previous proposals and correspondence.
- Seller's price and delivery schedule are based on the assumption that Buyer will take delivery as and when foreseen by the schedule. Where this is not the case, the Parties must agree in advance an alternative place of delivery, failing which the Seller will be entitled to ship the equipment to storage. Buyer shall issue a Change Order to take into account any additional cost or delay incurred by GE in implementing this change.
- Seller may manufacture and source the Equipment and any part thereof globally in the country or countries of its choosing, provided that the Equipment complies with all of the requirements specified in this Agreement.

4.7 Conditional Offering

Customer understands that this proposal has been issued based upon the information provided by customer, and currently available to, GE at the time of proposal issuance. Any changes or discrepancies in site conditions (including but not limited to system influent water characteristics, changes in environmental, health, and safety (EH&S) conditions, and/or newly discovered EH&S concerns), Customer financial standing, Customer requirements, or any other relevant change, or discrepancy in, the factual basis upon which this proposal was created, may lead to changes in the offering, including but not limited to changes in pricing, warranties, quoted specifications, or terms and conditions. GE's offering in the proposal is conditioned upon a full GE EH&S and Customer financial review.

4.8 After-Sales Service

Should you want to learn more about GE's expert service offerings on your equipment, including Insight, GE's Remote Monitoring & Diagnostics program, please contact your local GE Water Sales Representative or visit our website http://www.gewater.com/index.jsp to get connected with a Customer Service Representative in your region. In North America, please dial 1-866-GEWATER to contact a customer service representative.

4.8.1 InSight Remote Monitoring & Diagnostics

Water and process applications generate vast amounts of operating data. InSight, GE's easy-to-use, web-based Remote Monitoring & Diagnostics platform, captures and transforms your plant data into meaningful and actionable information, ultimately providing the knowledge you need to maximize performance, avoid operational interruptions, optimize your processes, and reduce the total cost of operation. InSight provides:

- **Analytics**: Seeing, at any point in time, historical and current plant performance against success criteria, and the trajectory of future performance; where it's on track, and the weaknesses that need improvement.
- **Early Detection and Alarming**: Detecting emerging problems, so that action can be taken now, before a failure is experienced in the future.
- **Optimization**: Identifying opportunities to optimize processes to lower total cost of operation without sacrificing performance.
- **Reporting**: Reporting on key performance indicators and their impact on business objectives.
- **Productivity**: Reducing the tedious work of entering and reporting operator-collected data. Help staff get more done with tools that enhance their personal productivity, enabling them to see and do more.

GE can offer InSight for the equipment proposed in this document. Two InSight packages are available to meet particular customer needs:

- InSight Basic – Digital Asset Monitoring

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- InSight Pro – Process Consulting Service

InSight Basic – Digital Asset Monitoring

With InSight Basic, you will gain visibility into your plant's current and future performance by having complete access to your plant data through InSight. InSight allows you to perform your own process monitoring, trending, and analysis suited to your individual plant operations and success criteria. You will have access to the tools in InSight to add your own annotations, load your own analytical data, and configure your own reports and alerts.

The service is enhanced with weekly automated performance reports and daily alarm notification summaries, allowing you to identify emerging problems earlier so that action can be taken now, before a failure can occur.

InSight Basic customers have access to personnel from GE's Service Reliability Center (SRC) who will provide training and support on the use and features of InSight.

InSight Pro – Process Consulting Service

InSight Pro – Process Consulting Service puts a professional GE Process Expert onto your team, collaborating to empower your operating team to apply the power of InSight to continuously improve their treatment processes.

The Process Expert is specifically assigned to your plant and will monitor key parameters on a regular rhythm using the InSight platform. The Process Expert will be in frequent contact with the key members of your operations team to discuss and resolve performance, process and operational issues. While supporting your operations team with day-to-day issues, the Process Expert will also use InSight to bring attention to long term trends and provide recommendations that will help increase member and equipment life and reduce costs.

As a part of InSight Pro – Process Consulting Service, the Process Expert provides bi-weekly performance reports with analysis of key trends and recommendations to improve plant operation, membrane cleaning and overall performance. In addition, a semi-annual summary of performance report is provided.

If the need for troubleshooting does arise, you will have your Process Expert available, deeply familiar with your system and empowered with information to assist.

GE Water & Process Technologies **Product Announcement**

2014-July-21

Notice of Discontinuation of Manufacture and Sale of E-Cell MK-2 Stack Product Line and Selected MK-3 / E-Cell-3X Product Line Stacks

Purpose:

This product announcement is to notify that:

1. The E-Cell MK-2 Stack product line will be discontinued. Stacks from the MK-3 product line are replacements or substitutes (see Applicability Table below.)
2. Selected MK-3 / E-Cell-3X product line stacks will be discontinued. Other stacks from the MK-3 product line are replacements or substitutes, except for the E-Cell-3XHH high hardness stack (see Applicability Table below.)

Final orders for stacks to be discontinued must be placed by the last order dates listed in the Applicability Table below and suitable replacement / substitute stacks must be identified.

This Notice is not intended to modify, amend or otherwise change the terms and conditions pursuant to which GE Water E-Cell Stacks identified in this Product Announcement have been sold. Moreover, this Product Bulletin should not be construed as containing or otherwise giving rise to any express or implied warranties, which are hereby disclaimed.

Distribution

Purchasers, owners, operators and servicers of E-Cell stacks and systems
Designers of E-Cell systems

Applicability

<u>MK-2 Product Line: Stack Replacement with System Conversion, or Stack Substitution</u>

There are two options for converting an E-Cell system from MK-2 to MK-3 product line stacks.

1. Replacement of the MK-2 product line stack with its corresponding MK-3 stack. Conversion of the MK-2 or MK-1 system to MK-3 configuration. Removal of Concentrate loop brine injection. A stack power extension cable may be needed.
2. Substitution of the MK-2 line stack with its corresponding MK-3 stack. Operation of the system with MK-3 stacks in MK-2 configuration. Removal of Concentrate loop brine injection. A stack power extension cable may be needed.

<u>MK-3 Product Line: Stack Substitution</u>

The discontinued MK-3 line stack can be directly substituted with another MK-3 line stack.

Applicability Table

Model Name	Part Number	Replacement / Substitute	Replacement / Substitute Part Number	Last Order Date	Last Pickup Date	Notes
STACKS						
MK-3Pharm	3020056	MK-3PharmHT	3041772	October 17, 2014	December 19, 2014	1
MK-3Mini	3018627	MK-3MiniHT	3044124	October 17, 2014	December 19, 2014	1
MK-2PharmHT	3019225	MK-3PharmHT	3041772	October 17, 2014	December 19, 2014	2, 3
MK-2Pharm	3019230	MK-3PharmHT	3041772	October 17, 2014	December 19, 2014	2, 3
MK-2Mini	3019231	MK-3MiniHT	3044124	October 17, 2014	December 19, 2014	2, 3
MK-2MiniHT	3019226	MK-3MiniHT	3044124	October 17, 2014	December 19, 2014	2, 3
MK-2ST	3019189	MK-3	3018626	October 17, 2014	December 19, 2014	2, 3
MK-2E	3019185	MK-3	3018626	December 19, 2014	March 27, 2015	2, 3
E-Cell-3XHH	3063891	None	- -	October 17, 2014	December 19, 2014	4
SYSTEMS						
ServicE-Cell	3043099	GEMK3-1, Basic, 60 Hz	3018925	October 17, 2014	5	
ServicE-Cell Mini	3043110	None	- -	October 17, 2014	5	4

<u>Applicability Table Notes</u>

1. Can operate together on same system, as long as HT stack has not been hot water sanitized.

2. MK-2 line and MK-3 line stacks cannot operate on the same system together due to operational differences. All MK-2 line stacks on a system must be replaced with their corresponding MK-3 stacks. At sites with multiple E-Cell systems, the switch from MK-2 line to MK-3 line stacks can be done one system at a time, consolidating MK-2 line stacks onto remaining systems for a gradual changeover.

3. MK-2 to MK-3 stack replacement and system conversion vs simple stack substitution
    a. For conversion of an MK-2 or MK-1 system to MK-3 configuration and stack replacement, contact your GE Water sales representative for instructions “E-Cell MK-3 Retrofit Instructions.”
    b. As an alternative to system conversion, an MK-3 product line stack can be substituted to operate in the same configuration as its corresponding MK-2 product line stack.
    c. In both cases a. and b., brine injection must be removed or damage to the MK-3 product line stack may occur and warranty will be void.
    d. In both cases a. and b., if a Primax P5000 600 V DC output rectifier is used (installed on early E-Cell MK-1 standard systems), an upgrade kit may be needed (contact your GE Water representative for instructions.) An upgrade kit is not needed for the Primax P5500 model rectifier or other power supplies used on GE manufactured E-Cell systems.
4. Will be discontinued with no direct substitute. Contact your GE Water sales representative for further assistance.
5. Last pickup date of ServicE-Cell and ServicE-CellMini systems is one week after the system is packaged for shipment. Contact your GE Water sales representative for lead times.

Issue Overview

GE Water is simplifying its E-Cell product line by phasing out E-Cell stack models that are outdated or with overlapping functions.

The MK-2 product line was introduced in 2002 and superseded by the MK-3 / E-Cell-3X product line in 2007.

The launch of the MK-3 / E-Cell-3X product line 7 years ago included an information package on converting MK-2 systems to MK-3, “E-Cell MK-3 Retrofit Instructions.”

MK-3 / E-Cell-3X will become the single E-Cell stack product line superseding the MK-2 product line, with all MK-2 stack models superseded at the end of 2014, except for MK-2E, which will be superseded by MK-3 at the end of March, 2015.

Some stacks of the MK-3 / E-Cell-3X product line will be consolidated with others to further streamline the product line.

The remaining stack models provide all the functionality of existing stacks, except for E-Cell-3XHH, which will be discontinued with no direct substitute.

This simplification allows GE Water to support today’s E-Cell customers, installations and applications while developing new additions to the product line with product improvements and new features.

Recommended Customer Action

- Read and distribute this product announcement to the appropriate personnel in your organization.
- Review your operations to determine one or both of the following: 1) the level you will need of spare stock of E-Cell stacks that will be discontinued; 2) the replacement or substitute stack model you will order when you next need to replace E-Cell stacks
- Place purchase orders for stacks that will be discontinued by the dates noted in the Applicability Table

Product Announcement Contacts

Questions or concerns about this product announcement can be directed to:

1) Your GE Water sales representative

2) GE Water Technical Support
   8:30am to 5:00pm (Monday to Friday, Eastern Standard Time)
   North America: 1-866-271-5425, press 3
   Outside North America: (905) 469-7723, press 3
   gewater.technicalsupport@ge.com

3) Tom Kosir
   Product Manager, E-Cell and PRO E-Cell
   GE Water & Process Technologies
   T +1-519-829-4538
   M +1-519-835-7845
   E tom.kosir@ge.com

Balance of Plant

CI Number: 47611

Title: POT – Demolish Unit 1 Stack

Start Date:	2016/03
In-Service Date:	2016/10
Final Cost Date:	2017/04
Function:	Steam
Forecast Amount:	$1,732,346

DESCRIPTION:

Pt. Tupper Unit 1 has been out of service since 1985. The stack for this unit was not demolished at the time of decommissioning and requires regular inspection and maintenance to ensure its integrity is maintained. The condition of the stack is reaching the point where concrete is spalling off, steel structures have corroded, and attachments are failing. This project will see the demolition of the Unit 1 stack to mitigate the safety risk and eliminate ongoing maintenance costs.

This capital project settles a portion of NS Power's Asset Retirement Obligation related to Pt. Tupper Generation Station. As such, the capital costs shown will not be added to NS Power's asset base.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Health & Safety

Why do this project?

This project is required to eliminate the ongoing maintenance costs and safety risks associated with deteriorated concrete. The stack was built in 1968 and taken out of service in 1985. The integrity of the concrete stack continues to deteriorate and demolition of the stack is required. Attachment 1 details the deteriorated condition of the stack, which can be anticipated to further deteriorate if not removed.

Why do this project now?

Demolition of the stack is required to eliminate the safety risk associated with a non-operating concrete structure built approximately 50 years ago. No major outage work is planned for 2016; therefore, opportunity exists to demolish the stack in the most cost-effective manner over several months.

Why do this project this way?

The stack cannot be imploded or felled by explosives due to its proximity to other operating plant equipment, so it must be dismantled from the top down. An opening will be made in the bottom of the stack and the stack chimney and liner will be dismantled and lowered to the ground for removal.

CI Number : 47611 - POT - Demolish Unit 1 Stack **Project Number**

Parent CI Number : -

Cost Centre : 351 - 351-Pt.Tupper Admin./Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal & Hydro Contracts AO		[redacted]	0	[redacted]
013	003	013 - POWER PRODUCTION Contracts	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
066	003	066 - Other Goods & Services	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
028	087	028 - Consulting	087 Field Super.& Ops.	[redacted]	0	[redacted]
			Total Cost:	1,732,346	0	1,732,346
			Original Cost:			

Capital Project Detailed Estimate

Location: Pt. Tupper
CI# : 47611
Title: POT - Demolish Unit 1 Stack
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
013 Contracts						
Demolish steel liner	lot	1	[redacted]		Cost Support Item #1	
Demolish concrete shell	lot	1			Cost Support Item #1	
			Sub-Total	[redacted]		
028 Consulting						
Supervision (33 weeks)	lot	1	[redacted]			
			Sub-Total	[redacted]		
066 Other Goods & Services						
Contingency	%	15%	[redacted]			
				$ -		
			Sub-Total	[redacted]		
095 Administrative Overhead						
Thermal / Hydro Contracts AO				[redacted]		
			Sub-Total			
			SUB-TOTAL (no AO, AFUDC)	$ 1,603,463		
			TOTAL (AO, AFUDC included)	$ 1,732,346		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

HAMON CUSTODIS-COTTRELL CANADA, INC.

Ref.: 285/11/16 *May 26th, 2015*

NOVA SCOTIA POWER INC. ***Fax 902-625-3292***
POINT TUPPER GENERATING STATION
4137 PORT MALCOM ROAD
POINT TUPPER, Nova Scotia
B9A 1Z4

Attention: Michelle Sampson Tel.902-625-2323 x3621
Mr. Raymond Barrett Tel. 902-625-2323(3663)
Sr. Maint. Super.

RE: P-14-408 – Repairs of Unit#1 and demolition of Unit #2.-REV.1

Dear, Michelle and Raymond.

Further to your recent request we are submitting our pricing for the following repair work on unit #2 and the demolition of unit#1. The repairs have been priced based on the scope, pictures provided and verbal clarification from Nova Scotia Power (May 25th 2015). Hamon proposes that all crack and insulation repairs be completed on T&M as the quantities are not accurately defined and after reviewing the 2014 inspection report, Hamon believes that, in particular, the insulation repairs may be more extensive than communicated in the scope.

<u>Unit #1, - 300' x 10' 6"</u>

PRICE AND TENTATIVE SCHEDULE:

Demolition of Steel liner [redacted] - CAD
Tentative Schedule

Demolition of Concrete shell [redacted] -CAD
Tentative Schedule

Complete for Labour, Material and Equipment.
Disposal of demolished liner steel by Owner.
Disposal of demolished concrete shell by Owner.
Regular working schedule, 5-8's, no weekend, holiday or overtime work.
Not priced for winter work.
Plus Applicable taxes.

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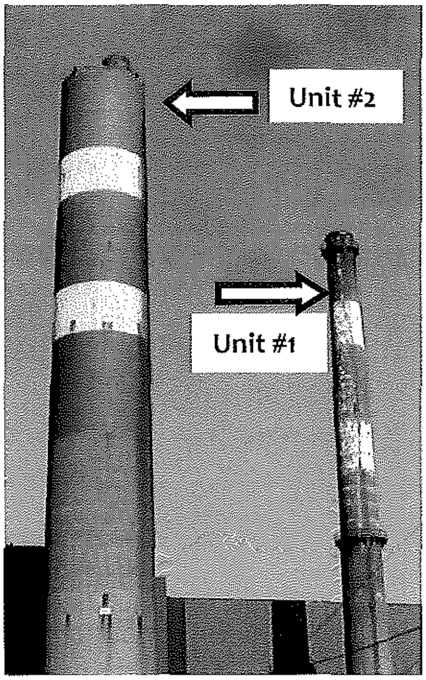
23 West Beaver Creek Road
Unit 2/3
Richmond Hill, Ontario L4B 1K4
Canada

Telephone
905.771.0234
Fax
905.771.9730

E-mail: Sean.Taylor@hamon.com
Web: www.hamon.com



INSPECTION REPORT

300' x 10'-6" Concrete chimney – Unit #1
350' x 11' Concrete chimney - Unit #2

Nova Scotia Power
Point Tupper

Job No. S-1440 / File No. 285/11
285/16
October 2014

Hamon Custodis performed an inspection on the 300' and 350'Reinforced Concrete chimneys in July 2014. Purpose of the inspection was to determine current conditions of the units.

Inspection consisted of visual observations of the exterior of the concrete column of the 300' chimney from the ladder.

The 350' was more thoroughly inspected; an external inspection, an inspection of the annular space and an interior inspection of the liner with detailed non-destructive thickness testing of the liner plate was conducted.

A comprehensive set of Ultrasonic Thickness Measurement readings were taken on the steel liner interior wall and are attached in chart form.

Photographs were taken and are referenced.

Repairs performed at the time of this inspection:

- ❑ None

HAMON
HAMON CUSTODIS
23 West Beaver Creek Road
Unit 2, Richmond Hill,
Ontario

HAMON CUSTODIS

Description (unit #1)

Construction: 300' x 10'-6" Top OD, reinforced concrete column with one steel liner. Concrete column is 300' in height with a base OD of 26'-6" and a top OD of 10'-6". There is an exterior ladder with a mid (360 degree) and top (360 degree) platform.

The lining is 1/4" wrought iron plate with 2" insulation and 1" galvanized wire mesh on both sides.

The steel liner is covered by a cap which is constructed of steel. The cap is painted black and held together with bolted connections. Each bolted connection uses 8 bolts to fasten the flanged connections. No access is possible to the liner from the cap.

Ladder: The concrete column has an exterior ladder with a Saf-T-Climb rail.

Breeching Ducts: There are 4 breaching openings. All of the openings have been sealed up with bricks.

LPS: 8 lightning points (air terminals) at the top of the chimney.

Observations

Video #	Elevation (feet)	Orientation	**Exterior East Unit #1** Notes
1	300	East	Roof Cap, flanged connections held together with bolts. Bolts are pitted and rusting. 8 bolts in each connection. Welded plate on top of chimney cap. Welds on the side and skirt of plate are broken. Cap was painted black, paint is deteriorating and the shop primer is exposed.
2	300	East	Underneath cap. Paint coverage under 50%. Paint easily scrapped off. Many cracks underneath the cap. Caulking and paint no longer protecting concrete. Safe-t-rail, pitted and unusable. A second large crack on the left side of the ladder. Paint protecting balcony handrails. Balcony grating at top is very pitted and thinning.
3	300	South	Paint on cap and concrete shell very deteriorated. 8 lightning points show no defects. Grating heavily rusted and pitted.
4	298	South West	Misc rigging plate 10"x12" area of concrete has rusted and blown out the surrounding concrete. Paint very deteriorated.
5	298	North West	Misc rigging plate 10"x12" area of concrete has rusted and blown out the surrounding concrete. Paint very deteriorated. Plate is really loose and anchors aren't embedded into the concrete. Crack open more than 1/8". Grating heavily rusted and pitted. Below 50% of paint remaining.
6	298	North West	Plate unable to be removed. Recommendation that plate be removed and concrete repaired to prevent falling hazard.
7	295	North East	Cracks no longer protects by paint and caulking. Crack open 1/8". Paint deteriorated.
8	290	East	Under balcony. Balcony components show no major issues. Light pitting. Paint showing signs of deterioration. Climbing rail needs to be replaced. Vertical crack from the top of the chimney to the left

			of the ladder continues down the chimney.
9	280	East	Large amount of scale behind climbing rail. Climbing rail should be replaced. Old electrical cable no longer feeds aircraft lights and could be removed. Concrete crack to the left of the ladder continues.
10	262	East	Ladder rung has been drilled and replaced. Hardware has been replaced in ladder side rail.
11	247	East	Paint heavily deteriorated. More than 75% of paint is missing. Crack to the left of the ladder is at approx. 1/16". Small horizontal crack almost 4' long to the right of the ladder. Hammer test shows no major issues with the concrete.
12	225	East	Circuit cable shows no major issues. Following the crack to the left of the ladder from the top to 225'. Crack is open about 1/16". Red paint is flaking and is at approx. 65% coverage.
13	200	East	Transition from red to white. White paint shows less than 50% coverage. Crack which was followed from the top is now a hairline crack. Lightning protection system shows no major issues.
14	190	East	Crack has opened up to 1/16" on the left side of the ladder. Second location where ladder is bent. Ladder step iron has breaks in the weld on the left side of the ladder side rail.
15	165	East	Crack continues to run from the top to 165'. Ladder rung replaced by a bolt. Areas of paint are deteriorated.
16	155	East	Mid balcony. Crack from the top continues. Another horizontal crack open 1/4". Grating on balcony is thinning, thinner than the grating at the top. Abandoned power cord from aircraft warning light. Small clean out door on the North side. Horizontal crack on the North side open as much as 1/4" looks to be previously repaired except a lot of the repair material has fallen out. Crack runs 360 degrees around the chimney. Grounding for small access door is not connected to chimney lightning protection system. Paint at elevation is deteriorated.
17	146	East	Underneath balcony, most balcony components show no major issues. Grating is heavily pitted and rusted. Area of exposed rebar where concrete has fallen out. Area surrounding exposed rebar shows no major issues.
18	130	East	Crack to the left of the ladder continues. Saf-T-Climb rails is heavily rusted and pitted.
19	125	East	Crack now open greater than 1/8" runs to the left of the ladder. No major issues in the concrete shell we found at this elevation.
20	93	East	Crack to the left of the ladder continues. Saf-T-climb rail is separated and shows scale build up behind the Saf-T-climb rail and fastening components to the ladder.
21	45	East	Ladder rung replaced by stainless steel threaded rod. Crack to the left of the ladder is no longer visible. Hammer test shows no major issues. Bricked breeching opening has no visible issues. Heavy pitting on the saf-T-climb rail.
22	7	East	10' section of the ladder has been removed at the base. Underneath the breeching, an area has been roped off to prevent falling material hazards. On the west side there is a light oil tank approx. 7' from the chimney base. The tank is 35' long and 18'

HAMON CUSTODIS

			high. Falling material hazards from the South side breeching. Man door has been covered with plywood on the south side.
23	0	North	Cracking on the North side, large crack from the mid platform to the top. Large crack on the West side from the mid platform to the top of the chimney.
24	0	South	View of cracks from the ground on the South side.
25	350		Looking at the top of the 300' chimney.

Recommendations

Exterior:

Cap:

1. Apply the appropriate protective coating to the areas of the cap which are exposed to the elements and are no longer protected by the black paint.
2. Replace all of the bolts in the flanged connections in the cap with stainless steel bolts.
3. Fit and weld sides and bottom of plate to the left of the ladder back onto the cap as the welds on the sides have broken. Repair and broken tacks or welds on the strapping plates welded to the cap. Paint over all newly welded components to prevent weather damage.

Concrete Column:

4. Clean away flaking paint and apply a new coat of paint to areas of the chimney where the coloured bands show heavy deterioration. The paint to match the existing international orange and white for the purpose of protecting the concrete column from weather damage and to satisfy ministry of transportation aircraft marking and lighting standards.
5. Long crack runs along the ladder (East). Cut out damaged concrete and remove old cracking/missing caulking and re-seal cracking of the concrete column. This should be done before applying touch up coat of paint to the chimney.
6. Crack from the mid platform to the top of the chimney (North). Cut out damaged concrete and remove old cracking/missing caulking and re-seal cracking of the concrete column. This should be done before applying touch up coat of paint to the chimney.
7. Crack from the mid platform to the top of the chimney (West). Cut out damaged concrete and remove old cracking/missing caulking and re-seal cracking of the concrete column. This should be done before applying touch up coat of paint to the chimney.
8. Remove all misc. plates (Elevation 298'), anchors etc from the chimney column. Apply bonding agent/corrosion inhibitor to exposed reinforcing steel and repair voids with repair material.

Climbing rail (Saf-T-Climb) and ladder:

9. Replace climbing rail throughout the entire height of the chimneys external ladder. Replace with galvanized sections throughout with an exception to the top 20' which should be stainless steel.
10. Grind and weld cracked ladder step iron connections at side rail.

Balconies

11. Grating at mid platform is in worse shape than grating at top platform. Grating at mid platform should have a protective coating applied or be replaced.
12. The clean out door at the mid platform should be grounded and attached to the lightning protection system.

CI Number: 47505

Title: LIN Coal Mill Refurbishment 2016

Start Date: 2016/02
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $749,183

DESCRIPTION:

Lingan Generating Station employs sixteen Raymond Bowl style mills to pulverize coal for combustion in the boiler. This project is to replace coal mill components that have reached the end of their useful life on two of the sixteen mills. Based on experienced wear characteristics, component failures will occur if a replacement plan is not performed. The consequence of such a failure could include unplanned unit derating. This capital item includes the replacement of welded steel rollers and tables with ceramic wear components, worm gear & shaft, vertical shaft and other non-repairable mill components. Components either to be replaced or refurbished will be determined based on the condition assessment when teardown is undertaken as part of the planned outage for each mill in 2016. Going forward, continued capital investment of the Lingan mills will still be required to extend asset life and ensure the reliability of this equipment is maintained.

These mills service all units at the Lingan generating station. Current expectation is that this project will not include the refurbishment of any mills on Unit #2. However, if mills on Unit #2 were found to require refurbishment in 2016, investment on Unit #2 could still be the best option. All four units at Lingan are similar and as such, the components refurbished on this coal mill can be transferred to any of the other Lingan coal mills when Lingan Unit #2 is retired. This includes welded steel rollers and tables with ceramic wear components, worm gear and shaft, vertical shaft and other components that will be addressed in this capital item. The useful life of these coal mill components is more than double the payback period shown in the EAM, providing a significant benefit to all of the coal mills at Lingan.

Summary of Related CIs +/- 2 years:
2014 CI 44351 LIN Pulverizer Refurbishment $536,481
2015 CI 46055 LIN Coal Mill Refurbishment $736,546
2017 CI TBD LIN Coal Mill Refurbishment $TBD
2018 CI TBD LIN Coal Mill Refurbishment $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

This project is being completed to mitigate the risk of mill failure. A mill failure could limit peak generation of the unit depending on the fuel blend in service. It is imperative that the mills are available full time between planned outages in order to maintain unit performance at rated capacity. The replacement of mechanical components and the upgrading of the ceramic surfaces is necessary to achieve the most economic operation of the unit.

Why do this project now?

A total of sixteen coal mills are installed on the four units at Lingan. An orderly approach to mill refurbishment manages the availability of the assets and supports the operation of the generating units that they serve. Operating and maintenance experience with the mills has identified several areas of concern that need to be addressed in order for the mills to meet availability targets. Replacement parts are now needed due to age and wear on many of the components. During periods of lower load it is possible to take 1 of 4 mills out of service without affecting generation. Isolated repairs and minor refurbishment are not typically possible for the mills. To access components and complete the required equipment replacement, it is necessary to disassemble the mill and therefore an overall refurbishment versus isolated repairs is more effective.

Why do this project this way?

A phased approach to maintaining the mills allows for scheduled outages of selected mills, reducing the risk of extended unplanned outages. By planning refurbishments and replacements in a given year, the refurbishment and replacement efforts can be made more efficient with dedicated labour and parts available as required.

CI Number : 47505 - LIN Coal Mill Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 301 - 301-Lingan Admin./Common Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,701	0	2,701
095		095-Thermal & Hydro Contracts AO		1,021	0	1,021
095		095-Thermal Regular Labour AO		26,564	0	26,564
095		095-Thermal Term Labour AO		20,704	0	20,704
001	018	001 - THERMAL Regular Labour	018 - SGP - Fuel Hndlg.Coal	131,053	0	131,053
004	018	004 - THERMAL Term Labour	018 - SGP - Fuel Hndlg.Coal	102,140	0	102,140
012	018	012 - Materials	018 - SGP - Fuel Hndlg.Coal	455,000	0	455,000
013	018	013 - POWER PRODUCTION Contracts	018 - SGP - Fuel Hndlg.Coal	10,000	0	10,000
			Total Cost:	749,183	0	749,183
			Original Cost:	539,022		

Capital Project Detailed Estimate

Location: Lingan Generating Station
CI# / FP#: 47505
Title: LIN Coal Mill Refurbishment 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate		Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	298	$ 365	$ 108,721		40655,43166, 44351
Utilityworker	PD	93	$ 240	$ 22,332		40655,43166, 44351
			Sub-Total	$ 131,053		
004 Term Labour						
Maintenance Trades	PD	280	$ 365	$ 102,140		40655,43166, 44351
			Sub-Total	$ 102,140		
012 Materials						
OEM and Locally Manufactured Parts	ea	1	$ 455,000	$ 455,000		40655,43166, 44351
			Sub-Total	$ 455,000		
013 Contracts						
Misc. Machining	ea	1	$ 10,000	$ 10,000		
			Sub-Total	$ 10,000		
094 Interest Capitalized						
AFUDC				$ 2,701		
				$ -		
			Sub-Total	$ 2,701		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 26,564		
Thermal Term Labour AO				$ 20,704		
Thermal / Hydro Contracts AO				$ 1,021		
			Sub-Total	$ 48,289		
			SUB-TOTAL (no AO, AFUDC)	$ 698,193		
			TOTAL (AO, AFUDC included)	$ 749,183		
Original Cost				$ 539,022		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN Coal Mill Refurbishment 2016
Summary of Alternatives

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47505
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank (based on PV of RR)**	**IRR**	**Disc Pay**
A	Refurbish Mills vs Replacement Energy	6.11%	-1,073,584	747,028	1	41.13%	3.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to complete this project to help avoid mill related deratings.

Notes/Comments :

Refurbish Mills vs Replacement Energy & Repair Costs

Failure scenario is the loss of a Mill during peak unit load. With current coal blends (Low sulf., low BTU) , all four Mills are required for peak load. A derate of approx 20 MW is expected if a Mill is not available. A significant Mill repair, including material lead time is 2 - 4 weeks. This scenario assumes the Mill is unavailable for 4 weeks for teardown and materials lead time.

Test 2

Test 3

Test 4

LIN Coal Mill Refurbishment 2016
Summary of Sensitivities

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47505
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Mills vs Replacement Energy & Repair	6.11%	-1,073,584	747,028	1	41.13%	3.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Mills vs Replacement Energy & Repair	10%	-1,001,716	692,851	1	35.63%	3.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change: **A**	71,868	-54,178	0	-5.51%	0.3 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Mills vs Replacement Energy & Repair	-10%	-894,357	618,148	1	35.08%	3.4 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change: **A**	179,226	-128,881	0	-6.06%	0.3 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	150,891	420,788	663,130	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN Coal Mill Refurbishment 2016
Avoided Cost Calculations

Division :	Power Production	Date :	03-Nov-15
Department :	Lingan Generating Station	CI Number:	47505
Originator :		Project No. :	

Refurbish Mills vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			161,800	168,287		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	20.0	20.0				
Duration (Hours)	672	672				
Totals	$0	$0	$161,800	$336,573	$161,800	$336,573
Total Capital Cost of Alternative						$749,183

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

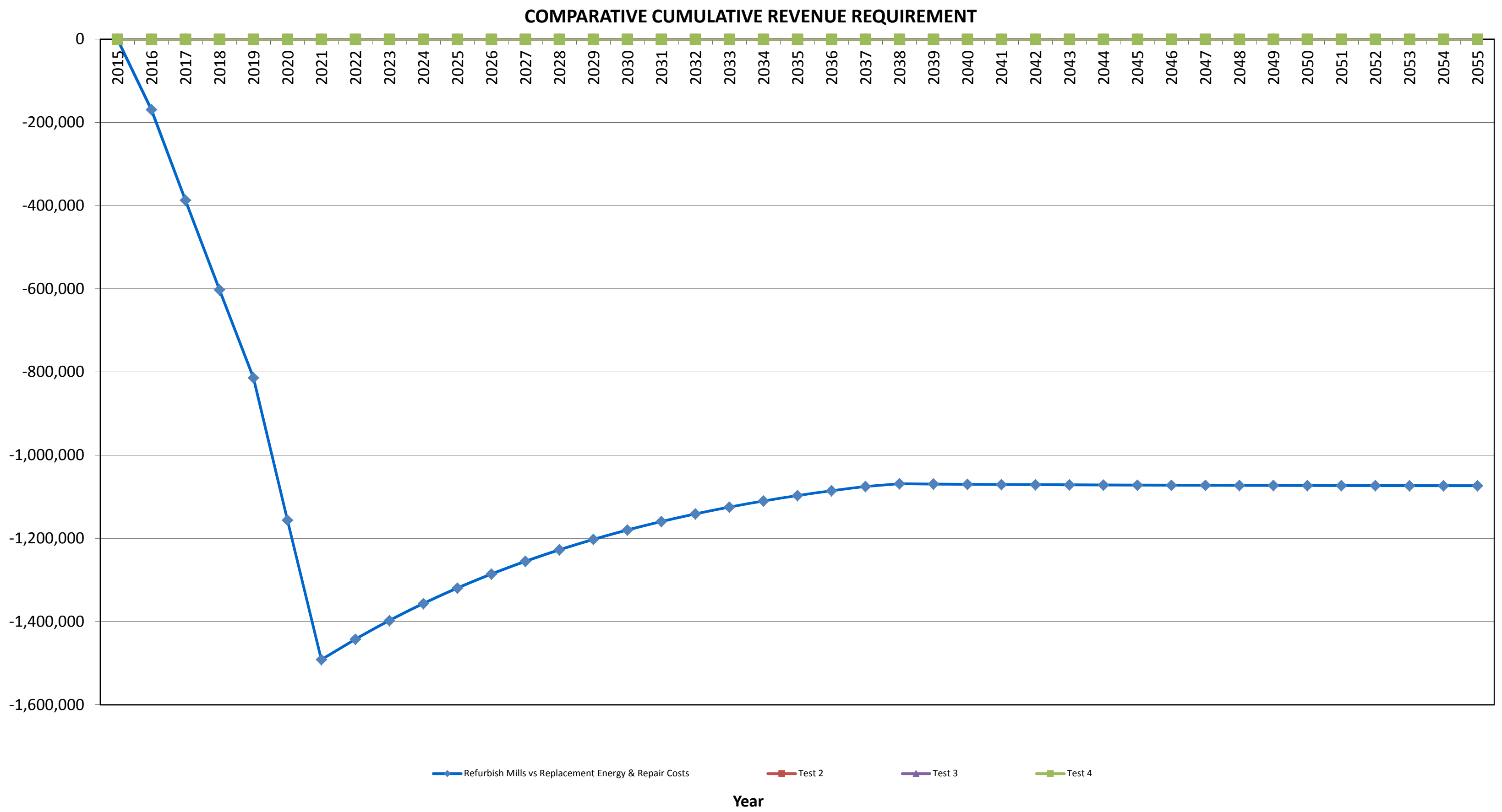
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN Coal Mill Refurbishment 2016
Refurbish Mills vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	161,800.0	(700,893.9)	27,927.7	683,593.1	(539,093.9)	(41,500.4)	(580,594.3)	(547,162.6)	0.94	(547,162.6)
2017	-	-	336,573.4	-	53,621.2	627,746.7	336,573.4	(87,715.2)	248,858.3	221,024.0	0.89	(326,138.6)
2018	-	-	350,067.0	-	49,331.5	576,368.0	350,067.0	(93,228.0)	256,839.0	214,977.0	0.84	(111,161.6)
2019	-	-	364,101.6	-	45,385.0	529,099.7	364,101.6	(98,802.1)	265,299.4	209,272.0	0.79	98,110.4
2020	-	-	568,048.2	-	41,754.2	485,612.7	568,048.2	(163,151.1)	404,897.0	300,997.6	0.74	399,107.9
2021	-	-	590,821.8	-	38,413.9	445,604.8	590,821.8	(171,246.5)	419,575.4	293,949.1	0.70	693,057.0
2022	-	-	-	-	35,340.8	408,797.5	-	10,955.6	10,955.6	7,233.4	0.66	700,290.4
2023	-	-	-	-	32,513.5	374,934.7	-	10,079.2	10,079.2	6,271.5	0.62	706,562.0
2024	-	-	-	-	29,912.4	343,781.0	-	9,272.8	9,272.8	5,437.6	0.59	711,999.6
2025	-	-	-	-	27,519.4	315,119.6	-	8,531.0	8,531.0	4,714.5	0.55	716,714.1
2026	-	-	-	-	25,317.9	288,751.1	-	7,848.5	7,848.5	4,087.6	0.52	720,801.7
2027	-	-	-	-	23,292.4	264,492.0	-	7,220.7	7,220.7	3,544.1	0.49	724,345.8
2028	-	-	-	-	21,429.0	242,173.7	-	6,643.0	6,643.0	3,072.8	0.46	727,418.5
2029	-	-	-	-	19,714.7	221,640.9	-	6,111.6	6,111.6	2,664.2	0.44	730,082.7
2030	-	-	-	-	18,137.5	202,750.7	-	5,622.6	5,622.6	2,309.9	0.41	732,392.6
2031	-	-	-	-	16,686.5	185,371.7	-	5,172.8	5,172.8	2,002.8	0.39	734,395.4
2032	-	-	-	-	15,351.6	169,383.0	-	4,759.0	4,759.0	1,736.4	0.36	736,131.8
2033	-	-	-	-	14,123.5	154,673.4	-	4,378.3	4,378.3	1,505.5	0.34	737,637.4
2034	-	-	-	-	12,993.6	141,140.6	-	4,028.0	4,028.0	1,305.3	0.32	738,942.7
2035	-	-	-	-	11,954.1	128,690.4	-	3,705.8	3,705.8	1,131.8	0.31	740,074.4
2036	-	-	-	-	10,997.8	117,236.3	-	3,409.3	3,409.3	981.3	0.29	741,055.7
2037	-	-	-	-	10,118.0	106,698.4	-	3,136.6	3,136.6	850.8	0.27	741,906.5
2038	-	-	-	-	9,308.5	97,003.6	-	2,885.6	2,885.6	737.6	0.26	742,644.1
2039	-	-	-	-	8,563.8	88,084.4	-	2,654.8	2,654.8	639.6	0.24	743,283.7
2040	-	-	-	-	7,878.7	79,878.7	-	2,442.4	2,442.4	554.5	0.23	743,838.2
2041	-	-	-	-	7,248.4	72,329.4	-	2,247.0	2,247.0	480.8	0.21	744,319.0
2042	-	-	-	-	6,668.6	65,384.1	-	2,067.3	2,067.3	416.8	0.20	744,735.8
2043	-	-	-	-	6,135.1	58,994.5	-	1,901.9	1,901.9	361.4	0.19	745,097.2
2044	-	-	-	-	5,644.3	53,116.0	-	1,749.7	1,749.7	313.4	0.18	745,410.6
2045	-	-	-	-	5,192.7	47,707.8	-	1,609.7	1,609.7	271.7	0.17	745,682.3
2046	-	-	-	-	4,777.3	42,732.2	-	1,481.0	1,481.0	235.6	0.16	745,917.8
2047	-	-	-	-	4,395.1	38,154.7	-	1,362.5	1,362.5	204.2	0.15	746,122.1
2048	-	-	-	-	4,043.5	33,943.4	-	1,253.5	1,253.5	177.1	0.14	746,299.1
2049	-	-	-	-	3,720.0	30,069.0	-	1,153.2	1,153.2	153.5	0.13	746,452.7
2050	-	-	-	-	3,422.4	26,504.5	-	1,061.0	1,061.0	133.1	0.13	746,585.8
2051	-	-	-	-	3,148.6	23,225.2	-	976.1	976.1	115.4	0.12	746,701.2
2052	-	-	-	-	2,896.7	20,208.2	-	898.0	898.0	100.1	0.11	746,801.3
2053	-	-	-	-	2,665.0	17,432.6	-	826.2	826.2	86.8	0.11	746,888.0
2054	-	-	-	-	2,451.8	14,879.1	-	760.1	760.1	75.2	0.10	746,963.3
2055	-	-	-	-	2,255.7	12,529.8	-	699.3	699.3	65.2	0.09	747,028.5
Total	**-**	**-**	**2,371,412.0**	**(700,893.9)**	**672,252.9**		**1,670,518.1**	**(526,739.3)**	**1,143,778.8**	**747,028.5**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
-1,400,000
-1,600,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish Mills vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47661

Title: POT – Asbestos Management 2016

Start Date: 2016/03
In-Service Date: 2016/04
Final Cost Date: 2016/10
Function: Steam
Forecast Amount: $721,551

DESCRIPTION:

The scope of this project includes the removal of asbestos insulation material and re-insulation of the main steam, hot reheat steam, and cold reheat steam lines on the third floor of the Point Tupper boiler house. This is approximately 200 feet of large diameter piping (14" and up). This area is a larger area than has been completed in the 2014 and 2015 Asbestos Management project.

Quarterly air samples, in conjunction with known areas of insulation requiring frequent repairs, will be correlated to determine the location and extent of asbestos insulation to be removed during the next major outage. Other areas not affected by the running unit will be identified for immediate attention.

The Point Tupper Generating Station has been in operation since the mid-1960s. Much of the insulation used during construction of Units 1 and 2 was asbestos-based. In 1997, an extensive asbestos removal project was undertaken on Unit 1. This removed the majority of the asbestos contained in the boiler house and turbine area for the unit. This unit had been decommissioned some time earlier.

During the conversion of Unit 2 from oil to coal (completed in 1987), the asbestos on the boiler was removed. This significantly reduced the quantity of asbestos on the unit. The asbestos insulation on the majority of the boiler piping and the turbine, as well as feedwater piping and building heating, was not addressed.

This is an ongoing asbestos management program with scope determined based on audits completed twice annually. Additionally, the scope can be determined based on other work ongoing within the plant and any asbestos abatement required in those areas in order to mitigate the risk of exposure during this work. This year's scope will allow for high energy piping inspections to be completed on the main steam, hot reheat steam and cold reheat steam lines. These areas are larger in scale (greater than 165 feet of piping) than the areas worked on in prior years, leading to a higher investment amount.

Summary of Related CIs +/- 2 years:
2014 CI 44586 POT Asbestos 2014 $158,220
2015 CI 46417 POT Asbestos Management 2015 $233,769
2017 CI TBD POT Asbestos Management 2017 $TBD
2018 CI TBD POT Asbestos Management 2018 $TBD

JUSTIFICATION:

Justification Criteria: Health and Safety

Why do this project?

The condition of the existing Point Tupper Unit 2 asbestos insulation continues to deteriorate due to maintenance activities and equipment vibration. In some cases, encapsulation of affected areas has required repeat and extensive maintenance to prevent asbestos fibers from becoming airborne. In addition, degenerated asbestos insulation causes maintenance delays, increase down time and increase operating costs.

Why do this project now?

There is still a large quantity of asbestos insulation in Unit 2 which requires constant inspection and repair. Periodic audits and tracking maintenance work orders identify areas requiring attention and removals throughout the plant. In order to perform pipe inspection on high energy piping, asbestos insulation must be removed on main steam, hot reheat, and cold reheat pipes in the boiler house during the 2016 outage.

Why do this project this way?

Removal of the bulk asbestos on Unit 2 is a very large project and must be done while the unit is offline. This is a multi-year program to remove the remaining insulation on Unit 2 piping. Tackling the removal in smaller portions allows the work to be carried out within normal shutdown windows, or on areas not affected by unit operation, without incurring additional down time on the unit. To remove all asbestos at one time would require many months of down time on the unit. This is the best balance between cost for removal and lost production.

CI Number : 47661 - POT - Asbestos Management 2016 **Project Number**

Parent CI Number : -

Cost Centre : 351 - 351-Pt.Tupper Admin./Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Overtime Labour AO		121	0	121
095		095-Thermal Regular Labour AO		121	0	121
095		095-Thermal Term Labour AO		121	0	121
095		095-Thermal & Hydro Contracts AO		38,756	0	38,756
001	003	001 - THERMAL Regular Labour	003 - SGP - Bldg.,Struct.Grnd.	598	0	598
002	003	002 - THERMAL Overtime Labour	003 - SGP - Bldg.,Struct.Grnd.	1,197	0	1,197
004	003	004 - THERMAL Term Labour	003 - SGP - Bldg.,Struct.Grnd.	598	0	598
012	003	012 - Materials	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
013	003	013 - POWER PRODUCTION Contracts	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
028	003	028 - Consulting	003 - SGP - Bldg.,Struct.Grnd.	50,400	0	50,400
066	003	066 - Other Goods & Services	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
011	085	011 - Travel Expense	085 Design	100	0	100
028	085	028 - Consulting	085 Design	50,400	0	50,400
041	085	041 - Meals & Entertainment	085 Design	100	0	100
			Total Cost:	721,551	0	721,551
			Original Cost:	118,494		

Capital Project Detailed Estimate

Location: Pt. Tupper
CI# : 47661
Title: POT - Asbestos abatement 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	1	$ 358	$ 358		
Utilityworker	PD	1	$ 240	$ 240		
			Sub-Total	$ 598		
002 OT Labour						
Electrician	PD	1	$ 717	$ 717		
Utilityworker	PD	1	$ 480	$ 480		
			Sub-Total	$ 1,197		
004 Term Labour						
Electrician	PD	1	$ 358	$ 358		
Utilityworker	PD	1	$ 240	$ 240		
			Sub-Total	$ 598		
011 Travel Expense						
Travel	lot	1	$ 100	$ 100		
			Sub-Total	$ 100		
012 Materials						
Materials and consumables	lot	1	[redacted]			
			Sub-Total	[redacted]		
013 Contracts						
Abatement/Reinsulation	lot	1	[redacted]			
Vendor Travel	lot	1				
Staging	lot	1				
			Sub-Total	[redacted]		
028 Consulting						
Supervision and testing	lot	1	$ 100,800	$ 100,800		
			Sub-Total	$ 100,800		
041 Meals & Entertainment						
Meals and expenses	lot	1	$ 100	$ 100		
			Sub-Total	$ 100		
066 Other Goods & Services						
Contingency	%	15%	[redacted]			
			Sub-Total	[redacted]		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 121		
Thermal OT Labour AO				$ 121		
Thermal Term Labour AO				$ 121		
Thermal / Hydro Contracts AO				$ 38,756		
			Sub-Total	$ 39,120		
			SUB-TOTAL (no AO, AFUDC)	$ 682,431		
			TOTAL (AO, AFUDC included)	$ 721,551		
Original Cost				$ 118,494		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47869

Title: LIN4 Bottom Ash Refurbishment

Start Date: 2016/03
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $616,599

DESCRIPTION:

This project is for the refurbishment of the boiler bottom ash system seal trough, dip plate, drip screen, discharge hopper structural steel refurbishment and replacement of refractory. The seal is comprised of a trough where a level of water is maintained, combined with a corrugated “dip plate” which extends into the water from the underside of the boiler. This arrangement provides for boiler expansion and seals the pressurized furnace from the boilerhouse.

This project is being completed as part of the planned major outage on Lingan Unit #4 in 2016 and includes investment on multiple assets in order to safely and reliably operate this unit up until its next maintenance interval (8-10 years). These investments are similar in nature to the planned major outage completed on Lingan Unit #3 in 2015, as both units are projected to be operated well beyond their next maintenance interval. These investments also enhance NS Power’s capability to two-shift (the process of cycling the unit off and on versus continuous operation) this unit in the future which provides much needed flexibility to the generating fleet.

Summary of Related CIs +/- 2 years:
2014 CI 46231 LIN4 U&U BA Structural Refurbishment $197,154

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

The bottom ash system is exposed to severe operating conditions that have weakened the structural integrity of the seal trough, discharge hopper and support systems, and refractory. Due to this deteriorated condition, refurbishment is necessary and will ensure the integrity of the bottom ash system on an ongoing basis.

Why do this project now?

This work should be completed during the Lingan 4 2016 planned outage so the unit can operate without a lengthy shutdown for bottom ash repairs. If the components fail in an unplanned manner and without material readily available, the unit stability, capacity and availability will be compromised. The refurbishment of the de-ashing system cannot be postponed until the next planned outage based on its current condition.

Why do this project this way?

The Plant maintenance and engineering personnel assessed the bottom ash system during the 2015 outage and wear and corrosion noted on the hopper slope steel dictates that replacement is required along with the associated refractory. The seal trough and dip plate refurbishments will correct leaks which have developed in the seal trough allowing for an extended operating period. Refurbishment of these components is the most economical way to complete this work as full replacement of the bottom ash system is more costly and not required at this time.

CI Number : 47869 - LIN4 Bottom Ash **Project Number**

Parent CI Number : -

Cost Centre : 305 - 305-Lingan 3&4 Prod.Unit **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		1,734	0	1,734
095		095-Thermal Regular Labour AO		11,068	0	11,068
095		095-Thermal Term Labour AO		24,146	0	24,146
095		095-Thermal Overtime Labour AO		5,437	0	5,437
095		095-Thermal & Hydro Contracts AO		16,847	0	16,847
001	021	001 - THERMAL Regular Labour	021 - SGP - Ash Handling	54,601	0	54,601
002	021	002 - THERMAL Overtime Labour	021 - SGP - Ash Handling	53,645	0	53,645
004	021	004 - THERMAL Term Labour	021 - SGP - Ash Handling	119,123	0	119,123
012	021	012 - Materials	021 - SGP - Ash Handling	165,000	0	165,000
013	021	013 - POWER PRODUCTION Contracts	021 - SGP - Ash Handling	165,000	0	165,000
			Total Cost:	616,599	0	616,599
			Original Cost:	421,863		

Capital Project Detailed Estimate

Location: Lingan Generating Station
CI# : 47869
Title: LIN4 Bottom Ash
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	98	$ 365	$ 35,763		
Utilityworker	PD	78	$ 240	$ 18,837		
			Sub-Total	$ 54,601		46070
002 OT Labour						
Maintenance Trades	PD	147	$ 365	$ 53,645		
			Sub-Total	$ 53,645		
004 Term Labour						
Maintenance trades	PD	294	$ 365	$ 107,290		
utilityworker	PD	49	$ 240	$ 11,832		
				$ -		
			Sub-Total	$ 119,123		46070
012 Materials						
Seal Trough Guard Mesh	ea	1	$ 25,000	$ 25,000		
Steel Plate for Chute and Seal Trough	ea	1	$ 30,000	$ 30,000		
Stainless Steel Dip Plate	ea	1	$ 70,000	$ 70,000		
Seal Trough Piping	ea	1	$ 10,000	$ 10,000		
consumables & safety equipment	ea	1	$ 10,000	$ 10,000		
Structural Steel	ea	1	$ 20,000	$ 20,000		
			Sub-Total	$ 165,000		
013 Contracts						
Supply and Install Refractory	ea	1	$ 140,000	$ 140,000		46070
Installation of Seal Plate to Boiler Tubes	ea	1	$ 25,000	$ 25,000		
			Sub-Total	$ 165,000.00		
094 Interest Capitalized						
AFUDC				$ 1,734		
				$ -		
			Sub-Total	$ 1,734		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 11,068		
Thermal OT Labour AO				$ 5,437		
Thermal Term Labour AO				$ 24,146		
Thermal / Hydro Contracts AO				$ 16,847		
			Sub-Total	$ 57,497		
			SUB-TOTAL (no AO, AFUDC)	$ 557,369		
			TOTAL (AO, AFUDC included)	$ 616,599		
Original Cost				$ 421,863		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN4 Bottom Ash Refurbishment
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47869
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish Bottom Ash vs. Replacement	6.11%	-1,676,643	1,221,122	1	32.05%	5.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid extended unplanned outages related to bottom ash failures on Unit 4.

Notes/Comments :

Refurbish Bottom Ash vs. Replacement Energy & Repair Costs

If the bottom ash system fails online the unit must be taken offline for a minimum of 2 weeks for repairs. As time passes the probability of failure increases.

Test 2

Test 3

Test 4

LIN4 Bottom Ash Refurbishment
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production		**Date :**	**02-Nov-15**
Department :	Lingan Generating Station		**CI Number:**	47869
Originator :			**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Bottom Ash vs. Replacement Energy &	6.11%	-1,676,643	1,221,122	1	32.05%	5.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Bottom Ash vs. Replacement Energy &	10%	-1,622,112	1,177,912	1	29.64%	5.3 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:					
A	54,531	-43,210	0	-2.41%	0.2 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish Bottom Ash vs. Replacement Energy &	-10%	-1,454,448	1,055,800	1	29.39%	5.3 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:					
A	222,195	-165,323	0	-2.66%	0.2 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**PV of Revenue Requirement**	**Delay?**
Yrs Delay:	1	2	3	
A	26,747	72,209	154,991	No
B	0	0	0	No
C	0	0	0	No
D	0	0	0	No

LIN4 Bottom Ash Refurbishment
Avoided Cost Calculations

Division :	Power Production	Date :	02-Nov-15
Department :	Lingan Generating Station	CI Number:	47869
Originator :		Project No. :	

Refurbish Bottom Ash vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			94,160	97,944		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	20%	40%	20%	40%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	150.0	150.0				
Duration (Hours)	336	336				
Totals	$9,849	$34,974	$18,832	$39,178	$28,681	$74,152
Total Capital Cost of Alternative						$616,599

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

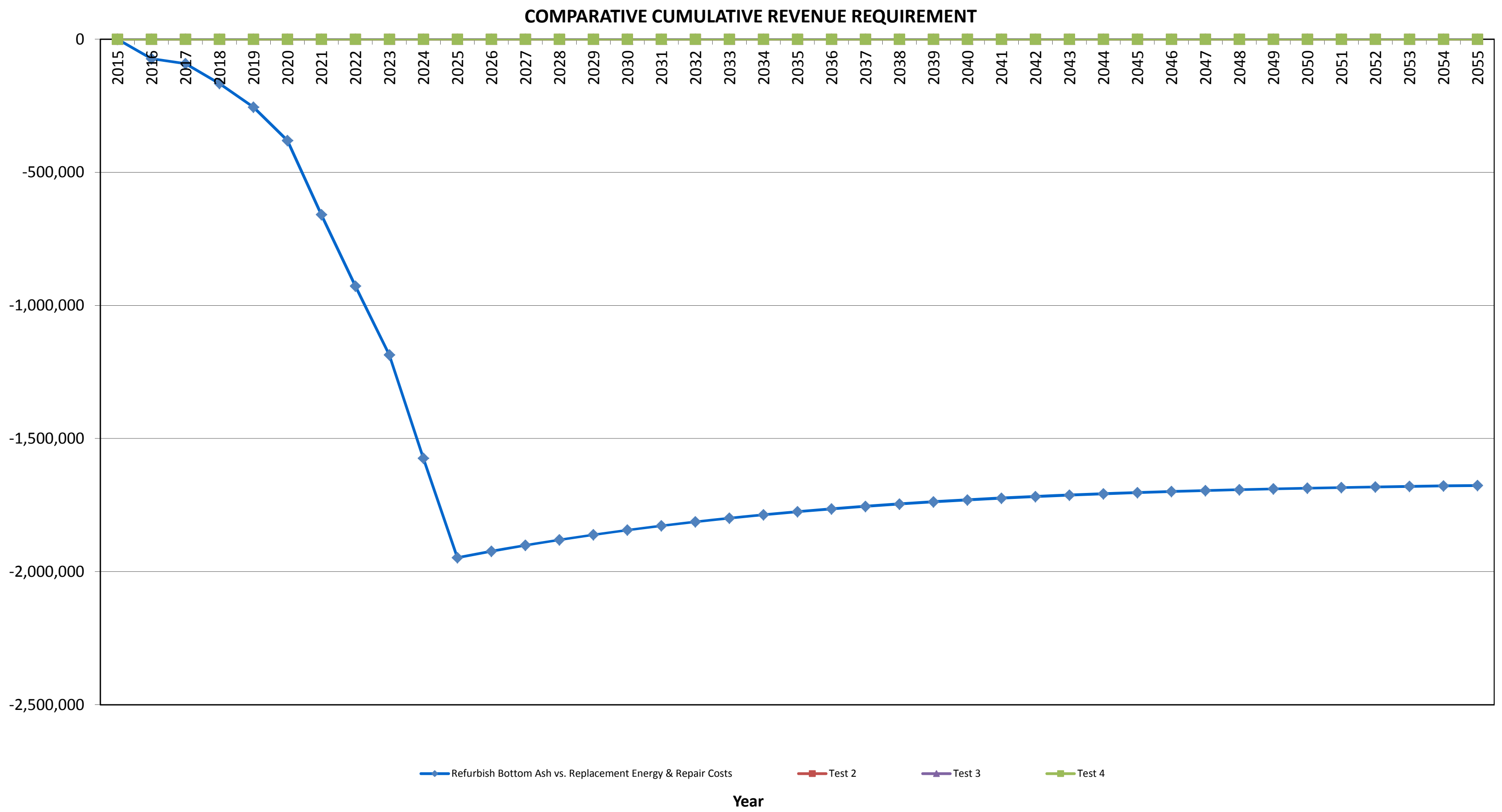
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN4 Bottom Ash Refurbishment

Refurbish Bottom Ash vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	28,681.3	(559,102.3)	22,294.7	550,943.0	(530,421.0)	(1,979.8)	(532,400.8)	(501,744.3)	0.94	(501,744.3)
2017	-	-	74,152.0	-	42,805.9	505,487.6	74,152.0	(9,717.3)	64,434.7	57,227.8	0.89	(444,516.4)
2018	-	-	145,320.2	-	39,381.4	463,668.7	145,320.2	(32,841.0)	112,479.2	94,146.3	0.84	(350,370.1)
2019	-	-	170,830.0	-	36,230.9	425,195.2	170,830.0	(41,725.7)	129,104.3	101,839.3	0.79	(248,530.8)
2020	-	-	231,444.8	-	33,332.4	389,799.7	231,444.8	(61,414.8)	170,030.0	126,399.1	0.74	(122,131.7)
2021	-	-	476,598.2	-	30,665.8	357,235.8	476,598.2	(138,239.0)	338,359.2	237,050.0	0.70	114,918.3
2022	-	-	490,759.7	-	28,212.6	327,277.0	490,759.7	(143,389.6)	347,370.1	229,349.7	0.66	344,268.0
2023	-	-	505,390.6	-	25,955.6	299,714.9	505,390.6	(148,624.9)	356,765.7	221,989.6	0.62	566,257.6
2024	-	-	780,761.4	-	23,879.1	274,357.8	780,761.4	(234,633.5)	546,127.9	320,248.8	0.59	886,506.5
2025	-	-	804,192.4	-	21,968.8	251,029.2	804,192.4	(242,489.3)	561,703.1	310,415.7	0.55	1,196,922.2
2026	-	-	-	-	20,211.3	229,567.0	-	6,265.5	6,265.5	3,263.1	0.52	1,200,185.3
2027	-	-	-	-	18,594.4	209,821.7	-	5,764.3	5,764.3	2,829.2	0.49	1,203,014.5
2028	-	-	-	-	17,106.8	191,656.0	-	5,303.1	5,303.1	2,453.0	0.46	1,205,467.5
2029	-	-	-	-	15,738.3	174,943.6	-	4,878.9	4,878.9	2,126.8	0.44	1,207,594.4
2030	-	-	-	-	14,479.2	159,568.2	-	4,488.6	4,488.6	1,844.0	0.41	1,209,438.4
2031	-	-	-	-	13,320.9	145,422.8	-	4,129.5	4,129.5	1,598.8	0.39	1,211,037.2
2032	-	-	-	-	12,255.2	132,409.0	-	3,799.1	3,799.1	1,386.2	0.36	1,212,423.4
2033	-	-	-	-	11,274.8	120,436.4	-	3,495.2	3,495.2	1,201.9	0.34	1,213,625.2
2034	-	-	-	-	10,372.8	109,421.5	-	3,215.6	3,215.6	1,042.0	0.32	1,214,667.3
2035	-	-	-	-	9,543.0	99,287.9	-	2,958.3	2,958.3	903.5	0.31	1,215,570.8
2036	-	-	-	-	8,779.6	89,964.9	-	2,721.7	2,721.7	783.3	0.29	1,216,354.1
2037	-	-	-	-	8,077.2	81,387.8	-	2,503.9	2,503.9	679.2	0.27	1,217,033.3
2038	-	-	-	-	7,431.0	73,496.8	-	2,303.6	2,303.6	588.9	0.26	1,217,622.2
2039	-	-	-	-	6,836.5	66,237.2	-	2,119.3	2,119.3	510.6	0.24	1,218,132.7
2040	-	-	-	-	6,289.6	59,558.3	-	1,949.8	1,949.8	442.7	0.23	1,218,575.4
2041	-	-	-	-	5,786.4	53,413.7	-	1,793.8	1,793.8	383.8	0.21	1,218,959.2
2042	-	-	-	-	5,323.5	47,760.6	-	1,650.3	1,650.3	332.8	0.20	1,219,292.0
2043	-	-	-	-	4,897.6	42,559.9	-	1,518.3	1,518.3	288.5	0.19	1,219,580.5
2044	-	-	-	-	4,505.8	37,775.1	-	1,396.8	1,396.8	250.2	0.18	1,219,830.6
2045	-	-	-	-	4,145.4	33,373.2	-	1,285.1	1,285.1	216.9	0.17	1,220,047.5
2046	-	-	-	-	3,813.7	29,323.4	-	1,182.3	1,182.3	188.0	0.16	1,220,235.6
2047	-	-	-	-	3,508.6	25,597.6	-	1,087.7	1,087.7	163.0	0.15	1,220,398.6
2048	-	-	-	-	3,227.9	22,169.9	-	1,000.7	1,000.7	141.4	0.14	1,220,540.0
2049	-	-	-	-	2,969.7	19,016.3	-	920.6	920.6	122.6	0.13	1,220,662.5
2050	-	-	-	-	2,732.1	16,115.1	-	847.0	847.0	106.3	0.13	1,220,768.8
2051	-	-	-	-	2,513.6	13,446.0	-	779.2	779.2	92.1	0.12	1,220,860.9
2052	-	-	-	-	2,312.5	10,990.4	-	716.9	716.9	79.9	0.11	1,220,940.8
2053	-	-	-	-	2,127.5	8,731.2	-	659.5	659.5	69.3	0.11	1,221,010.1
2054	-	-	-	-	1,957.3	6,652.8	-	606.8	606.8	60.1	0.10	1,221,070.1
2055	-	-	-	-	1,800.7	4,740.6	-	558.2	558.2	52.1	0.09	1,221,122.2
Total	**-**	**-**	**3,708,130.7**	**(559,102.3)**	**536,660.5**		**3,149,028.4**	**(983,155.8)**	**2,165,872.6**	**1,221,122.2**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-500,000
-1,000,000
-1,500,000
-2,000,000
-2,500,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish Bottom Ash vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47554

Title: TRE5 5-1 FD Fan Refurbishment

Start Date:	2016/06
In-Service Date:	2016/09
Final Cost Date:	2017/03
Function:	Steam
Forecast Amount:	$494,802

DESCRIPTION:

The scope of this project is to replace the shaft and bearings on the 5-1 forced draft fan. This fan is original equipment to the Trenton 5 Generation Station, approximately 47 years old (circa 1968). The bearings are being replaced with a style of bearings which offers equal service performance, but are less costly and more readily obtainable than the equipment currently in operation.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

In 2013, the inboard fan bearing on 5-1 overheated, resulting in damage to the shaft and bearing housings and distortion to the shaft. Temporary repairs, completed under OM&G, were made at the time and Unit 5 was returned to full load and has been operational since the repairs. The damage to the shaft and bearing housings has damaged the integrity of these components, thus compromising reliability and life expectancy of the fan. Due to this deterioration, replacement of the shaft and bearing assemblies are required in order to re-establish the operational integrity of the fan.

Why do this project now?

The condition of the fan is deteriorated to the point where an unplanned outage due to a failure can be reasonably anticipated in the next 1-2 years. Completing this work in a planned manner will avoid replacement energy costs that would be incurred if this failure occurred, likely causing an 18 week period of lost generation (14 week material ordering lead time with reduced generation and a 4 week outage to install). A four week planned outage is scheduled for Trenton 5 in 2016, which will allow enough time to complete this project without incurring the risk of these replacement energy costs.

Why do this project this way?

The shaft and bearing replacement is the preferred option rather than the replacement of the entire fan assembly, which is a more expensive option and at this time is not required. A full fan assembly replacement would cost approximately $1.5 - $2 million, with the reliability of the unit not experiencing a significant improvement.

CI Number : 47554 - TRE5 5-1 FD Fan Refurbishment **Project Number**

Parent CI Number : -

Cost Centre : 340 - 340-Trenton Unit 5 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,591	0	2,591
095		095-Thermal & Hydro Contracts AO		7,964	0	7,964
095		095-Thermal Term Labour AO		3,931	0	3,931
095		095-Thermal Regular Labour AO		10,011	0	10,011
095		095-Thermal Overtime Labour AO		6,012	0	6,012
001	017	001 - THERMAL Regular Labour	017 - SGP - Draft Equip./Stacks	41,283	0	41,283
002	017	002 - THERMAL Overtime Labour	017 - SGP - Draft Equip./Stacks	59,318	0	59,318
004	017	004 - THERMAL Term Labour	017 - SGP - Draft Equip./Stacks	19,395	0	19,395
012	017	012 - Materials	017 - SGP - Draft Equip./Stacks	212,618	0	212,618
013	017	013 - POWER PRODUCTION Contracts	017 - SGP - Draft Equip./Stacks	78,000	0	78,000
066	017	066 - Other Goods & Services	017 - SGP - Draft Equip./Stacks	42,072	0	42,072
001	087	001 - THERMAL Regular Labour	087 Field Super.& Ops.	8,106	0	8,106
011	087	011 - Travel Expense	087 Field Super.& Ops.	2,000	0	2,000
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	1,500	0	1,500
			Total Cost:	494,802	0	494,802
			Original Cost:	76,243		

Capital Project Detailed Estimate

Location: Trenton Generating Station
CI# / FP#: 47554
Title: TRE5 5-1 FD Fan Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Mech (Millwrights)	PD	80	$ 365	$ 29,183		
Mech (Welders)	PD	20	$ 365	$ 7,296		
Utility	PD	20	$ 240	$ 4,804		
Internal Supervision	PD	20	$ 405	$ 8,106		
				$ -		
			Sub-Total	$ 49,389		
002 OT Labour						
Mech (Millwrights)	PD	60	$ 730	$ 43,775		
Utility	PD	10	$ 480	$ 4,804		
Mech (Welders)	PD	15	$ 716	$ 10,740		
			Sub-Total	$ 59,318		
004 Term Labour						
Mech (Millwrights)	PD	40	$ 365	$ 14,592		
Utility	PD	20	$ 240	$ 4,804		
			Sub-Total	$ 19,395		
011 Travel Expense						
	lot	1	$ 2,000	$ 2,000		
			Sub-Total	$ 2,000		
012 Materials						
Replacement Shaft with Hub	lot	1	[redacted]		Cost Support #1 - Page 2 Item 2	
Bearings, pedestals, engineering, etc	lot	1			Cost Support #1 - Page 1 Item 1	
Price Escalation on 2013 Quote	%	6%			2% per year	
USD/CAD Exchange rate	%	32%				
Misc Materials	lot	1				
				$ -		
			Sub-Total	$ 212,618		
013 Contracts						
Machining/Fabrication	lot	1	$ 10,000	$ 10,000		
Vacuum services	lot	1	$ 5,000	$ 5,000		
Technical advisor	PD	21	$ 3,000	$ 63,000		
			Sub-Total	$ 78,000		
041 Meals & Entertainment						
Meals	lot	1	$ 1,500	$ 1,500		
			Sub-Total	$ 1,500		
066 Other Goods & Services						
Contingency	%	10%	$ 420,721	$ 42,072		
				$ -		
			Sub-Total	$ 42,072		
094 Interest Capitalized						
AFUDC				$ 2,591		
			Sub-Total	$ 2,591		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 10,011		
Thermal OT Labour AO				$ 6,012		
Thermal Term Labour AO				$ 3,931		
Thermal Contracts AO				$ 7,964		
			Sub-Total	$ 27,918		
			SUB-TOTAL (no AO, AFUDC)	$ 464,293		
			TOTAL (AO, AFUDC included)	$ 494,802		
Original Cost				$ 76,243		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

TRE5 5-1 FD Fan Refurbishment
Summary of Alternatives

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	47554
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	FD Fan Refurbishment vs Replacemen	6.11%	-13,077,296	9,825,084	1	655.47%	1.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to refurbish the 5-1 FD fan in a planned manner during the 2016 planned unit outage. This project is supported by favorable economic analysis data.

Notes/Comments :

FD Fan Refurbishment vs Replacement Energy & Repair Costs

This analysis compares the cost of refurbishment versus the avoided replacement energy costs associated with an unplanned failure and resultant refurbishment. Assumption that there is a 50% risk of failure in 2016, which increases each year thereafter.

Test 2

Test 3

Test 4

TRE5 5-1 FD Fan Refurbishment
Summary of Sensitivities

Division :	Power Production	**Date :**	**03-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	47554
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	FD Fan Refurbishment vs Replacement Energy &	6.11%	-13,077,296	9,825,084	1	655.47%	1.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	FD Fan Refurbishment vs Replacement Energy &	10%	-13,030,412	9,788,982	1	437.92%	1.2 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	46,885	-36,103	0	-217.55%	0.1 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	FD Fan Refurbishment vs Replacement Energy &	-10%	-11,722,682	8,806,473	1	422.63%	1.3 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	1,354,614	-1,018,611	0	-232.83%	0.1 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	502,909	1,200,503	1,840,792	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

TRE5 5-1 FD Fan Refurbishment
Avoided Cost Calculations

Division :	Power Production	Date :	03-Nov-15
Department :	Trenton Generating Station	CI Number:	47554
Originator :		Project No. :	

FD Fan Refurbishment vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			120,000	124,848		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	50%	60%	50%	60%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	48.0	48.0				
Duration (Hours)	8760	8760				
Totals	$479,270	$744,445	$60,000	$74,909	$539,270	$819,354
Total Capital Cost of Alternative						$494,802

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

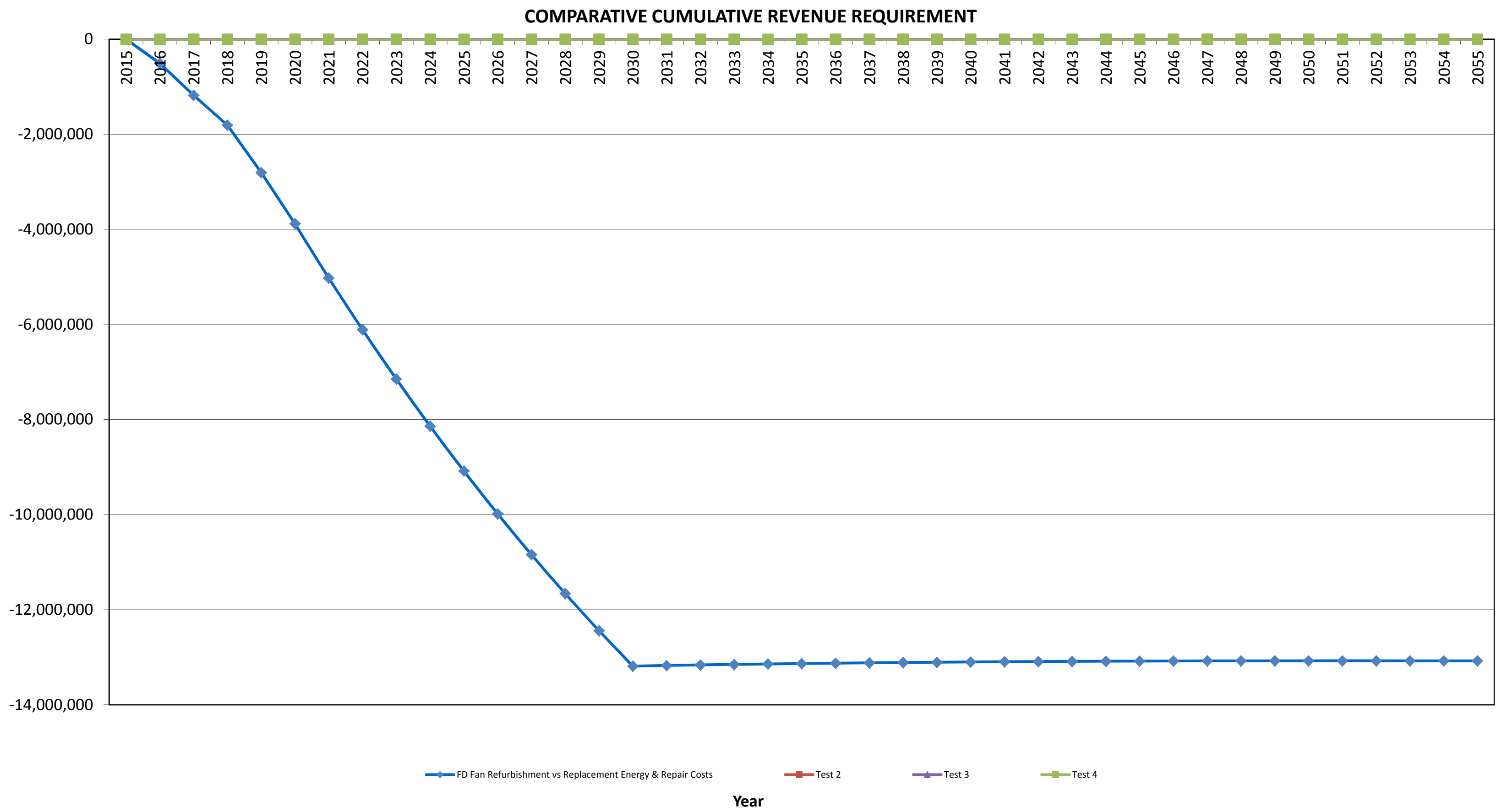
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

TRE5 5-1 FD Fan Refurbishment
FD Fan Refurbishment vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	539,269.8	(466,883.8)	18,571.7	453,426.3	72,386.0	(161,416.4)	(89,030.4)	(83,903.9)	0.94	(83,903.9)
2017	-	-	819,354.2	-	35,657.7	416,482.1	819,354.2	(242,945.9)	576,408.3	511,938.2	0.89	428,034.4
2018	-	-	823,385.3	-	32,805.1	382,493.5	823,385.3	(245,079.9)	578,305.4	484,047.9	0.84	912,082.2
2019	-	-	1,364,864.1	-	30,180.7	351,224.0	1,364,864.1	(413,751.9)	951,112.3	750,250.9	0.79	1,662,333.1
2020	-	-	1,569,713.5	-	27,766.2	322,456.1	1,569,713.5	(478,003.7)	1,091,709.9	811,569.4	0.74	2,473,902.5
2021	-	-	1,781,876.9	-	25,544.9	295,989.5	1,781,876.9	(544,462.9)	1,237,414.0	866,916.2	0.70	3,340,818.7
2022	-	-	1,820,498.5	-	23,501.3	271,640.4	1,820,498.5	(557,069.1)	1,263,429.4	834,174.2	0.66	4,174,993.0
2023	-	-	1,860,013.1	-	21,621.2	249,239.1	1,860,013.1	(569,901.5)	1,290,111.6	802,743.5	0.62	4,977,736.4
2024	-	-	1,900,443.5	-	19,891.5	228,629.9	1,900,443.5	(582,971.1)	1,317,472.4	772,564.4	0.59	5,750,300.8
2025	-	-	1,941,812.9	-	18,300.2	209,669.5	1,941,812.9	(596,289.0)	1,345,524.0	743,581.0	0.55	6,493,881.8
2026	-	-	1,984,145.6	-	16,836.2	192,225.9	1,984,145.6	(609,865.9)	1,374,279.6	715,740.6	0.52	7,209,622.4
2027	-	-	2,027,466.1	-	15,489.3	176,177.8	2,027,466.1	(623,712.8)	1,403,753.3	688,993.3	0.49	7,898,615.7
2028	-	-	2,071,799.9	-	14,250.1	161,413.6	2,071,799.9	(637,840.4)	1,433,959.5	663,292.1	0.46	8,561,907.8
2029	-	-	2,117,173.4	-	13,110.1	147,830.4	2,117,173.4	(652,259.6)	1,464,913.8	638,592.3	0.44	9,200,500.1
2030	-	-	2,163,613.4	-	12,061.3	135,334.0	2,163,613.4	(666,981.1)	1,496,632.2	614,851.7	0.41	9,815,351.8
2031	-	-	-	-	11,096.4	123,837.2	-	3,439.9	3,439.9	1,331.8	0.39	9,816,683.6
2032	-	-	-	-	10,208.7	113,260.2	-	3,164.7	3,164.7	1,154.7	0.36	9,817,838.3
2033	-	-	-	-	9,392.0	103,529.4	-	2,911.5	2,911.5	1,001.2	0.34	9,818,839.5
2034	-	-	-	-	8,640.6	94,577.0	-	2,678.6	2,678.6	868.0	0.32	9,819,707.5
2035	-	-	-	-	7,949.4	86,340.8	-	2,464.3	2,464.3	752.6	0.31	9,820,460.1
2036	-	-	-	-	7,313.4	78,763.5	-	2,267.2	2,267.2	652.5	0.29	9,821,112.7
2037	-	-	-	-	6,728.4	71,792.4	-	2,085.8	2,085.8	565.8	0.27	9,821,678.4
2038	-	-	-	-	6,190.1	65,379.0	-	1,918.9	1,918.9	490.5	0.26	9,822,168.9
2039	-	-	-	-	5,694.9	59,478.6	-	1,765.4	1,765.4	425.3	0.24	9,822,594.2
2040	-	-	-	-	5,239.3	54,050.3	-	1,624.2	1,624.2	368.7	0.23	9,822,963.0
2041	-	-	-	-	4,820.2	49,056.2	-	1,494.2	1,494.2	319.7	0.21	9,823,282.7
2042	-	-	-	-	4,434.5	44,461.7	-	1,374.7	1,374.7	277.2	0.20	9,823,559.9
2043	-	-	-	-	4,079.8	40,234.7	-	1,264.7	1,264.7	240.3	0.19	9,823,800.2
2044	-	-	-	-	3,753.4	36,345.9	-	1,163.6	1,163.6	208.4	0.18	9,824,008.6
2045	-	-	-	-	3,453.1	32,768.2	-	1,070.5	1,070.5	180.7	0.17	9,824,189.3
2046	-	-	-	-	3,176.9	29,476.7	-	984.8	984.8	156.6	0.16	9,824,345.9
2047	-	-	-	-	2,922.7	26,448.6	-	906.0	906.0	135.8	0.15	9,824,481.7
2048	-	-	-	-	2,688.9	23,662.6	-	833.6	833.6	117.8	0.14	9,824,599.5
2049	-	-	-	-	2,473.8	21,099.6	-	766.9	766.9	102.1	0.13	9,824,701.6
2050	-	-	-	-	2,275.9	18,741.6	-	705.5	705.5	88.5	0.13	9,824,790.1
2051	-	-	-	-	2,093.8	16,572.2	-	649.1	649.1	76.7	0.12	9,824,866.9
2052	-	-	-	-	1,926.3	14,576.4	-	597.2	597.2	66.5	0.11	9,824,933.4
2053	-	-	-	-	1,772.2	12,740.3	-	549.4	549.4	57.7	0.11	9,824,991.1
2054	-	-	-	-	1,630.4	11,051.0	-	505.4	505.4	50.0	0.10	9,825,041.1
2055	-	-	-	-	1,500.0	9,496.9	-	465.0	465.0	43.4	0.09	9,825,084.5
Total	**-**	**-**	**24,785,430.2**	**(466,883.8)**	**447,042.6**		**24,318,546.4**	**(7,544,900.1)**	**16,773,646.3**	**9,825,084.5**		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2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
FD Fan Refurbishment vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Howden

QUOTATION (PARTS)

1775 Wehrle Drive
Williamsville, NY 14221
ISO 9001:2008 Certified

Attention:	Gary Seely	From:	Phil Marino
Company/Representative:	Gary C Seely Limited	Phone:	716-817-6956
End User:	Trenton Thermal Generating Station	Email:	Phil.Marino@howden.com
Your Reference:	FD Fan		
Our Reference:	2 - 730 Ser. 27 Airfoils, DWDI, (C-6250)	Fax:	866-810-9419
Market:	Power	Quote #:	15 20130729 1
General Assembly Drawing:	C-13756	Date:	8/2/2013

Howden North America presents our offer as follows:

Item	Part Number	Description	Qty	Price Each	*Availability
1		Bearing retrofit kit changing 6" Fan Cooled Michell Bearing to 6" Sleevoil Bearing Kit includes: - (1) One 6" Sleevoil Held Bearing Assembly: Sleeve, Housing, Aux Seals, Thrust Plate Kit & Split Thrust Collar - (1) One 6" Sleevoil Free Bearing Assembly: Sleeve, Housing & Aux Seals - (2) 1/4" thick Shims for under bearings - (2) Two New Bearing Pedestals, shorter in height to allow for the centerline height difference between the old bearings and the new bearings Hardware to mount new bearings to new pedestal and new pedestal to existing sole plate - Existing Sole Plates to be reused (if new sole plates are required add $6794.00) - Price includes installation drawing - Split thrust collars require an approx 1 1/8" x 1/4" groove in the shaft (groove machining by others) - Each bearing requires 320 CFM @ 105F air cooling through jackets of sleeve (provided by others) or 4 GPM of 90 F water cooling per bearing (provided by others) Price does not include field service or installation of parts	1	[redacted]	
2		Bearing retrofit kit changing 6" Fan Cooled Michell Bearing to 6" Howden HD Bearing Kit includes: - (1) One 6" HD Held Bearing Assembly with Bushing Seals and Auxiliary Dust Seals - (1) One 6" HD Free Bearing Assembly with	1	[redacted]	

QUOTATION (PARTS)

Howden
1775 Wehrle Drive
Williamsville, NY 14221
ISO 9001:2008 Certified

Attention:	Mr. Fred Jordan	From:	Gary Seely
Company/Representative:	Gary C Seely Limited	Phone:	7506-847-0990
End User:	Trenton Thermal Generating Station	Email:	gcs@nbnet.nb.ca
Your Reference:	C-6250		
Our Reference:	2 - 730 Ser. 27 Airfoils, DWDI, (C-6250)	Fax:	506-847-9996
Market:	Power	Quote #:	36 20130729 1
General Assembly Drawing:	C-13756	Date:	8/6/2013

Howden North America presents our offer as follows:

Item	Part Number	Description	Qty	Price Each	*Availability
1	SPEC	**Engineering & Drawings - Custom Shaft Sleeve** Engineering Services and Drawings for Shaft Sleeve intended as part of customer in-place repair. Howden will furnish manufacturing drawings of a Shaft Sleeve & Pins for Nova Scotia Power's use during shaft repair. Engineering to be based off of original fan records (Sheldons) and original operating conditions, in conjunction with customer provided Michell bearing drawing 33953/37052/5. Howden assumes no responsibility for the customer's manufacturing and installing of the Shaft Sleeve. This method is intended as a short term repair, and Howden strongly recommends replacing the Shaft assembly at the next available opportunity. Howden's position is that shaft repair of this nature should not be treated as a permanent solution.	1	[redacted]	
2	SPEC	**Replacement Shaft with Hub** Complete replacement shaft, per original design, material A576, stress relieved. Includes fabricated hub design, mounted to shaft with interference fit. The Hub will be drilled to match existing wheel assembly. Howden to provide shaft with mounted Hub, for the customer to mount wheel assembly and install into fan. (Some field fit may be required). For proper installation, fit-up, and balancing, it is recommended that Trenton Station considers scheduling a Howden Technical Advisor at the time of installation. The costs are not included here, but an estimate can be provided upon request.	1	[redacted]	

CI Number: 41505

Title: TRE5 5F Conveyor Gallery Refurbishments

Start Date:	2016/07
In-Service Date:	2016/10
Final Cost Date:	2017/04
Function:	Steam
Forecast Amount:	$484,801

DESCRIPTION:

This project includes the refurbishment of the structure supporting the 5F coal conveyor, which is an integral part of the coal run system which supplies coal to Trenton Unit 5. The conveyor is housed within a gallery, originally constructed in 1969. It was observed in 2015 that the gallery structure and sections of the conveyor support structure had corroded and were showing signs of structural degradation and instability. It is now recommended that action be taken to mitigate risk associated with the structural stability of the gallery and conveyor support.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Health & Safety

Why do this project?

The structure supporting 5F Coal Conveyor has corroded and deteriorated to the point that it must be repaired in order to mitigate safety risk and operational downtime risk to the conveyor system. An engineering study (Attachment 1) was completed on the Conveyor Gallery in November 2014. Assessment, completed pursuant to the study, by NS Power personnel determined that this investment could be safely deferred until 2016.

Why do this project now?

The planned outage in 2016 is an excellent opportunity to perform the work in the most cost effective manner. The work can be done while the unit is operational but poses more work delays associated with starting and stopping work, more fire watch costs, safe work permit costs, prevention of access for periods, etc. In addition completing the work in 2016 is very important to eliminate a safety and operational risk proactively.

Why do this project this way?

The refurbishment involves replacement of degraded structural components, similar to strategies at other coal handling facilities. Full replacement of the gallery as an alternative isn't considered necessary at this time and would be approximately $2.5 million to complete.

CI Number : 41505 - TRE5 - 5F Conveyor Gallery Refurbishments **Project Number**

Parent CI Number : -

Cost Centre : 340 - 340-Trenton Unit 5 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		1,560	0	1,560
095		095-Thermal & Hydro Contracts AO		34,714	0	34,714
095		095-Thermal Regular Labour AO		2,604	0	2,604
095		095-Thermal Term Labour AO		487	0	487
001	018	001 - THERMAL Regular Labour	018 - SGP - Fuel Hndlg.Coal	12,848	0	12,848
002	018	002 - THERMAL Overtime Labour	018 - SGP - Fuel Hndlg.Coal	0	0	0
004	018	004 - THERMAL Term Labour	018 - SGP - Fuel Hndlg.Coal	2,402	0	2,402
012	018	012 - Materials	018 - SGP - Fuel Hndlg.Coal	30,000	0	30,000
013	018	013 - POWER PRODUCTION Contracts	018 - SGP - Fuel Hndlg.Coal	340,000	0	340,000
033	018	033 - Rental and Maintenance of	018 - SGP - Fuel Hndlg.Coal	18,782	0	18,782
066	018	066 - Other Goods & Services	018 - SGP - Fuel Hndlg.Coal	40,403	0	40,403
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	1,000	0	1,000
			Total Cost:	484,801	0	484,801
			Original Cost:	60,279		

Capital Project Detailed Estimate

Location: **Trenton**
CI# : 41505
Title: TRE5 5F Conveyor Gallery Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	4	$ 358	$ 1,433		
Maintenance Trades	PD	28	$ 365	$ 10,214		
Utilityworker	PD	5	$ 240	$ 1,201		
			Sub-Total	$ 12,848		
004 Term Labour						
Utilityworker	PD	10	$ 240	$ 2,402		
				$ -		
			Sub-Total	$ 2,402		
012 Materials						
Remove and replace floor plate - Materials	lot	1	$ 20,000	$ 20,000		
Misc tools and equipment	lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 30,000		
013 Contracts						
Remove and replace floor plate - Labour	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Sand blast existing supports/paint F belt	lot	1	[redacted]	[redacted]	Cost Support Item 1	
Support staging	lot	1	[redacted]	[redacted]		
Sand blast existing supports/paint E belt	lot	1	[redacted]	[redacted]		
			Sub-Total	$ 340,000		
033 Rentals						
Manlift rentals	month	2	$ 9,391	$ 18,782		
			Sub-Total	$ 18,782		
041 Meals & Entertainment						
Meals	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 1,000		
066 Other Goods & Services						
Contingency	%	10%	$ 404,032	$ 40,403		
			Sub-Total	$ 40,403		
094 Interest Capitalized						
AFUDC				$ 1,560		
			Sub-Total	$ 1,560		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 2,604		
Thermal OT Labour AO				$ -		
Thermal Term Labour AO				$ 487		
Thermal / Hydro Contracts AO				$ 34,714		
			Sub-Total	$ 37,805		
			SUB-TOTAL (no AO, AFUDC)	$ 445,435		
			TOTAL (AO, AFUDC included)	$ 484,801		
Original Cost				$ 60,279		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

MACGREGORS INDUSTRIAL GROUP
MacGregor's Custom Machining Ltd.
140 Coalburn MacLellan's Brook Rd. RR#4 New Glasgow, NS B2H 5C7

Phone (902) 922-2029 Fax (902) 922-2324

September 25th, 2015

Nova Scotia Power – Trenton Generating Station
ATT: Jack Lewis

Quote Ref #: 15FQ471 – Budgetary Quotation for Conveyor 'F' floor plate replacement

Jack,

With regards to your request for budgetary quotation submitted September 11th, we are pleased to offer the following budgetary proposal for your review.

MacGregors Industrial Group understands the scope of work to be as follows:

- Supply of labour, equipment and consumables to complete the removal of existing 1/8" mild steel plate floor on 'F' conveyor
- Supply of 3/16" mild steel plate, cut to size for floor replacement
- Supply of labour, equipment and consumables to complete the installation of new 3/16" mild steel plate floor on 'F' conveyor
- Entire floor to be re-plated, estimated to be approximately 1500 square feet.
- Existing angle and channel floor structure to remain intact with no structural repairs identified as being required at this time
- Plate to be supplied and installed as bare steel, unpainted Grade 44W plate

For the above scope of work, our budgetary price will be [redacted] **plus tax.**

Please note the following with regards to our budgetary quote:
- Pricing is based on work being completed between April – November 2016. If work is to be completed in the winter months, pricing will be subject to revision
- Price is based on work being completed Monday-Friday, 6:00AM – 6:00PM. If work needs to be completed on the weekend, pricing will be subject to revision.

Thank you for the opportunity to submit this budgetary quotation.

Best regards,

Nick MacGregor
(902) 922-2029 x.242 – nick.macgregor@macgregors.ca

AML PAINTING LTD

P.O. BOX 1608
BRAS D'OR, NOVA SCOTIA B1Y 3Y6
PHONE (902)562-2677 FAX (902)567-5947

QUOTE

Quote No: 176
Date: 09/23/2015
Page: 1

To: **NOVA SCOTIA POWER ~ TRENTON**
ACCOUNTS PAYABLE
PO BOX 910
HALIFAX, NS B3J 2W5

Business No.: 12374 4104 RT0001

Description	Amount
ATTENTION: JACK LEWIS	
WE ARE PLEASED TO PROVIDE OUR BUDGET PRICE OF [redacted] FOR THE SUPPLY OF LABOUR, MATERIAL, AND EQUIPMENT TO SAND BLAST, PRIME, AND PAINT THE UNDERSIDE OF 200' X 7.5' CONVEYOR.	[redacted]
PLEASE NOTE H.S.T. IS EXTRA	
Subtotal:	[redacted]

Shipped by

Comments THANK YOU FOR TAKING THE TIME TO REVIEW OUR QUOTE!

Total Amount [redacted]

Sold By:

PDI Engineering Group Inc.
Partner • Develop • Innovate

P O Box 1254
Truro, NS
B2N 5N2

06 November 2014 **Job No. 14046**

Bob Chisholm, P.Eng.
NSPI Trenton Generating Station
108 Power Plant Rd.
Trenton, NS B0K 1X0

Re: Structural Condition Survey - Tail Section of 5F Conveyor Gallery

This letter will serve as a summary of the site review conducted on November 05, 2014. The purpose of the site visit was to conduct a visual review of the structural condition of the floor construction of the tail section of the 5F conveyor gallery. NSPI forces removed one section (approximately 4 feet square) of the floor plate beneath the conveyor just down slope of the center of the tail section. NSPI forces also provided "zoom boom" access to the underside of the floor assembly of the tail section.

Observations made during the site visit are summarized below:

- in general, the floor plate is in very poor condition with a number of holes corroded through the existing 1/8" plate. At least some areas have a second layer of plate above the original floor plate;
- in general, the condition of the transverse 5" channel members is fair. The paint system has failed with much of the surface of these members exposed as bare metal. Welds at the ends of these members (to the bottom chord truss angles) are generally 1/4" fillet welds connecting the web of the channels to the underside of the bottom chord truss angles. The conveyor is supported on the walkway side by these transverse channels;
- in general, the condition of the longitudinal 4" channel members is fair. The paint system has failed with much of the surface of these members exposed as bare metal. Some of the welds connecting the floor plate to the top flange of the channels have failed. This has allowed the channels, at some locations, to bow out of alignment. At least some of the welds connecting the longitudinal channels to the transverse channels appear to be of questionable quality; and
- in general, the condition of the bottom chord angle of the side trusses is good except for the paint which has failed. There appears to be very little material loss of these angles due to corrosion. The welded connections of the truss web members (L 3x3x1/4) to the bottom chord angles appears to be satisfactory.

We offer the following general floor construction remediation suggestions:

- the floor plate should be removed (both layers) and replaced with new checkerplate with a minimum thickness of 3/16". The plate should have an appropriate coating system to help protect against future corrosion;

- we believe it makes sense to replace the transverse and longitudinal channels with new members of the same size, especially if future floor plate changes exposes these members to additional exposure to wash down water. The new channels should have an appropriate coating system to help protect against future corrosion; and
- the existing bottom chord angles (L5x5x5/16) should receive an appropriate coating system to help protect against future corrosion. The coating should also be applied to at least the bottom portion the web members to help protect against corrosion from coal accumulation in these areas.

We understand from previous discussions that you are contemplating future changes to the floor system to better accommodate cleaning operations and wash water flow. As discussed with you on site, we offer to assist with the design and layout of these proposed changes.

We are attaching three (3) pages of documentation photographs that were taken during the November 05 site visit.

Regards,

D M Bach

Douglas Bach, CET, P.Eng., FEC

PDI Engineering Group Inc.

Attachments: 3 pages of documentation photographs

This letter report was prepared by PDI Engineering Group Inc. for the account of NSPI Trenton Generating Station. The material herein reflects our best judgment in light of the information available at the time of preparation. Any use which a third party makes of this letter report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. PDI Engineering Group Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

14046

NSPI Trenton Generating Station
Conveyor Gallery
Structural Condition Review
05 Nov 2014
Page 5

5F Tail End

Attachment of Transverse Channel to Bottom Chord Angle

Attachment of Transverse Channel to Bottom Chord Angle

PDI Engineering Group Inc.
Partner • Develop • Innovate

5F Tail End

Attachment of 4" Longitudinal Channel to 5" Transverse Channel

Longitudinal Channel Bowed out of Plane

PDI Engineering Group Inc.
Partner • Develop • Innovate

5F Tail End

Perforations in Floor Plate

Perforations in Floor Plate

PDI Engineering Group Inc.
Partner • Develop • Innovate

CI Number: 47872

Title: LIN E Gallery Structural Steel Protective Coating

Start Date:	2016/05
In-Service Date:	2016/09
Final Cost Date:	2017/03
Function:	Steam
Forecast Amount:	$481,492

DESCRIPTION:

The E-gallery is the support structure to conveyor coal into the Lingan Generating Station. This project will include the recoating of the exposed structural steel, which was not part of the 2015 work, supporting the E-gallery. During the 2014/2015 E-Gallery Floor Replacement project (CI 45802, approved by the UARB on August 31, 2015), the structural steel coating was found to be in poor condition and is recommended that recoating the structural steel is required for long-term sustainability of the asset.

Summary of Related CIs +/- 2 years:
2015 CI 45802 LIN E-Gallery Floor Replacement $2,365,470

JUSTIFICATION:

Justification Criteria: Health & Safety

Why do this project?

The E gallery structural steel coating is deteriorated and at the end of its expected useful life. Replacing the coating will extend the life of the asset and help avoid deterioration of the structure, mitigating the risk of a safety hazard to plant personnel and avoiding the elimination of the only coal supply route into the plant if a structural failure were to occur.

Why do this project now?

The deteriorated condition of the structure is such that this protective coating is required in 2016. This project needs to be completed now to avoid any further deterioration and preserve any structural repairs that have been made. This project was not completed at the time of CI 45802 as the condition of the structural steel allowed for operation until 2016. Additionally, completing both work scopes on the same asset is not feasible.

Why do this project this way?

Recoating the structural steel is the only feasible option as full replacement of the structure is both unnecessary and more costly.

CI Number : 47872 - LIN E Gallery Structural Steel Protective Coating **Project Number**

Parent CI Number : -

Cost Centre : 301 - 301-Lingan Admin./Common Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,314	0	2,314
095		095-Thermal Regular Labour AO		1,146	0	1,146
095		095-Thermal & Hydro Contracts AO		38,288	0	38,288
095		095-Thermal Term Labour AO		2,291	0	2,291
001	003	001 - THERMAL Regular Labour	003 - SGP - Bldg.,Struct.Grnd.	5,651	0	5,651
004	003	004 - THERMAL Term Labour	003 - SGP - Bldg.,Struct.Grnd.	11,302	0	11,302
012	003	012 - Materials	003 - SGP - Bldg.,Struct.Grnd.	8,000	0	8,000
013	003	013 - POWER PRODUCTION Contracts	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
066	003	066 - Other Goods & Services	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
			Total Cost:	481,492	0	481,492
			Original Cost:	71,301		

Capital Project Detailed Estimate

Location: Steam
CI# : 47872
Title: LIN E Gallery Structural Steel Protective Coating
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Utilityworker	PD	24	$ 235	$ 5,651		
			Sub-Total	$ 5,651		
004 Term Labour						
Utilityworker	PD	48	$ 235	$ 11,302		
				$ -		
			Sub-Total	$ 11,302		
012 Materials						
Miscellaneous Consumables	$	1	$ 8,000	$ 8,000		
			Sub-Total	$ 8,000		
013 Contracts						
Installation of Protective Coating	$	1	[redacted]		Cost Support Item #1	
			Sub-Total	[redacted]		
066 Other Goods & Services						
Contingency	%	10%	[redacted]			
				$ -		
			Sub-Total	[redacted]		
094 Interest Capitalized						
AFUDC				$ 2,314		
				$ -		
			Sub-Total	$ 2,314		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 1,146		
Thermal Term Labour AO				$ 2,291		
Thermal / Hydro Contracts AO				$ 38,288		
			Sub-Total	$ 41,724		
			SUB-TOTAL (no AO, AFUDC)	$ 437,454		
			TOTAL (AO, AFUDC included)	$ 481,492		
Original Cost				$ 71,301		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

AML PAINTING LTD

QUOTE

P.O. BOX 1608
BRAS D'OR, NOVA SCOTIA B1Y 3Y6
PHONE (902)562-2677 FAX (902)567-5947

Quote No: 158
Date: 08/14/2015
Page: 1

To: **LINGAN GENERATING STATION**
LIVIO NICOLETTI
2599 HINCHEY AVENUE
LINGAN, NS
B1H 4N9

Business No.: 12374 4104 RT0001

Description	Amount
ATTENTION: LIVIO NICOLETTI	
RE: LINGAN GENERATING STATION CONVEYOR	
WE ARE PLEASED TO PROVIDE OUR BUDGET PRICES FOR THE FOLLOWING:	
SUPPLY OF LABOUR, MATERIALS, AND EQUIPMENT TO GRIT BLAST, APPLY 1 COAT OF [redacted] 1 COAT [redacted] AND 1 COAT OF [redacted] TO MANUFACTURES SPECIFICATIONS TO THE UNDERSIDE AND SIDE OF CONVEYOR.	[redacted]
SUPPLY OF LABOUR, MATERIALS, AND EQUIPMENT TO GRIT BLAST, APPLY 1 COAT OF [redacted], 1 COAT [redacted] AND 1 COAT OF [redacted] TO MANUFACTURES SPECIFICATIONS TO THE BENT LEGS ON THE CONVEYOR.	[redacted]
THIS PRICE IS BASED ON ALL WORK BEING DONE FROM ZOOM BOOMS WITH NO ENCLOSURE.	
PLEASE NOTE H.S.T. IS EXTRA.	
Subtotal:	[redacted]

Shipped by

Comments THANK YOU FOR TAKING THE TIME TO REVIEW OUR QUOTE!

Total Amount [redacted]

Sold By:

CBCL LIMITED
Consulting Engineers

February 4, 2015

Livio Nicoletti
Senior Plant Engineer
NSPI Lingan Thermal Generating Station
2599 Hinchey Avenue
New Waterford, N.S.
Dear Mr. Nicoletti:

RE: Bent No. 2 – E-Gallery

As per your request CBCL Limited carried out an inspection of Bent No. 2 which supports the E-Gallery at the Lingan Generating Station. The inspection was carried out on January 29, 2015. The following pages detail the areas where problems were noted and include recommended repairs.

The approximate repair location for each of the items listed below is noted on the attached sketch. The numbers on the sketch correspond to the item numbers given below.

164 Charlotte Street, Suite A
PO Box 567
Sydney, NS
Canada B1P 6H4

Telephone: 902 539 1330
Fax: 902 539 4406
E-mail: info@cbcl.ca
www.cbcl.ca

Solving today's problems with tomorrow in mind

1. The flanges of the W8x31 forming the columns of the portal frame above Bent No. 2 are severely corroded on the west side of the bent and will have to be repaired. The W8x31 bears directly on the top of Bent No. 2. The repair detail would be similar to the one carried out on Bent No. 3. We were unable to observe the connection on the west side of the support. See Photos below:

Photo 1a - Deteriorated Flanges at West Side Bearing, Viewed from the North

Photo 1b - West Side Bearing Viewed from the South

2. The stiffener on the on the west side of the bent just below the bearing is in poor condition with holes completely through and should be replaced. See photo below:

Photo 2a - Stiffener just below Bearing on West Side

3. There are holes in the flange and web of the W18x45 columns just below the bearing connection (Member 5). There is also some general corrosion of the web and Flange in the same area. It is recommended that plates be added to the web and flange to reinforce this area.

Photo 3a - Hole through the web or the W18x45 Column just below the West Bearing

Photo 3b - Hole through the Flange of the W18x45 Column just below the West Bearing

Photo 3c - Another View of holes through web and stiffener

4. Some pitting in the flange of the W18x45 column (Member 5) were noted in the edge of the flange, about 4 feet down from the bearing on the west side of the bent, but is not considered to be a serious problem.

Photo 4a - Pitting in Flange of W18x45

5. The gusset plate on the west side of the bent is severely pitted and should be replaced.

Photo 5a - Deteriorated Gusset Plate

6. Three of the bottom batten plates on the second cross member down (Member 2) are noted to be corroded and in need of replacement. (1st, 2nd and 5th from the east side).

Photo 6a - Hole through Batten Plate

7. The Gusset plate at this location (West End of Member 2)is reduced from ½ inch original thickness to about ¼ inch. There was also a hole in the angle framing into the connection. Both the angle and the gusset plate should be replaced.

Photo 7a - Deteriorated Gusset Plate, Corroded Angle and Channel Sections

8. On Horizontal Cross Member No. 3 the 2nd, 3rd, 5th and 6th bottom batten plates need to be replaced.

Photo 8a - Deteriorated Batten Plate

9. The web and flange of the diagonal member framing into Horizontal cross member 3 are noted to be in poor condition. The 1st batten plate on this member is corroded and needs to be replaced.

Photo 9 - Corrosion on the web and Flange of Diagonal Strut

Photo 10 - Deteriorated Connection between Batten Plate and Channel

10. Both Channels of Horizontal Cross member 4 have to be replaced.

Photo 10a - Holes through web and Flange of Channel Making up Lower Horizontal Strut

11. Holes were noted near the top of the channels webs of the diagonal members (Member 14). It is recommended that this member be replaced.

Photo 11a- Holes through the web of the lower diagonal Strut

12. The third bottom batten plate up from the bottom on this diagonal strut (Member 13) should be replaced.

In general it is recommended that once all repairs have been completed the entire bent should be sandblasted and painted to prevent further corrosion and extend the life of the structure.

If you have any questions or concerns regarding this report please contact the undersigned.

Yours truly,

CBCL Limited

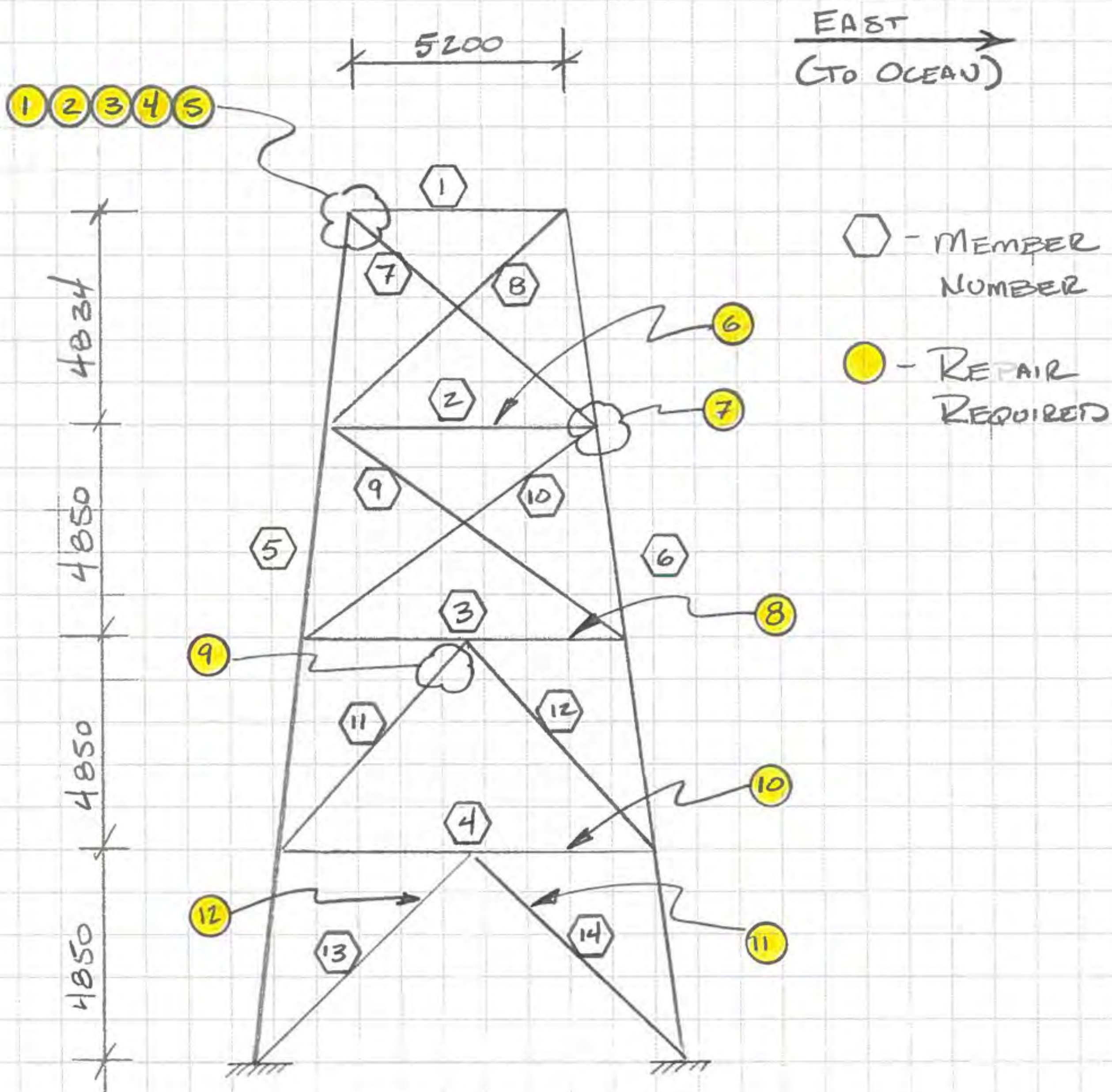
Prepared by:
Brian Gillis, P.Eng.
Senior Civil Engineer
Direct: 1-902-539-1330
E-Mail: bgillis@cbcl.ca

Reviewed by:
Brad Kennedy, P.Eng.
Senior Structural Engineer

Project No: 142481.00

CBCL LIMITED
Consulting Engineers

PROJECT NAME		NUMBER	PAGE OF
E-GALLERY, BENT No. 2		142481.00	
CLIENT		SUBJECT	
DESIGNED	CHECKED	APPROVED	DATE
BJG			FEB 4, 15



MEMBER DESIGNATION	SIZE
1 2	2 - C5 × 6.7
3 4	2 - C4 × 6.4
5 6	W18 × 45
7 8 9 10	2 - ∠3 × 2 × 1/4
11 12 13 14	2 - C5 × 6.7

CI Number: 47555

Title: TRE5 Coal System Upgrades

Start Date: 2016/02
In-Service Date: 2016/09
Final Cost Date: 2017/03
Function: Steam
Forecast Amount: $469,942

DESCRIPTION:

The purpose of this project is to continue to improve safety of the Trenton Unit #5 coal delivery system. Scope will include the following:

(1) Replacement of belt scrapers and skirt boards, which will focus on accumulations of dust and spilled coal build-up in the conveying processes.
(2) Replacement of corroded sprinkler piping (fire protection system).
(3) Replacement of deficient electrical components (lighting fixtures, junction boxes).
(4) Installation of ‘grizzly’ bars on hoppers.
(5) Upgrade control system to include anti-slip protection on belts.
(6) Structural repairs to conveyor system.

Summary of Related CIs +/- 2 years:
2014 CI 44731 TRE5 Coal System Upgrades $413,416

JUSTIFICATION:

Justification Criteria: Health & Safety

Why do this project?

The TRE5 coal delivery system was commissioned in 1969. The system is designed to deliver 200 tonnes/hour, and currently operates anywhere between 150 and 180 tonnes/hour at full load. Normal wear and tear on various components over the years, combined with a complicated transfer point design, generates a high level of everyday housekeeping to maintain a safe working environment. Excessive coal dust is an explosion hazard, and is minimized through the proper use of belt scrapers and skirt boards at the belt transfer areas.

Why do this project now?

The project should be executed during the next planned unit outage in 2016, to minimize safety risk in the coal delivery system, and to avoid replacement energy costs associated with an unplanned outage. In the interim, housekeeping and inspection efforts have been increased to address short term risk.

Why do this project this way?

The modifications proposed would bring these components of the conveyor system in line with standard industry practice. Replacement is being completed on parts where the condition of the component does not allow for a refurbishment to be completed.

CI Number : 47555 - TRE5 Coal System Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 340 - 340-Trenton Unit 5 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		5,474	0	5,474
095		095-Thermal Overtime Labour AO		2,692	0	2,692
095		095-Thermal Term Labour AO		9,094	0	9,094
095		095-Thermal Regular Labour AO		13,224	0	13,224
095		095-Thermal & Hydro Contracts AO		10,223	0	10,223
001	018	001 - THERMAL Regular Labour	018 - SGP - Fuel Hndlg.Coal	49,028	0	49,028
002	018	002 - THERMAL Overtime Labour	018 - SGP - Fuel Hndlg.Coal	26,561	0	26,561
004	018	004 - THERMAL Term Labour	018 - SGP - Fuel Hndlg.Coal	44,865	0	44,865
012	018	012 - Materials	018 - SGP - Fuel Hndlg.Coal	135,589	0	135,589
013	018	013 - POWER PRODUCTION Contracts	018 - SGP - Fuel Hndlg.Coal	100,122	0	100,122
066	018	066 - Other Goods & Services	018 - SGP - Fuel Hndlg.Coal	55,857	0	55,857
001	087	001 - THERMAL Regular Labour	087 Field Super.& Ops.	16,212	0	16,212
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	1,000	0	1,000
			Total Cost:	469,942	0	469,942
			Original Cost:	65,023		

Capital Project Detailed Estimate

Location: Trenton Generating Station
CI# : 47555
Title: TRE5 Coal System Upgrades
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	15	$ 358	$ 5,374		
Engineering	PD	30	$ 405	$ 12,159		
Maintenance Trades	PD	60	$ 365	$ 21,887		
Utilityworker	PD	40	$ 240	$ 9,607		
Supervision	PD	40	$ 405	$ 16,212		
			Sub-Total	$ 65,241		
002 OT Labour						
Utilityworker	PD	10	$ 480	$ 4,804		
Maintenance Trades	PD	20	$ 730	$ 14,592		
Electrician	PD	10	$ 717	$ 7,166		
				$ -		
			Sub-Total	$ 26,561		
004 Term Labour						
Utilityworker	PD	20	$ 240	$ 4,804		
Maintenance Trades	PD	100	$ 365	$ 36,479		
Electrician	PD	10	$ 358	$ 3,583		
			Sub-Total	$ 44,865		
012 Materials						
Belt Cleaner	each	2	$ 2,500	$ 5,000		
Conveyor Skirtboards	ft	300	$ 100	$ 30,000		
Reclaim Feeder Skirtboards	ft	60	$ 100	$ 6,000		
Reclaim Hopper Gates	each	3	$ 6,000	$ 18,000		
Electrical Materials	lot	1	$ 30,000	$ 30,000		
Misc Materials	lot	1	$ 10,000	$ 10,000		
Frozen Coal Crusher	each	1	$ 21,679	$ 21,679		
5F Gearbox	each	1	$ 14,910	$ 14,910		
			Sub-Total	$ 135,589		
013 Contracts						
Sprinkler Pipe Replacements	lot	1	$ 31,546	$ 31,546		
Crane Rental	lot	1	$ 10,000	$ 10,000		
Conveyor alignment survey	lot	1	$ 10,000	$ 10,000		
F-G Chute Modification	lot	1	$ 20,277	$ 20,277		
Gearbox installation	lot	1	$ 10,000	$ 10,000		
Replace 5G Belt	lot	1	$ 8,400	$ 8,400		
Replace A1 Belt	lot	1	$ 9,900	$ 9,900		
			Sub-Total	$ 100,122		
041 Meals & Entertainment						
Meals	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 1,000		
066 Other Goods & Services						
Contingency	%	15%	$ 372,378	$ 55,857		
			Sub-Total	$ 55,857		
094 Interest Capitalized						
AFUDC				$ 5,474		
			Sub-Total	$ 5,474		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 13,224		
Thermal OT Labour AO				$ 2,692		
Thermal Term Labour AO				$ 9,094		
Thermal / Hydro Contracts AO				$ 10,223		
			Sub-Total	$ 35,233		
			SUB-TOTAL (no AO, AFUDC)	$ 429,234		
			TOTAL (AO, AFUDC included)	$ 469,942		
Original Cost				$ 65,023		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47510

Title: LIN Coal Plant Structural Refurbishment Phase 2

Start Date: 2016/03
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Steam
Forecast Amount: $359,425

DESCRIPTION:

This project is for the refurbishment of the structural system in the Lingan coal reclaim. Lingan Generating Station has extensive coal handling facilities which move on average more than two million tonnes per year. Extending from the rotary rail car dumper though the stacker, coal reclaims, crushers, and conveyor systems, the coal handling system is supported by structural steel components installed in the mid-1970s. This project is part of a program approach, expected over a three year period, to refurbish the coal system structural steel at Lingan. Phase 1 focused on the coal system conveyor support structures mainly in coal reclaim (D belts), and the B belt which travels outside along the coal pile. Phase 2 will see the refurbishment of the structural system in the coal reclaim and crusher building.

Summary of Related CIs +/- 2 years:
2015 CI 46058 LIN Coal Plant Structural Refurbishment Phase 1 $516,818

JUSTIFICATION:

Justification Criteria: Health & Safety

Why do this project?

Coal must be delivered into the Lingan Plant through a coal conveyor system. An integral part of the conveyor system is the support structure and roller support system. Due to the corrosive nature of the coal and the high humidity conditions which exist in the conveyor system galleries, the support structure suffers corrosion damage over time. The conveyor support structure must be maintained in design condition in order to allow safe operation of the coal handling equipment and reliable performance of the generating units at Lingan.

Why do this project now?

The conveyor support structure must be refurbished in order for the coal system to meet the coal handling demands of the plant in a safe and reliable manner. In order to maintain safe operation of the coal system and reliable supply of coal to the generating units, this project needs to be undertaken now.

Why do this project this way?

Refurbishment of the support structure is the only option to allow coal supply to the plant to continue, while completing the work on the non-hoisting or opposite shifts. Retirement of the structure is not a feasible option, as the coal system is required to operate all four Lingan units. Retiring this system would mean Lingan would not be able to generate from any of its four units.

CI Number : 47510 - LIN Coal Plant Structural Refurbishment Phase 2 **Project Number**

Parent CI Number : -

Cost Centre : 301 - 301-Lingan Admin./Common Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		466	0	466
095		095-Thermal Regular Labour AO		10,784	0	10,784
095		095-Thermal & Hydro Contracts AO		5,105	0	5,105
095		095-Thermal Term Labour AO		11,091	0	11,091
001	018	001 - THERMAL Regular Labour	018 - SGP - Fuel Hndlg.Coal	53,201	0	53,201
004	018	004 - THERMAL Term Labour	018 - SGP - Fuel Hndlg.Coal	54,718	0	54,718
012	018	012 - Materials	018 - SGP - Fuel Hndlg.Coal	174,060	0	174,060
013	018	013 - POWER PRODUCTION Contracts	018 - SGP - Fuel Hndlg.Coal	50,000	0	50,000
			Total Cost:	359,425	0	359,425
			Original Cost:	85,888		

Capital Project Detailed Estimate

Location: Steam
CI# : 47510
Title: LIN Coal Plant Structural Refurbishment Phase 2
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	80	$ 365	$ 29,183		46058
Utilityworker	PD	100	$ 240	$ 24,018		46058
			Sub-Total	$ 53,201		
004 Term Labour						
Maintenance Trades	PD	150	$ 365	$ 54,718		46058
			Sub-Total	$ 54,718		
012 Materials						
Structural Steel	ea	1	$ 50,000	$ 50,000		46058
Troughing Roller	ea	900	$ 54	$ 48,960		
Trough Roller Support	ea	300	$ 217	$ 65,100		
Miscellaneous Consumables	ea	1.00	$ 10,000	$ 10,000		
			Sub-Total	$ 174,060		
013 Contracts						
Conveyor Structural Steel Refurbishment	ea	1	$ 50,000	$ 50,000		
			Sub-Total	$ 50,000		
094 Interest Capitalized						
AFUDC				$ 466		
			Sub-Total	$ 466		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 10,784		
Thermal Term Labour AO				$ 11,091		
Thermal / Hydro Contracts AO				$ 5,105		
			Sub-Total	$ 26,980		
			SUB-TOTAL (no AO, AFUDC)	$ 331,979		
			TOTAL (AO, AFUDC included)	$ 359,425		
Original Cost				$ 85,888		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47662

Title: POT Coal Mill Overhauls 2016

Start Date:	2016/01
In-Service Date:	2016/12
Final Cost Date:	2017/05
Function:	Steam
Forecast Amount:	$324,874

DESCRIPTION:

Point Tupper Unit 2 employs four Raymond Bowl style mills to pulverize coal for combustion in the boiler. This project will replace mill components that have reached the end of their useful life on one of the four mills. Based on experienced wear characteristics, component failures will occur if a replacement plan is not performed. The consequence of such a failure could include unplanned unit derating. This capital item includes the replacement of welded steel rollers and tables with ceramic wear components, and other non-repairable mill components. Components either to be replaced or refurbished will be decided based on the condition assessment when teardown is undertaken as part of the planned outage for the mill in 2016. Going forward, continued capital investment of the mills will still be required to extend asset life and maintain the reliability of this equipment.

This project is replacing components on one mill, compared to two mills in 2015. In addition to the component replacement on one mill, the feeder transition pipe is being replaced which was not required in 2015.

Summary of Related CIs +/- 2 years:
2014 CI 46334 - POT 2C Mill Overhaul $176,534
2015 CI 46372 POT – Coal Mill Overhauls $418,292

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

This project is being completed to mitigate the risk of mill failure. A mill failure could limit peak generation of the unit depending on the fuel blend in service. It is imperative that the mills are available full time between planned outages in order to maintain unit performance at rated capacity. The replacement of mechanical components and the upgrading of the ceramic surfaces is necessary to achieve the most economic operation of the unit.

Why do this project now?

Operating and maintenance experience with the mills has identified several areas of concern that need to be addressed in order for the mills to meet availability targets. Replacement parts are now needed due to age and wear on many of the components. During periods of lower load it is possible to take 1 of 4 mills out of service without affecting generation. Isolated repairs and minor refurbishment are not typically possible for the mills. It is often necessary to disassemble major components and therefore an overall refurbishment versus isolated repairs is more effective.

Why do this project this way?

A phased approach to maintaining the mills allows for scheduled outages of selected mills, reducing the risk of extended unplanned outages. By planning refurbishments and replacements in a given year, the refurbishment and replacement efforts can be made more efficient with dedicated labour and parts available as required.

CI Number : 47662 - POT Coal Mill Overhauls 2016 **Project Number**

Parent CI Number : -

Cost Centre : 351 - 351-Pt.Tupper Admin./Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal Regular Labour AO		6,188	0	6,188
095		095-Thermal & Hydro Contracts AO		306	0	306
095		095-Thermal Overtime Labour AO		340	0	340
095		095-Thermal Term Labour AO		7,249	0	7,249
001	018	001 - THERMAL Regular Labour	018 - SGP - Fuel Hndlg.Coal	30,527	0	30,527
002	018	002 - THERMAL Overtime Labour	018 - SGP - Fuel Hndlg.Coal	3,353	0	3,353
004	018	004 - THERMAL Term Labour	018 - SGP - Fuel Hndlg.Coal	35,763	0	35,763
012	018	012 - Materials	018 - SGP - Fuel Hndlg.Coal	189,000	0	189,000
013	018	013 - POWER PRODUCTION Contracts	018 - SGP - Fuel Hndlg.Coal	3,000	0	3,000
014	018	014 - Overtime Meals	018 - SGP - Fuel Hndlg.Coal	1,000	0	1,000
015	018	015 - Frt, Post & Delivery	018 - SGP - Fuel Hndlg.Coal	5,000	0	5,000
033	018	033 - Rental and Maintenance of	018 - SGP - Fuel Hndlg.Coal	1,000	0	1,000
066	018	066 - Other Goods & Services	018 - SGP - Fuel Hndlg.Coal	40,147	0	40,147
011	085	011 - Travel Expense	085 Design	1,000	0	1,000
041	085	041 - Meals & Entertainment	085 Design	1,000	0	1,000
			Total Cost:	324,874	0	324,874
			Original Cost:	295,873		

Location: POT
CI# / FP#: 47662
Title: POT Coal Mill Overhaul 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	2	$ 351	$ 703		
Maintenance Trades	PD	40	$ 358	$ 14,305		
Power Plant Technician	PD	10	$ 375	$ 3,746		
Utilityworker	PD	50	$ 235	$ 11,773		
			Sub-Total	$ 30,527		
002 OT Labour						
Electrician	PD	1	$ 703	$ 703		
Maintenance Trades	PD	2	$ 715	$ 1,431		
Power Plant Technician	PD	1	$ 749	$ 749		
Utilityworker	PD	1	$ 471	$ 471		
			Sub-Total	$ 3,353		
004 Term Labour						
Maintenance Trades	PD	100	$ 358	$ 35,763		
			Sub-Total	$ 35,763		
011 Travel Expense						
Travel	lot	1	$ 1,000	$ 1,000		
				$ -		
			Sub-Total	$ 1,000		
012 Materials						
Mill rolls	lot	1	$ 33,000	$ 33,000		
Grinding table	lot	1	$ 33,000	$ 33,000		
Rejects table	lot	1	$ 6,000	$ 6,000		
Roll seals	lot	1	$ 2,000	$ 2,000		
Main table seals	lot	1	$ 2,000	$ 2,000		
Riffle boxes	lot	1	$ 6,000	$ 6,000		
Scraper assemblies	lot	2	$ 2,500	$ 5,000		
Mill side liners	lot	1	$ 10,000	$ 10,000		
Rejects side liners	lot	1	$ 10,000	$ 10,000		
Exhauster periphery liners	lot	1	$ 12,000	$ 12,000		
Door assemblies	lot	3	$ 3,000	$ 9,000		
Trunnion bushings	lot	1	$ 3,500	$ 3,500		
Bowl ring extension	lot	1	$ 5,000	$ 5,000		
Exhauster fan	lot	1	$ 5,000	$ 5,000		
Exhauster bearings	lot	1	$ 2,000	$ 2,000		
Feeder parts	lot	1	$ 10,000	$ 10,000		
Transition piece	lot	1	$ 15,000	$ 15,000		
Coal pipe	lot	1	$ 6,000	$ 6,000		
Lubricating oil	lot	1	$ 4,500	$ 4,500		
Misc. and consumables	lot	1	$ 10,000	$ 10,000		
Freight (015)	lot	1	$ 5,000	$ 5,000		
			Sub-Total	$ 194,000		
013 Contracts						
Cranes, etc.	lot	1	$ 3,000	$ 3,000		
Rentals(033)	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 4,000		
041 Meals & Entertainment						
Meals and expenses	lot	1	$ 1,000	$ 1,000		
Overtime meals	lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 2,000		
066 Other Goods & Services						
Contingency 15% (Materials, Contracts, Labour	%	15%	$ 267,644	$ 40,147		
				$ -		
			Sub-Total	$ 40,146.61		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 6,188		
Thermal OT Labour AO				$ 340		
Thermal Term Labour AO				$ 7,249		
Thermal / Hydro Contracts AO				$ 306		
			Sub-Total	$ 14,083		
			SUB-TOTAL (no AO, AFUDC)	$ 310,791		
			TOTAL (AO, AFUDC included)	$ 324,874		
Original Cost				$ 295,873		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

POT Coal Mill Overhaul 2016
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production		**Date :**	**30-Oct-15**
Department :	Point Tupper Generating Station		**CI Number:**	47662
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish Mill vs Replacement Energy &	6.11%	-168,972	102,379	1	21.04%	3.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

This project is recommended to proceed based on good economics. The project should not be delayed as that will increase the cost of the repair and increase the number of failures substantially, and mill overhauls must be avoided in winter as available generation must be considered.

Notes/Comments :

Refurbish Mill vs Replacement Energy & Repair Costs

This option compares the cost of refurbishment with the cost related to the unplanned outages due to failures.

Test 2

Test 3

Test 4

POT Coal Mill Overhaul 2016
Summary of Sensitivities

Nova Scotia POWE
An Emera Compa

Division :	Power Production		**Date :**	**30-Oct-15**
Department :	Point Tupper Generating Station		**CI Number:**	47662
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Mill vs Replacement Energy & Repair C	6.11%	-168,972	102,379	1	21.04%	3.1 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Mill vs Replacement Energy & Repair C	10%	-137,783	78,376	1	16.21%	3.3 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	31,189	-24,003	0	-4.83%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Mill vs Replacement Energy & Repair C	-10%	-120,886	68,138	1	15.74%	3.3 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
Change:	A	48,086	-34,241	0	-5.30%	0.2 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	45,177	132,698	267,519	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

POT Coal Mill Overhaul 2016
Avoided Cost Calculations

Nova Scotia POWER An Emera Company

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Point Tupper Generating Station	**CI Number:**	47662
Originator :		**Project No. :**	

Refurbish Mill vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			27,436	27,985		
Events/Outages (#)	1	2	1	2		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	50.0	50.0				
Duration (Hours)	72	72				
Totals	$21,007	$56,156	$27,436	$55,969	$48,443	$112,126
Total Capital Cost of Alternative						$324,874

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

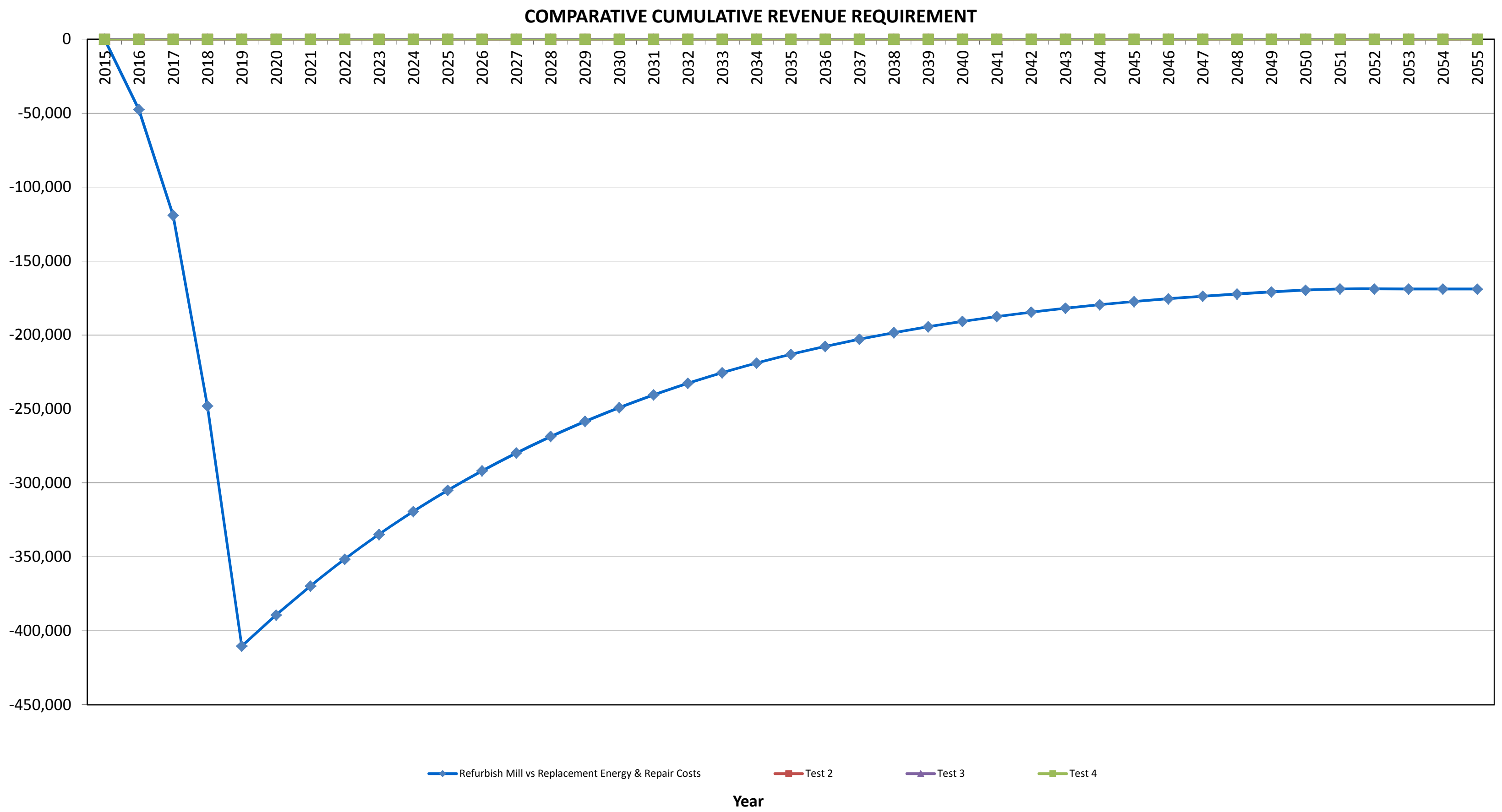
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

POT Coal Mill Overhaul 2016
Refurbish Mill vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	48,443.0	(310,790.7)	12,431.6	302,246.0	(262,347.7)	(11,163.5)	(273,511.2)	(257,761.9)	0.94	(257,761.9)
2017	-	-	112,125.5	-	23,868.7	277,728.3	112,125.5	(27,359.6)	84,765.9	75,285.0	0.89	(182,476.9)
2018	-	-	188,880.9	-	21,959.2	255,172.1	188,880.9	(51,745.7)	137,135.2	114,783.6	0.84	(67,693.3)
2019	-	-	244,562.1	-	20,202.5	234,420.3	244,562.1	(69,551.5)	175,010.6	138,050.9	0.79	70,357.6
2020	-	-	-	-	18,586.3	215,328.7	-	5,761.7	5,761.7	4,283.2	0.74	74,640.8
2021	-	-	-	-	17,099.4	197,764.4	-	5,300.8	5,300.8	3,713.7	0.70	78,354.5
2022	-	-	-	-	15,731.4	181,605.2	-	4,876.7	4,876.7	3,219.9	0.66	81,574.4
2023	-	-	-	-	14,472.9	166,738.8	-	4,486.6	4,486.6	2,791.7	0.62	84,366.0
2024	-	-	-	-	13,315.1	153,061.7	-	4,127.7	4,127.7	2,420.5	0.59	86,786.5
2025	-	-	-	-	12,249.9	140,478.8	-	3,797.5	3,797.5	2,098.6	0.55	88,885.1
2026	-	-	-	-	11,269.9	128,902.5	-	3,493.7	3,493.7	1,819.5	0.52	90,704.7
2027	-	-	-	-	10,368.3	118,252.3	-	3,214.2	3,214.2	1,577.6	0.49	92,282.2
2028	-	-	-	-	9,538.8	108,454.1	-	2,957.0	2,957.0	1,367.8	0.46	93,650.0
2029	-	-	-	-	8,775.7	99,439.8	-	2,720.5	2,720.5	1,185.9	0.44	94,836.0
2030	-	-	-	-	8,073.7	91,146.6	-	2,502.8	2,502.8	1,028.2	0.41	95,864.2
2031	-	-	-	-	7,427.8	83,516.9	-	2,302.6	2,302.6	891.5	0.39	96,755.7
2032	-	-	-	-	6,833.6	76,497.5	-	2,118.4	2,118.4	772.9	0.36	97,528.6
2033	-	-	-	-	6,286.9	70,039.7	-	1,948.9	1,948.9	670.2	0.34	98,198.8
2034	-	-	-	-	5,783.9	64,098.5	-	1,793.0	1,793.0	581.1	0.32	98,779.9
2035	-	-	-	-	5,321.2	58,632.7	-	1,649.6	1,649.6	503.8	0.31	99,283.6
2036	-	-	-	-	4,895.5	53,604.0	-	1,517.6	1,517.6	436.8	0.29	99,720.4
2037	-	-	-	-	4,503.9	48,977.7	-	1,396.2	1,396.2	378.7	0.27	100,099.1
2038	-	-	-	-	4,143.6	44,721.5	-	1,284.5	1,284.5	328.4	0.26	100,427.5
2039	-	-	-	-	3,812.1	40,805.8	-	1,181.7	1,181.7	284.7	0.24	100,712.2
2040	-	-	-	-	3,507.1	37,203.3	-	1,087.2	1,087.2	246.8	0.23	100,959.0
2041	-	-	-	-	3,226.5	33,889.1	-	1,000.2	1,000.2	214.0	0.21	101,173.0
2042	-	-	-	-	2,968.4	30,839.9	-	920.2	920.2	185.6	0.20	101,358.6
2043	-	-	-	-	2,730.9	28,034.7	-	846.6	846.6	160.9	0.19	101,519.5
2044	-	-	-	-	2,512.5	25,454.0	-	778.9	778.9	139.5	0.18	101,658.9
2045	-	-	-	-	2,311.5	23,079.6	-	716.6	716.6	120.9	0.17	101,779.9
2046	-	-	-	-	2,126.6	20,895.3	-	659.2	659.2	104.9	0.16	101,884.7
2047	-	-	-	-	1,956.4	18,885.6	-	606.5	606.5	90.9	0.15	101,975.7
2048	-	-	-	-	1,799.9	17,036.8	-	558.0	558.0	78.8	0.14	102,054.5
2049	-	-	-	-	1,655.9	15,335.9	-	513.3	513.3	68.3	0.13	102,122.8
2050	-	-	-	-	1,523.4	13,771.0	-	472.3	472.3	59.3	0.13	102,182.1
2051	-	-	-	-	1,401.6	12,331.3	-	434.5	434.5	51.4	0.12	102,233.4
2052	-	-	-	-	1,289.4	11,006.8	-	399.7	399.7	44.5	0.11	102,278.0
2053	-	-	-	-	1,186.3	9,788.3	-	367.7	367.7	38.6	0.11	102,316.6
2054	-	-	-	-	1,091.4	8,667.2	-	338.3	338.3	33.5	0.10	102,350.1
2055	-	-	-	-	1,004.1	7,635.8	-	311.3	311.3	29.0	0.09	102,379.1
Total	**-**	**-**	**594,011.5**	**(310,790.7)**	**299,243.8**		**283,220.8**	**(91,378.0)**	**191,842.8**	**102,379.1**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-50,000
-100,000
-150,000
-200,000
-250,000
-300,000
-350,000
-400,000
-450,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish Mill vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

CI Number: 47617

Title: TRE6 Elevator Controls Upgrade

Start Date:	2016/02
In-Service Date:	2016/06
Final Cost Date:	2016/12
Function:	Steam
Forecast Amount:	$320,704

DESCRIPTION:

The Trenton Unit 6 elevator is a critical piece of equipment required for transporting personnel, tools, and smaller equipment and materials throughout the upper levels of the plant. The elevator is original to the plant, and outfitted with original controls which are approximately 25 years old. This elevator has been subject to frequent break-downs during which the elevator has been unavailable for periods at a time. The scope of this project is to provide new controls, motor, door operators, fixtures, and wiring.

The upgrades will improve reliability as a result of new controls and operational upgrades with current technology. The new controls will also allow remote 24/7 diagnostic monitoring of elevator operation that will result in early maintenance intervention. This controls enhancement will improve availability of the elevator.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Justification Criteria: Health & Safety

Why do this project?

Elevator upgrades are required so that reliability and safety of the elevator's operation can be improved. This can be accomplished by upgrading the elevator and its controls to modern standards. Downtime has resulted in personnel becoming trapped in the elevator which forces personnel to use multiple flights of stairs to access the boiler house, often carrying tools and equipment.

Why do this project now?

A major planned outage is scheduled for 2017 on Trenton Unit 6 where this elevator will be heavily used. Completing this project now will improve the safety and reliability of the elevator prior to heavy use

Why do this project this way?

Due to failures over the past number of years, small repairs have been completed to keep the elevator operational. These repairs are no longer considered an acceptable option from a reliability and safety perspective. Therefore, completing this refurbishment is the only option.

CI Number : 47617 - TRE6 Elevator Controls Upgrade **Project Number**

Parent CI Number : -

Cost Centre : 345 - 345-Trenton unit 6 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,960	0	3,960
095		095-Thermal Overtime Labour AO		243	0	243
095		095-Thermal Term Labour AO		243	0	243
095		095-Thermal Regular Labour AO		546	0	546
095		095-Thermal & Hydro Contracts AO		16,704	0	16,704
001	003	001 - THERMAL Regular Labour	003 - SGP - Bldg.,Struct.Grnd.	2,695	0	2,695
002	003	002 - THERMAL Overtime Labour	003 - SGP - Bldg.,Struct.Grnd.	2,402	0	2,402
004	003	004 - THERMAL Term Labour	003 - SGP - Bldg.,Struct.Grnd.	1,201	0	1,201
012	003	012 - Materials	003 - SGP - Bldg.,Struct.Grnd.	102,500	0	102,500
013	003	013 - POWER PRODUCTION Contracts	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
066	003	066 - Other Goods & Services	003 - SGP - Bldg.,Struct.Grnd.	[redacted]	0	[redacted]
			Total Cost:	320,704	0	320,704
			Original Cost:	199,201		

Capital Project Detailed Estimate

Location: Trenton
CI# : 47617
Title: TRE6 Elevator Controls Upgrade
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Maintenance Trades	PD	2	$ 365	$ 730		
Power Plant Technician	PD	2	$ 382	$ 764		
Utilityworker	PD	5	$ 240	$ 1,201		
			Sub-Total	$ 2,695		
002 OT Labour						
Utilityworker	PD	5	$ 480	$ 2,402		
				$ -		
			Sub-Total	$ 2,402		
004 Term Labour						
Utilityworker	PD	5	$ 240	$ 1,201		
				$ -		
			Sub-Total	$ 1,201		
012 Materials						
Misc materials	lot	1	$ 2,500	$ 2,500		
Elevator Upgrades	lot	1	$ 100,000	$ 100,000		
			Sub-Total	$ 102,500		
013 Contracts						
Elevator Upgrades	lot	1	[redacted]	[redacted]	Cost Support Item #1	
Project Manager	PD	20	$ 680	$ 13,600		
			Sub-Total	[redacted]		
066 Other Goods & Services						
Contingency	%	10%	[redacted]	[redacted]		
			Sub-Total	[redacted]		
094 Interest Capitalized						
AFUDC				$ 3,960		
			Sub-Total	$ 3,960		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 546		
Thermal OT Labour AO				$ 243		
Thermal Term Labour AO				$ 243		
Thermal / Hydro Contracts AO				$ 16,704		
			Sub-Total	$ 17,737		
			SUB-TOTAL (no AO, AFUDC)	$ 299,007		
			TOTAL (AO, AFUDC included)	$ 320,704		
Original Cost				$ 199,201		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Nova Scotia Power – Trenton Generating Station
Capital Investment Recommendations

RED = Safety Upgrade/Elevator Code Requirement
A = Highest Priority
B = High Priority – for Budget purposes
C = Medium Priority – consideration for long term - future budgeting

Trenton Generating Station

Priority	Scope	Reason/Benefit	Budget Pricing
A	**Complete Elevator Modernization** New Controls, Machines, Door Operators, Fixtures and Wiring. Microcomputer-based Elevonic® RM REGEN control system Variable Voltage Variable Frequency Self Commissioning Regenerative Drive New AC motor Refurbish Otis machines	Current elevator equipment is 25 years old and is relay based technology. Improved performance in leveling, acceleration/ deceleration and flight times Improved reliability as all the controller components would be completely replaced Otis Elevonic controller is the industry benchmark for reliability and low callbacks Energy savings, environmental benefits and improved performance with replacement of the MG Sets with SCR drives Remote Elevator Monitoring 24/7 monitoring of elevator operation for diagnostics and improved reliability	[redacted] **total**

I trust this is helpful for your planning. Please do not hesitate to contact me should you wish to discuss these recommendations in greater detail.

Jonathan Parsons

Account Manager | 902-237-1592 | jonathan.parsons @otis.com

CI Number: 47614

Title: PHB Fuel System Refurbishment 2016

Start Date: 2016/05
In-Service Date: 2016/05
Final Cost Date: 2016/11
Function: Steam
Forecast Amount: $296,556

DESCRIPTION:

The scope of this project includes the replacement of the discharge screw for the biomass chip storage silo.

The biomass fuel system consists of two truck dumpers, fifteen conveyors, and a 10,000m^3 fuel storage silo. Routine replacement of hydraulic and structural components on the truck dumpers, as well as belts, chains and drivetrain components on the conveyors is essential for maintaining the flow of biomass fuel to the boiler. Under this project, portions of these components would be replaced annually on a rotating basis. This project falls within the projected sustaining capital investment for the biomass plant.

Summary of Related CIs +/- 2 years:
2015 CI 46452 PHB Fuel System Refurbishment 2015 $195,449
2017 CI TBD PHB Fuel System Refurbishment 2017 $TBD
2018 CI TBD PHB Fuel System Refurbishment 2018 $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Based on recent condition assessments, the discharge screw cannot be expected to reliably operate past 2016. Temporary, preventative repairs have been completed prior to this replacement in order to safely defer this investment to this point. This project enables reliable operation of the fuel handling systems which supply the boiler with fuel. Any disruptions in the flow of fuel to the biomass boiler lead to unplanned outages and the loss of Renewable Energy Standards (RES) credits.

Why do this project now?

The project is planned to be undertaken during the 2016 annual outage in order to ensure the reliability of the unit and preserve the asset. Efficiencies of executing the work in conjunction with other boiler projects and plant work will assist in keeping costs to a minimum. The planned outage for PHB in 2016 is of sufficient duration to complete this work.

Why do this project this way?

The annual rotating basis approach to addressing the life extension work allows the work to be performed in order of priority, maximizing the life of individual components. Isolated repairs and minor refurbishment are not typically possible due to the number of components between the truck dumpers and boiler which work in series to maintain a steady flow of fuel to the boiler. It is often necessary to disassemble major components and therefore an overall refurbishment is more effective than isolated repairs.

CI Number : 47614 - PHB - Fuel System Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 251 - 251-PH Biomass Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
095		095-Thermal & Hydro Contracts AO		2,348	0	2,348
095		095-Thermal Term Labour AO		362	0	362
095		095-Thermal Regular Labour AO		532	0	532
001	091	001 - THERMAL Regular Labour	091 Fuel Hndlg.Biomass	2,625	0	2,625
004	091	004 - THERMAL Term Labour	091 Fuel Hndlg.Biomass	1,788	0	1,788
012	091	012 - Materials	091 Fuel Hndlg.Biomass	[redacted]	0	[redacted]
013	091	013 - POWER PRODUCTION Contracts	091 Fuel Hndlg.Biomass	[redacted]	0	[redacted]
015	091	015 - Frt, Post & Delivery	091 Fuel Hndlg.Biomass	10,000	0	10,000
			Total Cost:	296,556	0	296,556
			Original Cost:	210,000		

Location: PHB
CI# / FP#: 47614
Title: PHB Fuel System Refurbishment 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	4	$ 351	$ 1,405		
Power Plant Technician	PD	2	$ 375	$ 749		
Utilityworker	PD	2	$ 235	$ 471		
			Sub-Total	$ 2,625		
004 Term Labour						
Maintenance Trades	PD	5	$ 358	$ 1,788		
			Sub-Total	$ 1,788		
012 Materials						
Replacement biomass silo screw	lot	1	[redacted]		Cost Support Item #1	
			Sub-Total	[redacted]		
013 Contracts						
Cranes	lot	1	[redacted]			
Biomass silo screw, mechanical	lot	1				
			Sub-Total	[redacted]		
015 Freight						
Freight	lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 10,000		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 532		
Thermal Term Labour AO				$ 362		
Thermal / Hydro Contracts AO				$ 2,348		
			Sub-Total	$ 3,243		
			SUB-TOTAL (no AO, AFUDC)	$ 293,313		
			TOTAL (AO, AFUDC included)	$ 296,556		
Original Cost				$ 210,000		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

ANDRITZ
Pulp & Paper

QUOTATION

Customer: 148405
Nova Scotia Power Inc
PO Box 910
HALIFAX NS B3J 2W5
CANADA

Contact:
Fax: **+19024287550**
Copy to:
Your inquiry:

Our quote no: **20304402**

Supplier: **Andritz Inc. Alpharetta**

Contact: **Marc Powell**
Phone: **+18138556902**
Fax: **+18137923731**
E-mail: **marc.powell@andritz.com**

Date: **05/21/2015**

Ladies and Gentlemen,

We thank you for your inquiry and are pleased to quote as follows:

1. Scope of supply

Item	Product	ID No.	S/W*	Quantity	Unit	Unit Price	Amount
20	DISCHARGE SCREW RCE80-30LC ***POWER SCREW C/W P5S WEARMAX CHROMIUM CARBIDE LH FLIGHTS WITH 124 PCS OF REMOVABLE HARDFACED DIGGER TEETH*** **Delivery time:** 16 weeks	202374170		1	PC	[redacted]	[redacted]
30	HARDWARE PH ***SET OF 124 REMOVABLE DIGGER TEETH WITH HARDFACING*** **Delivery time:**	201806009		1	PC	[redacted]	[redacted]
Items total							[redacted]
Total Amount						CAD	[redacted]

* S = Spare Parts, W = Wear Parts

ANDRITZ Inc.
5405 Windward Pkwy, Suite 100W
Alpharetta, GA 30004 USA
Tel: +1 (770) 640-2500
Fax: +1 (770) 640-2449
Federal Tax ID Number: 14-1438713

Remit to:
USD funds = Dept. 3236
P.O. Box 123236
Dallas, TX 75312-3236 USA
CAD funds = Lockbox #T42359C
P.O. Box 4235 STN A
Toronto, ON M5W 5P7 Canada

Wire instructions:
Nordea Bank Finland PLC
New York Branch
SWIFT: NDEAUS3N
ABA: 026010786
USD Account: 7416943001
CAD Account:7220173101
EUR Account: 7219693101

CI Number: 47668

Title: POT Plant Siding Replacement 2016

Start Date:	2016/01
In-Service Date:	2016/12
Final Cost Date:	2017/05
Function:	Steam
Forecast Amount:	$287,926

DESCRIPTION:

As part of life cycle management at the Point Tupper Generating Station, the condition of buildings, pipe bridges, walkways, and other structural components are regularly assessed. Several areas of the plant siding have been identified as requiring replacement.

This project includes replacement of Galbestos plant siding, fasteners, and structural components on the Unit 1 Boilerhouse. The Galbestos siding has deteriorated to the point that the asbestos in the siding coating may become loose and become a health hazard. This project is intended to address that issue before it occurs. This project will see the selective replacement of siding on areas identified with deteriorated Galbestos. Less replacement is expected in 2016 than is being completed in 2015.

Summary of Related CIs +/- 2 years:
2014 CI 44590 POT Water Treatment Plant Siding $382,406
2015 CI 46392 POT Plant Siding Replacement $547,659

JUSTIFICATION:

Justification Criteria: Health & Safety

Why do this project?

Replacing the siding will mitigate the risk of further deterioration of the siding resulting in separation from the building structure and asbestos fibres being disturbed and airborne. Replacing the siding will also ensure the building envelope is adequately sealed, prevent premature damage to the building's interior structural components and ensure equipment inside the plant is protected.

Why do this project now?

The siding to be replaced under this project has reached the end of its useful life and must be replaced. Further deterioration could result in asbestos fibres being released. This project is a continuation of similar work that has been completed in 2014 and 2015.

Why do this project this way?

Replacing the siding is the most practical solution to preserving the building structure. The removal of Galbestos siding is treated as an outdoor asbestos remediation.

CI Number : 47668 - POT - Plant Siding Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 351 - 351-Pt.Tupper Admin./Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,053	0	2,053
095		095-Thermal Overtime Labour AO		48	0	48
095		095-Thermal & Hydro Contracts AO		13,273	0	13,273
095		095 - Proj Supp Regular Labour AO		724	0	724
095		095-Thermal Term Labour AO		286	0	286
095		095-Thermal Regular Labour AO		500	0	500
001	003	001 - Proj Supp Regular Labour	003 - SGP - Bldg.,Struct.Grnd.	1,192	0	1,192
001	003	001 - THERMAL Regular Labour	003 - SGP - Bldg.,Struct.Grnd.	2,467	0	2,467
002	003	002 - THERMAL Overtime Labour	003 - SGP - Bldg.,Struct.Grnd.	471	0	471
004	003	004 - THERMAL Term Labour	003 - SGP - Bldg.,Struct.Grnd.	1,413	0	1,413
012	003	012 - Materials	003 - SGP - Bldg.,Struct.Grnd.	110,000	0	110,000
013	003	013 - POWER PRODUCTION Contracts	003 - SGP - Bldg.,Struct.Grnd.	130,000	0	130,000
014	003	014 - Overtime Meals	003 - SGP - Bldg.,Struct.Grnd.	500	0	500
066	003	066 - Other Goods & Services	003 - SGP - Bldg.,Struct.Grnd.	24,000	0	24,000
011	085	011 - Travel Expense	085 Design	500	0	500
041	085	041 - Meals & Entertainment	085 Design	500	0	500
			Total Cost:	287,926	0	287,926
			Original Cost:	49,471		

Capital Project Detailed Estimate

Location: Pt. Tupper
CI# : 47668
Title: POT Plant Siding Replacement 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	3	$ 351	$ 1,054		
Engineering	PD	3	$ 397	$ 1,192		
Utilityworker	PD	6	$ 235	$ 1,413		
			Sub-Total	$ 3,659		
002 OT Labour						
Utilityworker	PD	1	$ 471	$ 471		
			Sub-Total	$ 471		
004 Term Labour						
Utilityworker	PD	6	$ 235	$ 1,413		
			Sub-Total	$ 1,413		
011 Travel Expense						
Travel expenses	lot	1	$ 500	$ 500		
				$ -		
			Sub-Total	$ 500		
012 Materials						
Siding, insulation, fasteners, etc.	lot	1	$ 100,000	$ 100,000		46392
Misc. and consumables	lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 110,000		
013 Contracts						
Siding removal and replacement	lot	1	$ 130,000	$ 130,000		46392
				$ -		
			Sub-Total	$ 130,000		
014 OT meals						
OT meals	lot	1	$ 500	$ 500		
				$ -		
			Sub-Total	$ 500		
041 Meals & Entertainment						
Meals and expenses	lot	1	$ 500	$ 500		
				$ -		
			Sub-Total	$ 500		
066 Other Goods & Services						
Contingency	%	10%	$ 240,000	$ 24,000		
				$ -		
			Sub-Total	$ 24,000		
094 Interest Capitalized						
Interest				$ 2,053		
				$ -		
			Sub-Total	$ 2,053		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 500		
Thermal OT Labour AO				$ 48		
Thermal Term Labour AO				$ 286		
Thermal / Hydro Contracts AO				$ 13,273		
Project Support Regular AO				$ 724		
			Sub-Total	$ 14,831		
			SUB-TOTAL (no AO, AFUDC)	$ 271,042		
			TOTAL (AO, AFUDC included)	$ 287,926		
Original Cost				$ 49,471		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47596

Title: TRE6 ID Fan Damper Upgrades

Start Date:	2016/04
In-Service Date:	2016/08
Final Cost Date:	2017/02
Function:	Steam
Forecast Amount:	$272,239

DESCRIPTION:

The purpose of this project is to upgrade the Induced Draft (ID) fan dampers by replacing the pneumatic actuators with new electric drive actuators, similar to the approach used at the Lingan Generating Station.

The ID fans are critical components of the Trenton 6 boiler fan system. Their purpose is to maintain the draft conditions in the boiler while it is in operation. Two of the components on the ID fans, the actuator for the variable intake vanes and the actuator for the discharge dampers, are used to modulate the air flow through the boiler as required under operating conditions.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Refurbishment

Why do this project?

The actuators that are currently in use on ID fans are approximately 15 years old. The pneumatic cylinders in the actuator and the electronic controls are reaching the point where they require replacement. Failure of the actuators to modulate properly caused a trip on Unit 6 in December 2014 and in December 2013. It is expected that, as these actuators continue to age, failures will occur which will cause more forced outages on Unit 6.

Why do this project now?

As the actuators continue to age, the likelihood of experiencing further equipment malfunctions/failures will increase which will cause unplanned/forced outages. The 2016 planned outage will provide sufficient time to replace these actuators with electric drive actuators, which are similar to reliable units installed elsewhere at Trenton.

Why do this project this way?

At this time, it is preferred to replace the pneumatic actuators with new electric drive actuators. Moving from a pneumatic style to an electric style will eliminate freeze-up issues created by the instrument air when operating in winter conditions. Further, the style of electric actuator being proposed for use has already been used on other applications in the Trenton Generation Station and has been proven to be very reliable with very little maintenance required.

CI Number : 47596 - TRE6 ID Fan Damper Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 345 - 345-Trenton unit 6 Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,395	0	3,395
095		095-Thermal Overtime Labour AO		1,109	0	1,109
095		095-Thermal Term Labour AO		3,405	0	3,405
095		095-Thermal Regular Labour AO		3,959	0	3,959
095		095-Thermal & Hydro Contracts AO		2,144	0	2,144
001	017	001 - THERMAL Regular Labour	017 - SGP - Draft Equip./Stacks	11,424	0	11,424
002	017	002 - THERMAL Overtime Labour	017 - SGP - Draft Equip./Stacks	10,944	0	10,944
004	017	004 - THERMAL Term Labour	017 - SGP - Draft Equip./Stacks	16,798	0	16,798
012	017	012 - Materials	017 - SGP - Draft Equip./Stacks	165,117	0	165,117
013	017	013 - POWER PRODUCTION Contracts	017 - SGP - Draft Equip./Stacks	21,000	0	21,000
066	017	066 - Other Goods & Services	017 - SGP - Draft Equip./Stacks	23,339	0	23,339
001	087	001 - THERMAL Regular Labour	087 Field Super.& Ops.	8,106	0	8,106
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	1,500	0	1,500
			Total Cost:	272,239	0	272,239
			Original Cost:	167,762		

Capital Project Detailed Estimate

Location: **Trenton Generating Station**
CI# : 47596
Title: TRE6 ID Fan Damper Upgrades
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	15	$ 358	$ 5,374		
Engineering	PD	10	$ 405	$ 4,053		
Maintenance Trades	PD	10	$ 365	$ 3,648		
Utilityworker	PD	10	$ 240	$ 2,402		
Supervision	PD	10	$ 405	$ 4,053		
			Sub-Total	$ 19,530		
002 OT Labour						
Maintenance Trades	PD	15	$ 730	$ 10,944		
				$ -		
			Sub-Total	$ 10,944		
004 Term Labour						
Electrician	PD	30	$ 358	$ 10,748		
Maintenance Trades	PD	10	$ 365	$ 3,648		
Utilityworker	PD	10	$ 240	$ 2,402		
			Sub-Total	$ 16,798		
012 Materials						
VIV actuator	ea	2	[redacted]	[redacted]	Cost Support #1 - Item 1	
Pedestal kit for VIV actuator	ea	2	[redacted]	[redacted]	Cost Support #1 - Item 2	
Discharge damper actuator	ea	2	[redacted]	[redacted]	Cost Support #1 - Item 3	
Pedestal kit for discharge damper	ea	2	[redacted]	[redacted]	Cost Support #1 - Item 4	
USD to CDN Exchange	%	32%				
Misc mechanical supplies	lot	1	$ 2,500	$ 2,500		
Electrical supplies (panel, breakers, panel	lot	1	$ 3,000	$ 3,000		
Electrical power cable	lot	1	$ 5,000	$ 5,000		
Other misc. supplies	lot	1	$ 2,500	$ 2,500		
				$ -		
			Sub-Total	$ 165,117		
013 Contracts						
Misc. machining services	lot	1	$ 5,000	$ 5,000		
Project management	PD	10	$ 600	$ 6,000		
OEM commissioning representative	lot	1	$ 10,000	$ 10,000		
				$ -		
			Sub-Total	$ 21,000		
041 Meals & Entertainment						
Meals		1	$ 1,500	$ 1,500		
			Sub-Total	$ 1,500		
066 Other Goods & Services						
Contingency (Contracts, Materials & Labour)	%	10%	$ 233,388	$ 23,339		
			Sub-Total	$ 23,339		
094 Interest Capitalized						
AFUDC				$ 3,395		
			Sub-Total	$ 3,395		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 3,959		
Thermal OT Labour AO				$ 1,109		
Thermal Term Labour AO				$ 3,405		
Thermal / Hydro Contracts AO				$ 2,144		
			Sub-Total	$ 10,617		
			SUB-TOTAL (no AO, AFUDC)	$ 258,227		
			TOTAL (AO, AFUDC included)	$ 272,239		
Original Cost				$ 167,762		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

TRE6 ID Fan Damper Upgrades
Summary of Alternatives

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	47596
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	ID Fan Damper Upgrades vs Replacem	6.11%	-758,618	569,059	1	31.17%	4.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

It is recommended to upgrade the Trenton Unit 6 ID Fan Dampers to avoid replacement energy costs associated with unplanned outages. This decision is supported by favorable economic analysis data.

Notes/Comments :

ID Fan Damper Upgrades vs Replacement Energy & Repair Costs

This option compares the cost to replace the actuator with leaving current state and dealing with the unplanned outage, and replacement energy costs associated with these failures.

Test 2

Test 3

Test 4

TRE6 ID Fan Damper Upgrades
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Trenton Generating Station	**CI Number:**	47596
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	ID Fan Damper Upgrades vs Replacement Energy	6.11%	-758,618	569,059	1	31.17%	4.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	ID Fan Damper Upgrades vs Replacement Energy	10%	-733,201	548,796	1	28.06%	4.8 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change: A	25,417	-20,263	0	-3.12%	0.5 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	ID Fan Damper Upgrades vs Replacement Energy	-10%	-657,339	491,890	1	27.75%	4.8 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change: A	101,279	-77,169	0	-3.42%	0.5 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	75,518	125,627	176,306	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

TRE6 ID Fan Damper Upgrades
Avoided Cost Calculations

Division :	Power Production	Date :	02-Nov-15
Department :	Trenton Generating Station	CI Number:	47596
Originator :		Project No. :	

ID Fan Damper Upgrades vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			37,280	38,778		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	160.0	160.0				
Duration (Hours)	48	48				
Totals	$43,698	$28,534	$37,280	$38,778	$80,978	$67,312
Total Capital Cost of Alternative						$272,239

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

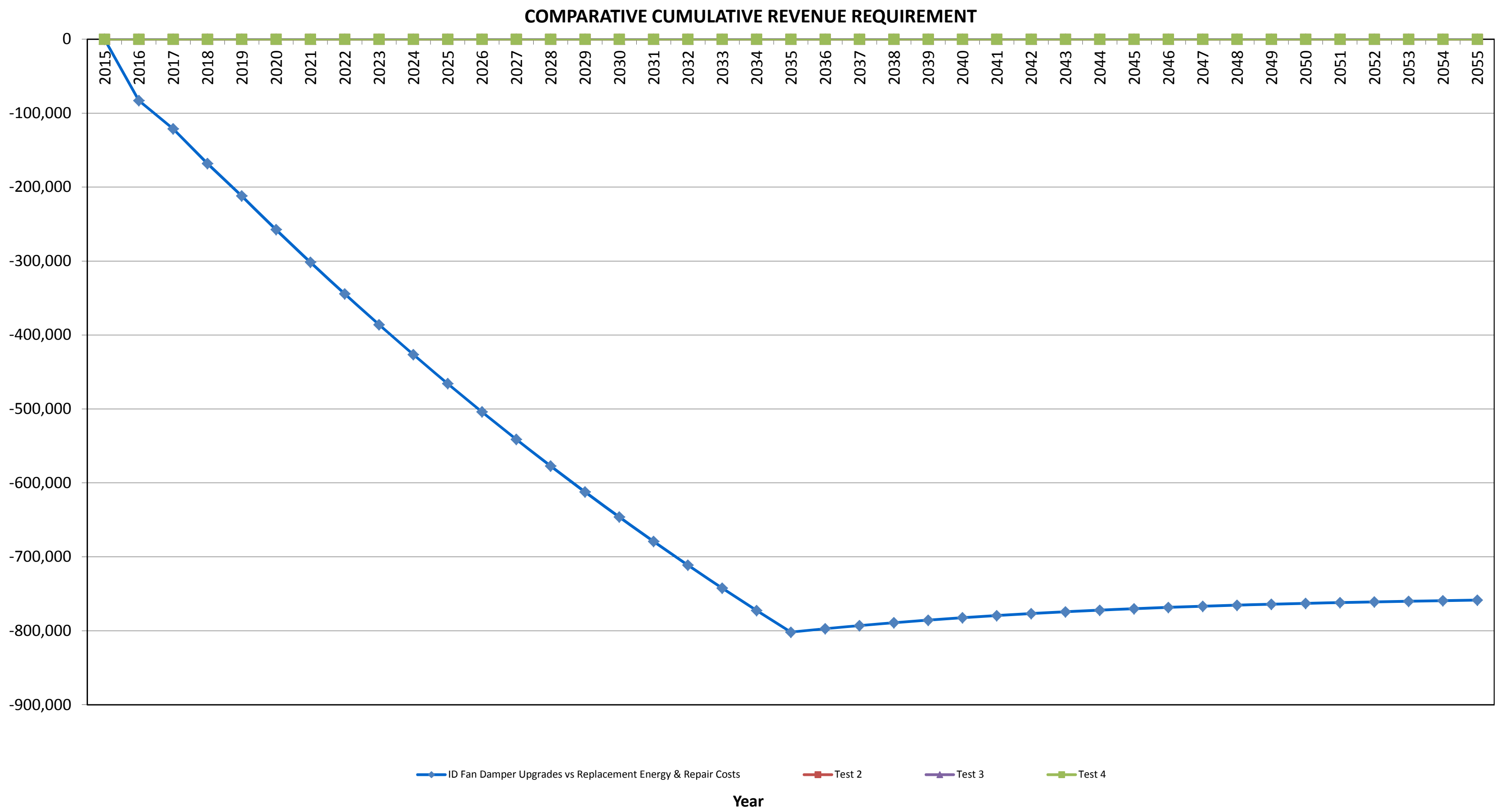
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

TRE6 ID Fan Damper Upgrades

ID Fan Damper Upgrades vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	80,977.9	(261,622.1)	10,329.1	250,828.2	(180,644.2)	(21,901.1)	(202,545.4)	(190,882.4)	0.94	(190,882.4)
2017	-	-	67,312.0	-	19,831.8	230,507.1	67,312.0	(14,718.9)	52,593.2	46,710.7	0.89	(144,171.7)
2018	-	-	81,644.9	-	18,245.3	211,811.8	81,644.9	(19,653.9)	61,991.0	51,887.2	0.84	(92,284.5)
2019	-	-	81,493.1	-	16,785.7	194,612.0	81,493.1	(20,059.3)	61,433.8	48,459.8	0.79	(43,824.7)
2020	-	-	88,204.4	-	15,442.8	178,788.2	88,204.4	(22,556.1)	65,648.3	48,802.5	0.74	4,977.8
2021	-	-	90,849.5	-	14,207.4	164,230.4	90,849.5	(23,759.0)	67,090.4	47,002.7	0.70	51,980.5
2022	-	-	93,582.8	-	13,070.8	150,837.1	93,582.8	(24,958.7)	68,624.1	45,308.8	0.66	97,289.3
2023	-	-	96,407.7	-	12,025.1	138,515.4	96,407.7	(26,158.6)	70,249.1	43,710.9	0.62	141,000.2
2024	-	-	99,327.3	-	11,063.1	127,179.3	99,327.3	(27,361.9)	71,965.4	42,200.5	0.59	183,200.7
2025	-	-	102,345.2	-	10,178.1	116,750.2	102,345.2	(28,571.8)	73,773.4	40,769.6	0.55	223,970.3
2026	-	-	105,465.0	-	9,363.8	107,155.3	105,465.0	(29,791.3)	75,673.6	39,411.7	0.52	263,382.0
2027	-	-	108,690.2	-	8,614.7	98,328.1	108,690.2	(31,023.4)	77,666.8	38,120.6	0.49	301,502.6
2028	-	-	112,024.7	-	7,925.5	90,207.1	112,024.7	(32,270.7)	79,754.0	36,891.0	0.46	338,393.5
2029	-	-	115,472.6	-	7,291.5	82,735.7	115,472.6	(33,536.1)	81,936.5	35,718.1	0.44	374,111.7
2030	-	-	119,038.0	-	6,708.2	75,862.0	119,038.0	(34,822.2)	84,215.8	34,597.8	0.41	408,709.5
2031	-	-	122,725.2	-	6,171.5	69,538.3	122,725.2	(36,131.6)	86,593.5	33,526.2	0.39	442,235.7
2032	-	-	126,538.6	-	5,677.8	63,720.4	126,538.6	(37,466.8)	89,071.7	32,499.9	0.36	474,735.7
2033	-	-	130,482.9	-	5,223.6	58,367.9	130,482.9	(38,830.4)	91,652.5	31,516.0	0.34	506,251.6
2034	-	-	134,562.8	-	4,805.7	53,443.7	134,562.8	(40,224.7)	94,338.1	30,571.5	0.32	536,823.2
2035	-	-	138,783.5	-	4,421.2	48,913.4	138,783.5	(41,652.3)	97,131.2	29,664.2	0.31	566,487.3
2036	-	-	-	-	4,067.5	44,745.5	-	1,260.9	1,260.9	362.9	0.29	566,850.3
2037	-	-	-	-	3,742.1	40,911.1	-	1,160.1	1,160.1	314.7	0.27	567,164.9
2038	-	-	-	-	3,442.8	37,383.4	-	1,067.3	1,067.3	272.8	0.26	567,437.7
2039	-	-	-	-	3,167.3	34,137.9	-	981.9	981.9	236.5	0.24	567,674.3
2040	-	-	-	-	2,914.0	31,152.1	-	903.3	903.3	205.1	0.23	567,879.4
2041	-	-	-	-	2,680.8	28,405.1	-	831.1	831.1	177.8	0.21	568,057.2
2042	-	-	-	-	2,466.4	25,877.9	-	764.6	764.6	154.2	0.20	568,211.4
2043	-	-	-	-	2,269.1	23,552.8	-	703.4	703.4	133.7	0.19	568,345.0
2044	-	-	-	-	2,087.5	21,413.8	-	647.1	647.1	115.9	0.18	568,460.9
2045	-	-	-	-	1,920.5	19,445.9	-	595.4	595.4	100.5	0.17	568,561.4
2046	-	-	-	-	1,766.9	17,635.4	-	547.7	547.7	87.1	0.16	568,648.5
2047	-	-	-	-	1,625.5	15,969.8	-	503.9	503.9	75.5	0.15	568,724.1
2048	-	-	-	-	1,495.5	14,437.4	-	463.6	463.6	65.5	0.14	568,789.6
2049	-	-	-	-	1,375.9	13,027.6	-	426.5	426.5	56.8	0.13	568,846.3
2050	-	-	-	-	1,265.8	11,730.6	-	392.4	392.4	49.2	0.13	568,895.6
2051	-	-	-	-	1,164.5	10,537.3	-	361.0	361.0	42.7	0.12	568,938.3
2052	-	-	-	-	1,071.4	9,439.5	-	332.1	332.1	37.0	0.11	568,975.3
2053	-	-	-	-	985.7	8,429.5	-	305.6	305.6	32.1	0.11	569,007.4
2054	-	-	-	-	906.8	7,500.4	-	281.1	281.1	27.8	0.10	569,035.2
2055	-	-	-	-	834.3	6,645.5	-	258.6	258.6	24.1	0.09	569,059.3
Total	**-**	**-**	**2,095,928.3**	**(261,622.1)**	**248,633.0**		**1,834,306.2**	**(572,661.5)**	**1,261,644.7**	**569,059.3**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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ID Fan Damper Upgrades vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

PROVAN Control Associates Inc.
2315 HALPERN, ST-LAURENT QC H4S 1S3
Tel : (514) 332-3230 Fax : (514) 332-3552
info@provan.ca Web: www.provan.ca

QUOTATION

Page	
1 / 1	

Date	Quotation No	REV.
25/06/2015	S-3507560	0
FOB: PA, USA	Seq. : 3507560	
Terms : TO BE DISCUSSED		
Sale conditions :	Manufacturer :	
	Provan:	x
Prices firm for: 30 Days	Taxes: Extra	
Delivery : [redacted] WEEKS		

17592

To : **NOVA SCOTIA POWER**
P.O. BOX 183
NEW WATERFORD NS
B1H 4N9

Att : DION E. ANTLE **Tel:** (902) 862-6422
Email : dion.antle@nspower.ca **Fax :** (902) 862-2537

Project :

Reference :

****Please note that Restocking or Cancelation charges may apply**

Item	Model / Description	Qty	Unit price	Total
1	MODEL 22-309 BECK ACTUATOR 120 Volts, 1 Phase, 60 Hertz. 3000 lb-ft torque output. 30 seconds timing for 100 degree full stroke. Mechanical stops - End of travel electrical limit switches. 2 SPDT optional switches, adjustable. Handwheel for manual operation without power. Handswitch for electrical-manual operation. Non-coasting Beck control motor with instant magnetic braking. Self-locking, self-releasing gear train. Actuator stays in place on loss of power. Contactless Position Sensor (CPS) for position sensing. Digital Control Module (DCM) with HART communications and local pushbutton interface. 4-20 mA proportional signal operation. 4-20 mA feedback sourcing. Temperature sensing technology. Stall protection circuitry. Response to loss of input signal factory set to stay in place, field changeable to drive to pre-determined intermediate position. Totally enclosed, cast, weatherproof, dust-tight construction. Crank arm with adjustable radius. Temperature and torque sensing	2	[redacted]	[redacted]
2	P/N 20-2825-29 PEDESTAL REPLACEMENT KIT FOR BAILEY UP50/60 TO BECK 22	2	[redacted]	[redacted]
3	MODEL 11-433 MODEL 11-433 BECK ROTARY ELECTRONIC CONTROL DRIVE 120 Volts, 1 Phase, 60 Hertz. 2900 lb-ft torque output. 120 seconds timing for 100 degree full stroke. Mechanical stops - End of travel electrical limit switches 2 SPDT optional switches, adjustable. Open-close or pushbutton operation. Handwheel for manual operation without power. Handswitch for electrical-manual operation. Non-coasting Beck control motor with instant magnetic braking. Self-locking, self-releasing gear train. Actuator stays in place on loss of power. Totally enclosed, cast, weatherproof, dust-tight construction. Crank arm with adjustable radius.	2	[redacted]	[redacted]
4	P/N 20-2825-30 PEDESTAL REPLACEMENT KIT FOR BAILEY UP50/60 TO BECK 11-430	2	[redacted]	[redacted]

Thank you for your support

SUB-TOTAL:	[redacted]
HST (15%) NS (15.00%) :	[redacted]
N/A (0.000%) :	0.00
NET AMOUNT : **(US)**	[redacted]

This quote is in US$ dollars

Please Address Purchase Order as follows:

C/O : **PROVAN Control Associates Inc.**

2315 HALPERN
ST-LAURENT QC H4S 1S3
Tel: (514) 332-3230 1-800-361-3370 Fax : (514) 332-3552
www.provan.ca info@provan.ca

Prepared by: MATHIEU LABRANCHE
Email : mlabranche@provan.ca **Tel:**
To : PAUL KURYLOWICZ
Email : pkurylowicz@provan.ca

Les Contrôles PROVAN Associés Inc.

PROVAN Control Associates Inc.

MODALITÉS DE VENTE/ TERMS AND CONDITIONS

1. **SOUMISSIONS:**
   À moins d'indication contraire, toute soumission écrite expire automatiquement trente (30) jours après la date de rédaction.
   QUOTES:
   Unless otherwise indicated, all quoted prices are firm for 30 days from date of quotation or as stipulated in writing.
2. **PRIX:**
   Les prix sont fermes pour les produits dont la date de livraison est de moins 6 mois, et dont la livraison sera acceptée par l'Acheteur à la date de livraison prévus. Si la livraison du matériel commandé est retardée, à la demande de l'Acheteur au-delà de la date de livraison prévue, le Vendeur se réserve le droit de réviser le prix du matériel jusqu'à un maximum de 10% par année. Pour les expéditions de plus de 12 mois, le prix sera celui en vigueur au moment de l'expédition.
   PRICES:
   If the delivery of equipment ordered is delayed, at the request of the buyer, beyond the original delivery date, the seller reserves the right to amend the price of the goods to a maximum of 10% per year. For deliveries exceeding 12 months, the prices will be subject to the current prices in effect at time of delivery.
3. **TAXES:**
   Les taxes Provinciales et Fédérales sont en supplément, si applicable.
   TAX:
   Provincial and Federal taxes are extra, when applicable.
4. **TERMES DE PAIEMENT:**
   Tout paiement doit être effectué en monnaie canadienne. À moins d'indication contraire, tout montant est payable en 30 jours. Advenant le cas où des expéditions partielles seraient effectuées, l'Acheteur sera facturé de façon proportionnelle au matériel livré.
   PAYMENT TERMS:
   Unless otherwise indicated, all amounts are payable 30 days after shipment date and are in Canadian Funds. For partial shipments, the buyer will be billed according to each shipment 30 day terms still in effect, unless otherwise specified on the quote or agreed to on the order.
5. **LIVRAISON:**
   A moins d'indication contraire, toutes les expéditions seront F.A.B. Ville St-Laurent, Québec. Aucune pénalité ne sera acceptée pour quelque raison que ce soit.
   DELIVERY:
   Unless otherwise indicated, all shipments are F.O.B. Ville St-Laurent, Quebec. No penalties will be accepted for any reason whatsoever.
6. **PERTES OU DOMMAGES DURANT LE TRANSPORT:**
   Provan ne pourra être tenue responsable de tout dommage, perte ou pillage advenus lors du transport du matériel vers sa destination. Toute réclamation à ce sujet devra être signalée au transporteur par écrit dans les plus brefs délais. Si Provan reçoit un avis écrit de toute réclamation, elle procurera toute l'assistance possible de manière à accélérer et faciliter le règlement.
   LOSS OR DAMAGE DURING TRANSPORTATION:
   Provan will not be held liable for any or all loss, theft or damage of goods at the time of transportation for all “collect” shipments. Provan will indicate value of goods shipped for insurance purposes, if requested on the purchase order. Provan will comply with any documentation required by the Purchaser on order to expedite the claims with the carrier.
7. **GARANTIE:**
   Tous les produits et équipements sont garantis pour une période d'un (1) an suivant la date d'expédition, contre tout défaut de fabrication et de main d'œuvre, à moins que les dits produits aient été soumis à un usage abusif ou contre-indiqué. Tout remplacement ou réparation sera effectué F.A.B. Ville St-Laurent, Québec. L'Acheteur doit immédiatement signaler toute défectuosité par écrit. La responsabilité de Provan devient nulle au moment où se termine la période de garantie.
   GUARANTEE:
   All products and equipment are guaranteed for a period of one (1) year from delivery against all manufacturers’ defects, unless products were subjected to improper usage. All replacements or repairs will be carried out F.O.B. Ville St-Laurent, Quebec. The buyer must immediately notify the Vendor, in writing, for any imperfections found. Provan’s responsibility becomes void at the end of the guarantee period.
8. **FORCE MAJEURE:**
   Provan ne pourra être tenue responsable pour toute perte, dommage ou délai causés par un conflit armé, guerre, invasion, révolution, émeute ou par un incendie, inondation, ou tout autre élément, grève, désordre, protestation syndicale ou le défaut par le fournisseur de livrer la marchandise en temps, ou toute autre cause hors du contrôle de Provan. La réception par l'Acheteur du matériel commandé, rendra nulle et non-avenue, toute réclamation pour perte ou dommage ainsi causé.
   FORCE MAJEURE:
   Provan will not be held responsible for any or all loss, damage or delay caused by an armed conflict, war, invasion, revolution, riot or by a fire, flood, or all other elements, strikes, disorders, union protests or the default by the manufacturer for delays on delivery, or all other causes outside the control of Provan. Receipt by the purchaser of the equipment ordered, make null and void, any claim for loss or damage caused.
9. **LIMITE DE RESPONSABILITÉ:**
   Ni Provan, ni l'Acheteur ne pourront être tenus responsables, l'un envers l'autre, pour tout dommage direct, indirect, spécial ou autre, de quelque nature que ce soit, et la responsabilité de Provan Inc. ne pourra en aucun temps excéder la valeur de la marchandise fournie.
   LIMIT OF RESPONSIBILITY:
   Neither Provan nor the buyer will be held responsible for any limits exceeding the value of merchandise furnished. Neither Provan nor the Buyer shall be held liable, one towards the other, for all damages be it direct, indirect, special or otherwise, of any nature whatsoever, and the responsibility of Provan Inc. may not at any time exceed the value of the goods supplied.
10. **RETOUR DE MATÉRIEL:**
   Un numéro d'autorisation de la part de Provan Inc. est nécessaire et obligatoire avant qu'un équipement ne soit retourné. Provan Inc. fournira alors tous les détails concernant la méthode d'expédition, identification du matériel, etc. Tout équipement retourné sans la permission de Provan Inc. le sera aux risques de l'Acheteur et pourra être refusé. Seulement le matériel courant, non-utilisé, dans son emballage original, pourra être retourné pour crédit. Lorsque Provan Inc. consent à reprendre le matériel, un crédit équivalent au montant facturé moins les frais de remise en inventaire et de transport sera alloué. Tous les frais déboursés en vue de remettre le matériel en état de revente seront déduits du montant alloué.
   EQUIPMENT RETURN:
   A Returned goods authorization number from Provan Inc. is necessary and obligatory before return of any equipment. Provan will then provide the details concerning the method of transportation, transportation costs for repair etc. Any returned equipment without the permission of Provan will be it at the risk of the buyer and could be refused. Only the recent materials, not used and in its original packaging can be returned for credit. Once Provan Inc. agrees to accept the returned material, a credit equivalent to the amount invoiced deducting the restocking fees and transportation costs will be allocated. All fees paid to restore the item to its original state will be deducted from the amount allocated.
11. **ANNULATION ET CHANGEMENTS:**
   Toute commande peut être annulée ou modifiée par l'Acheteur à condition qu'un montant représentant les frais réels encourus par Provan Inc. et découlant de l'annulation ou de la révision de la dite commande, soient payés par l'Acheteur. Selon les circonstances, des frais d'annulation de 100% sont applicables.
   CANCELLATION AND MODIFICATIONS:
   Subject to agreement between purchaser and Provan, orders may be cancelled or modified by the purchaser with applicable restocking charges to be assumed by the buyer subject to inspection of returned goods. In certain circumstances, 100% cancellation charges will apply.
12. **INSTALLATION:**
   Le matériel commandé sera installé par l'Acheteur à ses frais, à moins d'indication contraire.
   INSTALLATION:
   Unless otherwise indicated, all equipment purchased will be installed by the buyer at his own expense.

CI Number: 47507

Title: LIN CW Pump Refurbishment 2016

Start Date: 2016/04
In-Service Date: 2016/11
Final Cost Date: 2017/05
Function: Steam
Forecast Amount: $441,560

DESCRIPTION:

This project is for the refurbishment of one of eight cooling water (CW) pumps at Lingan Generating Station. As pump performance degrades, the CW water flow is not great enough to maintain cooling in the condenser and the pumps must be refurbished to regain performance. The CW pumps are routinely inspected for running shaft misalignment/whipping but all developing failures are not always indicated in advance as monitoring of the submersed lower pump shaft is not feasible while the pump is in service.

The refurbishment includes re-surfacing/re-building and coating of worn, corroded and damaged surfaces and components, a new sleeveless, chromed stainless pump shaft, new marine bearings, and verification of all mating fits and alignments. The refurbishment project includes the installation of an additional bearing on the pump shaft. This bearing will help to maintain alignment and will reduce the movement of the pump shaft if misalignment occurs, protecting related bearings and running surfaces.

Each Generating Unit is equipped with two CW pumps. Current expectation is that this project will not include the refurbishment of the CW pumps on Unit #2 However, if CW pumps on Unit #2 were found to require refurbishment in 2016, investment on Unit #2 could still be the best option. All four units at Lingan are similar and as such, the components refurbished/replaced on the CW pump can be transferred to any of the other Lingan CW pumps when Lingan Unit #2 is retired. The useful life of these CW pump components will extend beyond the payback period shown in the EAM, providing a significant benefit to all of the CW pumps at Lingan.

Summary of Related CIs +/- 2 years:
2015 CI 43168 LIN – CW Pump Refurbish $417,461

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Each Generating Unit is equipped with two CW pumps, which supply cooling water to each unit's condenser as well as to various smaller heat exchangers serving the Unit. Adequate condenser cooling is necessary to ensure proper condenser vacuum, which is a major contributor to unit efficiency. During the cooler months, one CW pump per operating unit is capable of providing adequate condenser cooling. During warmer months, both pumps are required to maintain condenser vacuum. If one of a unit's two pumps is unavailable during the warmer months, the unit's heat rate and/or ability to generate full load will be restricted. The loss of both pumps would lead to an unplanned outage. Therefore, the reliability and availability of these pumps is critical to plant operation. Many of the CW pumps range in age from 18 to 23 years, and over the years have developed normal operating wear and component erosion and corrosion due to solid particle and salt water exposure, which has been managed through periodic maintenance overhauls.

Why do this project now?

The station's aged CW pumps are currently at operating hours where pumps have failed in the past due to wear which can result in rapid deterioration with little notice. These conditions put the availability and reliability of these critical pieces of equipment and the performance of the associated operating units at an unacceptable level of risk. The plant is faced with a risk of de-rating or forced outage if a CW pump fails which is at risk knowing the rebuild frequency profiles of the pumps. CW pumps refurbishments are also a long lead time item.

Why do this project this way?

Compared to a full replacement or operate until failure, the most economic and efficient solution is to rebuild deteriorated CW pumps. Condition assessments from recent failed pumps indicate pump refurbishment for normal wear is required every 7 years to reduce potential for shaft misalignment. Repair and balancing facilities are not available on site or locally; the plant proposes to have restorations done at reputable repair facility ensuring an effective overhaul. New pumps have an 11 Month lead time and cost approximately 50 percent more than refurbishment.

CI Number : 47507 - LIN CW Pump Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 301 - 301-Lingan Admin./Common Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		7,172	0	7,172
095		095-Thermal & Hydro Contracts AO		3,063	0	3,063
095		095-Thermal Term Labour AO		4,350	0	4,350
095		095-Thermal Regular Labour AO		10,929	0	10,929
001	014	001 - THERMAL Regular Labour	014 - SGP - Circ.Water Sys.	53,915	0	53,915
004	014	004 - THERMAL Term Labour	014 - SGP - Circ.Water Sys.	21,458	0	21,458
012	014	012 - Materials	014 - SGP - Circ.Water Sys.	262,431	0	262,431
013	014	013 - POWER PRODUCTION Contracts	014 - SGP - Circ.Water Sys.	30,000	0	30,000
015	014	015 - Frt, Post & Delivery	014 - SGP - Circ.Water Sys.	22,000	0	22,000
066	014	066 - Other Goods & Services	014 - SGP - Circ.Water Sys.	26,243	0	26,243
			Total Cost:	441,560	0	441,560
			Original Cost:	303,034		

Capital Project Detailed Estimate

Location: Steam
CI# : 47507
Title: LIN CW Pump Refurbishment 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	20	$ 358	$ 7,025		
Engineering	PD	10	$ 405	$ 3,974		
Maintenance Trades	PD	118	$ 365	$ 42,916		
			Sub-Total	$ 53,915		
004 Term Labour						
Maintenance Trades	PD	59	$ 365	$ 21,458		
				$ -		
				$ -		
			Sub-Total	$ 21,458		
012 Materials						
CW Pump Refurbishment	$	1	[redacted]		Cost Support Item #1	
			Sub-Total	[redacted]		
013 Contracts						
Machining Contractor	$	1	[redacted]			43168
			Sub-Total	[redacted]		
015 Freight						
Transportation & Shipping	$	1	$ 22,000	$ 22,000		
			Sub-Total	$ 22,000		
066 Other Goods & Services						
Contingency	%	10%	$ 262,431	$ 26,243		
				$ -		
			Sub-Total	$ 26,243		
094 Interest Capitalized						
				$ 7,172		
				$ -		
			Sub-Total	$ 7,172		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 10,929		
Thermal Term Labour AO				$ 4,350		
Thermal / Hydro Contracts AO				$ 3,063		
			Sub-Total	$ 18,341		
			SUB-TOTAL (no AO, AFUDC)	$ 416,047		
			TOTAL (AO, AFUDC included)	$ 441,560		
Original Cost				$ 303,034		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN CW Pump Refurbishment 2016
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production		**Date :**	**02-Nov-15**
Department :	Lingan Generating Station		**CI Number:**	47507
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish CW Pump vs Replacement E	6.11%	-917,245	636,093	1	38.02%	3.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to avoid any potential of a unit derating.

Notes/Comments :

Refurbish CW Pump vs Replacement Energy & Repair Costs

If the CW pump fails the whole unit will lose approximately 40 MW for as long as 8 weeks depending on the severity of the damage when the pump fails.

Test 2

Test 3

Test 4

LIN CW Pump Refurbishment 2016
Summary of Sensitivities

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47507
Originator :		**Project No. :**	

	Alternative	**After Tax WACC**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish CW Pump vs Replacement Energy & R	6.11%	-917,245	636,093	1	38.02%	3.2 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish CW Pump vs Replacement Energy & R	10%	-876,535	603,285	1	34.11%	3.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change: **A**	40,710	-32,808	0	-3.91%	0.2 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	**Variance (%)**	**PV of Revenue Requirement**	**PV of EVA / NPV**	**Rank**	**IRR**	**Disc Pay**
A	Refurbish CW Pump vs Replacement Energy & R	-10%	-784,810	539,675	1	33.71%	3.4 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change: **A**	132,434	-96,418	0	-4.31%	0.3 years
B	0	0	0	#NUM!	0.0 years
C	0	0	0	#NUM!	0.0 years
D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	**PV of Revenue Requirement** 1	**PV of Revenue Requirement** 2	**PV of Revenue Requirement** 3	**Delay?**
	A	47,043	136,149	286,356	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN CW Pump Refurbishment 2016
Avoided Cost Calculations

Division :	Power Production	**Date :**	**02-Nov-15**
Department :	Lingan Generating Station	**CI Number:**	47507
Originator :		**Project No. :**	

Refurbish CW Pump vs Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			157,760	164,118		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	25%	50%	25%	50%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	40.0	40.0				
Duration (Hours)	1344	1344				
Totals	$11,005	$36,217	$39,440	$82,059	$50,445	$118,275

Total Capital Cost of Alternative **$441,560**

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

Test 3

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

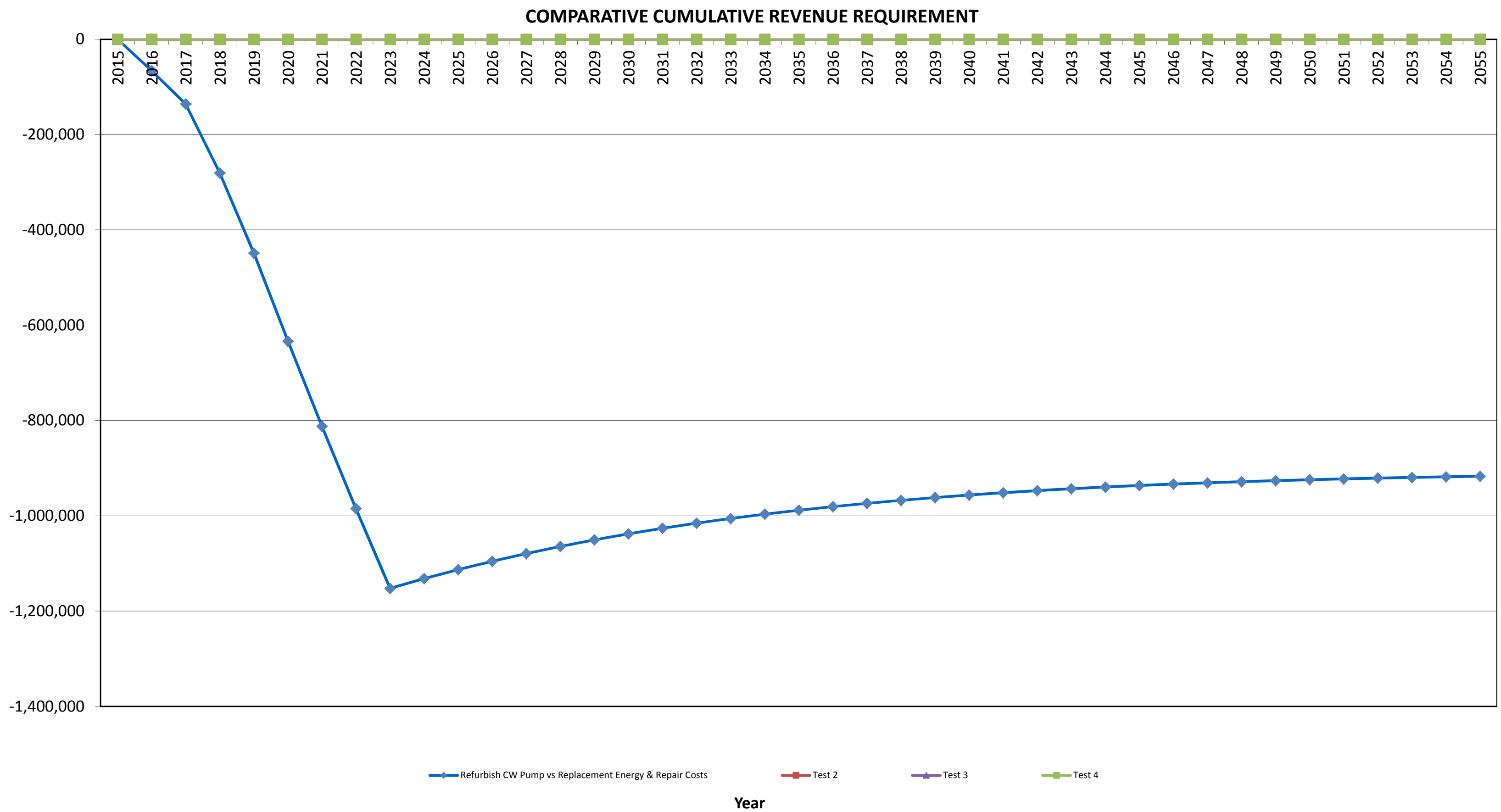
Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0

Total Capital Cost of Alternative **$0**

LIN CW Pump Refurbishment 2016
Refurbish CW Pump vs Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	50,444.7	(423,219.0)	16,641.9	404,467.2	(372,774.3)	(10,478.9)	(383,253.2)	(361,184.8)	0.94	(361,184.8)
2017	-	-	118,275.5	-	31,952.4	371,669.6	118,275.5	(26,760.2)	91,515.3	81,279.5	0.89	(279,905.3)
2018	-	-	216,475.4	-	29,396.2	341,495.9	216,475.4	(57,994.6)	158,480.9	132,650.2	0.84	(147,255.1)
2019	-	-	260,771.0	-	27,044.5	313,736.0	260,771.0	(72,455.2)	188,315.8	148,546.2	0.79	1,291.1
2020	-	-	300,410.2	-	24,881.0	288,197.0	300,410.2	(85,414.1)	214,996.1	159,826.6	0.74	161,117.7
2021	-	-	310,169.0	-	22,890.5	264,701.0	310,169.0	(89,056.3)	221,112.6	154,908.6	0.70	316,026.4
2022	-	-	320,274.1	-	21,059.2	243,084.7	320,274.1	(92,756.6)	227,517.5	150,217.5	0.66	466,243.9
2023	-	-	330,738.5	-	19,374.5	223,197.8	330,738.5	(96,522.8)	234,215.7	145,735.5	0.62	611,979.4
2024	-	-	-	-	17,824.5	204,901.8	-	5,525.6	5,525.6	3,240.2	0.59	615,219.6
2025	-	-	-	-	16,398.6	188,069.4	-	5,083.6	5,083.6	2,809.3	0.55	618,028.9
2026	-	-	-	-	15,086.7	172,583.7	-	4,676.9	4,676.9	2,435.8	0.52	620,464.7
2027	-	-	-	-	13,879.8	158,336.8	-	4,302.7	4,302.7	2,111.9	0.49	622,576.6
2028	-	-	-	-	12,769.4	145,229.7	-	3,958.5	3,958.5	1,831.0	0.46	624,407.6
2029	-	-	-	-	11,747.8	133,171.1	-	3,641.8	3,641.8	1,587.6	0.44	625,995.2
2030	-	-	-	-	10,808.0	122,077.3	-	3,350.5	3,350.5	1,376.5	0.41	627,371.6
2031	-	-	-	-	9,943.4	111,870.9	-	3,082.4	3,082.4	1,193.4	0.39	628,565.1
2032	-	-	-	-	9,147.9	102,481.0	-	2,835.8	2,835.8	1,034.7	0.36	629,599.8
2033	-	-	-	-	8,416.1	93,842.4	-	2,609.0	2,609.0	897.1	0.34	630,496.9
2034	-	-	-	-	7,742.8	85,894.8	-	2,400.3	2,400.3	777.8	0.32	631,274.8
2035	-	-	-	-	7,123.4	78,583.0	-	2,208.2	2,208.2	674.4	0.31	631,949.2
2036	-	-	-	-	6,553.5	71,856.2	-	2,031.6	2,031.6	584.7	0.29	632,533.9
2037	-	-	-	-	6,029.2	65,667.5	-	1,869.1	1,869.1	507.0	0.27	633,040.9
2038	-	-	-	-	5,546.9	59,973.9	-	1,719.5	1,719.5	439.6	0.26	633,480.4
2039	-	-	-	-	5,103.1	54,735.8	-	1,582.0	1,582.0	381.1	0.24	633,861.5
2040	-	-	-	-	4,694.9	49,916.8	-	1,455.4	1,455.4	330.4	0.23	634,191.9
2041	-	-	-	-	4,319.3	45,483.2	-	1,339.0	1,339.0	286.5	0.21	634,478.4
2042	-	-	-	-	3,973.7	41,404.4	-	1,231.9	1,231.9	248.4	0.20	634,726.8
2043	-	-	-	-	3,655.8	37,651.9	-	1,133.3	1,133.3	215.4	0.19	634,942.2
2044	-	-	-	-	3,363.4	34,199.5	-	1,042.6	1,042.6	186.7	0.18	635,128.9
2045	-	-	-	-	3,094.3	31,023.4	-	959.2	959.2	161.9	0.17	635,290.8
2046	-	-	-	-	2,846.8	28,101.3	-	882.5	882.5	140.4	0.16	635,431.2
2047	-	-	-	-	2,619.0	25,413.0	-	811.9	811.9	121.7	0.15	635,552.9
2048	-	-	-	-	2,409.5	22,939.8	-	746.9	746.9	105.5	0.14	635,658.4
2049	-	-	-	-	2,216.7	20,664.4	-	687.2	687.2	91.5	0.13	635,749.9
2050	-	-	-	-	2,039.4	18,571.1	-	632.2	632.2	79.3	0.13	635,829.2
2051	-	-	-	-	1,876.2	16,645.2	-	581.6	581.6	68.8	0.12	635,898.0
2052	-	-	-	-	1,726.1	14,873.4	-	535.1	535.1	59.6	0.11	635,957.6
2053	-	-	-	-	1,588.1	13,243.4	-	492.3	492.3	51.7	0.11	636,009.3
2054	-	-	-	-	1,461.0	11,743.7	-	452.9	452.9	44.8	0.10	636,054.1
2055	-	-	-	-	1,344.1	10,364.0	-	416.7	416.7	38.9	0.09	636,093.0
Total	**-**	**-**	**1,907,558.3**	**(423,219.0)**	**400,589.5**		**1,484,339.3**	**(467,160.4)**	**1,017,178.9**	**636,093.0**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
-1,400,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish CW Pump vs Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Sulzer Pumps
Sulzer Pumps (Canada) Inc
Service Center Toronto
1851 Albion Road
Toronto ON M9W 5S8
Phone: 416-675-2470
Fax: 416-675-2174
www.sulzerpumps.com

NOVA SCOTIA POWER INC
LINGHAM GENERATING STATION
2599 HICHY AVENUE LINGAN
NOVA SCOTIA NS B1H 5E6

Project Manager David Veselinovski
Phone 416-675-2470
Fax 416-675-2174
E-mail david.veselinovski@sulzer.com
Date 11/21/2014

Customer Contact: Bill Delaney
Phone: 902-862-6422 EXT:3224
Email: bill.delaney@nspower.ca

Customer RFQ #: TBD
Customer PO#: TBD

Sulzer Quote#:Q100176490
Sulzer Sales Order#: 100176490

Subject: Repair of your model 48SP-1STG

Serial No.: 08JX8-4

Equipment No: 10023867

Dear Bill,

Thank you for the opportunity to provide our services in the repair of your Pump:
48SP-1STG.

The attached work scope and proposal is based on the results of a complete "As Found" inspection applied to this unit upon its arrival at Sulzer's. For your convenience, we have divided this proposal to include the following sections; we believe that you will find this format to be helpful in reviewing our proposal.

Section No. 1 Detailed Recondition Requirements
Section No. 2 Detailed Parts Requirements
Section No. 3 Pricing Summary and Commercial Terms

If you have any questions or need any additional information regarding this proposal, please feel free to contact us at any time. We look forward to your advisements.

SULZER

OPTION 1

Section 1:

Detailed Recondition Requirements

Dissassembly and Inspection (Qty 1.000/ / / S.O. 4390784)

Dissassembly and Report Findings to Customer- Inspection.

Suction Cone (Qty 1.000/ / / S.O. 4392014)

[redacted]

Sandblast (Qty 1.000/ / / S.O. 4392015)

Sandblast only as follows: [redacted]

Suction Liner (Qty 1.000/ / / S.O. 4392017)

Suction Liner is worn from the Impeller rubbing against it once the Bowl and the Retainer Bearings failed. [redacted]

Interbowl (Qty 1.000/ / / S.O. 4392018)

Inter Bowl Wear Ring is Worn out and the Bowl Bearing (Marine Style)are worn out. [redacted]

Impeller (Qty 1.000/ / / S.O. 4392019)

Impeller Wear Ring and Tips are worn from coming into contact with the suction liner. [redacted]

Retainer bearing (Bracket) (Qty 1.000/ / / S.O. 4392041)

Retainer bearing (Bracket) was badly worn at the bearing bore area out by the shaft. [redacted]

Assembly Model 48sp-1stg (Qty 1.000/ / / S.O. 4392016)

[redacted]

TOTAL RECONDITIONING: [redacted]

Section 2:

Detailed Parts Requirements:

SERVICE ORDER NO.	QTY	PART NAME	SCOPE	DRAWING NO.	MATERIAL	PRICE EA.	PRICE TOTAL
4392042	1.000	SHAFT,PUMP	Pump Shaft is badly worn close to the coupling area. [redacted]				[redacted]
4392043	1.000	COUPLING ASSY.	Coupling and Wedges were not received. manufacture new once.				[redacted]
4392047	4.000	BEARING, BUSHING	Bowl Marine Style bearing's and Line Shaft Bearings were severely worn, wiping the shaft once the bearing was gone and resulted in the retainer being worn by the shaft. [redacted]				[redacted]
4392048	1.000	Gaskets/Elastimers and missing Bolting	Replace pump 'O'-rings and 316 bolting				[redacted]

SULZER

4392052	1.000	RING, IMPELLER	Impeller wear ring worn out. [redacted]				[redacted]
						TOTAL PARTS:	[redacted]
4392054	1.000	OPTIONAL-LOWER HEAD SHAFT	Lower Head Shaft was not received. [redacted]				[redacted]
						TOTAL OPTIONAL PARTS:	[redacted]

Section 3:

Pricing Summary:	
Total Cost for Recondition Requirements:	[redacted]
Total Cost for New Part Requirements:	[redacted]
Total Freight:	0.00
Expedite Fee:	0.00
Total Repair Cost:	[redacted]
TOTAL OPTIONAL PARTS:	[redacted]
TOTAL	[redacted]

Delivery time:
Delivery time, after technical and commercial Confirmation. — 14 Weeks

Offer Validity:
Offer Valid Until. — 12-21-2014

Conditions:
According to INCOTERMS latest edition. — EXW SULZER-TORONTO

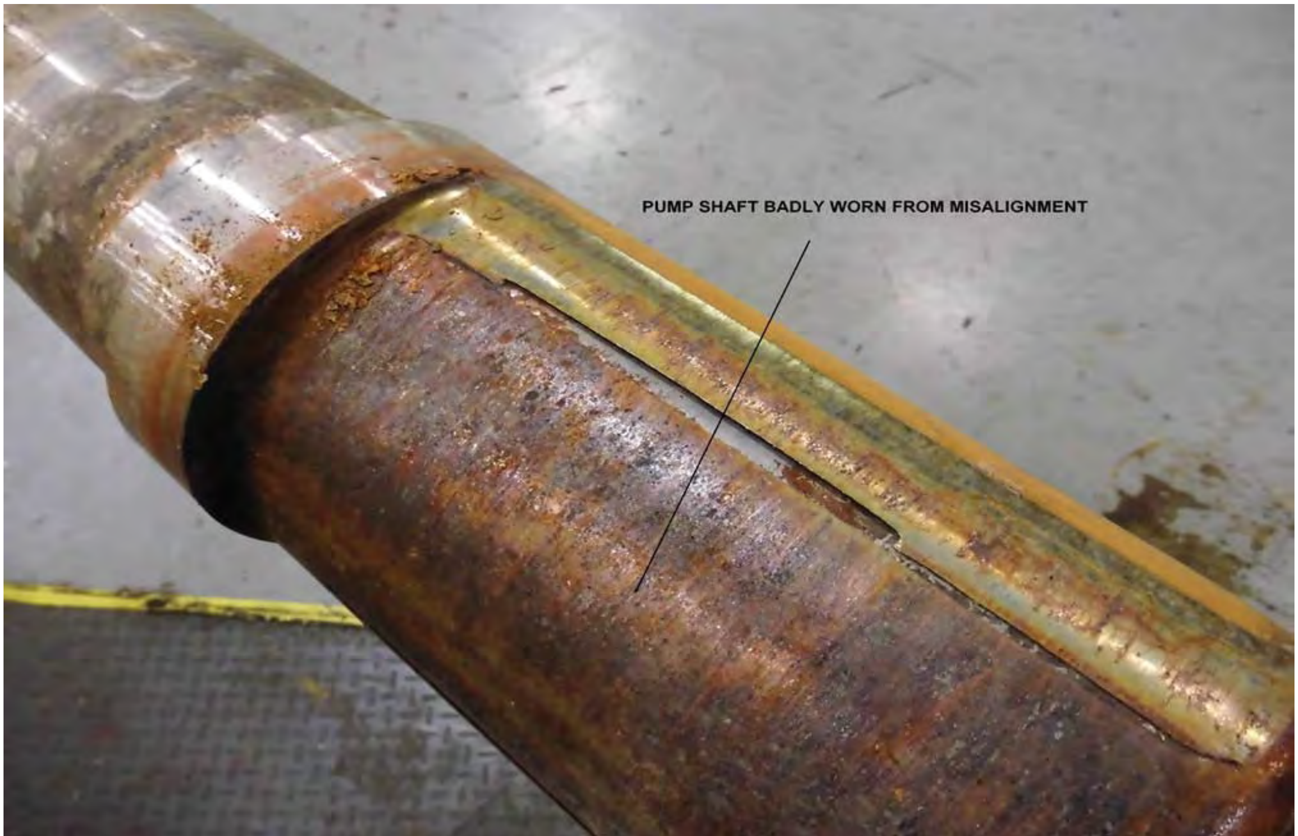
Terms of payment: — Net due in 30 days

-

Unless otherwise agreed in writing, our delivery is subject to our General Terms and Conditions of Supply which can be found on www.sulzerpumps.com if not attached hereto. At your request, we will send you a copy thereof.

SULZER

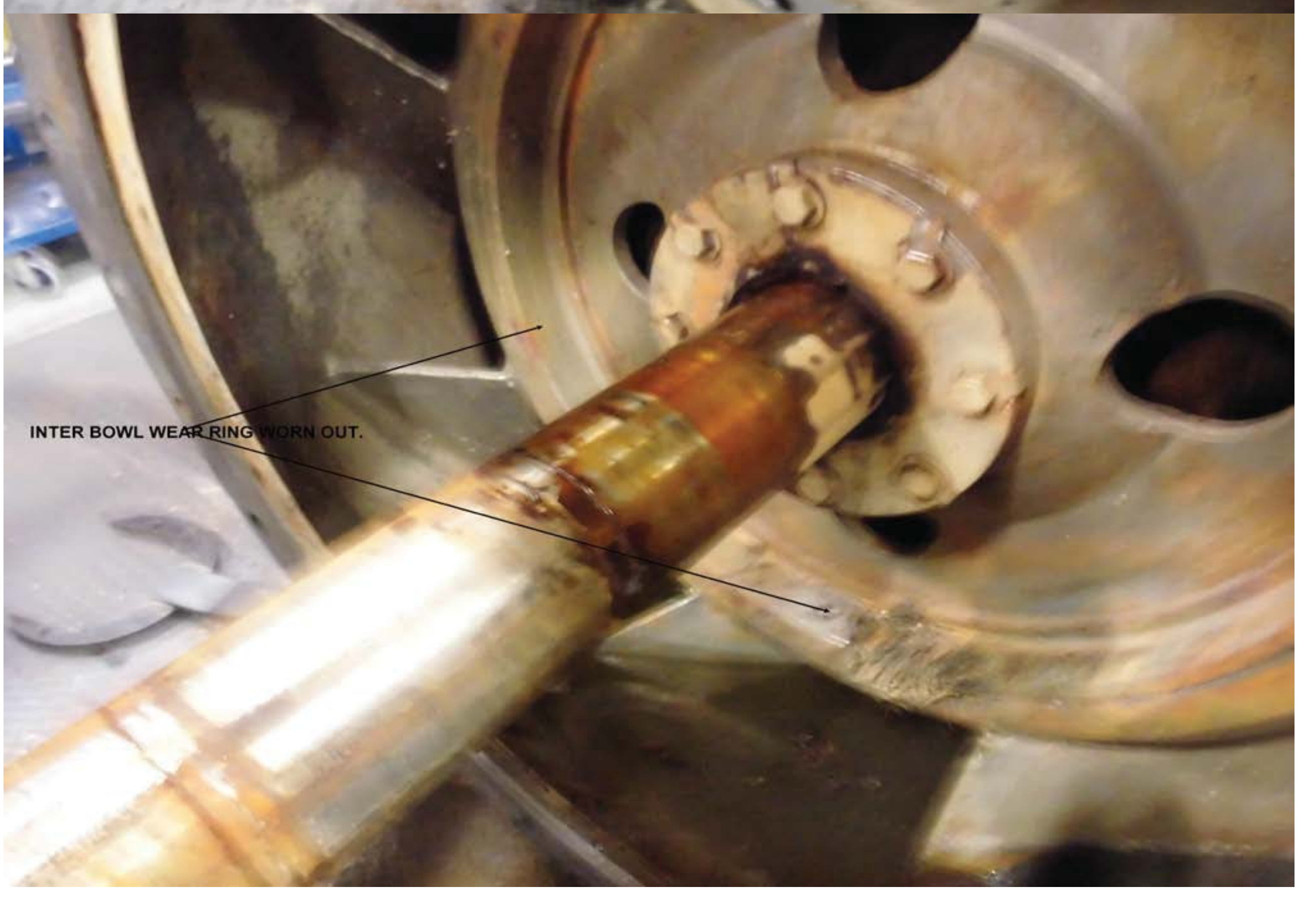
SULZER


PUMP SHAFT BADLY WORN FROM MISALIGNMENT

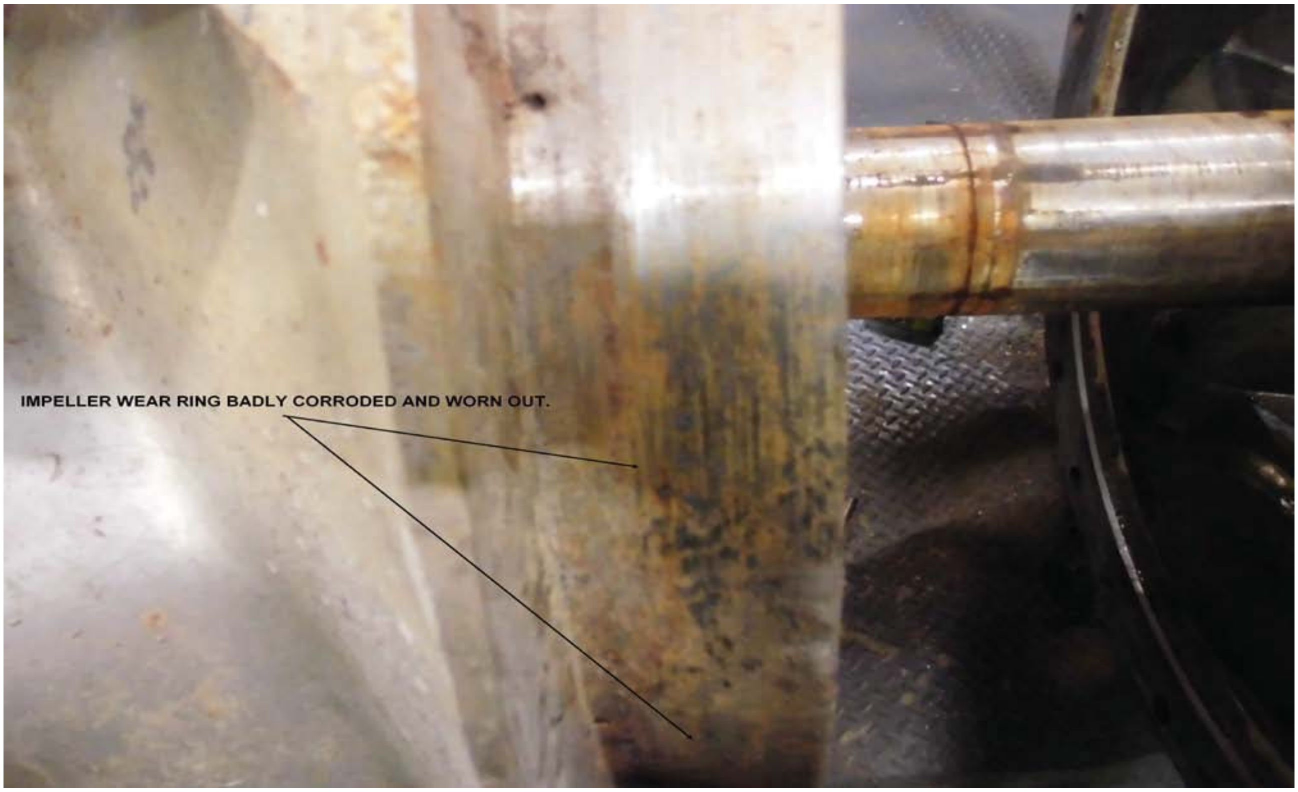

IMPELLER VANE TIPS WORN OUT FROM
COMING IN CONTACT WITH THE SUCTION LINER.

SULZER


GAP BETWEN THE PUMP SHAFT AND INTER BOWL.
BOWL BEARING WORN OUT


INTER BOWL WEAR RING WORN OUT.

SULZER


IMPELLER WEAR RING BADLY CORRODED AND WORN OUT.


INTER BOWL BEARING REMOVED

SULZER

CI Number: 47506

Title: LIN CW Screen Refurbishment 2016

Start Date:	2016/03
In-Service Date:	2016/07
Final Cost Date:	2017/01
Function:	Steam
Forecast Amount:	$349,743

DESCRIPTION:

There are eight travelling screens (two per unit) at the Lingan Generating Station. The self-cleaning screens remove debris from the incoming seawater before it enters the cooling water (CW) pump and downstream cooling systems including unit condensers.

The travelling screen assemblies consist of bottom, top and intermediate sections. The bottom section includes the tail sprocket assembly and support structure. The top section is comprised of the drive sprocket assembly and the support structure. The intermediate section spans vertically between the bottom and top sections, and supports the entire structure. The bottom and intermediate sections are submerged in salt seawater, and the upper sections are wetted components, and in a salt spray environment.

Seasonally, during periods of low seaweed loading in the cooling water intake, screens can be taken out of service with no impact to production, and refurbished. Screens are selected for refurbishment based on performance, condition and operational strategy for the unit.

Each Generating Unit is equipped with two CW travelling screens. Current expectation is that this project will not include the refurbishment of the screens on Unit #2 However, if screens on Unit #2 were found to require refurbishment in 2016, investment on Unit #2 could still be the best option. All four units at Lingan are similar and as such, the components refurbished/replaced on the CW travelling screens can be transferred to any of the other Lingan CW travelling screens when Lingan Unit #2 is retired. The useful life of these CW travelling screens will extend beyond the payback period shown in the EAM, providing a significant benefit to all of the CW travelling screens at Lingan.

Summary of Related CIs +/- 2 years:
2014 CI 44352 LIN CW Travelling Screen Refurbish $255,007
2015 CI 46057 LIN CW Screen Refurbishment $292,634
2017 CI TBD LIN CW Screen Refurbishment $TBD
2018 CI TBD LIN CW Screen Refurbishment $TBD

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Replacement/Refurbishment

Why do this project?

Eel grass passing through degraded or non-functioning travelling screen panels results in downstream fouling of strainers at CW and Auxiliary CW locations and increases the risk of unit de-rating or outages due to inadequate cooling capacity, particularly during the late summer and fall. The degree of eel grass fouling also results in high mechanical loading on the screens and drive systems and on the circulating water pumps. This high loading causes component failure at the screens and CW pumps and increases the risk of unit de-rating or forced outages due to insufficient cooling water flow.

Why do this project now?

The screens have degraded over time due to wear and corrosion and are in need of refurbishment. Completing this project will reduce existing issues with the circulating water system during periods of heavy seaweed and debris. This will reduce the risk of unit de-ratings and subsequent associated replacement energy costs.

Why do this project this way?

The screens operate in an aggressive seawater environment and have experienced related corrosion and wear. The most cost effective solution is to replace the corroded and worn components as opposed to replacing the complete screen assembly. Primary components to be refurbished include the top drives (sprocket refurbishment, bearing replacement, shaft refurbishment, top boot replacement with stainless steel material), Intermediate Section (guides, supports and screen panels replacement) and Lower Section (sprocket refurbishment, bearing replacement, shaft refurbishment, bottom boot replacement with stainless steel material).

CI Number : 47506 - LIN CW Screen Refurbishment 2016 **Project Number**

Parent CI Number : -

Cost Centre : 301 - 301-Lingan Admin./Common Capital **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		1,750	0	1,750
095		095-Thermal & Hydro Contracts AO		2,042	0	2,042
095		095-Thermal Regular Labour AO		19,596	0	19,596
095		095-Thermal Term Labour AO		11,744	0	11,744
001	014	001 - THERMAL Regular Labour	014 - SGP - Circ.Water Sys.	96,675	0	96,675
004	014	004 - THERMAL Term Labour	014 - SGP - Circ.Water Sys.	57,937	0	57,937
012	014	012 - Materials	014 - SGP - Circ.Water Sys.	140,000	0	140,000
013	014	013 - POWER PRODUCTION Contracts	014 - SGP - Circ.Water Sys.	20,000	0	20,000
			Total Cost:	349,743	0	349,743
			Original Cost:	216,342		

Capital Project Detailed Estimate

Location: Lingan Generating Station
CI# / FP#: 47506
Title: LIN CW Screen Refurbishment 2016
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	8	$ 358	$ 2,810		
Maintenance Trades	PD	241	$ 365	$ 87,978		
Utilityworker	PD	25	$ 240	$ 5,887		
			Sub-Total	$ 96,675		46057
004 Term Labour						
Maintenance Trades	PD	159	$ 365	$ 57,937		
				$ -		
				$ -		
			Sub-Total	$ 57,937		
012 Materials						
Top boot screen components	Lot	2	$ 21,000	$ 42,000		
Screen Section Panels -stainless	Lot	2	$ 30,000	$ 60,000		
Bottom Boot screen components	Lot	2	$ 19,000	$ 38,000		
			Sub-Total	$ 140,000		46057
013 Contracts						
Machining	Lot	2	$ 10,000	$ 20,000		
			Sub-Total	$ 20,000		
094 Interest Capitalized						
AFUDC				$ 1,750		
				$ -		
			Sub-Total	$ 1,750		
095 Administrative Overhead						
Thermal Reg. Labour AO				$ 19,596		
Thermal Term Labour AO				$ 11,744		
Thermal / Hydro Contracts AO				$ 2,042		
			Sub-Total	$ 33,382		
			SUB-TOTAL (no AO, AFUDC)	$ 314,611		
			TOTAL (AO, AFUDC included)	$ 349,743		
Original Cost				$ 216,342		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

LIN CW Screen Refurbishment 2016
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :	Power Production		**Date :**	**30-Oct-15**
Department :	Lingan Generating Station		**CI Number:**	47506
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Refurbish Screens vs. Replacement En	6.11%	-590,866	419,805	1	37.19%	3.6 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

The plant recommends completing this project to maintain cw screen reliability.

Notes/Comments :

Refurbish Screens vs. Replacement Energy & Repair Costs

It is assumed if a CW screen fails it can repaired to allow it to operate. If the screen is taken out of service it is assumed that one CW pump may have to come out of service and it is estimated it may cause generation reduction of 20 MW until a repair is made to return the screen to service.

Test 2

Test 3

Test 4

LIN CW Screen Refurbishment 2016
Summary of Sensitivities

Nova Scotia POWE An Emera Compa

Division :	Power Production	**Date :**	**30-Oct-15**
Department :	Lingan Generating Station	**CI Number:**	47506
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Screens vs. Replacement Energy & Re	6.11%	-590,866	419,805	1	37.19%	3.6 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Screens vs. Replacement Energy & Re	10%	-558,546	395,342	1	32.94%	3.9 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:						
	A	32,320	-24,463	0	-4.25%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	Refurbish Screens vs. Replacement Energy & Re	-10%	-499,459	353,361	1	32.52%	3.9 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:						
	A	91,407	-66,444	0	-4.67%	0.3 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	79,418	145,766	201,013	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

LIN CW Screen Refurbishment 2016
Avoided Cost Calculations

Division :	Power Production	Date :	30-Oct-15
Department :	Lingan Generating Station	CI Number:	47506
Originator :		Project No. :	

Refurbish Screens vs. Replacement Energy & Repair Costs

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			85,160	88,584		
Events/Outages (#)	1	1	1	1		
Probability of Occurance (%)	100%	100%	100%	100%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	20.0	20.0				
Duration (Hours)	504	504				
Totals	$0	$0	$85,160	$88,584	$85,160	$88,584
Total Capital Cost of Alternative						$349,743

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

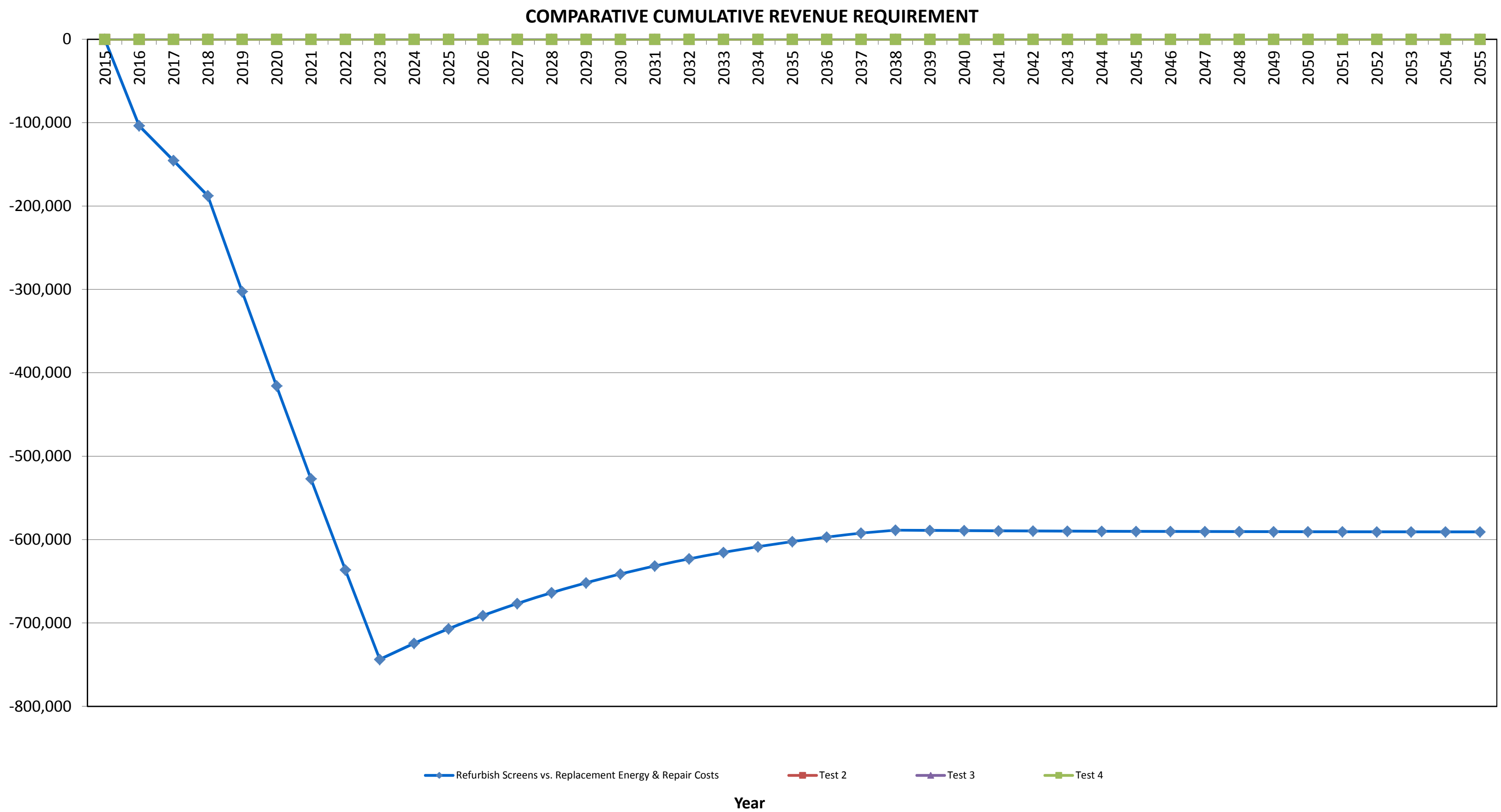
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

LIN CW Screen Refurbishment 2016
Refurbish Screens vs. Replacement Energy & Repair Costs

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	-	-	-	-	-	-	-	1.00	-
2016	-	-	85,160.0	(316,360.8)	12,584.4	311,239.9	(231,200.8)	(22,498.4)	(253,699.2)	(239,090.8)	0.94	(239,090.8)
2017	-	-	88,584.1	-	24,162.1	285,539.6	88,584.1	(19,970.8)	68,613.3	60,939.0	0.89	(178,151.8)
2018	-	-	92,145.8	-	22,229.2	261,895.2	92,145.8	(21,674.2)	70,471.6	58,985.5	0.84	(119,166.2)
2019	-	-	191,701.5	-	20,450.8	240,142.5	191,701.5	(53,087.7)	138,613.8	109,340.5	0.79	(9,825.7)
2020	-	-	199,409.4	-	18,814.8	220,129.9	199,409.4	(55,984.3)	143,425.0	106,621.2	0.74	96,795.5
2021	-	-	207,427.1	-	17,309.6	201,718.3	207,427.1	(58,936.4)	148,490.7	104,030.7	0.70	200,826.1
2022	-	-	215,767.3	-	15,924.8	184,779.7	215,767.3	(61,951.2)	153,816.1	101,556.5	0.66	302,382.6
2023	-	-	224,442.8	-	14,650.8	169,196.2	224,442.8	(65,035.5)	159,407.3	99,187.6	0.62	401,570.2
2024	-	-	-	-	13,478.8	154,859.3	-	4,178.4	4,178.4	2,450.2	0.59	404,020.5
2025	-	-	-	-	12,400.5	141,669.4	-	3,844.1	3,844.1	2,124.4	0.55	406,144.9
2026	-	-	-	-	11,408.4	129,534.7	-	3,536.6	3,536.6	1,841.9	0.52	407,986.8
2027	-	-	-	-	10,495.7	118,370.8	-	3,253.7	3,253.7	1,597.0	0.49	409,583.8
2028	-	-	-	-	9,656.1	108,099.9	-	2,993.4	2,993.4	1,384.6	0.46	410,968.4
2029	-	-	-	-	8,883.6	98,650.8	-	2,753.9	2,753.9	1,200.5	0.44	412,168.9
2030	-	-	-	-	8,172.9	89,957.6	-	2,533.6	2,533.6	1,040.9	0.41	413,209.7
2031	-	-	-	-	7,519.1	81,959.8	-	2,330.9	2,330.9	902.5	0.39	414,112.2
2032	-	-	-	-	6,917.6	74,601.8	-	2,144.4	2,144.4	782.5	0.36	414,894.6
2033	-	-	-	-	6,364.1	67,832.5	-	1,972.9	1,972.9	678.4	0.34	415,573.0
2034	-	-	-	-	5,855.0	61,604.8	-	1,815.1	1,815.1	588.2	0.32	416,161.2
2035	-	-	-	-	5,386.6	55,875.2	-	1,669.9	1,669.9	510.0	0.31	416,671.2
2036	-	-	-	-	4,955.7	50,604.0	-	1,536.3	1,536.3	442.2	0.29	417,113.4
2037	-	-	-	-	4,559.2	45,754.6	-	1,413.4	1,413.4	383.4	0.27	417,496.7
2038	-	-	-	-	4,194.5	41,293.0	-	1,300.3	1,300.3	332.4	0.26	417,829.1
2039	-	-	-	-	3,858.9	37,188.4	-	1,196.3	1,196.3	288.2	0.24	418,117.3
2040	-	-	-	-	3,550.2	33,412.2	-	1,100.6	1,100.6	249.9	0.23	418,367.2
2041	-	-	-	-	3,266.2	29,938.0	-	1,012.5	1,012.5	216.6	0.21	418,583.8
2042	-	-	-	-	3,004.9	26,741.8	-	931.5	931.5	187.8	0.20	418,771.7
2043	-	-	-	-	2,764.5	23,801.3	-	857.0	857.0	162.9	0.19	418,934.5
2044	-	-	-	-	2,543.4	21,096.1	-	788.4	788.4	141.2	0.18	419,075.7
2045	-	-	-	-	2,339.9	18,607.2	-	725.4	725.4	122.4	0.17	419,198.1
2046	-	-	-	-	2,152.7	16,317.5	-	667.3	667.3	106.1	0.16	419,304.3
2047	-	-	-	-	1,980.5	14,210.9	-	613.9	613.9	92.0	0.15	419,396.3
2048	-	-	-	-	1,822.0	12,272.9	-	564.8	564.8	79.8	0.14	419,476.1
2049	-	-	-	-	1,676.3	10,489.9	-	519.6	519.6	69.2	0.13	419,545.3
2050	-	-	-	-	1,542.2	8,849.5	-	478.1	478.1	60.0	0.13	419,605.3
2051	-	-	-	-	1,418.8	7,340.4	-	439.8	439.8	52.0	0.12	419,657.3
2052	-	-	-	-	1,305.3	5,952.0	-	404.6	404.6	45.1	0.11	419,702.4
2053	-	-	-	-	1,200.9	4,674.7	-	372.3	372.3	39.1	0.11	419,741.5
2054	-	-	-	-	1,104.8	3,499.5	-	342.5	342.5	33.9	0.10	419,775.4
2055	-	-	-	-	1,016.4	2,418.4	-	315.1	315.1	29.4	0.09	419,804.8
Total	**-**	**-**	**1,304,637.9**	**(316,360.8)**	**302,922.2**		**988,277.1**	**(310,531.9)**	**677,745.2**	**419,804.8**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
0
-100,000
-200,000
-300,000
-400,000
-500,000
-600,000
-700,000
-800,000
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055
Refurbish Screens vs. Replacement Energy & Repair Costs
Test 2
Test 3
Test 4
Year

Transmission

Transmission

The Transmission capital investment included in this plan is focused on system reliability through sustaining capital programs and the integration of the Maritime Link. These investments can be categorized into five categories: Sustaining, Customer Driven, Compliance, Metro Transmission Upgrades and Maritime Link.

Category	2016 ACE Plan ($M)
Sustaining	38.6
Customer Driven	5.8
Compliance	6.2
Metro Transmission Upgrades	4.7
Maritime Link Trans. Investment	0.8
Total Capital Program	**$56.1**

Sustaining

Sustaining capital investment projects target asset replacement and refurbishment identified through NS Power's transmission line and substation inspection program. These investments are based on health and criticality assessments of the assets, and include the replacement of transmission line and substation assets, transmission right of way widening, critical spares and protection modifications and replacements. The asset replacements are described further in Section 8.1.7 Impact of Reliability Projects.

Transmission line investments are determined based on the results of the transmission line inspection program, historical reliability performance of the line and assessment of the criticality of the line. Inspection results are utilized to perform health assessments on the transmission structures. Transmission line investments are prioritized based on the transmission lines criticality and health assessment.

Customer Driven

Customer driven investments on the transmission system are determined based on load growth and have been identified through transmission system planning studies. This investment is required to serve our customers.

Compliance

Compliance investments in 2015 are required to comply with NPCC standards surrounding bulk power system (BPS) and environmental regulations. Investments in BPS upgrades have been ongoing for three years and will be completed by the end of 2018. Planned replacement of equipment containing PCBs in substations is required to meet federal environmental regulations surrounding the removal of PCB from electrical equipment by 2025.

CI Number: 46591

Title: 88S Lingan Replace 230kV GIS

Start Date: 2014/11
In-Service Date: 2018/11
Final Cost Date: 2019/05
Function: Transmission
Forecast Amount: $14,249,882

DESCRIPTION:

This project includes the replacement of Lingan Westinghouse Gas Insulated Switchgear (GIS) equipment in order to mitigate the risk of a failure, reduce required maintenance manpower, eliminate SF6 gas losses, and improve equipment reliability.

The project scope includes:

- Retirement of Westinghouse GIS equipment
- Addition of a new air insulated breaker and a half scheme with five breakers (and provision for a sixth)
- Retirement of Westinghouse Gas Insulator Bus
- Addition of new HV cable to connect new air insulated nodes with the existing equipment
- Retirement of existing associated protection panels
- Addition of new protection panels with electronic relaying
- Addition of a new control building
- Addition of new cable trench/conduit
- Installation/termination of new cabling for 88S panels, breakers and instrumentation
- Commissioning of new and modified equipment

The GIS replacement project will be done concurrently with CI 46757 882 Lingan 230kV BPS Upgrades project.

Summary of Related CIs +/- 2 years:
2015 CI 46757 882 Lingan 230kV BPS Upgrade $3,236,969

Depreciation Class: Transmission Equipment - Substation

Estimated Life of the Asset: 20 Years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

The project will replace obsolete GIS switchgear and bus from Westinghouse which has become a maintenance issue and poses an operation risk.

The Westinghouse switchgear at 88S-Lingan is critical to the operation of the generation plant, as without this equipment, Lingan Units 1 & 2 cannot deliver the energy produced at the plant. Due to the age of the equipment, it is no longer supported by the manufacturer and replacement parts are not available. The Westinghouse GIS switchgear presently experiences leaks of the SF6 insulating gas and corrosion issues. SF6 is a greenhouse gas and NS Power must track and report leakage to provincial regulators.

Why do this project now?

The Westinghouse GIS switchgear and GIS bus are original to Lingan Unit 1 & 2 and are no longer supported by the manufacturer and parts are not available. To minimize the impact of future issues the equipment must be replaced. The replacement of the equipment requires significant engineering design and equipment delivery lead time therefore the project must begin to minimize the impact of future failures.

Why do this project this way?

Multiple equipment replacement options were studied and reviewed with the decision taken to replace the Westinghouse GIS equipment with open air insulated equipment and HV cable. This solution is the most economic and allows for the equipment to be easily repurposed if it is no longer needed at Lingan, avoiding the possibility of a stranded investment.

The options considered for this project include:

- Replace existing Westinghouse GIS with four new GIS Breakers: This option is approximately $3 million more expensive.

- Replace all existing Westinghouse GIS with nine new GIS Breakers: This option is approximately $8 million more expensive.

- Install new Air Insulated Open Air substation with nine SF6 dead tank (open air) breakers: This option is approximately $3 million more expensive.

- Install new Air Insulated Open Air substation with four SF6 dead tank (open air) breakers: This is the option selected.

- Modifications to substations 2S and 88S with eight SF6 dead tank (open air) breakers: This option is approximately $3 million more expensive.

- The addition of new Hybrid Breakers was evaluated, and eliminated as a feasible option due to higher equipment costs for the breakers, approximately $1 million more expensive per breaker.

While all of these options meet the requirements of this project, the selected option (four SF6 open air breakers) is the least costly option while still meeting all technical requirements of this project.

CI Number : 46591-T828 - 88S Lingan Replace 230kV GIS **Project Number** T828

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		306,277	0	306,277
094		094 - Interest Capitalized		939,307	0	939,307
095		095-COPS Contracts AO		642,643	0	642,643
095		095 - Proj Supp Regular Labour AO		17,508	0	17,508
095		095-COPS Regular Labour AO		454,194	0	454,194
001	003	001 - T&D Regular Labour	003 - TP - Bldg.,Struct.Grnd.	12,132	0	12,132
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	557,000	0	557,000
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	1,724,990	0	1,724,990
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	24,793	0	24,793
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	641,827	0	641,827
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	152,064	0	152,064
012	023	012 - Materials	023 - TP - Power Equip.-Station S	77,960	0	77,960
013	023	013 - COPS Contracts	023 - TP - Power Equip.-Station S	30,400	0	30,400
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	4,206	0	4,206
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	10,848	0	10,848
011	043	011 - Travel Expense	043 - TP - Substn Dev.	1,400	0	1,400
012	043	012 - Materials	043 - TP - Substn Dev.	1,992,681	0	1,992,681
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	126,920	0	126,920
033	043	033 - Rental and Maintenance of	043 - TP - Substn Dev.	11,000	0	11,000
041	043	041 - Meals & Entertainment	043 - TP - Substn Dev.	692	0	692
012	045	012 - Materials	045 - TP - U/G Conduit	1,500	0	1,500
013	045	013 - COPS Contracts	045 - TP - U/G Conduit	11,600	0	11,600
012	046	012 - Materials	046 - TP - U/G Conductor	3,097,400	0	3,097,400
013	046	013 - COPS Contracts	046 - TP - U/G Conductor	836,580	0	836,580
033	046	033 - Rental and Maintenance of	046 - TP - U/G Conductor	5,000	0	5,000
001	085	001 - Regular Labour (No AO)	085 Design	308	0	308
001	085	001 - Proj Supp Regular Labour	085 Design	29,475	0	29,475
001	085	001 - T&D Regular Labour	085 Design	395,138	0	395,138
011	085	011 - Travel Expense	085 Design	47,600	0	47,600
013	085	013 - COPS Contracts	085 Design	20,917	0	20,917
028	085	028 - Consulting	085 Design	534,574	0	534,574
041	085	041 - Meals & Entertainment	085 Design	308	0	308
066	085	066 - Other Goods & Services	085 Design	1,080,905	0	1,080,905
001	086	001 - T&D Regular Labour	086 Commissioning	200,412	0	200,412

CI Number : 46591-T828 - 88S Lingan Replace 230kV GIS **Project Number** T828

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
013	086	013 - COPS Contracts	086 Commissioning	63,840	0	63,840
013	087	013 - COPS Contracts	087 Field Super.& Ops.	190,485	0	190,485
013	088	013 - COPS Contracts	088 Survey/Mapping	5,000	0	5,000
			Total Cost:	14,249,882	0	14,249,882
			Original Cost:	724,751		

Capital Project Detailed Estimate

Location: Transmission
CI# : 46591
Title: 88S Lingan Replace 230kV GIS
Execution Year: 2016-2018

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	635	$ 358.28	$ 227,598		
Engineering	PD	1048	$ 405.31	$ 424,920		
Technologists	PD	75	$ 332.09	$ 24,793		
			Sub-Total	$ 677,311		
011 Travel Expense						
Travel during Design / Construction	Lot	1	$ 49,000	$ 49,000		
			Sub-Total	$ 49,000		
012 Materials						
Structural Steel (230kv High Sw support, erected)	ea	17	$ 13,000	$ 221,000		
Structural Steel (230kv 3 Phase Low Bus Support)	ea	24	$ 13,000	$ 312,000		
Structural Steel (230 kv 1 Phase PT/CT Support)	ea	12	$ 2,000	$ 24,000		
Control Cables (shielded)	m	5000	$ 20	$ 100,000		
Misc conduit, connectors, jumpers, jboxes	lot	1	$ 42,000	$ 42,000		
Electrical Control Equipment - Panels & Mods	ea	12	$ 40,819	$ 489,827		
Power Equipment - Battery & Charger	ea	2	$ 28,000	$ 56,000		
Power Equipment - DC Dist Panel Sys	ea	2	$ 10,980	$ 21,960		
Circuit Breaker	ea	5	$ 200,000	$ 1,000,000		
230 KV Switch, Ground & Motor (w/o insulators)	ea	18	$ 30,000	$ 540,000		
Insulators	ea	174	$ 1,200	$ 208,800		
Surge Arrestors	ea	21	$ 5,000	$ 105,000		
230 kv Post CT	ea	7	$ 8,000	$ 56,000		
Connectors, Pipe, Jumper Wire, Welding, Grounding Switch Mats	lot	1	$ 82,881	$ 82,881		
Underground Conduit	m	100	$ 15	$ 1,500		
SF6 Cable Cans for GIB	ea	2	[redacted]	[redacted]	Cost Support Item #1 - Item 3	
USD to CDN Exchange	%	33%	[redacted]	[redacted]		
CF6 Cable Cans for Transformer Bushings	ea	4	[redacted]	[redacted]	Cost Support Item #1 - Item 2	
USD to CDN Exchange	%	33%	[redacted]	[redacted]		
230 kV Terminators - Air Insulated & Plug	ea	42	$ 17,143	$ 720,000		
230 kV Cable Circuit	m	1600	$ 525	$ 840,000		
230 kV Cable Towers & Conduit	ea	12	$ 6,200	$ 74,400		
Retire Electrical Control Equipment	lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 6,368,368		
013 Contracts						
003 Site Prep	m2	4500	$ 6	$ 24,750		
Control Building including foundation/package/fencing	ea	1	$ 240,840	$ 240,840		
Grounding - Well Casings	ea	3	$ 25,000	$ 75,000		
Overhead Crane - Structural Steel Install	lot	1	$ 50,000	$ 50,000		
Cable Trenching & Conduit	m	1614	$ 699	$ 1,128,200		
Concrete Foundations (49 structures)	lot	1	$ 206,200	$ 206,200		
Contract Labour - Control Cable Install and Terminations	lot	1	$ 152,064	$ 152,064		
Contract Labour - Station Services Install	hr	[redacted]	[redacted]	$ 30,400		
Install Switches / Breakers / Buswork	hr	[redacted]	[redacted]	$ 109,440		
Underground Conduit - Trenching and Backfill	hr	240	$ 48	$ 11,600		
Underground Conductors - Install Including Travel and Expense	hr	3528	$ 237	$ 836,580		
Commissioning - Breakers & Switches	hr	[redacted]	[redacted]	$ 63,840		
Survey and Mapping	lot	1	$ 5,000	$ 5,000		
Site supervision (Civil and Electrical Including Travel and Expenses)	hr	2160	$ 88	$ 190,485		
Retire Substation Devices	Lot	1	$ 17,480	$ 17,480		
Misc Contracts	Lot	1	$ 20,917	$ 20,917		
			Sub-Total	$ 3,162,796		
028 Consulting						
Design - Gas Insulated Bus for Transformers	lot	1	[redacted]	[redacted]	Cost Support Item #1 - Item 1	
USD to CDN Exchange	%	33%	[redacted]	[redacted]		
Design - Substation and Control	hr	2900	[redacted]	[redacted]		
			Sub-Total	$ 534,574		
033 Rentals						
Crane Rental	Lot	1	$ 16,000	$ 16,000		
			Sub-Total	$ 16,000		
041 Meals & Entertainment						
Meals During Travel	Lot	1	$ 1,000	$ 1,000		
			Sub-Total	$ 1,000		
066 Other Goods & Services						
Contingency	%	10%	$ 10,809,049	$ 1,080,905		
			Sub-Total	$ 1,080,905		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 306,277		
			Sub-Total	$ 306,277		
094 Interest Capitalized						
AFUDC				$ 939,307		
			Sub-Total	$ 939,307		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 454,194		
COPS Contract AO				$ 642,643		
Project Support Regular AO				$ 17,508		
			Sub-Total	$ 1,114,345		
			SUB-TOTAL (no AO, AFUDC)	$ 11,889,954		
			TOTAL (AO, AFUDC included)	$ 14,249,882		
Original Cost				$ 724,751		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

BEATON, TREVOR

From:	HILLIER, ROD
Sent:	Wednesday, October 07, 2015 8:56 AM
To:	BEATON, TREVOR
Subject:	FW: NSPI T828 - Generator Transformers and GIB Details
Attachments:	9927D62-Sheet 1.pdf

FYI

From: Jonathan Flood [mailto:JonathanFlood@AZZ.com]
Sent: September-17-15 2:27 PM
To: HILLIER, ROD
Cc: Jim Walsh (jwalsh@ctsales.ca); T828_Lingan88S; JOHNSON, BOB; Edwin Vasan; Sean Noel; Robert Finch; Michael Mercier; Patrick Fitzgerald; Jonathan Flood
Subject: RE: NSPI T828 - Generator Transformers and GIB Details

Hello Rod,

Please see the drawing attached which is the drawing associated with the photo I sent yesterday. I have used this basic design to estimate the Transformer to cable supplies. The GIS would be similar but instead of the transformer bushing tank we would have a simpler tank connecting our GIB to the Toshiba GIS. I know you are in a hurry for the budgetary pricing so I will present it in email format. The supply at all locations includes a simple junction box for landing the Gas density monitors in from here the signals coulkd be wired into your control room or a new local contral cabinet for this supply only. The pricing below does not include the LCC supply. Scope of supply and pricing as follows:

Item	Qty	Description	Unit Price (USD)	Total Price (USD)
1	1	Engineering, Design, and Project Management. Both supply options	[redacted]	[redacted]
2	4	Transformer to XLPE Cable connection GIB (rated for 230kV 2000A	[redacted]	[redacted]
3	2	Existing Toshiba GIS to XLPE Cable GIB	[redacted]	[redacted]
			Total	[redacted]

Let me know if you have any questions or require a more formalized quote. I would appreciate if you could provide some estimates on when this project is being budgeted for and anticipated award and completion dates.

Best regards,

Jonathan

Jonathan Flood
Sales Manager
High Voltage Bus Systems Division
Office: +1.774.854.0686
Cell: +1.508.331.7157
azz.com

CI Number: 48066

Title: 2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program

Start Date: 2016/01
In-Service Date: 2016/01
Final Cost Date: 2017/12
Function Class: Transmission
Forecast Amount: $3,500,427

DESCRIPTION:

This project provides for the costs associated with the polychlorinated biphenyl (PCB) sampling of all substation oil-filled equipment and the removal of substation devices with 50 mg/kg or more of PCBs, to be in compliance with 2008 Federal Environmental PCB Regulations. The 2016 Program will also include replacement of equipment where sampling was not feasible. The 2008 Federal Environmental PCB Regulations were amended on January 1, 2015 to extend the deadline from 2015 to 2025 to replace PCB contaminated equipment. NS Power was notified of this amendment in April 2014.

To date, our focus on the PCB Removal - Substation projects has been primarily on sampling and replacing equipment with very high concentrations of PCBs. NS Power is now moving into replacement of substation equipment with lower concentrations of PCBs and equipment that cannot be sampled. There are approximately 100 breakers identified for replacement that need to be off the system by 2025. To complete this work by 2025 the amount of equipment being replaced needs to increase. In 2015, five breakers are scheduled to be replaced, increasing to twelve breakers in 2016.

Summary of Related CIs +/- 2 years:
2014 CI 44974 2014 PCB Equipment Removals $1,172,392
2015 CI 46586 2015 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program $1,236,351
2017/2018 CI TBD 2017/2018 PCB Removal – Substation $TBD
2018/2019 CI TBD 2018/2019 PCB Removal – Substation $TBD

Depreciation Class: Transmission Plant

Estimate Useful Life: 40 Years

JUSTIFICATION:

Justification Criteria: Environment

Sub Criteria: Environmental Agreement, Guidelines, International Standards and Voluntary Action Criteria

Why do this project?

This project is required to ensure NS Power is compliant with the revised 2008 Federal PCB Regulations, which set specific deadlines for ending the use of all equipment containing PCBs in concentrations at or above 50 mg/kg.

Why do this project now?

This project needs to be completed now to ensure replacement of all applicable substation contaminated equipment containing PCBs can be completed before the 2025 deadline.

Why do this project this way?

The sampling and replacement of equipment containing greater than 50 mg/kg concentration of PCBs must be planned over a period of several years to ensure outages are effectively managed and the Regulations are met.

CI Number : 48066 - 2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		63,544	0	63,544
095		095 - Proj Supp Regular Labour AO		94,026	0	94,026
095		095-COPS Contracts AO		223,565	0	223,565
095		095-COPS Regular Labour AO		94,144	0	94,144
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	840	0	840
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	69,430	0	69,430
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	9,000	0	9,000
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	105,272	0	105,272
012	043	012 - Materials	043 - TP - Substn Dev.	1,154,974	0	1,154,974
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	804,000	0	804,000
001	044	001 - T&D Regular Labour	044 - TP - Substn.Transf.	29,411	0	29,411
012	044	012 - Materials	044 - TP - Substn.Transf.	180,000	0	180,000
013	044	013 - COPS Contracts	044 - TP - Substn.Transf.	228,960	0	228,960
001	085	001 - Regular Labour (No AO)	085 Design	13,448	0	13,448
001	085	001 - Proj Supp Regular Labour	085 Design	154,800	0	154,800
066	085	066 - Other Goods & Services	085 Design	275,014	0	275,014
			Total Cost:	3,500,427	0	3,500,427
			Original Cost:	438,716		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48066
Title: 2016/2017 Substation Polychlorinated Biphenyl (PCB) Equipment Removal Program
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	381	$ 354	$ 134,684		
Procurement / Financial Support	Lot	1	$ 13,448	$ 13,448		
Project Support AO - Engineering Design	PD	400	$ 387	$ 154,800		
			Sub-Total	$ 302,932		
012 Materials						
Ground Connectors	ea	24	$ 35.00	$ 840		
Control Cables	m	200	$ 20.00	$ 4,000		
Junction Box	ea	5	$ 1,000.00	$ 5,000		
138 kV Circuit Breaker	ea	5	$ 98,630.00	$ 493,150		
138 kV Post PT	ea	9	$ 10,000.00	$ 90,000		
69 kV Circuit Breaker	ea	7	$ 71,232.00	$ 498,624		
69 kV Post PT	ea	9	$ 8,000.00	$ 72,000		
Grounding Equipment	ea	24	$ 50.00	$ 1,200		
HV Bushings	ea	12	$ 10,000.00	$ 120,000		
LV Bushings	ea	12	$ 5,000.00	$ 60,000		
			Sub-Total	$ 1,344,814		
013 Contracts						
Installation of Foundations (138kV)	ea	5	$ 5,300.00	$ 26,500		
Installation of Foundations (69 kV)	ea	7	$ 4,600.00	$ 32,200		
Conduit Installation	Lot	1	$ 10,730.00	$ 10,730		
Crane Services	Lot	1	$ 18,000.00	$ 18,000		
Mobile Transport	Lot	1	$ 6,000.00	$ 6,000		
Transformer Assembly	Lot	1	$ 36,960.00	$ 36,960		
Oil Processing	Lot	1	$ 192,000.00	$ 192,000		
Breaker installation external Contractor	EA	12	$ 65,000.00	$ 780,000		
			Sub-Total	$ 1,102,390		
066 Other Goods & Services						
Contingency	%	10%	$ 2,750,135.50	$ 275,014		
			Sub-Total	$ 275,014		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 63,544		
			Sub-Total	$ 63,544		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 94,144		
COPS Contract AO				$ 223,565		
Project Support Regular AO				$ 94,026		
			Sub-Total	$ 411,734		
			SUB-TOTAL (no AO, AFUDC)	$ 3,025,149		
			TOTAL (AO, AFUDC included)	$ 3,500,427		
Original Cost				$ 438,716		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 46587

Title: Metro Voltage Support - Add Capacitor Bank

Start Date:	2015/06
In-Service Date:	2016/12
Final Cost Date:	2017/06
Function:	Transmission
Forecast Amount:	$3,373,511

DESCRIPTION:

This work order provides the cost for design, supply, and installation of 50 MVAR capacitor banks, complete with breaker and associated protection, on the 138 kV busses at Sackville (90H) and Lakeside (103H) substations.

The purpose of this project is to increase the transfer limit on the Onslow South transmission corridor into the metro Halifax load centre. It will allow oil and natural gas fired generation in Halifax to be incrementally displaced by more economic power from coal plants in Eastern Nova Scotia or from New Brunswick imports.

This is the first phase of investment to address transmission system restrictions that limit the uneconomic dispatch of Tuft's Cove generation. Five additional capital items, listed in Summary of Related CIs, will be submitted in 2016.

Summary of Related CIs +/- 2 years:
2016 CI 48025 L7018 Upgrade to 345kV & Capacitor $21,505,112
2016 CI 48022 Spider Lake Substation Addition $6,354,458
2016 CI 48024 90H - Sackville: Capacitor Bank Addition & L-6010/L6005 Breaker Upgrades $3,857,964
2016 CI 48023 103H - Lakeside: Capacitor Bank Additions & L-6003 Breaker Upgrades $3,236,286
2016 CI 48026 L-6033/L6035 CT Ratio Changes at 1H - Water St. $50,516

Depreciation Class: Transmission Equipment - Substation

Estimated Life of the Asset: 40 Years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

Tuft's Cove generation in the metro Halifax area supplies reactive power to support steady state voltages during the combination of high transfer levels on the Onslow South transmission corridor and high system load (greater than 1600 MW). This isn't a concern when the Tuft's Cove fuel (gas or oil) is comparable to other fuel sources in the system, as these units would be dispatched economically. However, Tuft's Cove is occasionally required to be dispatched in order to provide reactive power capability in the metro Halifax area. Some of the reactive power is used for steady state voltage support while the rest is counted towards the reactive reserve which is needed for dynamic voltage support (required in the event of a transmission line trip). In this scenario, when gas or oil prices are higher than other fuel sources in the system, the cost of running Tufts Cove is uneconomic.

By installing capacitor banks, reactive power requirements to support steady state voltage from Tuft's Cove generators can be reduced. Additional static reactive power sources will release dynamic reactive power from generators and the Brushy Hill SVC. This additional reactive power can be counted towards reactive power reserve needed during contingency. In this way, higher Onslow South transfer can be achieved with reduced Tuft's Cove Generation. Another benefit of using capacitor banks over synchronous condensers is that capacitors banks have much lower real power losses.

Why do this project now?

System study has shown that, 100 MVAR of reactive power located on the power system south of Onslow substation increases the Onslow South corridor transfer capability by 70-90 MW. A study using the system planning simulation model Plexos has concluded that a reduction in must-run Halifax based generation improves the economics of system dispatch.

Why do this project this way?

Alternative A "Do Nothing":

This is a status quo option. There is no investment and no benefit. NPV is zero.

Alternative B "Install 50MVAR CAP Banks at both Sackville and Lakeside substations":

This is the economic option – the capital investment avoids incremental uneconomic dispatch fuel costs at Tuft's Cove. Please refer to the corresponding Economic Analysis Model.

Using the Plexos model, the optimum size of capacitor bank that would minimize the fuel cost was found to be 100 MVAR. Upgrading to higher than 100 MVAR will not have further significant fuel savings. NS Power transmission planning engineers consider the maximum size of a single capacitor bank in the metro area to be 50 MVAR for all possible operating conditions. Capacitor banks larger than 50 MVAR would change the system voltage significantly causing adverse impact on voltage sensitive customer equipment. More than two capacitor banks smaller than 50 MVAR each and totaling 100 MVAR would increase the capital investment significantly. Hence, it was decided to install two capacitor banks of size 50 MVAR each.

Five 138 kV substations in the metro were considered. It was found that Sackville and Lakeside substations can each accommodate a 50 MVAR capacitor bank. Physical space was a concern at other substations considered.

CI Number : 46587-T856 - Metro Voltage Support Add Capacitor **Project Number** T856

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		114,767	0	114,767
094		094 - Interest Capitalized		99,521	0	99,521
095		095-COPS Regular Labour AO		171,133	0	171,133
095		095-COPS Contracts AO		182,217	0	182,217
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	127,847	0	127,847
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	382,620	0	382,620
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	22,250	0	22,250
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	124,200	0	124,200
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	48,000	0	48,000
012	023	012 - Materials	023 - TP - Power Equip.-Station S	23,200	0	23,200
013	023	013 - COPS Contracts	023 - TP - Power Equip.-Station S	12,160	0	12,160
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	3,450	0	3,450
012	043	012 - Materials	043 - TP - Substn Dev.	1,060,140	0	1,060,140
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	256,880	0	256,880
033	043	033 - Rental and Maintenance of	043 - TP - Substn Dev.	10,500	0	10,500
001	085	001 - T&D Regular Labour	085 Design	102,137	0	102,137
011	085	011 - Travel Expense	085 Design	1,880	0	1,880
013	085	013 - COPS Contracts	085 Design	92,000	0	92,000
066	085	066 - Other Goods & Services	085 Design	255,079	0	255,079
001	086	001 - T&D Regular Labour	086 Commissioning	111,200	0	111,200
011	087	011 - Travel Expense	087 Field Super.& Ops.	2,800	0	2,800
013	087	013 - COPS Contracts	087 Field Super.& Ops.	83,280	0	83,280
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	12,000	0	12,000
028	088	028 - Consulting	088 Survey/Mapping	74,250	0	74,250
			Total Cost:	3,373,511	0	3,373,511
			Original Cost:			

Capital Project Detailed Estimate

Location: Transmission
CI# : 46587
Title: Metro Voltage Support-Add Capacitor Bank
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Electrician	PD	320	$ 358	$ 114,650		
Engineering & Project Support	PD	252	$ 405	$ 102,137		
Technologists	PD	67	$ 332	$ 22,250		
			Sub-Total	$ 239,037		
011 Travel Expense						
Travel to Site	Lot	1	$ 4,680	$ 4,680		
				$ -		
			Sub-Total	$ 4,680		
012 Materials						
Structural Steel	Lot	1	$ 111,000	$ 111,000		
Grounding Materials	Lot	1	$ 16,847	$ 16,847		
Protection Panels / Control Cables	Lot	1	$ 124,200	$ 124,200		
Distribution Panels	Lot	1	$ 23,200	$ 23,200		
138kV Switches, Insulators, Circuit Breakers & Reactors	Lot	1	$ 640,140	$ 640,140		
Capacitor Banks	Ea	2	$ 210,000	$ 420,000		
			Sub-Total	$ 1,335,387		
013 Contracts						
Concrete Foundations / Conduit / Fencing	Lot	1	$ 382,620	$ 382,620		
Control Cable Installation	Lot	1	$ 48,000	$ 48,000		
Dist. Panel Installation	Lot	1	$ 12,160	$ 12,160		
138kV Equip. Installation	Lot	1	$ 256,880	$ 256,880		
Field Supervision - Electrical	hr	480	$ 76	$ 36,480		
Field Supervision - Civil	hr	520	$ 90	$ 46,800		
Survey and Mapping	Lot	1	$ 4,000	$ 4,000		
Project Management	hr	880	$ 100	$ 88,000		
			Sub-Total	$ 874,940		
028 Consulting						
Engineering Design	Hrs	550	$ 135	$ 74,250		
			Sub-Total	$ 74,250		
033 Rentals						
Boom Truck Rental	Lot	1	$ 10,500	$ 10,500		
			Sub-Total	$ 10,500		
041 Meals & Entertainment						
Meals during Construction	Lot	1	$ 12,000	$ 12,000		
			Sub-Total	$ 12,000		
066 Other Goods & Services						
Contingency	%	10%	$ 2,550,794	$ 255,079		
				$ -		
			Sub-Total	$ 255,079		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 114,767		
Vehicle T&D Labour Overtime AO				$ -		
			Sub-Total	$ 114,767		
094 Interest Capitalized						
				$ 99,521		
				$ -		
			Sub-Total	$ 99,521		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 171,133		
COPS Contract AO				$ 182,217		
Project Support Regular AO				$ -		
			Sub-Total	$ 353,350		
			SUB-TOTAL (no AO, AFUDC)	$ 2,805,874		
			TOTAL (AO, AFUDC included)	$ 3,373,511		
Original Cost				$ 724,751		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Metro Voltage Support - Add Capacitor Banks
Summary of Alternatives

Division :	Transmission Planning	**Date :**	**28-Oct-15**
Department :	T&D Engineering	**CI Number:**	46587
Originator :		**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	100 MVAR Capacitor Bank	6.11%	-25,880,327	19,125,442	1	87.51%	1.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

Recommendation :

Based on the analysis, installing these two capacitor banks is a more economical option due to the avoided fuel costs.

Notes/Comments :

100 MVAR Capacitor Bank

This option compares the proposed option of installing two capacitor banks with a "do nothing" option. The revenue shown represents fuel savings from avoided out-of-merit generation due to system constraints. By removing these constraints, NS Power is able to generate electricity at a less costly generating station. The annual avoided fuel costs are estimated at $3,394,930, which was calculated through NS Power's generation modelling tool, Plexos.

Test 2

Test 3

Test 4

Metro Voltage Support - Add Capacitor Banks
Summary of Sensitivities

Division :	Transmission Planning		**Date :**	**28-Oct-15**
Department :	T&D Engineering		**CI Number:**	46587
Originator :			**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	100 MVAR Capacitor Bank	6.11%	-25,880,327	19,125,442	1	87.51%	1.3 years
B	Test 2	6.11%	0	0	2	#NUM!	0.0 years
C	Test 3	6.11%	0	0	2	#NUM!	0.0 years
D	Test 4	6.11%	0	0	2	#NUM!	0.0 years

	Alternative Variance on Capital Spend	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	100 MVAR Capacitor Bank	10%	-25,613,006	18,900,022	1	79.54%	1.4 years
B	Test 2	10%	0	0	2	#NUM!	0.0 years
C	Test 3	10%	0	0	2	#NUM!	0.0 years
D	Test 4	10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	267,321	-225,420	0	-7.97%	0.1 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

	Alternative Variance on Avoided Expenses	Variance (%)	PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
A	100 MVAR Capacitor Bank	-10%	-25,880,327	19,125,442	1	87.51%	1.3 years
B	Test 2	-10%	0	0	2	#NUM!	0.0 years
C	Test 3	-10%	0	0	2	#NUM!	0.0 years
D	Test 4	-10%	0	0	2	#NUM!	0.0 years

Change:		PV of Revenue Requirement	PV of EVA / NPV	Rank	IRR	Disc Pay
	A	0	0	0	0.00%	0.0 years
	B	0	0	0	#NUM!	0.0 years
	C	0	0	0	#NUM!	0.0 years
	D	0	0	0	#NUM!	0.0 years

Alternative Variance on Avoided Expenses - Change in Revenue Requirement	Yrs Delay:	PV of Revenue Requirement 1	PV of Revenue Requirement 2	PV of Revenue Requirement 3	Delay?
	A	126,635	2,976,906	5,543,463	No
	B	0	0	0	No
	C	0	0	0	No
	D	0	0	0	No

Metro Voltage Support - Add Capacitor Banks
Avoided Cost Calculations

Division :	Transmission Planning	Date :	28-Oct-15
Department :	T&D Engineering	CI Number:	46587
Originator :		Project No. :	

100 MVAR Capacitor Bank

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$3,373,511

Test 2

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 3

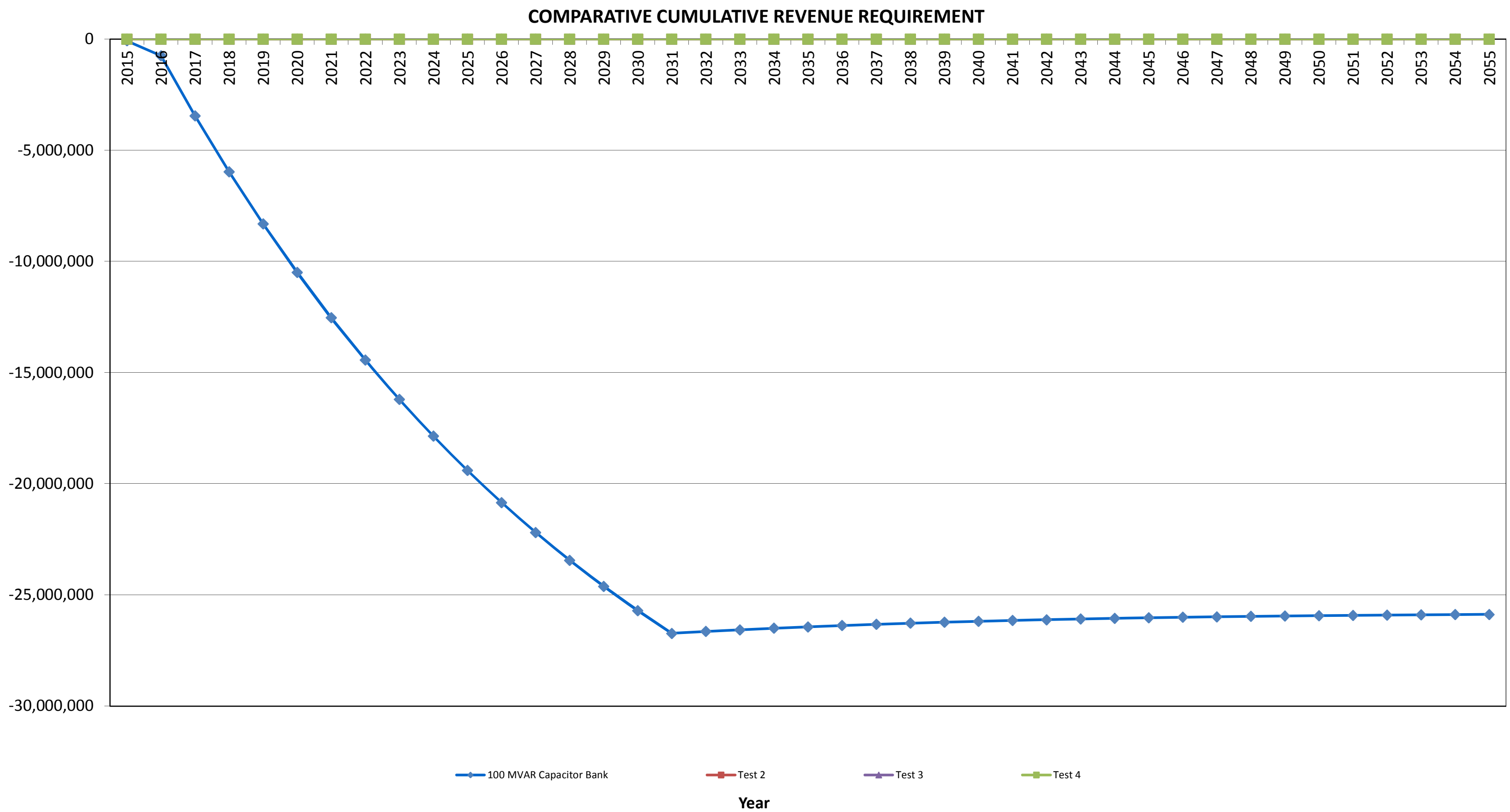
	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Test 4

	Avoided Replacement Energy Costs		Avoided Unplanned Repair Costs		Total Annual Avoided Costs	
Year	2016	2017	2016	2017	2016	2017
Replacement Energy Cost ($/MWh)	[redacted]					
Repair Cost ($)			0	0		
Events/Outages (#)	0	0	0	0		
Probability of Occurance (%)	0%	0%	0%	0%		
Capacity Factor (%)	[redacted]					
Energy Replaced (MW)	0.0	0.0				
Duration (Hours)	0	0				
Totals	$0	$0	$0	$0	$0	$0
Total Capital Cost of Alternative						$0

Metro Voltage Support - Add Capacitor Banks
100 MVAR Capacitor Bank

Year	Total Revenue	Operating Costs	Avoided Expenses	Capital	CCA	UCC	CFBT	Applicable Taxes	CFAT	PV of CF	Discount Factor	CNPV
2015	-	-	-	(102,501.8)	-	-	(102,501.8)	-	(102,501.8)	(102,501.8)	1.00	(102,501.8)
2016	141,455.4	-	-	(2,547,813.2)	102,031.8	2,577,962.9	(2,406,357.8)	(12,221.3)	(2,418,579.2)	(2,279,313.1)	0.94	(2,381,815.0)
2017	3,394,930.0	-	-	(255,079.4)	216,307.4	2,595,164.1	3,139,850.6	(985,373.0)	2,154,477.5	1,913,503.9	0.89	(468,311.1)
2018	3,394,930.0	-	-	-	199,002.8	2,376,316.2	3,394,930.0	(990,737.4)	2,404,192.6	2,012,335.1	0.84	1,544,024.0
2019	3,394,930.0	-	-	-	183,082.6	2,174,976.1	3,394,930.0	(995,672.7)	2,399,257.3	1,892,568.3	0.79	3,436,592.3
2020	3,394,930.0	-	-	-	168,435.9	1,989,743.2	3,394,930.0	(1,000,213.2)	2,394,716.8	1,780,215.6	0.74	5,216,807.9
2021	3,394,930.0	-	-	-	154,961.1	1,819,328.9	3,394,930.0	(1,004,390.4)	2,390,539.6	1,674,781.1	0.70	6,891,589.0
2022	3,394,930.0	-	-	-	142,564.2	1,662,547.8	3,394,930.0	(1,008,233.4)	2,386,696.6	1,575,807.0	0.66	8,467,396.0
2023	3,394,930.0	-	-	-	131,159.1	1,518,309.2	3,394,930.0	(1,011,769.0)	2,383,161.0	1,482,869.3	0.62	9,950,265.3
2024	3,394,930.0	-	-	-	120,666.3	1,385,609.6	3,394,930.0	(1,015,021.7)	2,379,908.3	1,395,575.7	0.59	11,345,840.9
2025	3,394,930.0	-	-	-	111,013.0	1,263,526.1	3,394,930.0	(1,018,014.3)	2,376,915.7	1,313,562.2	0.55	12,659,403.1
2026	3,394,930.0	-	-	-	102,132.0	1,151,209.2	3,394,930.0	(1,020,767.4)	2,374,162.6	1,236,491.1	0.52	13,895,894.2
2027	3,394,930.0	-	-	-	93,961.4	1,047,877.6	3,394,930.0	(1,023,300.3)	2,371,629.7	1,164,048.6	0.49	15,059,942.8
2028	3,394,930.0	-	-	-	86,444.5	952,812.6	3,394,930.0	(1,025,630.5)	2,369,299.5	1,095,942.8	0.46	16,155,885.6
2029	3,394,930.0	-	-	-	79,528.9	865,352.8	3,394,930.0	(1,027,774.3)	2,367,155.7	1,031,901.9	0.44	17,187,787.5
2030	3,394,930.0	-	-	-	73,166.6	784,889.8	3,394,930.0	(1,029,746.6)	2,365,183.4	971,672.9	0.41	18,159,460.4
2031	3,394,930.0	-	-	-	67,313.3	710,863.8	3,394,930.0	(1,031,561.2)	2,363,368.8	915,019.8	0.39	19,074,480.2
2032	-	-	-	-	61,928.2	642,759.9	-	19,197.8	19,197.8	7,004.8	0.36	19,081,484.9
2033	-	-	-	-	56,974.0	580,104.3	-	17,661.9	17,661.9	6,073.3	0.34	19,087,558.2
2034	-	-	-	-	52,416.1	522,461.1	-	16,249.0	16,249.0	5,265.7	0.32	19,092,823.9
2035	-	-	-	-	48,222.8	469,429.4	-	14,949.1	14,949.1	4,565.5	0.31	19,097,389.4
2036	-	-	-	-	44,365.0	420,640.3	-	13,753.1	13,753.1	3,958.4	0.29	19,101,347.8
2037	-	-	-	-	40,815.8	375,754.2	-	12,652.9	12,652.9	3,432.0	0.27	19,104,779.9
2038	-	-	-	-	37,550.5	334,459.1	-	11,640.7	11,640.7	2,975.7	0.26	19,107,755.5
2039	-	-	-	-	34,546.5	296,467.6	-	10,709.4	10,709.4	2,580.0	0.24	19,110,335.5
2040	-	-	-	-	31,782.7	261,515.3	-	9,852.6	9,852.6	2,236.9	0.23	19,112,572.4
2041	-	-	-	-	29,240.1	229,359.3	-	9,064.4	9,064.4	1,939.4	0.21	19,114,511.8
2042	-	-	-	-	26,900.9	199,775.8	-	8,339.3	8,339.3	1,681.5	0.20	19,116,193.4
2043	-	-	-	-	24,748.8	172,558.9	-	7,672.1	7,672.1	1,457.9	0.19	19,117,651.3
2044	-	-	-	-	22,768.9	147,519.4	-	7,058.4	7,058.4	1,264.1	0.18	19,118,915.4
2045	-	-	-	-	20,947.4	124,483.0	-	6,493.7	6,493.7	1,096.0	0.17	19,120,011.3
2046	-	-	-	-	19,271.6	103,289.6	-	5,974.2	5,974.2	950.2	0.16	19,120,961.6
2047	-	-	-	-	17,729.9	83,791.6	-	5,496.3	5,496.3	823.9	0.15	19,121,785.5
2048	-	-	-	-	16,311.5	65,853.5	-	5,056.6	5,056.6	714.3	0.14	19,122,499.8
2049	-	-	-	-	15,006.6	49,350.4	-	4,652.0	4,652.0	619.3	0.13	19,123,119.1
2050	-	-	-	-	13,806.1	34,167.5	-	4,279.9	4,279.9	537.0	0.13	19,123,656.1
2051	-	-	-	-	12,701.6	20,199.3	-	3,937.5	3,937.5	465.6	0.12	19,124,121.7
2052	-	-	-	-	11,685.4	7,348.6	-	3,622.5	3,622.5	403.7	0.11	19,124,525.4
2053	-	-	-	-	10,750.6	(4,474.1)	-	3,332.7	3,332.7	350.0	0.11	19,124,875.4
2054	-	-	-	-	9,890.6	(15,351.0)	-	3,066.1	3,066.1	303.4	0.10	19,125,178.8
2055	-	-	-	-	9,099.3	(25,357.7)	-	2,820.8	2,820.8	263.1	0.09	19,125,441.9
Total	**51,065,405.4**	**-**	**-**	**(2,905,394.5)**	**2,701,231.7**		**48,160,010.9**	**(14,992,893.9)**	**33,167,117.0**	**19,125,441.9**		


COMPARATIVE CUMULATIVE REVENUE REQUIREMENT
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100 MVAR Capacitor Bank
Test 2
Test 3
Test 4
Year

CI Number: 46757

Title: 88S Lingan 230kV BPS Upgrades

Start Date:	2015/09
In-Service Date:	2018/12
Final Cost Date:	2019/06
Function:	Transmission
Forecast Amount:	$3,218,221

DESCRIPTION:

This project includes the upgrade of the protection system at 88S – Lingan (230kV) to comply with Northeast Power Coordination Council (NPCC) bulk power system (BPS) protection risk reduction plan.

Summary of Related CIs +/- 2 years:
2016 CI 46591 88S Lingan Replace 230kV GIS $14,303,459

JUSTIFICATION:

Justification Criteria: Transmission Plant

Depreciation Class: Transmission Plant – Station Equipment

Estimated Useful Life: 30 years

Why do this project?

On August 30, 2010, NPCC requested a Mitigation Plan (please refer to Attachment 1) for bulk power system (BPS) facilities that lack a second set of protective relays on a BPS element and/or second battery at a BPS substation. The substation at Lingan lacks these requirements. NS Power identified the work provided in this project as part of its compliance plan (please refer to Attachment 2). NS Power complies with UARB approved NPCC criteria such as their requirements around bulk power system design and operation.

Why do this project now?

Implementation of all redundant protection and second battery upgrades is required to be completed by the end of 2016. NS Power has four stations requiring this upgrade (120H-Brushy Hill, 67N-Onslow, 3C-Port Hastings & 88S-Lingan). Because this work is significant, NS Power chose to complete the four stations requiring this upgrade starting in 2013. NS Power has completed 120H-Brushy Hill 230kV in 2014 and plans to complete 67N-Onslow and 3C-Port Hasting in early 2016 and 88S-Lingan by the end of 2018. An agreement with NPCC has been attained to delay the work to complete by end of 2018 (please refer to Attachment 3).

Why do this project this way?

The project is being completed in the same manner as the prior BPS Upgrade projects in order to comply with the August 30, 2010 NPCC request and associated Mitigation Plan noted above.

CI Number : 46757-T867 - 88S Lingan 230kV BPS Upgrades **Project Number** T867

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		129,492	0	129,492
094		094 - Interest Capitalized		239,742	0	239,742
095		095-COPS Regular Labour AO		191,979	0	191,979
095		095-COPS Contracts AO		128,151	0	128,151
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	336,240	0	336,240
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	12,396	0	12,396
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	1,171,552	0	1,171,552
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	152,059	0	152,059
066	022	066 - Other Goods & Services	022 - TP - Elec Contr.Equip.	229,896	0	229,896
012	023	012 - Materials	023 - TP - Power Equip.-Station S	74,480	0	74,480
013	023	013 - COPS Contracts	023 - TP - Power Equip.-Station S	15,200	0	15,200
012	045	012 - Materials	045 - TP - U/G Conduit	750	0	750
013	045	013 - COPS Contracts	045 - TP - U/G Conduit	5,800	0	5,800
001	085	001 - T&D Regular Labour	085 Design	116,397	0	116,397
011	085	011 - Travel Expense	085 Design	33,310	0	33,310
028	085	028 - Consulting	085 Design	112,994	0	112,994
001	086	001 - T&D Regular Labour	086 Commissioning	145,173	0	145,173
013	086	013 - COPS Contracts	086 Commissioning	63,840	0	63,840
013	087	013 - COPS Contracts	087 Field Super.& Ops.	58,770	0	58,770
			Total Cost:	3,218,221	0	3,218,221
			Original Cost:	49,378		

Capital Project Detailed Estimate

Location: **Transmission**
CI# / FP#: 46757
Title: 88S Lingan 230kV BPS Upgrades
Execution Year: 2016-2018

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Electrician - Cable & Jumper Termination	PD	35	$ 358	$ 12,396		
P&C Engineering	PD	287	$ 405	$ 116,397		
T&D Electrician - Commissioning	PD	405	$ 358	$ 145,173		
				$ -		
			Sub-Total	$ 273,966		
011 Travel Expense						
Travel during Construction	Lot	1	$ 33,310	$ 33,310		
			Sub-Total	$ 33,310		
012 Materials						
Electrical Control Equipment - Panels, Mods & Cable	ea	24	$ 37,981	$ 911,552		
Electrical Control Equipment - Gen Transformer Bus CT Install	ea	2	$ 125,000	$ 250,000		
Power Equipment - Battery & Charger	ea	2	$ 28,000	$ 56,000		
Power Equipment - DC Dist Panel and Cabling	ea	2	$ 9,240	$ 18,480		
Underground Conduit	m	50	$ 15	$ 750		
Retire Electrical Control Equipt	lot	1	$ 10,000	$ 10,000		
			Sub-Total	$ 1,246,782		
013 Contracts						
Bldng, Struct. Grnd. - Cable Trench & Conduit	m	160	$ 758	$ 121,200		
Bldng, Struct. Grnd. - Control Building Shell & Foundation	ea	1	$ 215,040	$ 215,040		
Electrical Control Equipment - Install of Panels & Cable	hr	800	$ 190	$ 152,059		
Power Equipment - Station Services - Install	hr	80	$ 190	$ 15,200		
Underground Conduit - Install	hr	31	$ 190	$ 5,800		
Commissioning	hr	336	$ 190	$ 63,840		
Field Supervision & Ops	hr	720	$ 82	$ 58,770		
			Sub-Total	$ 631,909		
028 Consulting						
Design - P&C	hr	1000	$ 113	$ 112,994		
				$ -		
				$ -		
			Sub-Total	$ 112,994		
066 Other Goods & Services						
Contingency	%	10%	$ 2,298,961	$ 229,896		
				$ -		
				$ -		
			Sub-Total	$ 229,896		
094 Interest Capitalized						
AFUDC				$ 239,742		
				$ -		
				$ -		
			Sub-Total	$ 239,742		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 129,492		
				$ -		
				$ -		
			Sub-Total	$ 129,492		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 191,979		
COPS Contract AO				$ 128,151		
			Sub-Total	$ 320,130		
			SUB-TOTAL (no AO, AFUDC)	$ 2,528,857		
			TOTAL (AO, AFUDC included)	$ 3,218,221		
Original Cost				$ 49,378		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

NPCC, Inc.
NORTHEAST POWER COORDINATING COUNCIL, INC.
1040 AVE OF THE AMERICAS, NEW YORK, NY 10018 TELEPHONE (212) 840-1070 FAX (212) 302-2782

August 30, 2010

Members, Northeast Power Coordinating Council, Inc.

Re: Approved Implementation Plan for Bulk Power System Protection Risk Reduction

Ladies and Gentlemen:

This is to inform you that the Reliability Coordinating Committee (RCC) at the June 9, 2010 meeting approved the attached Implementation Plan for the Bulk Power System Protection Risk Reduction. As required in the Implementation Plan, affected Facility Owner that has identified bulk power system (bps) facility(ies) lacking either or both of the following two attributes:

1. lack of a second set of protective relays on a bps element,
2. the lack of a second battery at a bps substation.

must establish a mitigation plan and submit that plan to the NPCC Task Force on System Protection (TFSP) within 18 months of the approval of the Implementation Plan or by December 9, 2011; the mitigation plan must identify the time-period needed to acquire and install equipment to bring those existing facility(ies) in conformance with the following, with explanations of any delays beyond five years. Delays beyond five years must be approved by the RCC.

- For those stations which have only a single battery bank, add a second battery bank in accordance with the requirements of Section 5.8 of Directory #4, and
- For those **elements** whose **protection** does not include two independent sets of **protective relays**, add a second set of **protective relays**, and associated auxiliary relays (if used), that meet the required operating time consistent with Section 5.5 of Directory #4. The second set of **protective relays** and associated auxiliary relays shall be physically separated from the existing **protective relays**.

If you have BPS facilities lacking one or both of two attributes identified above, please submit a mitigation plan by December 9, 2011. TFSP maintains a record of the survey completed in 2007-2008 of facilities which were identified to be lacking one or both of these attributes and would be glad to review your facilities on the list. Your prompt attention and response to this request will be appreciated. Mitigation plan should be submitted to NPCC to the attention of Mr. Quoc Le at quoc@npcc.org.

Please do not hesitate to contact Quoc at 212-840-1070, Extension 4908 with any questions regarding this. Thank you for your assistance in this matter.

Yours very truly,

Bryan

Bryan Gwyn, Chairman
Task Force on System Protection

Attachment (1):

- Approved Implementation Plan for Bulk Power System Risk Reduction

CC: Members, Task Force on System Protection
Members, Reliability Coordinating Committee

Implementation Plan for Bulk Power System Protection Risk Reduction

RCC Approved - June 9, 2010

I. Introduction

At the request of the RCC, an assessment of all NPCC BPS facilities was conducted in 2007-2008. The result of this assessment was presented to the RCC at the March 4, 2009 and September 10, 2009 meetings. The predominant risk presented was judged to be due to the lack of two attributes: specifically, lack of a second set of protection relays, and the lack of a second battery. This implementation plan is intended to mitigate the identified higher risk protection attributes at these facilities but does not necessary imply conformance with all provisions of Directory 4.

II. Facility Owner Mitigation Plan

An affected Facility Owner that has identified BPS facility(ies) lacking either of the two attributes above, must establish a mitigation plan and submit that plan to the TFSP within 18 months of the approval of this Implementation Plan by the RCC; the mitigation plan must identify the time-period needed to acquire and install equipment to bring those existing facility(ies) in conformance with the following, with explanations of any delays beyond five years. Delays beyond five years must be approved by the RCC.

– For those stations which have only a single battery bank, add a second battery bank in accordance with the requirements of Section 5.8 of Directory #4, and
– For those **elements** whose **protection** does not include two independent sets of **protective relays**, add a second set of **protective relays**, and associated auxiliary relays (if used), that meet the required operating time consistent with Section 5.5 of Directory #4. The second set of **protective relays** and associated auxiliary relays shall be physically separated from the existing **protective relays**.

The affected Facility Owner must submit a Periodic Progress Report (see III Below) to the TFSP to demonstrate efforts and schedules to attain conformance with respect to the above attributes. Deviations from previously submitted schedules resulting in extension of the mitigation dates will be reported to the TFSP, who will submit the information to the RCC along with the Facility Owner's explanations for the delays. Any previously approved plans with delays beyond five years must be re-approved by the RCC.

III. Periodic Progress Report

TFSP will report to the RCC regarding receipt of all necessary mitigation plans.

The Facility Owner must provide annual progress reports to the TFSP for monitoring of project schedules.

TFSP will forward a summary report to the RCC annually on the progress of the implementation plans, until those plans are complete.

Developed by Task Force on System Protection

Nova Scotia POWER
An Emera Company

PO Box 910 • Halifax, Nova Scotia • Canada • B3J 2W5

December 9, 2011

Northeast Power Coordinating Council Inc.
1040 Avenue of the Americas - 10th Floor
New York, NY 10018

Dear Mr. Quoc Le:

In accordance with the Implementation Plan for the Bulk Power System Protection Risk Reduction, approved by the Reliability Coordinating Committee (RCC) at the June 9, 2010 meeting, Nova Scotia Power Inc. has identified bulk power system (BPS) facilities lacking either or both of the following two attributes:

1. lack of a second set of protective relays on a BPS element,
2. the lack of a second battery at a BPS substation.

and has established a mitigation plan. This plan is outlined in the attached document.

Yours truly,

Ron Tutty

Ron Tutty, P.Eng.
Protection & Control Specialist
Transmission Engineering
Nova Scotia Power Inc.

energy everywhere.

Nova Scotia POWER An Emera Company

energy everywhere.

Mitigation Plan for NPCC Bulk Power System Protection Risk Reduction

This Plan is being submitted in accordance with the NPCC Request dated August 30, 2010 (reference Attachment) to submit to NPCC a Mitigation Plan for bulk power system (BPS) facilities that lack either or both of the following two attributes:

1. lack of a second set of protective relays on a BPS element,
2. the lack of a second battery at a BPS substation.

Mitigation Plan Scope of Work

After reviewing the Task Force on System Protection (TFSP) survey completed in 2007-2008, Nova Scotia Power has determined that the following 230 kV substations have BPS facilities that lack a second battery or a second set of protective relays on a BPS element.

At 120H Brushy Hill a second set of bus protection relays will be installed on bus 120H-B71 and bus 120H-B72 and transformer protections will be added to 120H-T71 and 120H-T72. A second DC supply will also be added to this substation which will include a 125 V battery, a charger and a DC distribution panel with transfer capability.

At 67N Onslow a second set of bus protection relays will be installed on bus 67N-B5, 67N-B7 and 67N-B9 and transformer protection will be added to 67N-T71. The DC supply for the B protection schemes will be modified to ensure compliance with NPCC Directory #4 Section 5.8.

At 3C Port Hastings a second set of bus protection relays will be installed on bus 3C-B71 and bus 3C-B72 and transformer protections will be added to 3C-T71 and 3C-T72. The DC supply for the B protection schemes will be modified to ensure compliance with NPCC Directory #4 Section 5.8.

Nova Scotia Power
PO Box 910
Halifax, Nova Scotia
Canada B3J 2W5

Customer Service
1.800.428.6230
(428.6230 in HRM)

nspower.ca

At 88S Lingan a second set of bus protection relays will be installed on bus 88S-B71 and bus 88S-B72 and transformer protections will be added to 88S-T71, 88S-T72, 88S-GT1, 88S-GT2, 88S-GT3 and 88S-GT4. A second DC supply will also be added to this substation which will include a 125 V battery, a charger and a DC distribution panel with transfer capability.

The estimated completion dates for these projects are as follows:
120H Brushy Hill – Q4 2013
67N Onslow – Q4 2014
3C Port Hastings – Q4 2015
88S Lingan – Q4 2016

NPCC, Inc.
NORTHEAST POWER COORDINATING COUNCIL, INC.
1040 AVE. OF THE AMERICAS, NEW YORK, NY 10018 (212) 840-1070 FAX (212) 302-2782

September 29, 2015

Members, Reliability Coordinating Committee
and
Members, Task Force on Coordination of Operation
Members, Task Force on Coordination of Planning
Members, Task Force on Infrastructure Security and Technology
Members, Task Force on System Protection
Members, Task Force on System Studies

Re: Minutes of the June 3, 2015 RCC Meeting

Sir / Madam:

Attached are the minutes of the June 3, 2015 meeting of the NPCC Reliability Coordinating Committee, as approved at the September 10, 2015 RCC meeting.

Sincerely,

Phil Fedora

Philip A. Fedora
Assistant Vice President-Reliability Services

cc: NPCC Staff

NORTHEAST POWER COORDINATING COUNCIL
Reliability Coordinating Committee Minutes
June 3, 2015

Mr. Schiavone called the meeting of the Reliability Coordinating Committee (RCC), held at the New York Times Square Residence Inn by the Marriott to order at 10:00 am.

Attendance

Officers of the Reliability Coordinating Committee

Michael Schiavone, Chair	National Grid USA
Brian Evans-Mongeon, Co-Vice Chair	Utility Services, Inc.
Randy Crissman, Co-Vice Chair	New York Power Authority

Sector 1 - Transmission Owners

Central Hudson Gas & Electric Corp.	Frank Pace (Alternate)
Central Maine Power Company	David Conroy
Consolidated Edison Company of New York, Inc.	Mike Forte Peter Yost (Alternate)
Eversource Energy	Brad Bentley
Hydro-One, Inc.	Tom Irving
Long Island Power Authority	(proxy to Anie Philip)
National Grid USA	Michael Schiavone
New Brunswick Power Corporation	Randy McDonald (Alternate – via phone)
New York Power Authority	(proxy to Randy Crissman)
New York State Electric & Gas Corp.	(proxy to Dave Conroy)
Nova Scotia Power Incorporated	David Stanford (Alternate)
Rochester Gas & Electric Corporation	(proxy to Dave Conroy)
The United Illuminating Company	Robert Pelligrini Jonathan Appelbaum (Alternate)
Vermont Transco	Hantz Presume

Sector 2 – Reliability Coordinators

Hydro-Québec TransÉnergie	Pierre Paquet
Independent Electricity System Operator	Leonard Kula
ISO-New England, Inc.	(proxy to Brent Oberlin)
New Brunswick Power Corporation	(proxy to Randy MacDonald – via phone)
New York Independent System Operator	Dana Walters (Alternate)

Sector 3 – Transmission Dependent Utilities, Distribution Companies and Load Serving Entities

Eversource Energy	Barry Bruun
Hydro-Québec Distribution	Abdelhakim Sennoun (Alternate - via phone)
Long Island Power Authority	Anie Philip (Alternate)
New York Power Authority	(proxy to Randy Crissman)

NPCC, Inc.

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Sector 4 Generation Owners

Dominion Energy Marking, Inc.	(proxy to Randi Heise - via phone)
Dynegy, Inc.	(via written proxy)
Eversource Energy	(proxy to Bradley Bentley)
Long Island Power Authority	(proxy to Anie Philip)
New York Power Authority	Randy Crissman
NextEra Energy Resources	(via written proxy)
Ontario Power Generation	(via written proxy)

Sector 5 – Marketers, Brokers, and Aggregators

Constellation Energy Commodities Group	(via written proxy)
Long Island Power Authority	(proxy to Anie Philip)
New York Power Authority	(proxy to Randy Crissman)
Talen Energy Marketing, LLC	Bradley Weghorst (via phone)
Utility Services	Brian Evans-Mongeon

Sector 6 – State and provincial Regulatory and/or Governmental Authorities

New York Power Authority	(proxy to Randy Crissman)
New York State Department of Public Service	Ed Schrom (Alternate)

Sector 7 – Sub-Regional Reliability Councils, Customers, other Regional Entities and Interested Entities

New York State Reliability Council, LLC	Roger Clayton (via phone)

NPCC Staff

Gerry Dunbar	Manager of Reliability Criteria Requirements
Phil Fedora	Assistant Vice President, Reliability Services
Jessica Hala (part-time)	Manager, Finance and Accounting
Brian Hogue	Information Systems & Security Management
Stanley Kopman	Assistant Vice President Compliance, Registration & Enforcement
Quoc Le	Manager, System Planning and Protection
Neeraj Lal	Senior RAPA Engineer
Jennifer Mattiello	Vice President and Chief Operating Officer
John Mosier, Jr.	Assistant Vice President of System Operations
Scott Nied	Manager, Compliance Program Development

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Andrey Oks	Manager, Reliability Performance Criteria Assessment
Frantz Roc	Manager, Information Technologies
Paul Roman	Manager, Operations Planning
Edward Schwerdt	President and Chief Executive Officer

Guests

Sylvain Bastien (via phone)	Hydro-Québec TransÉnergie
Kelly Dash (via phone)	Consolidated Edison
Paul DiFilippo	Chair, Task Force on System Protection
Marc Dusseault	Chair, Task Force on Coordination of Planning
Liana Hopkins	New York Power Authority
Jonarath Kutty	New York Power Authority
Alex Rost	ISO New England, Inc.
Isen Widjaja (via phone)	Chair, Load Modeling Working Group
Robert Winston (via phone)	Consolidated Edison
Ben Wu	Orange & Rockland Utilities, Inc.

Quorum Statement

Mr. Fedora indicated that a quorum had been achieved, by member attendance, proxy or alternate designation. He also noted having received the following written proxies:

Sector 4 – Generator Owners
David Ramkalawan – Ontario Power Generation
Allen Schriver – NextEra Energy Resources
James Watson – Dynegy, Inc.

Sector 5 – Marketers, Brokers, and Aggregators
Glen McCartney - Constellation Energy Commodities Group, Inc

Antitrust Guidelines for NPCC Meetings

Mr. Fedora reviewed the NPCC Antitrust Guidelines in the Agenda package, and suggested contacting NPCC Inc.'s Secretary, Ruta Skucas at (202) 530-6428 for further information.

President & CEO Report

FERC Technical Conference

Mr. Schwerdt reported that FERC will be holding its annual Technical Conference on Reliability at its offices in Washington DC. The session is divided into three topic areas: 1) the review of NERC's 2015 State of Reliability Report, 2) identification of Emerging Issues, and 3) consideration of the ERO's Performance and its Initiatives.

1) NERC's recently released 2015 State of Reliability Report contains seven Key Findings:

1. Sustained high performance of BPS reliability continues;
2. No load was lost due to physical and cyber security events;
3. Continued decline in average transmission outage severity;
4. A significant decrease in unplanned transmission outages resulting in loss of load during the 2012 through 2014 time period;
5. Frequency Response trends remain stable;
6. Reduced protection system misoperations trending (but continued escalated risk in Qualified Events); and,
7. The use of Energy Emergency Alert Level 3 continues to decline.

2) Emerging issues identified in prepared testimony included:

- ✓ The changing nature of the grid, resource mix and resource energy limitations;
- ✓ The continuing need for Essential Reliability Services and accurate modelling;
- ✓ Gas pipeline and transmission siting concerns;
- ✓ BPS resiliency – more emphasis on cyber events; and,
- ✓ The potential reliability impacts of environmental legislation.

3) Aspects of the ERO's performance that will likely be discussed include:

- ✓ The 2015 rollout of risk-based registration and risk-based compliance monitoring and enforcement;
- ✓ Implementation of both CIP Version 5 Standards and CIP-014 (Physical Security) Standard;
- ✓ Expanded utilization of the ES-ISAC; and,
- ✓ The NOPR associated with the Stage 2 GMD Standard.

The FERC Technical Conference will be broadcast over the internet through the Capitol Connection link on the FERC website.

NERC's Recent Review of NPCC's Reliability Assurance Initiative (RAI) Implementation

As a part of its oversight responsibilities and coordination efforts, Mr. Schwerdt reported that NERC's compliance staff, augmented by representatives from an outside auditing firm, is conducting on-site reviews of each of the Regional Entity's implementation of the Inherent Risk Assessment and Internal Controls Evaluations components of the risk-based Compliance Monitoring and Enforcement Program. The RAI was piloted in 2014 and officially rolled out throughout the ERO Enterprise January 1st of this year. NERC and the Regional Entities share the common goal of consistent application of sound auditing and assessment principles and the feedback provided from these reviews has that as an objective.

Mr. Schwerdt reported that NPCC's Inherent Risk Assessment and Internal Control Evaluation processes were found to be "fully aligned" with all of NERC's identified criteria.

NPCC, Inc.

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In addition, the review team noted a number of "better practice elements" in NPCC's approach and procedures. He also noted that during the piloting process one of the recurrent themes from the Trade Groups that represent the smaller registered entities was the perceived burden that establishment and evaluation of internal controls imposes on entities. NPCC took up the challenge of scalability, and developed separate templates for smaller entities that are specifically designed to reduce the reporting burden, while capturing the requisite information.

He indicated that NPCC is in the process of sharing its experience with the other Regional Entities as they are sharing some of their innovative and adaptive approaches to the RAI with all of the other Regional Entities. He indicated this is a work progress; he thanked those participating and providing helpful feedback during this implementation year; recognizing we are all in this effort together. NPCC's approach to reliability and compliance hasn't changed; its focus is on a rigorous approach and through review, focused on reliability.

NPCC Draft 2016 Business Plan and Budget

Lastly, Mr. Schwerdt stated that in the agenda package for today's meeting includes a copy of Draft No. 2 of the NPCC 2016 Business Plan and Budget; he mentioned that it has been posted for comment and will be reviewed by the NPCC Board for further discussion during tomorrow's teleconference meeting. This draft incorporates previous comments from both the NPCC Finance and Audit Committee and comments received from the Board. It has been presented to the NERC Finance and Audit Committee and to FERC staff.

He them introduced Ms. Hala, NPCC's Manager of Finance and Accounting, who provided an overview of the NPCC Draft 2016 Business Plan and Budget: for RCC review and information.

Ms. Hala highlighted the following aspects of the NPCC Draft 2016 Business Plan and Budget:

- ✓ For 2016, NPCC's Regional Entity division total budget and assessments are up by 2%;
- ✓ NPCC is currently fully staffed (39 FTEs); no additional FTE's budgeted for 2016;
- ✓ All focus areas in 2016 are fully aligned with the ERO;
- ✓ Included in capital expenditures for 2016 is the initial implementation of a document management system; and,
- ✓ No change in the Working Capital and Operating Reserve requirements since last year.

She noted that potential increases in pension liability associated with termination of the NPCC defined benefit plan would be funded from reserves. NPCC's defined benefit plan termination is currently pending IRS approval. The 2016 budget assumes that IRS rules favorably on defined benefit plan termination prior to year-end 2015.

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She then described the breakdown of the percentage of total resources by program area for the RE, including a summary of the budget change from 2015 by program; both of which are very similar to the funding requirements in 2015.

She provided a review of the 2016 Regional Entity Budget (which is up 2%) noting:

- ✓ Assessments are also up by 2%, despite the fact that penalty receipts as a result of the release of reserves in order to smooth assessments;
- ✓ Personnel expenses include a 3% average wage package increase;
- ✓ Meetings expense increase is based on greater participation in NPCC seminars;
- ✓ Consultants and Contracts are down, primarily in the Compliance area, as a result of greater efficiencies anticipated to be gained from the risk based approach; and,
- ✓ Rent and improvements expense increase is due to a projected increase in landlord operating expenses and real estate taxes.

She reported that the assessment and reprioritization of staffing resources is ongoing and will continue through 2016. And as far as unknowns, the impact of any special reliability studies to address Clean Power Plan, to evaluate Essential Reliability Services or to analyze specific, significant Events are currently unknown.

With respect to efficiency and cost control, she stated there is an ongoing effort to hold more meetings on site and via conference call or webinar, and that NPCC is also limiting staff attendance at offsite meetings.

The initial implementation of a Document Management System is planned for 2016, with the intent to leverage the benefit of the ERO's associated Document management System investment.

Chair Report

Meeting Agenda

Mr. Schiavone referred the RCC to the Agenda provided in the Agenda package. No changes were presented.

The RCC then approved the Agenda.

Consent Agenda

The Reliability Coordinating Committee approved the following Consent Agenda items (all written proxies in favor).

March 4, 2015 Meeting Minutes

The Draft-For-Approval Minutes of the March 4, 2015 Reliability Coordinating Committee were approved, with minor corrections noted.

NPCC, Inc.

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RCC Membership Changes

The following changes to RCC Membership were approved:

Sector 1, Transmission Owners

- ✓ Mr. Michael Craven to succeed Mr. John Allen as a member, both from Rochester Gas & Electric Corporation. Mr. John Allen moved from primary member to alternate.
- ✓ Mr. Martin Paszek to succeed Mr. Peter Yost as an alternate, both from Consolidated Edison Company of New York. Mr. Michael Forte will remain as the primary member.
- ✓ Mr. Curt Dahl to succeed Mr. David Clarke as a member, both from Long Island Power Authority. Ms. Anie Philip representing Long Island Power Authority as the alternate.

Sector 3, TDUs, Dist., and LSEs

- ✓ Ms. Christine Schmitt to succeed Mr. Gian DeLuca as a member, both of New York Power Authority. Mr. Gian DeLuca moved from primary member to alternate to succeed Mr. Andrew Stewart, both of New York Power Authority.
- ✓ Ms. Kelly Dash representing Consolidated Edison Company of New York, Inc. as a member. Mr. Vitaly Spitsa representing Consolidated Edison Company of New York, Inc. as the alternate.
- ✓ Mr. Ronald Clare to succeed Mr. Curt Dahl as member, both from Long Island Power Authority. Mr. Robert Eisenhuth to succeed Ms. Anie Philip as an alternate, both of Long Island Power Authority.

Sector 4, Generator Owners

- ✓ Mr. Peter Yost representing Consolidated Edison Company of New York, Inc. as the member. Mr. Robert Winston representing Consolidated Edison Company of New York as the alternate.
- ✓ Ms. Lucyna Khazanovich representing Long Island Power Authority as the alternate.

Sector 5, Marketers, Brokers and Aggregators

- ✓ Mr. Louis Guilbault (member) and Mr. Scott Leuthauser (alternate) representing Hydro-Québec Energy Services (U.S.), Inc. are no longer on the RCC; no replacement has been named.
- ✓ Mr. Yannick Vennes representing Hydro-Québec Energy Marketing, Inc. is no longer a member on the RCC; no replacement has been named.
- ✓ Mr. Brian O'Boyle representing Consolidated Edison Company of New York, Inc. as the member. Mr. Mayer Sasson representing Consolidated Edison Company of New York, Inc. as the alternate.
- ✓ Mr. Peter Andolena to succeed Mr. Ben Chu as the member, both of Long Island Power Authority. Mr. Stephen Cantore representing Long Island Power Authority as the alternate.

Sector 6, State and Provincial Regulatory and/or Governmental

- ✓ Mr. Bruce Metruck from New York Power Authority will remain as the primary member.
- ✓ Mr. Shivaz Chopra to succeed Mr. Wayne Sipperly as the alternate, both from New York Power Authority.
- ✓ Mr. Robert Ganley representing Long Island Power Authority as the member. Mr. Richard Zambratto representing Long Island Power Authority as the alternate.

NPCC, Inc.

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Task Force Roster Changes

The following changes to Task Force and Working Group memberships were approved:

Task Force on System Studies

- ✓ Mr. Brian Robinson moved from alternate member to primary member to succeed Mr. Brian Evans-Mongeon, both from Utility Services. Mr. Brian Evans-Mongeon moved from primary member to alternate member.
- ✓ Mr. Hasan Matin will serve as the member from The United Illuminating Company.
- ✓ Mr. Ben Wu will serve as the alternate member from Orange and Rockland Utilities Inc.
- ✓ Mr. Alex Rost to succeed Mr. Alan McBride as the member, both from ISO New England.

Task Force on Coordination of Planning

- ✓ Mr. Scott Leuthauser representing Hydro-Québec Energy Services (U.S) is no longer a member; no replacement has been named.
- ✓ Ms. Caroline Beaulieu-Côté to succeed Mr. Alain Pageau as the alternate member, both from Hydro-Québec TransÉnergie.

Task Force on Coordination of Operation

- ✓ Mr. Patrick Doyle to succeed Mr. Richard Mailhot as a member, both from Hydro-Québec TransÉnergie.
- ✓ Mr. Marc Roy will serve as the primary representative for the New Brunswick Power Corporation.
- ✓ Mr. Scott Brown will serve as the alternate representative for the New Brunswick Power Corporation.

Task Force on Infrastructure Security and Technology

- ✓ Mr. Côme Chaput has moved from alternate to primary member. Mr. Jacquelin Bisson to succeed Mr. Côme Chaput as an alternate, both from Hydro-Québec TransÉnergie.
- ✓ Ms. Alexandra St-Hilaire representing Hydro-Québec TransÉnergie as a member.
- ✓ Mr. Mikhail Falkovich representing PSEG Power New York, Inc. as a member.
- ✓ Ms. Sheranee Nedd representing PSEG Power New York, Inc. as the alternate.
- ✓ Ms. Whitney Wallace representing Dynegy, Inc. as the member.
- ✓ Ms. Robin Wheeler representing ISO-New England, Inc. as the alternate.
- ✓ Mr. Michael Gerken to succeed Ms. Suzanne Black as a member, both from Eversource.
- ✓ Mr. Greg Goodrich representing New York Independent System Operator as the member.
- ✓ Mr. Neal Hickey representing New Brunswick Power Corporation as the member.
- ✓ Mr. John Keany representing National Grid as the alternate.

SP-7 Working Group on Protection System Misoperation Review

- ✓ Mr. Jean-Francois Marquis will serve as a member from Hydro-Québec TransÉnergie.
- ✓ Ms. Andrea Valenca to succeed Mr. Athul Hangilipola as a member, both from Hydro-One.

SS-37 Working Group on Base Case Development

- ✓ Mr. Rafael Sahiholamal to serve as the second alternate member from NPCC.

CO-02 Working Group on System Operator Training

- ✓ Mr. Daniel Nason will serve as the primary representative primary representative for the New Brunswick Power Corporation.
- ✓ Mr. Glenn Pelkey will serve as the alternate representative for the New Brunswick Power Corporation.

CO-7 Working Group on Operational Planning

- ✓ Mr. Charles-Éric Langlois to succeed Mr. Pierre Parent as the member, both from Hydro-Québec TransÉnergie.

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CO-8 Working Group on System Operations Managers
- ✓ Ms. Maxime Nadeau to succeed Mr. Richard Mailhot as an alternate, both from Hydro-Québec TransÉnergie.
- ✓ Mr. Rodney Hicks will succeed Mr. Marc Roy as the primary representative for the New Brunswick Power Corporation.
- ✓ Mr. Gaetan Benoit will succeed Mr. Daniel Nason as the alternate representative for the New Brunswick Power Corporation.

CO-10 Working Group on System Operational Tools
- ✓ Eugen Dimbu representing Hydro-Québec TransÉnergie as the member.

CO-11 Restoration Working Group
- ✓ Mr. Daniel Nason will succeed Mr. Scott Brown as the alternate representative for the New Brunswick Power Corporation.

CO-12 Working Group on Seasonal Assessments
- ✓ Mr. Danny Waye will serve as the primary representative for the New Brunswick Power Corporation.
- ✓ Mr. Rodney Hicks will serve as the alternate representative for the New Brunswick Power Corporation.

CP-8 Working Group on Review of Resource and Transmission Adequacy
- ✓ Mr. Scott Leuthauser representing Hydro-Québec Energy Services (U.S) is no longer a Member; replacement has been named.

CP-11 Working Group on Review of NPCC Basic Criteria
- ✓ Ms. Caroline Beaulieu-Côté to succeed Mr. Alain Pageau as the alternate member, both from Hydro-Québec TransÉnergie.

IST-5 Physical Security Working Group
- ✓ Ms. Alexandra St-Hilaire from Hydro-Québec TransÉnergie to succeed Mr. Benoit Tardif, who has retired from TransÉnergie.

Intermediate Area Transmission Reviews

The RCC approved the Task Force on Coordination of Planning's recommendation for approval of the:
- ✓ 2014 New York Area Intermediate Transmission Review;
- ✓ 2014 New England Area Intermediate Transmission Review; and,
- ✓ 2014 Maritimes Area Intermediate Transmission Review.

New York A-10 List

The RCC approved the Task Force on System Studies' recommendation for approval of the revised 2014 NPCC Bulk Power System (BPS) List for the New York Area.

New England Bulk Power System (BPS) list

The RCC approved the Task Force on System Studies' recommendation for approval of the updated New England 2014 BPS List incorporating the results from the New England system reassessment.

NORTHEAST POWER COORDINATING COUNCIL
Reliability Coordinating Committee Minutes
June 3, 2015

NPCC representatives to NERC's Critical Infrastructure Protection Committee

The RCC agreed with the Task Force on Infrastructure Security and Technology recommendation for the following NPCC representatives to NERC's Critical Infrastructure Protection Committee:

Primary	Expertise	Name	Organization
Representative	Cyber	Greg Goodrich	New York ISO
Representative	Physical	Dave Cadregari	RGE
Representative	Operations	John Galloway	ISO-New England
Alternate		Jacquelin Bisson	Hydro-Quebec TransEnergie
Alternate		John Helme	Utility Services
Alternate		Neal Hickey	New Brunswick Power
Alternate		Bruce Metruck	NYPA
Alternate		Brian Hogue	NPCC

Reliability Coordinating Committee Actions

Niagara 230 kV Generator Rejection Type 1 Special Protection System (SPS) Modification

Ms. Hopkins described the modifications associated with the Niagara 230 kV Generation Rejection Type I SPS provided in the Agenda package. She reviewed the studies and analysis performed in support if the recommended modification to remove the Packard 230 kV breaker failure via transfer trip as initiating event for arming the subject SPS.

In accordance with the NPCC Regional Reliability Reference Directory No. 7, "*Special Protection Systems*," the Task Force on System Studies, the Task Force on System Protection, and the Task Force on Coordination of Operation have reviewed the proposed Niagara SPS modification and concur with that proposed modification will not have an adverse impact on the Bulk Power System.

Consequently, the Task Force on Coordination of Planning reviewed this SPS modification for conformance with NPCC Regional Reliability Reference Directory No. 1 "*Design and Operation of the Bulk Power System*", and recommends RCC approval of this modified Type I SPS.

The RCC then unanimously approved the Niagara 230 kV Generator Rejection Type 1 SPS Modification, as provided in the Agenda package (all written proxies in favor).

2014 Quebec Area (TransÉnergie) Comprehensive Area Transmission Review

Mr. Bastien provided the RCC with the presentation provided in the Agenda package regarding the underlying assumptions and subsequent assessment performed for the 2014 Quebec Area (TransÉnergie) Comprehensive Area Transmission Review.

The 2014 Quebec (TransÉnergie) Comprehensive Transmission Review provides a five-year ahead reliability assessment of the Hydro Quebec controlled grid and its conformance to the NPCC Design and Operation of the Bulk Power System (Directory No. 1). The forecast and conclusions made in the Review are based on the integrated results from expected changes in load, transmission and generation up to the year 2019.

This Comprehensive Review of TransÉnergie's 2014-2019 Transmission System was performed in accordance with the NPCC Regional Reliability Reference Directory No. 1 and:

- ✓ demonstrates TransÉnergie's transmission system's conformance to the Transmission Design Criteria in Directory No. 1; and,
- ✓ is in conformance with the NERC Transmission Planning Standards (TPL-001-0.1, TPL-002-0b, TPL-003-0b and TPL-004-0a) for the specific 2014-2019 period (5-year case).

The Task Force on System Studies conducted a review of the findings and approved the Review. The Task Force on Coordination of Planning agreed that the Bulk Power System in Quebec, as planned through the 2019, will remain in conformance with the NPCC Directory No. 1 criteria and the NERC Transmission Planning standards TPL-001 to TPL-004. The Review was conducted in conformance with the TPL standards currently in effect and the BES definition. The Task Force on Coordination of Planning recommends RCC approval of the 2014 Quebec Comprehensive Transmission Review.

The RCC then unanimously approved 2014 Quebec Area (TransÉnergie) Comprehensive Area Transmission, as provided in the Agenda Package (all written proxies in favor).

<u>Nova Scotia Power, Inc. (NSPI) Extension Request for BPS Risk Mitigation - 88S Lingan Substation</u>

Mr. DiFilippo reported that NSPI submitted a request (provided in the Agenda package) for an extension to the 2016 mitigation schedule for the BPS risk reduction implementation plan identified at 88S Lingan Substation. A two-year extension was requested to coordinate with the end-of-life replacement project in 2017 and the planned retirement of the generator G2 in 2018 at this substation.

The Task Force on System Protection reviewed the request from NSPI and recommends RCC approval.

The RCC then unanimously approved the NSP Extension Request for BPS Risk Mitigation - 88S Lingan provided in the Agenda package (all written proxies in favor).

NPCC, Inc.

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Reliability Coordinating Committee Minutes
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Status Reports

Mr. Schiavone referred the RCC to the materials provided in the Agenda package; the RCC discussed the following Agenda items:

NPCC Regional Standards Committee (RSC) Report

Mr. Dunbar stated that the RSC continues to coordinate regional comments and recommend ballot positions on standards under development, as well as monitor development of certain key standards. The NERC standards are expected to move to a "steady state" condition in early 2016, at which point most of the FERC recommendations will have been incorporated, with NERC satisfied that the standards have evolved sufficiently.

He highlighted the following Regional Standard Authorization Request (RSAR):

- ✓ The RSC has approved the RSAR related for the Regional standard for disturbance monitoring; a drafting team has been approved, and is waiting to begin a review to determine if the regional standard can be retired in light of the fact that the related continental standard has been approved by NERC and is awaiting regulatory approval; and,
- ✓ Regional UFLS Standard RSAR on the agenda for approval at the June RSC meeting.

NPCC Reliability Directory Status Report

Mr. Dunbar referred the RCC to the materials provided in the Agenda package. Regarding the revision of Directory No. 1, he reported that Directory No. 1 had been posted on the NPCC Open Process through July 13, 2015 (third time); concerns regarding the protection A & protection B language appear to have been addressed through an implantation plan, that is planned to be presented to the RCC along with Directory No. 1 for consideration at the September 2015 RCC meeting.

NPCC Compliance Committee

Mr. Kopman highlighted the following from the materials provided in the Agenda package:

- ✓ the Entity Risk Assessment (ERA) program – NERC assessment of the Inherent Risk Assessments (IRA) and Internal Control Evaluations (ICE) practices were completed last week; an initial draft report is scheduled to be submitted to NPCC by June 12, 2015 with comments due by June 19, 2015. Better practices identified include:
  - scalability;
  - public access to high level IRA and ICE procedures;
  - identified "rational" codes – as a standard way of linking an entities' IRA to the scoping of future monitoring engagements.

In addition, he stated that NPCC is scheduled to conduct approximately 42 IRAs and 8 ICEs in 2015.

Mr. Kopman then provided an update on the implementation of Risk Based Registration Phase 1, to date, NPCC has deactivated 80 PSE only entities; 16 additional entities have had the PSE responsibilities deactivated.

NPCC is currently reviewing requests for UFLS DP only reclassification; four requests have been received – NPCC expects as many as eight requests will be received.

He mentioned NPCC continues to implement compliance exceptions and self-logging; to date, NPCC has identified four additional entities for self-logging, bringing total participation to ten. He stated NPCC continues to review entities for possible participation in this program.

Mr. Nied then gave an overview of the Risk Based Registration Phase 2 activities provided in the Agenda package.

SP-7 Working Group - Review of Protection Systems Misoperations

Mr. DiFilippo reviewed the status of SP-7 Working Group (WG) on Protection System Misoperation as provided in the Agenda package. He stated that the protection system misoperations rate has been holding steady around of six percent through the Fourth Quarter 2014. He mentioned that the SP-7 WG is also reviewing reported Special Protection System (SPS) operations and misoperations as requested by NERC using the new SPS reporting template. There were nine reported correct SPS operations in the Third Quarter 2014 and four reported correct SPS operations in the Fourth Quarter 2014. He said that there were no reported SPS misoperations during these Quarters.

SS-38 Working Group

Mr. Schiavone referred the RCC to the materials provided in the Agenda package.

Task Force on Infrastructure Security & Technology (TFIST) Update

Mr. Appelbaum highlighted the following Cyber and Physical Security issues provided in the Agenda package:

Cyber Security

- ✓ Various Information Sharing Bills with liability provisions are being discussed in Congress;
- ✓ Electric Sector Coordination Council (ESCC) is conducting a strategic review of the ES-ISAC; a report is due June 15; and,
- ✓ CIP version 5 implementation NERC has issued Compliance Application Memorandums and FAQs.

Physical Security

- ✓ EMP protection is being discussed in Congress;
- ✓ Increased number of articles related to drones (air and ground) – becoming an increasing threat vector; and,
- ✓ Gridex III – November 18-19, 2015 - Lead Planners conference scheduled for June 10-11, 2015.

NPCC, Inc.

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Task Force on System Studies Special Protection System (SPS)/ Remedial Action Scheme (RAS) assessment

Mr. Conroy summarized the material provided in the Agenda package; he stated that the Task Force on System Studies was asked to compare all of the SPSs in NPCC as to how they would be classified under the new NERC RAS definition. The details of the comparison are provided in the Agenda package; he reported out of the 105 NPCC SPSs, only one Type I SPS would not be considered an RAS (located in New England) – of the Type 2 SPSs, there wouldn't be any changes, and a total of six Type III SPSs would not be considered as a RAS.

He also mentioned that five new RASs were identified in the New York area that are not existing NPCC SPSs; the classification was not due to the RAS definition, but due to the new Bulk Electric System definition.

2015-2016 Work Plan Progress

Mr. Schiavone referred the RCC to the materials provided in the Agenda package.

NPCC Reliability Assessment Program (NRAP) Highlights Report

Mr. Schiavone referred the RCC to the materials provided in the Agenda package and the NPCC website.

NERC Agenda Items

Operating Committee (OC)

Mr. Mosier reviewed the following June 2015 NERC Operating Committee Agenda items:

- ✓ The update to the Eastern Interconnection Data Sharing Network – NERC Net disconnection date is June 30, 2015;
- ✓ Winter Operations Panel Discussion – looking back on the lessons learned from the past two winter's experience;
- ✓ The April 7, 2015 Operating Event in the Washington, D.C. Area;
- ✓ Approval of a Field Test Associated with a Reliability Standard – either new or existing; and,
- ✓ Informational presentation of the PJM Intelligent Event Alarming Tool; and,
- ✓ Preparations for the November 18-19, 2015 GridEx III.

Planning Committee (PC)

Mr. Fedora reviewed the following items from the Draft June 2015 NERC Planning Committee Agenda:

- ✓ Transition plan for the activities of the Integration of Variable Generation Task Force recommendations;
- ✓ Essential Reliability Services Task Force Update – preliminary results to be presented at the September PC meeting;
- ✓ Short Term Reliability Assessment Proposal;
- ✓ FERC Order 754 Assessment of Protection System Single Points of Failure Based on the Section 1600 Data Request; and,
- ✓ Considerations for Power Plant and Transmission System Protection Coordination Technical Guideline.

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Critical Infrastructure Protection Committee (CIPC)

Mr. Hogue noted that there are no voting items on the June 2015 NERC Critical Infrastructure Committee Agenda; he highlighted the following items:

- ✓ Physical Security Advisory Group Update;
- ✓ Development of Additional Guidance for CIP-014-1, "Physical Security" and the related activities of the Physical Security Standard Working Group;
- ✓ CIP V5 Transition and CIP V5 Revisions; and,
- ✓ Preparations for GridEx III, and the related activities of the:
    - Business continuity Working Group;
    - Grid Exercise Working Group; and,
    - Control Systems Security Working Group.

Informational Items

Mr. Schiavone referred the RCC to the materials included in the Agenda package. The following Informational Items were discussed at the meeting:

Events Analysis Program (EAP)

Mr. Mosier briefly summarized the materials provided in the Agenda package regarding recent Events Analysis Program activities. He highlighted the following activities:

- ✓ The NERC Event Analysis Subcommittee periodic review of the EAP process document – NERC PC approval expected in September;
- ✓ Category 2 b (loss of SCADA system for 30 minutes or more) event – lowered to a Category 1 event;
- ✓ Timing requirements for Brief Reports and Event Analysis reports extended from five business days to the Region and ten to NERC to ten and 20 business days, respectively;
- ✓ Clarification of Category 2c events – voltage excursions; and,
- ✓ Formal event closure process – a letter will be sent to the Registered Entity, signed by both NERC counsel and CEO of the Regional Entity, confirming that NERC and the Regional Entity consider the event closed.

FERC June 4th Reliability Technical Conference

Previously covered in the President & CEO Report.

Eastern Interconnection Planning Collaborative (EIPC) Gas Electric Study

Mr. Fedora referred to the Agenda of the May 28, 2015 EIPC Stakeholder Study Committee provided in the Agenda package. Their Final report was presented at that meeting, and is expected to be released, following a comment period, on June 4, 2015.

Eastern Interconnection Reliability Assessment Group

Mr. Schiavone referred the RCC to the materials provided in the Agenda package.

NPCC, Inc.

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Other Matters

With no other matters to consider, the RCC meeting was adjourned.

Next RCC Meeting Date	**Location**
Thursday, September 10, 2015	Marriott New York Times Square Residence Inn

Distribution of Approved Minutes

NPCC Full & General Member Representatives and Alternates
Members, NPCC Board of Directors
Members, NPCC Reliability Coordinating Committee
Members, NPCC Public Information Committee
Members, NPCC Compliance Committee
Members, NPCC Regional Standards Committee
Members, NPCC Task Force on Coordination of Operation
Members, NPCC Task Force on Coordination of Planning
Members, NPCC Task Force on Infrastructure Security and Technology
Members, NPCC Task Force on System Protection
Members, NPCC Task Force on System Studies
NPCC Officers
NPCC Staff
Ruta Skucas, Esq.
and
Federal Energy Regulatory Commission – Mike Bardee, David O'Connor, Juan Villar
La Régie de L'Énergie – Daniel Soulier
Ontario Energy Board – Peter Fraser
United States Department of Energy – David Meyer
New Brunswick Department of Energy and Mines – David Sallows
Nova Scotia Utility & Review Board – S. Bruce Outhouse, Q.C.

CI Number: 46811

Title: 2H Armdale Transformer Addition

Start Date:	2016/04
In-Service Date:	2017/03
Final Cost Date:	2017/09
Function:	Transmission
Forecast Amount:	$2,545,596

DESCRIPTION:

This project includes the addition of a second transformer, a new transmission tap, and a high-side circuit switcher at the Armdale substation. This additional transformer being installed at 2H-Armdale is the transformer which was removed from 82V-T1. The installation of additional transformation at 2H-Armdale enables a greater number of feeder configurations both on and off of the Halifax peninsula. This alternative will also provide the capacity required at 2H-Armdale to supply the related 20H-Spryfield conversions, and a significant portion of the 23H-Rockingham conversions.

Summary of Related CIs +/- 2 years:
2015 CI 46398 20H Spryfield Conversion $480,510
2016 CI 46651 23H Rockingham Conversion Phase 1 $516,577

Depreciation Class: Transmission Plant

Estimate Useful Life: 45 Years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

The benefits of this project are twofold. It provides additional feeder capacity to address the growing load at the adjacent substation 20H-Spryfield. It will also provide contingency in the event of a failed transformer in any of the three main substations that supply the Halifax peninsula. Please refer to Attachment 1 for the Distribution Planning Study.

Why do this project now?

The lone transformer at 2H-Armdale has a nameplate capacity rating of 42 MVA. The 2014 peak on this transformer was 37.82MVA, and another 3 MVA of load is projected to be added to this unit in the next 3-5 years. This additional load will put the transformer very close to its nameplate rating. The addition of the second transformer at 2H-Armdale will alleviate the loading concern on the existing transformer while providing contingency in the event of a transformer failure at 1H-Lower Water Street or 104H-Kempt Road in the Halifax peninsula.

Why do this project this way?

Adding a fourth transformer at 104H was considered, however there is little capacity to add additional feeders at 104H and therefore the transformer would have little use other than a hot spare. This option, as shown in attached Distribution Planning Study is the most economic option.

This work will be completed by NS Power Personnel and external resources.

CI Number : 46811 - 2H Armdale Transformer Addition **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		60,309	0	60,309
094		094 - Interest Capitalized		41,302	0	41,302
095		095-COPS Regular Labour AO		89,352	0	89,352
095		095-COPS Contracts AO		183,534	0	183,534
095		095 - Proj Supp Regular Labour AO		32,909	0	32,909
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	400,000	0	400,000
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	680,000	0	680,000
001	007	001 - T&D Regular Labour	007 - TP - Environmental	3,535	0	3,535
013	007	013 - COPS Contracts	007 - TP - Environmental	50,000	0	50,000
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	14,140	0	14,140
001	023	001 - T&D Regular Labour	023 - TP - Power Equip.-Station S	17,740	0	17,740
001	035	001 - T&D Regular Labour	035 - TP - Wood Poles	3,600	0	3,600
012	037	012 - Materials	037 - TP - Steel Towers	100,000	0	100,000
013	037	013 - COPS Contracts	037 - TP - Steel Towers	40,000	0	40,000
001	038	001 - T&D Regular Labour	038 - TP - Insulators	1,440	0	1,440
012	038	012 - Materials	038 - TP - Insulators	30,000	0	30,000
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	3,600	0	3,600
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	17,740	0	17,740
012	043	012 - Materials	043 - TP - Substn Dev.	310,000	0	310,000
001	044	001 - T&D Regular Labour	044 - TP - Substn.Transf.	21,275	0	21,275
013	044	013 - COPS Contracts	044 - TP - Substn.Transf.	80,000	0	80,000
013	046	013 - COPS Contracts	046 - TP - U/G Conductor	55,000	0	55,000
001	085	001 - Proj Supp Regular Labour	085 Design	54,180	0	54,180
001	085	001 - Regular Labour (No AO)	085 Design	16,800	0	16,800
066	085	066 - Other Goods & Services	085 Design	194,381	0	194,381
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	44,760	0	44,760
			Total Cost:	2,545,596	0	2,545,596
			Original Cost:	112,743		

Capital Project Detailed Estimate

Location: **Transmission**
CI# / FP#: 46811
Title: 2H Armdale Transformer Addition
Execution Year: 2016 / 2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - PLT	PD	54	$ 360	$ 19,438		
T&D Labour - Electrician/Technician	PD	180	$ 354	$ 63,630		
T&D Labour - Site Supervision	PD	120	$ 373	$ 44,760		
Procurement / Financial Support	Lot	1	$ 16,800	$ 16,800		
Project Support AO - Engineering Design	PD	140	$ 387	$ 54,180		
			Sub-Total	$ 198,808		
012 Materials						
Structural steel - new buswork	lot	1	400,000	$ 400,000		
138kV Steel transmission structure	ea	1	100,000	$ 100,000		
Insulators	lot	1	30,000	$ 30,000		
25 kV recloser	ea	3	30,000	$ 90,000		
High side circuit switcher	ea	1	60,000	$ 60,000		
Load break switches	lot	4	20,000	$ 80,000		
Gang operated switches	lot	8	10,000	$ 80,000		
			Sub-Total	$ 840,000		
013 Contracts						
Site remediation	ea	1	50,000	$ 50,000		
Construct new low side bus	lot	1	500,000	$ 500,000		
Decommission old low-side bus	ea	1	50,000	$ 50,000		
Transformer pad	ea	1	30,000	$ 30,000		
Transformer pad removal	ea	1	20,000	$ 20,000		
Concrete footings	lot	1	30,000	$ 30,000		
Oil Containment	ea	1	50,000	$ 50,000		
Transformer transportation and placement	lot	1	80,000	$ 80,000		
Underground feeder trenchwork	m	500	110	$ 55,000		
138 kV transmission structure	ea	1	40,000	$ 40,000		
			Sub-Total	$ 905,000		
066 Other Goods & Services						
Contingency	%	10%	$ 1,943,808	$ 194,381		
			Sub-Total	$ 194,381		
094 Interest Capitalized						
AFUDC				$ 41,302		
			Sub-Total	$ 41,302		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 60,309		
			Sub-Total	$ 60,309		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 89,352		
COPS Contract AO				$ 183,534		
Project Support Regular AO				$ 32,909		
			Sub-Total	$ 305,795		
			SUB-TOTAL (no AO, AFUDC)	$ 2,138,189		
			TOTAL (AO, AFUDC included)	$ 2,545,596		
Original Cost				$ 112,743		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Nova Scotia POWER An Emera Company

Peninsular Halifax and Area
DISTRIBUTION PLANNING STUDY
Report number 342-1113-H50

Revision		Date	Drafted By	Reviewed by	Approved By
0	Issued for Study	29-Nov-13	JMQ		
1	Issued for Release	30-Jan-15	JMQ	DK	
2	Issued for Release	15-Feb-15	JMQ	DK	

EXECUTIVE SUMMARY

This study was initiated by Central Regional Engineering to examine the loading on the Halifax Peninsula and surrounding areas, with consideration of the continued anticipated load growth within the area. This study considers the ongoing recommendations of the Halifax 4kV Conversion study (303-0612-H49).

Given the significant growth, both commencing and anticipated, within the Halifax Peninsula and surrounding areas, a review of the current and future capacity requirements is required. This study will review the existing capacity at the substations indicated below, as well as the future capacity requirements in these areas, to meet the anticipated load growth. Some of the large developments announced within the study area are:

- The Nova Centre (under construction)
- Brunello Estates (under construction)
- Lovett Lake (under construction)
- Larry Uteck area (under expansion)
- The Mother House Lands (before HRM council)

The study has been bounded by the following substations:

- 1H-Water Street
- 2H-Armdale
- 103H-Lakeside
- 104H-Kempt Road
- 129H-Kearney Lake
- 20H-Spryfield
- 23H-Rockingham

The outcome of the Economic Analysis to the alternatives, outlined in Section 5 of this study, indicates the completion of the following:

1. Add an additional 138-26.4kV transformer at 2H-Armdale, in 2015
2. Add an additional 138-26.4kV transformer at 103H-Lakeside, in 2018
3. Replace 103H-T63, in 2015 and reduce loading at 20H-Spryfield through conversions to 25kV
4. Retire 23H-Rockingham in 2026, through planned conversions to 25kV

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1.0 SCOPE

This study was initiated by Central Regional Engineering to examine the loading on the Halifax Peninsula and surrounding areas, with consideration of the continued anticipated load growth within the area. With the current and proposed load developments on the Halifax Peninsula and adjacent areas, it is imperative to investigate the overall load in the area, to determine the future capacity requirements of both the Halifax Peninsula and the adjacent areas.

This study will recommend general feeder reconfigurations, as new feeders are added, but the final determination of these configurations will be at the discretion of Central Regional Engineering.

Given the significant growth, both commencing and anticipated, within the Halifax Peninsula and surrounding areas, a review of the current and future capacity requirements is required. This study will review the existing capacity at the substations indicated below, as well as the future capacity requirements in these areas, to meet the anticipated load growth.

The study has been bounded by the following substations:

- 1H-Water Street
- 2H-Armdale
- 103H-Lakeside
- 104H-Kempt Road
- 129H-Kearney Lake
- 20H-Spryfield
- 23H-Rockingham

This study considers the ongoing recommendations of the Halifax 4kV Conversion study (303-0612-H49).

2.0 EXISTING SYSTEMS

2.1 Transmission

Presently, the substations within the scope of this study are supplied from the bulk power systems at 103H-Lakeside and 91H-Tufts Cove. An overview of the substations within the scope of this study can be found in Figure 1 below. The System Operating Diagrams can be found in Appendix A.

Table 1 Transmission Line Ratings

Transmission Line	Substation		MVA Rating	
	From	To	Summer	Winter
L-8002	67N-Onslow	103H-Lakeside	554	554
L-6008	90H-Sackville	103H-Lakeside	215	231
L-6014	91H-Tufts Cove	104H-Kempt Road	268	287
L-6016	120H-Brushy Hill	103H-Lakeside	231	231
L-6033	103H-Lakeside	1H-Water Street 2H-Armdale	230	230
L-6035	104H-Kempt Road	1H-Water Street 2H-Armdale	230	230
L-6038	103H-Lakeside	129H-Kearney Lake	95	95
L-5004	90H-Sackville	34H-Geizer's Hill	55	72
L-5032	22H-Rockingham Tap	23H-Rockingham	31	45
L-5039	103H-Lakeside	20H-Spryfield	41	60

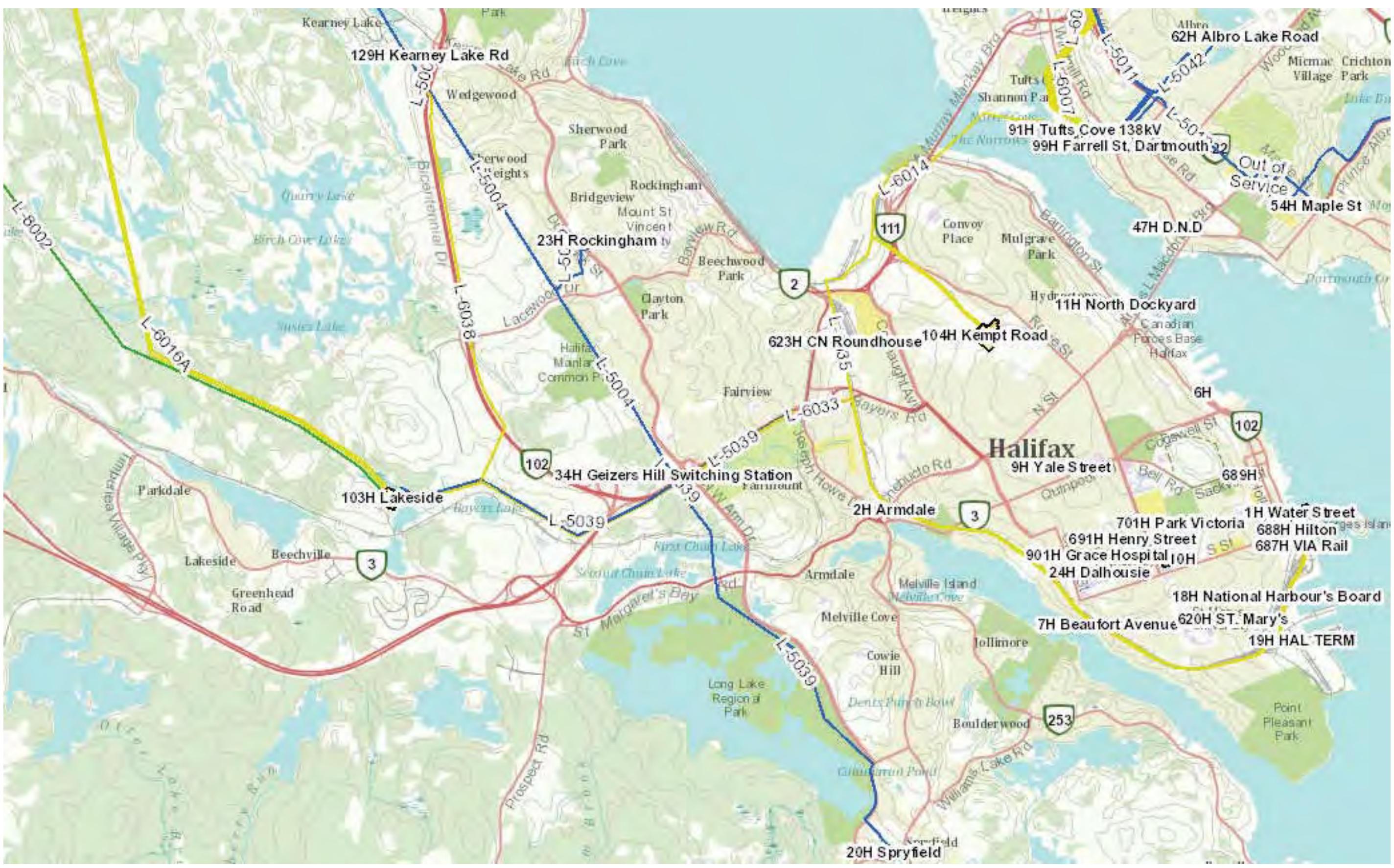


Figure 1 Peninsular Halifax Transmission

2.2 Distribution

The distribution system being studied in this report includes the 25kV feeders supplied from the substations located on/ or adjacent to Peninsular Halifax. All of these substations are capable of providing transfer capacity to adjacent substations, when required.

With this in mind the 12kV and 25kV substations adjacent to the Halifax Peninsula are also being considered, with respect of potential transfer capacity and additional load that may be added to the 25kV distribution system bounded by the scope of this study, in the future.

Table 2 provides the transformer data for the substations that are directly impacted by the scope of this study.

Table 2 Substation Transformers, within Scope of Study

Substation	Transformer Data				
	ID	MAN	kV	Rating (in MVA)	In Service
1H-Water Street	T61	ASEA	138-25kV	40/53	1979
1H-Water Street	T62	ASEA	138-25kV	40/53	1979
1H-Water Street	T63	Shihlin	138-25kV	40/53	2014
2H-Armdale	T61	ABB	138-25kV	//25/35/42	2000
103H-Lakeside	T61	Federal Pioneer	138-26.4kV	25/33.3/41.6//46.6	1978
103H-Lakeside	T63	CGE	138-69kV	20/26.7//29.9	1971
104H-Kempt Road	T61	Siemens	138-25kV	25/33.3/41.7	2009
104H-Kempt Road	T62	CGE	138-25kV	25/33.3/41.7	2009
104H-Kempt Road	T63	CGE	138-25kV	25/37/46.7	1996 (rebuilt 2002)
129H-Kearney Lake	T61	Ferranti Packard	138-26.4kV	25/33.3//41.5	1988
20H-Spryfield	T1	CGE	69-13.2kV	15/20//22.4	1987 (rebuilt)
20H-Spryfield	T2	Ferranti Packard	69-13.2kV	15/20/25//28	1977
23H-Rockingham	T51	ABB	69-13.2kV	15/20//25	1991

2.2.1 Halifax 4kV Conversions

Presently, recommendations from the Halifax 4kV Conversions Distribution Planning Study (303-0612-H49) are being completed with an anticipated completion of conversions in 2018. The extents of the remaining Halifax 4kV can be found in Figure 2. It is worth noting that the two remaining 4kV substations, 9H-Yale Street and 10H-VG Hospital are supplied by 25kV distribution feeders supplied by the Peninsular Halifax substations.

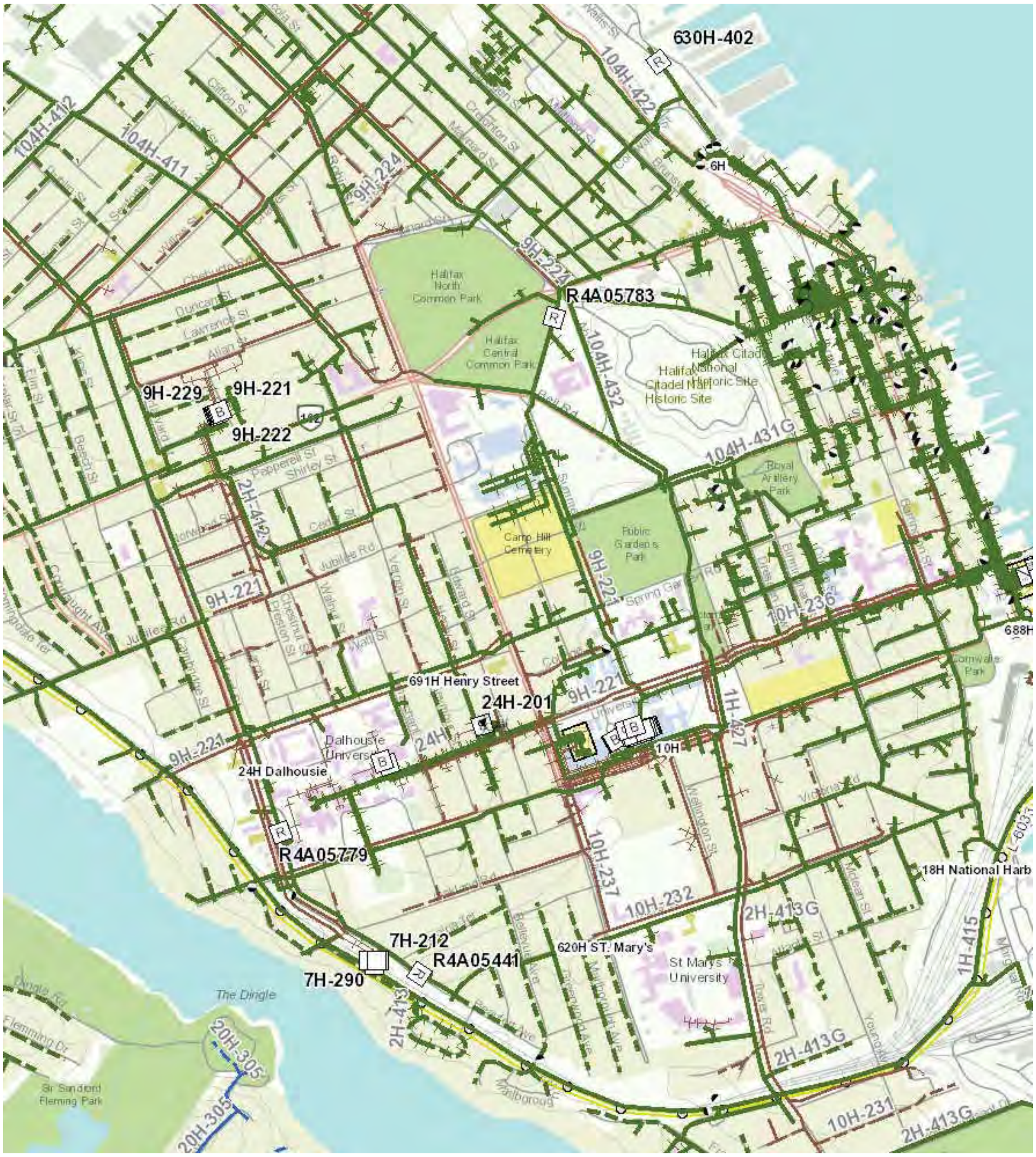


Figure 2 **Halifax 4kV Overview (brown)**

3.0 LOAD HISTORY AND FORECAST

The majority of the load being considered within this study is residential, with a number of commercial and industrial customers. As illustrated in the load history (Appendix B) for the substation transformers and feeders, the load being considered, within this study, continues to have a larger winter peak than summer. Historical load data for the feeders and transformers was collected from the Distribution Load Check Database and archived PI data and is presented below.

3.1 Load Forecast

Overall customer load has been increasing in substations that service the Halifax Peninsula, as well as the adjacent areas. The overall load growth is anticipated to continue for the next several years, due to the proposed developments outlined in subsequent sections of this study.

Due to the ability to reconfigure feeders on the Halifax Peninsula, the utilization of the 90th percentile forecast is difficult to compile, on a feeder basis. With this in mind, the overall load growth has been calculated utilizing the 90th percentile calculations, for each substation examined within this study. Refer to Table 10 and Table 11 below.

An overview of the peak loading of the individual feeders, organized by substation, is contained within the tables below.

Table 3 1H-WaterStreet peak 2013/2014 feeder loading, in Amps

	1H-403	1H-405	1H-415	1H-419	1H-424	1H-429	1H-431
2013/2014 Peak	186	213	222	263*	212	220*	197

Table 4 2H-Armdale and 103H-Lakeside peak 2013/2014 feeder loading, in Amps

	2H-411	2H-412	2H-413	103H-431	103H-432	103H-433	103H-434
2013/2014 Peak	206	284	272	160	331	332	327

Table 5 104H-Kempt Road 2014 peak 2013/2014 feeder loading, in Amps

	104H-411	104H-412	104H-413	104H-421*	104H-422*	104H-423*	104H-431	104H-432	104H-433*	104H-441	104H-442
2013/ 2014 Peak	139	209	280	208	239	232	385	146		217	

Note:

- * indicates feeders with gaps in telemetry data.

Table 6 129H-Kearney Lake 2014 peak 2013/2014 feeder loading, in Amps

	129H-411	129H-412	129H-413
2013/2014 Peak	175	226	354

Table 7 20H-Spryfield and 23H-Rockingham 2014 peak 2013/2014 feeder loading, in Amps

	20H-301	20H-302	20H-303	20H-304	20H-305	20H-306	23H-301	23H-302	23H-303	23H-304	23H-301
2014 Peak	357	288	318	237	475	372	105	207	318	288	105

Table 8 90th Percentile Load Forecast for Halifax Peninsula Transformers, in MVA

Year / Load Growth	1H-T61	1H-T62	2H-T61	104H-T61	104H-T62	104H-T63	Peninsula Total
Rating	**40/53**	**40/53**	**//25/32/42**	**25/33.3/41.7**	**25/33.3/41.7**	**25/37/46.7**	
Load Growth	**-0.8%**	**1.4%**	**0.24%**	**0.6%**	**0.2%**	**-0.1%**	**0.7%**
2013/2014 Peak	**42**	**36**	**38**	**46**	**49**	**41**	**205**
2014 / 2015	43	37	40	47	46	44	219
2015 / 2016	43	38	40	48	46	44	220
2016 / 2017	43	38	40	48	46	44	222
2017 / 2018	42	39	40	48	47	44	224
2018 / 2019	42	40	40	49	47	43	225
2019 / 2020	42	40	40	49	47	43	227
2020 / 2021	41	41	41	49	47	43	229
2021 / 2022	41	42	41	50	47	43	230
2022 / 2023	41	42	41	50	47	43	232
2023 / 2024	40	43	41	50	47	43	234
2024 / 2025	40	43	41	51	47	43	235
2025 / 2026	40	44	41	51	47	43	237
2026 / 2027	39	45	41	51	47	43	239
2027 / 2028	39	45	41	52	47	43	240
2028 / 2029	39	46	41	52	47	43	242

Table 9 90th Percentile Load Forecast for adjacent substation Transformers, in MVA

Year / Load Growth	20H-T1	20H-T2	23H-T51	103H-T61	129H-T61	Study Total
Rating	**15/20//22.4**	**15/20/25//28**	**15/20//25**	**25/33.3/41.6//46.6**	**25/33.3//41.5**	
Load Growth	**0.4%**	**0.1%**	**0.4%**	**0.2%**	**1.1%**	**0.9%**
2013/2014 Peak	**21**	**22**	**25**	**51**	**42**	**375**
2014 / 2015	21	20	24	51	40	383
2015 / 2016	21	20	24	51	40	387
2016 / 2017	21	20	24	51	40	390
2017 / 2018	21	20	24	51	41	394
2018 / 2019	21	20	24	51	41	398
2019 / 2020	21	21	24	52	42	402
2020 / 2021	21	21	24	52	42	406
2021 / 2022	21	21	24	52	43	409
2022 / 2023	22	21	25	52	43	413
2023 / 2024	22	21	25	52	44	417
2024 / 2025	22	21	25	52	44	421
2025 / 2026	22	21	25	52	45	425
2026 / 2027	22	21	25	52	45	428
2027 / 2028	22	21	25	53	46	432
2028 / 2029	22	21	25	53	46	436

Note:

- The load forecast for the individual 20H-Spryfield transformers utilizes both the monthly distribution load check values, as well as the recent PI archive values.

4.0 OVERLOADS AND OTHER CONSIDERATIONS

The following section identifies issues that warrant correction based on NSPI's *Capital Expenditure Justification Criteria*.

4.1 Feeder Overloads

In consideration of the variety of feeder reconfigurations available within the study area, the indication of feeders of exceeding 325A will be indicated, for reference only. The load histories for the feeders can be found in Appendix B. The loading on the following feeders was above 325A, during the 2013/2014 peak loading period.

- 103H-Lakeside 103H-432, 103H-433, 103H-434
- 104H-Kempt Road 104H-431
- 129H-Kearney Lake 129H-413
- 20H-Spryfield 20H-301, 20H-305, 20H-306

4.2 Contingency Loss of Supply

In the event of a single transformer failure at any of the substations on the Halifax Peninsula, it is possible to transfer load to the remaining substation transformers on the Peninsula. As the load on the Peninsula continues to grow, the ability to accomplish this will require more extensive switching than presently required.

4.3 Age of Plant

The age of the distribution plant on the Halifax Peninsula ranges from relatively new (<10years), due to load growth and Hurricane Juan (South End), to more than 40years old, in mature communities.

A large portion of the older overhead distribution plant on the Peninsula is supplied via the 4kV system. Given the recommendations of the Halifax 4kV Distribution Planning Study (303-0612-H49), significant portions of this older infrastructure will be replaced, as part of the conversion work that will take place. The conversion of the remaining 4kV distribution on the Halifax Peninsula has been recommended to be completed prior to 2018.

4.4 Proposed Load Growth

There are several areas of load growth in Halifax Peninsula and adjacent areas. An overview of these areas can be found below, with discussions relating to the recommendations and overall impacts on the overall distribution system in subsequent sections.

4.4.1 Halifax Peninsula Load Growth

Peninsular Halifax is in the midst of a large scale redevelopment plan, ranging from redevelopment of existing buildings through to new developments and the repurposing of existing lands. While there have been a variety of developments before HRM council, for the last several years, a significant number of these developments have been approved to proceed, since the last municipal election (Oct. 2012). Some of the significant developments that have been approved include:

- New convention centre (under construction)
- Redevelopment of TD Bank block (under construction)
- New Halifax Regional Library (under construction)
- Port of Halifax Shore Power Project (under construction)

While individually these developments do not represent significant load growth (with the exception of the Convention Centre and Shore Power), the cumulative load of these developments represents significant growth in the area (above the forecasted rate of 0.7%). Consideration for these developments is required, for the planning of the transformation capacity on the Halifax Peninsula.

4.4.2 103H-Lakeside and 129H-Kearney Lake Load Growth

103H-Lakeside currently provides additional transfer capacity to the Halifax Peninsula via feeder ties with 2H-Armdale and also to the Kearney Lake area via feeder ties with 129H-Kearney Lake. Continued load growth at 103H-Lakeside and 129H-Kearney Lake will see reductions in this transfer capacity.

Currently, there are several projects in various stages of construction and approvals, within the 103H-Lakeside service area. The larger projects include new housing developments, as well as increases in commercial and industrial load, within the service area. The list below is a sample of these projects:

- Brunello Estates 530 Acre development
- Lovett Lake Estates 49.5 Acre development

Continued growth in the Larry Uteck area and development west of Highway 102, in the area will provide significant growth in the 129H-Kearney Lake service area. There is also a variety of new anticipated growth in the 129H-Kearney Lake service area, in addition to projects currently under construction.

Given these increases in load growth, the requirement to address both the substation capacity, as well as the transfer capacity available to adjacent substations is required.

4.4.3 20H-Spryfield Load Growth

20H-Spryfield is an islanded12kV distribution, with no ability to transfer, to adjacent substations, only between transformers within the substation (20H-T1 and 20H-T2). As the load in the service area continues to grow, the ability to transfer load to other feeders supplied by the substation decrease. Presently, the load is nearing the contingency capacity. Given the overall growth rate of 20H-Spryfield has been calculated to be 1.06%, it is projected that the contingency capacity (54.7MVA) will be exceeded prior to 2024. The 12kV service area supplied by 20H-Spryfield is highlighted in Figure 3 and Figure 4.

Currently, there are a number of projects in construction, as well as others that have been approved by HRM council. The list below is a sample of these projects:

- Kidston Estates 900 Acre development
- Governor's Brook 351 Acre development

Figure 3 20H-Spryfield Service Area Part 1

Figure 4 20H-Spryfield Service Area Part 2

With consideration of the continued forecasted load growth in the area, and the inability to transfer load to another 12kV source, a solution to address these requirements needs to be determined.

4.4.4 23H-Rockingham Load Growth

23H-Rockingham is another area of islanded 12kV distribution, with no ability to transfer to any adjacent substations. While the load at this substation has been relatively small in recent years, new anticipated load growth will exceed the capacity of the 5P-MS (25MVA), in the near term, under peak loading conditions. Presently, there are a variety of development applications that have been approved by HRM council. Some of these developments have begun or are preparing to begin construction. These developments include:

- Halifax West High School Redevelopment
- Rockingham South 55 Acre Development
- The Motherhouse Lands 63 Acre Development

Figure 5 **23H-Rockingham Service Area**

With consideration of the proposed future growth within the service area, the requirement to address substation and contingency capacities are required, both in the near and long terms.

5.0 SOLUTIONS AND EVALUATION

Peninsular Halifax is in the beginning stages of large redevelopment. Within this redevelopment, a great deal of new load will be added to the existing 25kV distribution system in the coming years. Due to this growth, this study will investigate the need for additional transformation and feeders within the peninsula.

In addition to the load growth on the peninsula, the areas adjacent to the peninsula are also experiencing significant growth. As a result of this growth, the initial scope of this study has expanded to include the islanded 12kV systems at 20H-Spryfield and 23H-Rockingham as well as the 25kV distribution at 103H-Lakeside and 129H-Kearney Lake.

In consideration of the large area being considered within the scope of this study, the study will be separated by the following areas:

- Halifax Peninsula
- 103H-Lakeside and 129H-Kearney Lake
- 20H-Spryfield
- 23H-Rockingham

The discussions for each of these areas are outlined below:

5.1 Halifax Peninsula

The Halifax Peninsula area is on the cusp of large scale load growth **(0.7%)**, that hasn’t been seen in Halifax for a number of years. The proposed redevelopment of the downtown core will increase the population density in the downtown core, as well as create more retail and office space, than ever before.

While there is a resurgence in the downtown core, the remainder of the peninsula is also in the midst of significant growth, both residentially and industrial (Halifax Ship Yards, CFB Halifax and Shore Power). With this in mind, there is a renewed requirement to review the substation transformer and feeder loading to ensure enough capacity is available, when required, to meet this growth.

With the introduction of Shore Power, a new type of load will be introduced into Nova Scotia for cruise ships visiting the Port of Halifax. This seasonal load will require one entire feeder (with prospects for a second), to enable a cruise ship to be supplied via a dedicated source, rather than utilize on-board generation, while in port. This will reduce the ship’s fuel consumption, as well as lower emissions, while in port.

Additionally, as part of the National Shipbuilding Procurement Strategy, The Halifax Shipyards are in the process of designing and constructing a new fabrication facility to construct the new Arctic Offshore Patrol Ships (AOPS) and Canadian Surface Combatant (CSC) vessels over the next 25-30 years. This additional load is anticipated to require a reconfiguration of the feeders supplying the area.

A new transformer, 1H-T63, was procured for 1H-Water Street in 2012. This transformer (138kV-26.4kV 40/53MVA) was initially to be utilized as spare capacity at 1H-Water Street to accommodate increases in load. As a result, additional transfer capacity will not be required at 1H-Water Street despite the load increase due to Shore Power under both normal and contingency conditions for the foreseeable future.

Additionally, another transformer will be available to be installed within the peninsula in 2015. This transformer will provide additional capacity on the Halifax Peninsula, when installed. The location of this transformer is the basis of the alternatives presented below.

Alternative New Transformer- A would see the new transformer placed at 104H-Kempt Road. This alternative would add a fourth transformer to the 104H-Kempt Road substation, as per its current design configuration. The placement of this transformer would be difficult, by way of the existing infrastructure within the substation. The installation of a new transformer would require the relocation of 104H-T63 to the new location, prior to the installation of the fourth transformer (in the current location of 104H-T64). An additional challenge would be adding new feeders to this substation, given the congestion and ability to secure easements for any new feeders. Further to this, in the event of a 104H-T63 failure, the process for removing the unit is the reverse of the installation, in that the new transformer would need to be removed to access the third unit. This would potentially create additional outages and/or extensive switching with two units de-energized at one time, due to one unit failure.

Alternative New Transformer – B would see the new transformer installed at 2H-Armdale. Utilizing this location would require significant work, on both the high and low side buses. Unlike, Alternative New Transformer – A, the ability to add additional feeders to the substation is less complicated, in that the substation is constructed roadside near the Armdale rotary. This location would allow for additional feeders to be added and provide the widest array of transfer capacity to both the substations on the Halifax Peninsula (1H-Water Street and 104H-Kempt Road), as well as 103H-Lakeside. In the event of a transformer failure at 2H-Armdale, either unit would be readily accessible unlike the process of outlined in the previous alternative.

Further detail of each alternative can be found below.

5.1.1 Alternative New Transformer-A Place Transformer at 104H-Kempt Road

This alternative (New Transformer-A) would see the installation of a fourth transformer at 104H-Kempt Road. This substation had been originally designed as a four transformer substation. With the addition of a fourth transformer, an additional three feeders would be added to the substation.

The first new feeder would supply the North Street area, near the MacDonald Bridge. This new feeder would utilize the feeder exits on Young Street and require a new double circuit to Robie Street. The new double circuit would continue on Robie Street to Almon Street, where advancement of the 4kV conversions would be required. The de-energized 4kV along Robie Street would then be reconductored, from Almon Street to North Street, continuing on North Street to Creighton Street. New open points and feeder configurations would reduce the loading on the feeders in the area. Refer to Figure 6 below for a general outline of this new feeder.

Figure 6 Alternative A; 104H-Kempt Road New Feeder-A

The second new feeder would supply the Duffus Street, north Barrington Street area. This would be accomplished through extending the duct containing 104H-433 along Stairs Street, to Massachusetts Avenue. Transitioning to overhead configuration, the new feeder would continue along Stairs Street to Isleville Street, rebuilding the single phase portions to three phase. Isleville Street would then be rebuilt from Livingstone Place to Duffus Street, with this portion of Isleville Street being supplied via Stairs Street. A new open point would be installed on Duffus Street on the opposite side of the Robie Street intersection, than D431-431. Additionally, an open point would be installed on Barrington Street, near North Marginal Road. Refer to Figure 7 below for a general outline of this new feeder.

Figure 7 Alternative A; 104H-Kempt Road New Feeder-B

The third new feeder would provide an additional supply to Joseph Howe Drive, via Lady Hammond Road. This would be accomplished by utilizing the feeder exit ducts to Kempt Road and double circuiting Kempt Road to Hood Street, as well as Commission Street to Lady Hammond Road. Lady Hammond Road already has a double circuit configuration from Commission Street to McKintosh Street. Reconfiguration in this area would require the relocation of open points, to enable the use of the new feeder. Refer to Figure 8 below for a general outline of this new feeder.

Figure 8 Alternative A; 104H-Kempt Road New Feeder-C

Due to growth in the area, the installation of a fourth transformer would be difficult to implement. Installation of a fourth transformer at 104H-Kempt Road would require that the third transformer (104H-T63) be moved into the empty transformer location and the fourth transformer installed. Due to congestion in the substation, 104H-T63 would not be able to be hoisted into position.

Additionally, in the event of a failure of 104H-T63, the process of installation would need to be reversed. The new transformer would need to be removed from service to enable the removal of 104H-T63. If this failure occurred under peak loading conditions, extensive switching and/or longer duration of outages would occur because of the affected buses,.

5.1.2 Alternative New Transformer-B Place Transformer at 2H-Armdale

This alternative (New Transformer-B) would see the addition of the new 138-25kV 25/33/42MVA transformer at the 2H-Armdale substation. The location of the 2H-Armdale substation enables the ability to transfer load between adjacent substations, both on and off of the peninsula. With the installation of this new transformer, four additional feeders would be added to the substation.

The first feeder, Feeder-A, would be utilized to reduce load on 104H-423, along Joseph Howe Drive. This would be accomplished through the construction of a double circuit along Clinton Avenue to Joseph Howe Drive. The Joseph Howe Drive tap would be moved from 2H-411 to the new feeder. D431-190 would close and recloser R4A05791 would open. Refer to Figure 9 below for a general outline of this new feeder.

Figure 9 **Alternative B; 2H-Armdale New Feeder-A**

The second and third feeders, Feeder B & C, would supply St, Margaret's Bay Road and Purcell's Cove Road via the Armdale Rotary. This would be accomplished through extending the feeders down Chebucto Road to the Armdale Rotary to Purcell's Cove Road. One feeder would supply the upper circuit (currently 2H-411) and the other the lower circuit (currently 20H-302, prior to conversion). A new open point would then be installed, on 2H-411, between the current supply and the new supply. Additionally, the Regency Park area would be transferred from 103H-433 to 2H-411 through shifting the open point on St. Margaret's Bay Road, through Opening D431-309 and closing D431-310. Refer to Figure 10 below for a general outline of this new feeder.

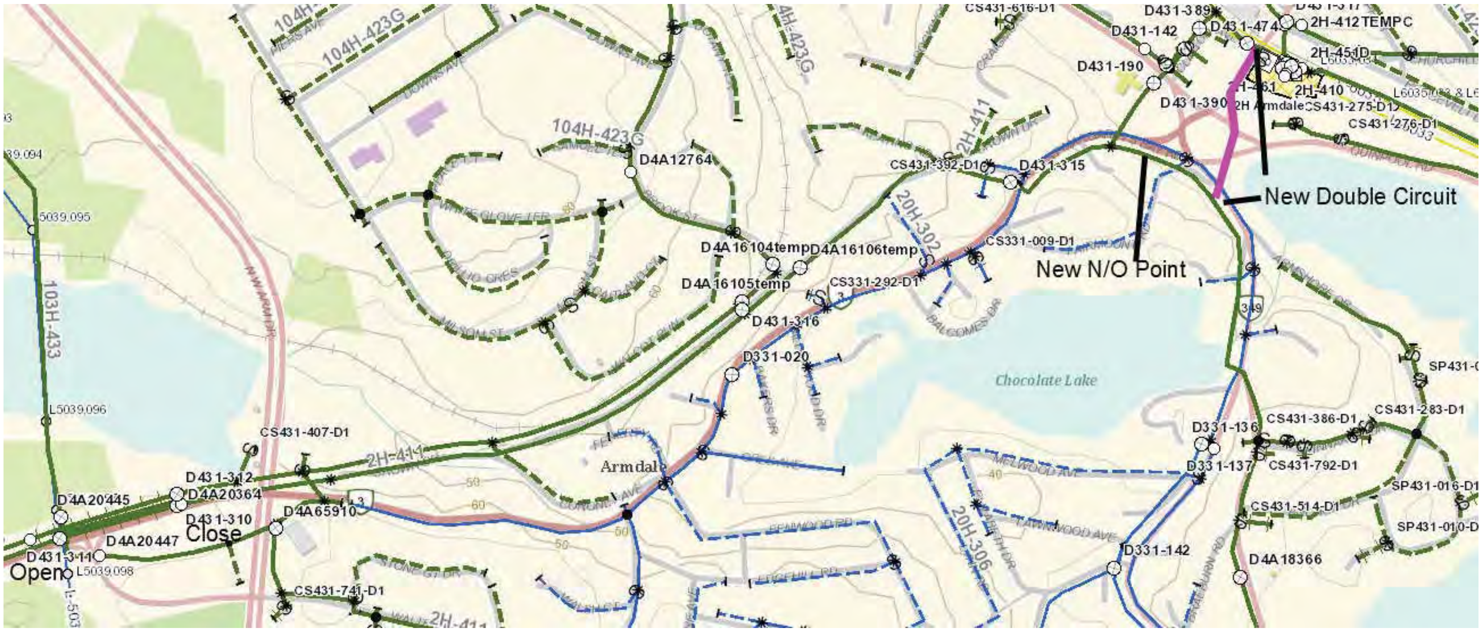


Figure 10 **Alternative B; 2H-Armdale New Feeders B&C**

The fourth feeder, Feeder D, would add an additional supply into the Quinpool Road area. This would be accomplished by utilizing the same routing as Feeders B&C down Chebucto Road. Extending the existing feeder on Quinpool Road towards the Armdale Rotary would meet the routing on Chebucto Road. The tap from 2H-413, where it crosses Quinpool Road, would need to be removed. A new open point on MacDonald Street, near Quinpool Road, as well as closing D431-492, will enable the feeder to extend along Quinpool Road. This new feeder would reduce loading to 2H-412, as well as 2H-413. Refer to Figure 11 below for a general outline of this new feeder.

Figure 11 **Alternative B; 2H-Armdale New Feeder-D**

In addition to providing additional feeders to the peninsula and adjacent areas, the feeders would provide the greatest capability to supply large portions of the forthcoming conversions at both 20H-Spryfield and 23H-Rockingham (as outlined in subsequent sections).

5.1.3 Recommend Alternative Install New Transformer at 2H-Armdale

The recommended alternative for the Halifax Peninsula is to install a new 138-25kV 25/33/42MVA transformer at 2H-Armdale. The installation of additional transformation at 2H-Armdale enables a greater amount of feeder configurations both on and off of the Halifax Peninsula. This alternative will also provide the capacity required to supply the 20H-Spryfield conversions, as well as a significant portion of the 23H-Rockingham conversions, as described later in this study.

The results of the Economic Analysis Model (EAM) indicated that the installation of the new transformer at 2H-Armdale is the least cost alternative, of those presented.

5.2 103H-Lakeside and 129H-Kearney Lake

The area supplied by 103H-Lakeside is currently experiencing noticeable growth through new residential developments. There are also industrial development applications before HRM council. The combined effect of these new developments will load 103H-T61 beyond its nameplate rating. This transformer is the lone distribution transformer at 103H-Lakeside.

The areas supplied by the 129H-Kearney Lake substation are continuing to see considerable residential and commercial growth. Presently the substation supplies a large portion of the 25kV in Clayton Park, as well as the Larry Uteck Boulevard area. The anticipated growth within the Larry Uteck Boulevard area, in particular is projected to continue for the next several years, with an increase in the population density in the area continuing to grow. With this projected continued growth, opportunities to transfer load to adjacent substations need to be considered.

The 129H-Kearney Lake substation is supplied via a radial 138kV transmission line, L-6038. The lone transformer at this substation is 138-26.4kV 25/33.3/41.5MVA unit (55MVA at 133% of nameplate rating). In consideration of the limited capacity available, prior to requiring a second transmission supply into the substation, an investigation into load transfers between 129H-Kearney Lake and adjacent substations is required. The scope of this study bounds these potential load transfers to the substations within and adjacent to the Halifax Peninsula (presently 103H-Lakeside and 104H-Kempt Road for 129H-Kearney Lake).

Alternative 103H/129H-A would see the replacement of 103H-T61 with a larger unit, to meet the anticipated near term load growth. Currently, the largest 138-26.4kV transformer in the NSPI fleet is a 40/53MVA, located at 1H-Water Street. A transformer, of this size, would be capable of supplying the existing four feeders, with the ability to add one additional feeder. Given that the majority of the 103H-Lakeside distribution is mostly radial, outside of Lakeside and Bayers Lake area, the ability to transfer load between feeders would require the construction of double circuits to balance load across feeders. Additionally, a new feeder could be created at 129H-Kearney Lake to reduce load on 129H-413, through reconfiguring existing feeders. In consideration of the anticipated load growth in the area, a second transformer would need to be installed at 103H-Lakeside in 2023.

Alternative 103H/129H-B would see an additional distribution transformer added to 103H-Lakeside. This alternative would allow for three additional feeders to be added to the substation initially, with provisions for a fourth, as demanded by load growth. These new feeders would reduce loading at 129H-Keaney Lake via load transfers to 103H-Lakeside. Similarly to Alternative 103H/129H-A, a new feeder could be created at 129H-Kearney Lake to further reduce loading on 129H-413.

Alternative 103H/129H-C would see the installation of a new 69-25kV 25/33/42MVA transformer at 129H-Kearney Lake. This new transformer would add an additional three feeders initially, with the ability to add a fourth feeder, when required. The existing 129H-Kearney Lake feeders, as well as those adjacent, would see reductions, through transfers to the new feeders created. These load reductions would then be cascaded to the other feeders, of the adjacent substations, where possible.

Further detail of each alternative can be found below.

5.2.1 Alternative 103H/129H-A Replace 103H-T61

This alternative (103H/129H-A) would see the replacement of the 103H-T61 (138–26.4kV 25/33.3/41.6//46.6 MVA) with a larger (53MVA) unit. The additional capacity created by this replacement will allow for one additional feeder to be created. Additional feeder reconfigurations would be required to reduce loading on the feeders where growth is anticipated. A second transformer would be installed in 2023, utilizing similar feeder configurations, as outlined in Alternative 103H/129H-B.

The new feeder would exit the 103H-Lakeside substation along the transmission corridor to Horseshoe Lake Drive. A new open point would be created on 103H-433, south of the transmission corridor crossing, as well as on Chain Lake Drive, south of Susie Crescent. The existing open point on Hobson Lake Drive (D4A11144) and Chain Lake Drive (D431-299) would be closed. D431-296 (along the Salt Marsh Trail) would be opened. This would allow the new feeder to supply the northern portion of the Bayers Lake Industrial Park, while 103H-422 would supply the southern portion of the business park. A general outline of this new feeder and reconfigurations within the Bayers Lake Industrial Park can be found in Figure 12 below.

Figure 12 Alternative 103H/129H-A; New 103H-Lakeside Feeder

With the reduction in load on 103H-431, a reduction of load on 103H-432 can be accomplished by extending the double circuit on St. Margaret's Bay Road to Greenhead Road. This would enable the transfer of load from 103H-432 to 103H-431, to this point. Refer to Figure 13 below for a general outline of this feeder reconfiguration.

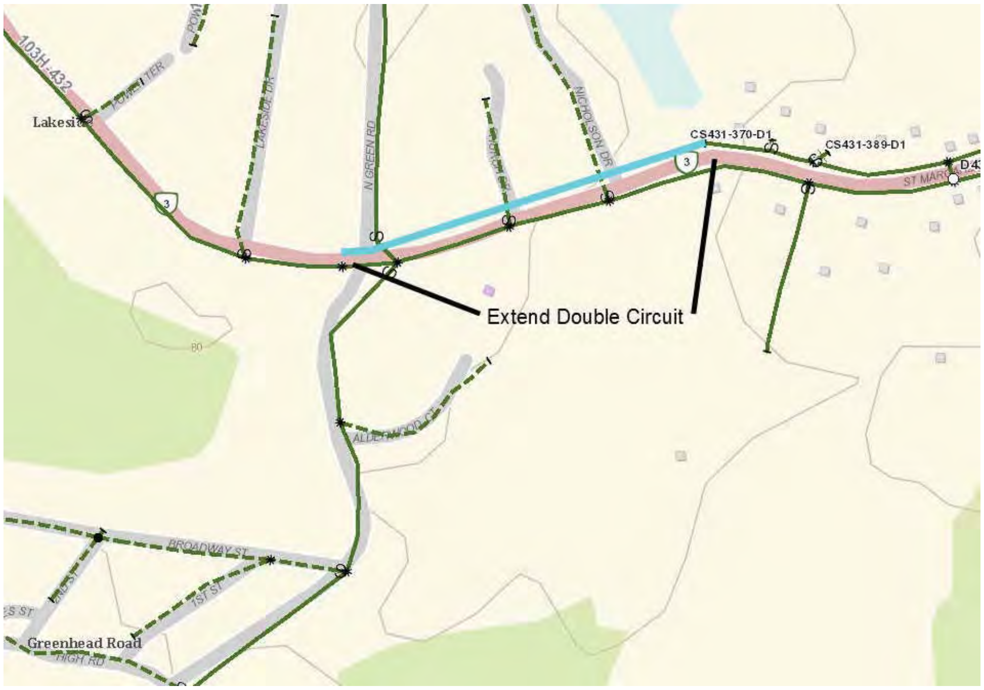


Figure 13 **Alternative 103H/129H-A; 103H-432 Load Reduction**

Further feeder reconfigurations of 103H-Lakeside feeders would see an extension of the double circuit along Prospect Road, reducing load on 103H-434. Given that the existing load on this feeder is primarily radial, load reductions can only be achieved through extending the existing double circuit. Given that Prospect Road is capable of being supplied by three feeders (103H-431, 103H-433 and 103H-434), extending the double circuit beyond Ragged Lake Boulevard will enable the transfer of load from 103H-434 to another feeder.

The initial extension of this double circuit would extend from Ragged Lake Boulevard to Mills Drive and supplied by 103H-431, via Ragged Lake Boulevard. Further extension of this double circuit would be dependent on the rate of load growth, in the future. Refer to Figure 14 below for a general outline of the double circuit extension.

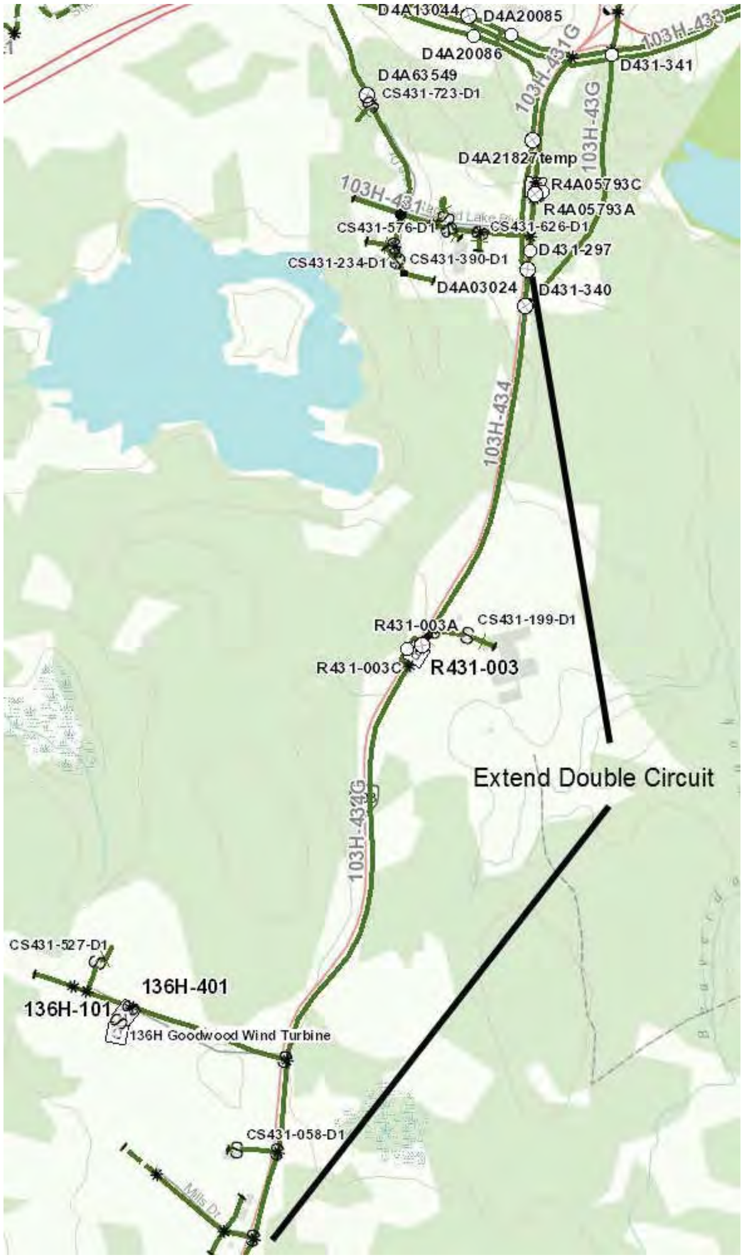


Figure 14 **Alternative 103H/129H-A; Prospect Road Double Circuit Extension**

Additionally, a fourth feeder would be created at 129H-Kearney Lake, to reduce the overall loading on 129H-413. This feeder would exit the substation and cross Highway 102, in a double circuit configuration with 129H-413. The feeder would then continue along Kearney Lake Road, to Castle Hill Drive. The supply to Castle Hill Drive would be changed to the new feeder. A new open point would also be added on Kearney Lake Road, where 129H-412 currently crosses the road, near the Dunbrack Street intersection. Refer to Figure 15 below for a general outline of this new feeder.

Figure 15 **Alternative 103H/129H-A; New 129H-Keaney Lake Feeder**

With the introduction of this new feeder, further load reductions can be realized through the reconfiguration of 129H-413. Utilizing the new feeder's supply along the Bedford Highway, load could be transferred to this feeder, through operating existing switches. An overview of these feeder reconfigurations can be seen in Figure 16 below.

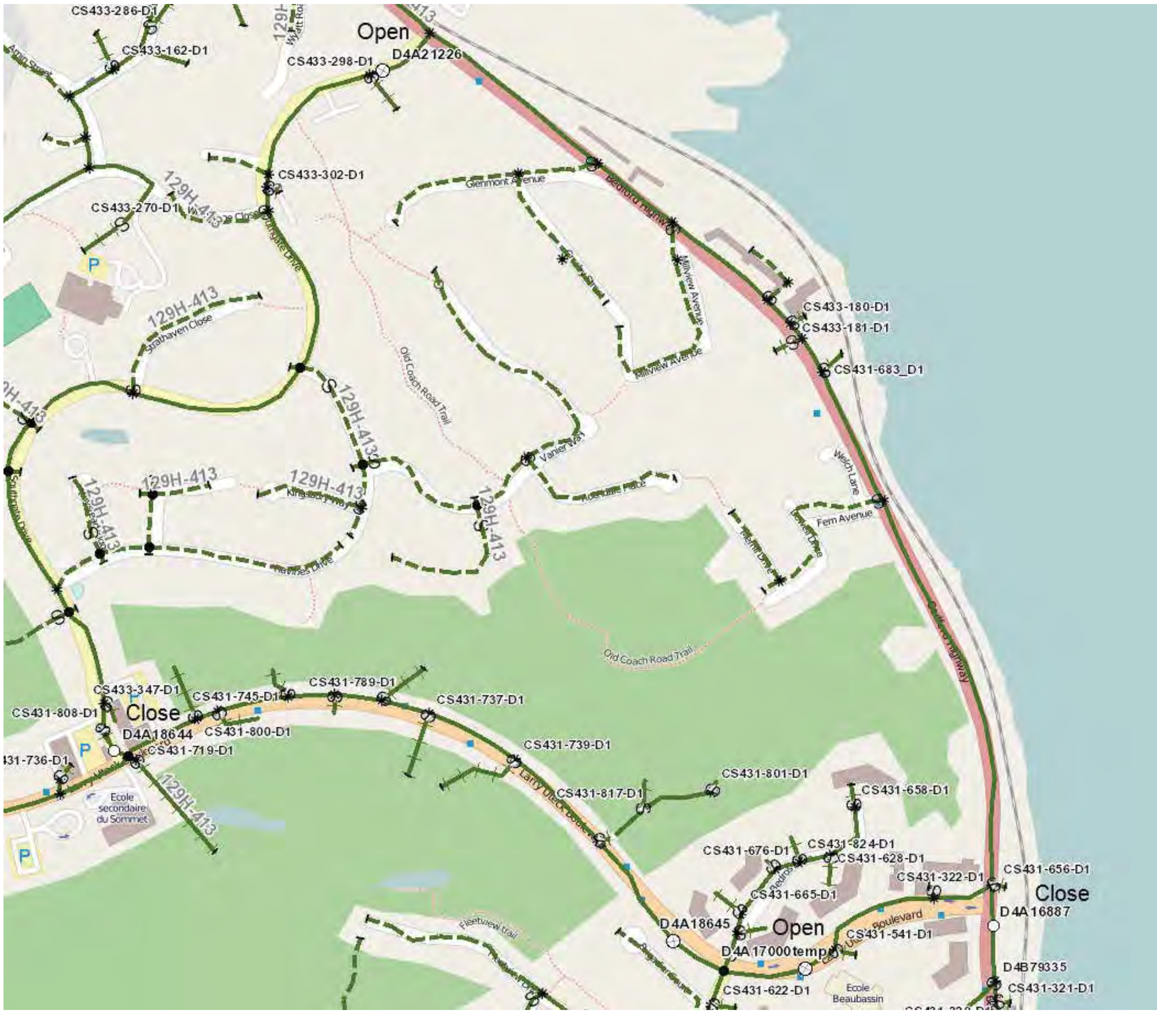


Figure 16 **Alternative 103H/129H-A; 129H-Kearney Lake Reconfiguration**

5.2.2 Alternative 103H/129H-B Additional 103H-Lakeside Transformer

Alternative 103H/129H-B would see the addition of a 138kV-26kV 25/33/42MVA transformer installed at the 103H-Lakeside substation. This new transformer would initially provide three new feeders to the 103H-Lakeside substation and reduce loading at 129H-Kearney Lake via load transfers to these new feeders. Provisions for a fourth feeder would be considered, in the future, as required.

The three new feeders would be routed via the transmission corridor from 103H-Lakeside into the Bayers Lake Industrial Park. Two of the new feeders would supply the area north of the transmission corridor on Horseshoe Lake Drive, extending to Chain Lake Drive. The third feeder, would supply the southern portion of the Bayers Lake Industrial Park. Refer to Figure 17 below for a general outline of these new feeders.

Figure 17 **Alternative 103H/129H-B; New 103H-Lakeside Feeders**

With the reduction in load on 103H-431, a reduction of load on 103H-432 can be accomplished by extending the double circuit on St. Margaret's Bay Road to Greenhead Road. This would enable the transfer of load from 103H-432 to 103H-431, to this point. Refer to Figure 18 below for a general outline of this feeder reconfiguration.

Figure 18 Alternative 103H/129H-B; 103H-432 Load Reduction

As outlined in the previous alternative, further feeder reconfigurations of 103H-Lakeside feeders would see an extension of the double circuit along Prospect Road, reducing load on 103H-434. Given that the existing load on this feeder is primarily radial, load reductions can only be achieved through extending the existing double circuit. Given that Prospect Road is capable of being supplied by three feeders (103H-431, 103H-433 and 103H-434), extending the double circuit beyond Ragged Lake Boulevard will enable the transfer of load from 103H-434 to another feeder.

The initial extension of this double circuit would extend from Ragged Lake Boulevard to Mills Drive and supplied by 103H-431, via Ragged Lake Boulevard. Further extension of this double circuit would be dependent on the rate of load growth, in the future. Refer to Figure 19 below for a general outline of the double circuit extension.

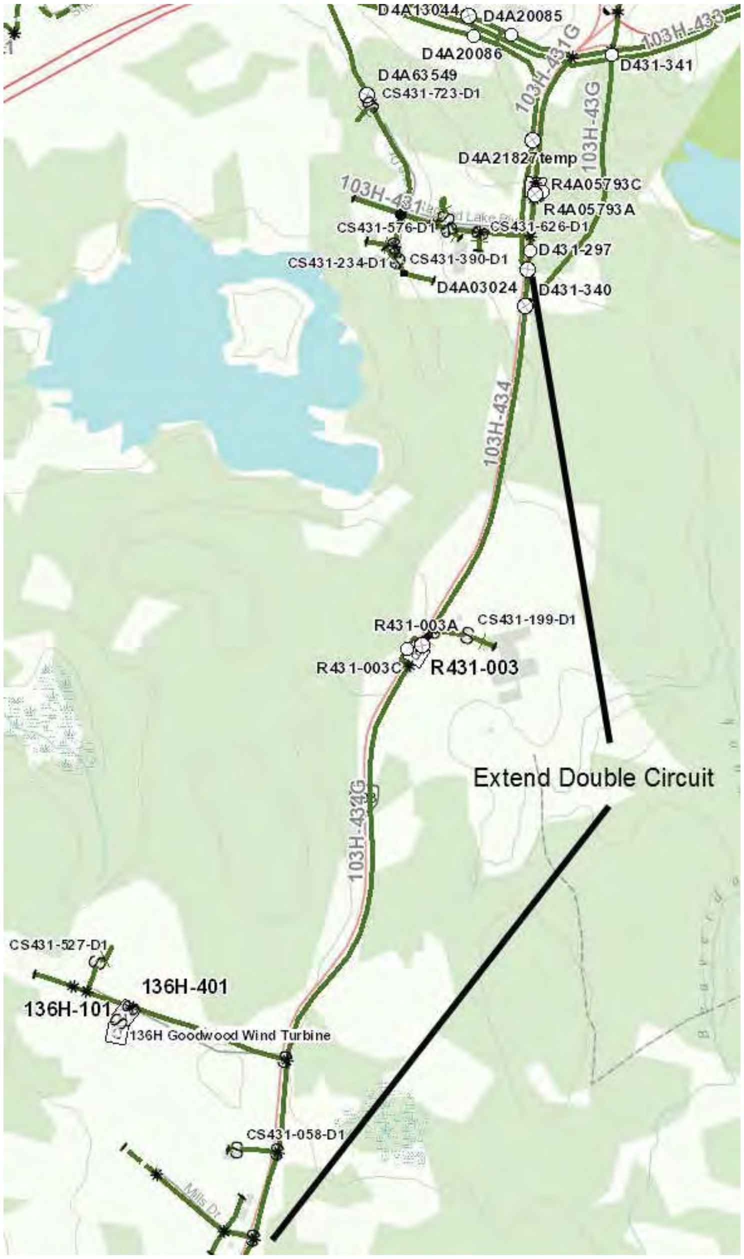


Figure 19 **Alternative 103H/129H-B; Prospect Road Double Circuit Extension**

Load reductions at 129H-Kearney Lake would be realized through transferring load to the Chain Lake Drive feeders. Initially, these new feeders would have sections of both 129H-411 and 129H-412 transferred to them, utilizing the existing feeder tie points, on Lacewood Drive. Refer to Figure 20 below for a general outline of this feeder reconfiguration.

Figure 20 Alternative 103H/129H-B; 129H-Kearney Lake Load Transfer

Similar to Alternative 103H/129H-A, a fourth feeder would be created at 129H-Kearney Lake, to reduce the overall load on 129H-413. This feeder would exit the substation and cross Highway 102, in a double circuit configuration with 129H-413. The feeder would then continue along Kearney Lake Road, to Castle Hill Drive. The supply to Castle Hill Drive would be changed to the new feeder. A new open point would also be added on Kearney Lake Road, where 129H-412 currently crosses the road, near the Dunbrack Street intersection. Refer to Figure 21 below for a general outline of this new feeder.

Figure 21 Alternative 103H/129H-B; New 129H-Keaney Lake Feeder

With the introduction of this new feeder, further load reductions can be realized through the reconfiguration of 129H-413. Utilizing the new feeder's supply along the Bedford Highway, load could be transferred to this feeder, through operating existing switches. An overview of these feeder reconfigurations can be seen in Figure 22 below.

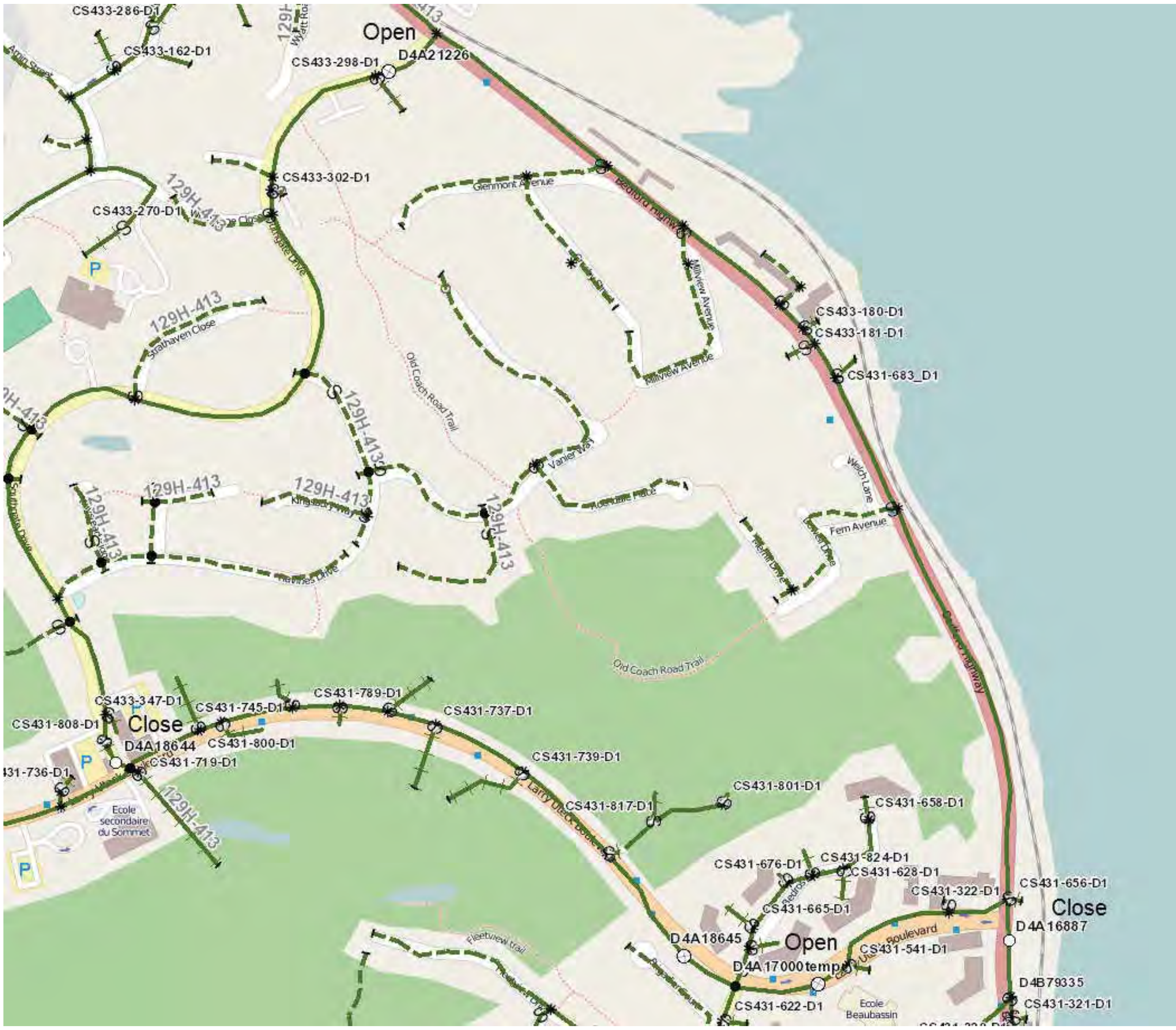


Figure 22 Alternative 103H/129H-B; 129H-Kearney Lake Reconfiguration

5.2.3 Alternative 103H/129H-C 129H-Kearney Lake Transformer Addition

Alternative 103H/129H-C would see the addition of a 69-25kV 25/33/42MVA transformer at 129H-Kearney Lake. This new transformer would initially supply three feeders to reduce loading on the current 129H-Kearney Lake feeders and meet the anticipated load growth in the surrounding areas. Additionally, feeder reconfigurations would be required at 103H-Lakeside to reduce loading on heavily loaded feeders.

The first of these feeders would exit the substation, similarly to the new 129H-Kearney Lake feeder outlined in the previous alternatives. This feeder would utilize the existing pole line, in a new double circuit configuration to Castle Hill Drive. The supply to Castle Hill Drive would then change from 129H-412, to this new feeder. A new open point would also be added on Kearney Lake Road, where 129H-412 currently crosses the road, near the Dunbrack Street intersection. Refer to Figure 23 below for a general outline of this new feeder.

Figure 23 **Alternative 103H/129H-C; New 129H-Keaney Lake Feeder-A**

With the introduction of this new feeder, further load reductions can be realized through the reconfiguration of 129H-413. Utilizing the new feeder's supply along the Bedford Highway, load could be transferred to this feeder, through operating existing switches. An overview of these feeder reconfigurations can be seen in Figure 24 below.

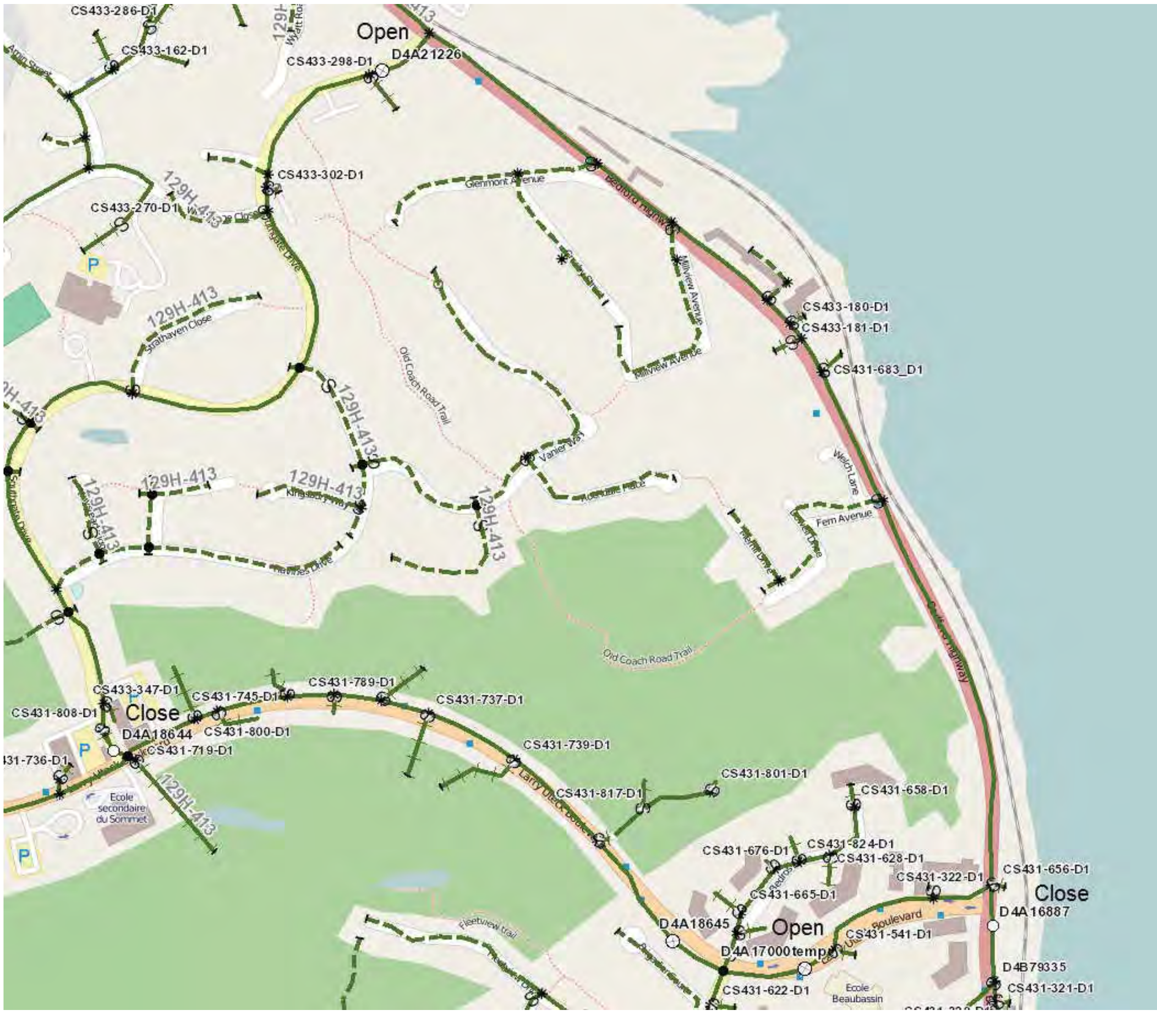


Figure 24 **Alternative 103H/129H-C; 129H-Kearney Lake Reconfiguration -A**

The second new feeder to be created at 129H-Kearney Lake would utilize the existing 129H-413 feeder tap that extends south of the substation, parallel to Highway 103. This feeder would initially remove a small portion of load from 129H-413, but in combination with the proposed reconfiguration (next portion) would provide an additional feeder into the Clayton Park area. Refer to Figure 25 below for a general outline of this new feeder.

Figure 25 **Alternative 103H/129H-C; New 129H-Kearney Lake Feeder-B**

The initial feeder reconfigurations associated with the second new 129H-Kearney Lake feeder would create an additional feeder supplying the Clayton Park area, via Farnham Gate Road. This new feeder would be capable of reducing load on both 129H-411 and 129H-412, as well as enable the transfer of load from 103H-433 (via Lacewood Drive). An overview of these feeder reconfigurations can be seen in Figure 26 below.

Figure 26 **Alternative 103H/129H-C; 129H-Kearney Lake Reconfiguration -B**

The third new feeder created with the addition of the new transformer at 129H-Kearney Lake would be utilized for the future growth of the Larry Uteck Boulevard area. This feeder would exit the substation and end adjacent to the existing 137H-414, on Kearney Lake Road. As the anticipated development of the Larry Uteck Boulevard area continues on the western side of Highway 103, this new feeder would be used to supply this new load. Refer to Figure 27 below for a general outline of this new feeder.

Figure 27 Alternative 103H/129H-C; New 129H-Kearney Lake Feeder-C

As outlined in the previous alternatives, a reconfiguration of 103H-Lakeside feeders would see an extension of the double circuit along Prospect Road, reducing load on 103H-434. Given that the existing load on this feeder is primarily radial, load reductions can only be achieved through extending the existing double circuit. Given that Prospect Road is capable of being supplied by three feeders (103H-431, 103H-433 and 103H-434), extending the double circuit beyond Ragged Lake Boulevard will enable the transfer of load from 103H-434 to another feeder.

The initial extension of this double circuit would extend from Ragged Lake Boulevard to Mills Drive and supplied by 103H-433, via St. Margaret's Bay Road. Further extension of this double circuit would be dependent on the rate of load growth, in the future. Refer to Figure 28 below for a general outline of the double circuit extension.

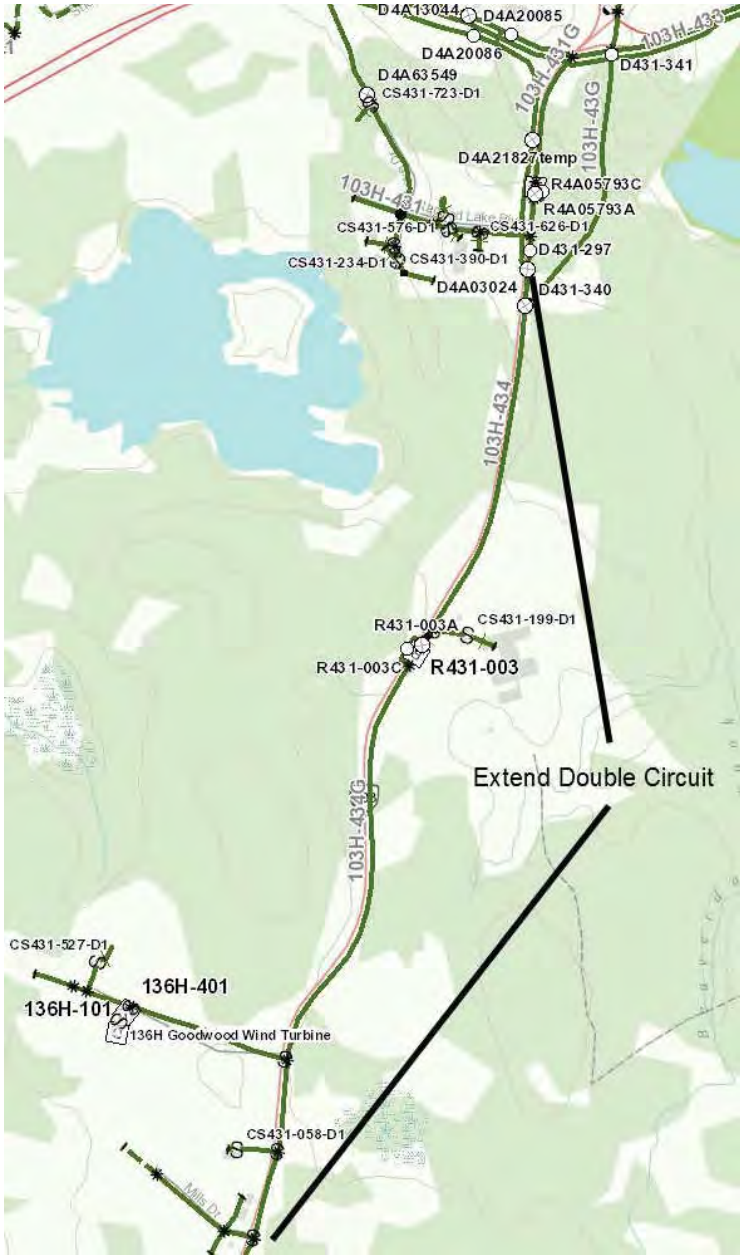


Figure 28 **Alternative 103H/129H-C; Prospect Road Double Circuit Extension**

A reduction of load on 103H-432 would be accomplished through the initial extension of the double circuit on St. Margaret's Bay Road to Greenhead Road. This would enable the transfer of load from 103H-432 to 103H-431. Future extensions of this double circuit will be required, as load continues to develop. Refer to Figure 29 below for a general outline of this feeder reconfiguration.

Figure 29 **Alternative 103H/129H-C; 103H-432 Load Reduction**

5.2.4 Recommend Alternative New 103H-Lakeside Transformer

The recommended alternative for this portion of the study is the implementation of a new 138-25kV 25/33/42MVA transformer at 103H-Lakeside, for the 2017/2018 peak loading period. The installation of a transformer at this location will provide the capacity for the anticipated load growth in the Lakeside/Timberlea area, as well as being able to supply a portion of the future conversions of 23H-Rockingham.

It is also recommended that a fourth feeder be created at 129H-Kearney Lake, in 2016, to reduce load on 129H-413, in anticipation of continued development in the area.

5.3 20H-Spryfield Load Growth

The 20H-Spryfield service area is in the midst of continued residential growth. Given the close proximity to the downtown Halifax core, as well as the nearby industrial parks (Bayers Lake and Ragged Lake), residential development has seen a significant increase in the last several years. This growth is projected to continue in the near future. This continued growth, of the islanded 12kV at 20H-Spryfield, needs to be addressed.

An examination of the loading at 103H-T63, which supplies 69kV to 20H-Spryfield via L-5039, indicates that the transformer has exceeded 133% of its nameplate rating, under peak loading conditions. Given the continued growth in Spryfield, the continued exceeding of the transformer's rating (103H-T63) is inevitable. A plan to mitigate this overload is required.

For the 2014 capital year, 12kV load reductions (through conversion to 25kV), at 20H-Spryfield have been recommended to reduce the total loading on 103H-T63, for the 2014/2015 winter peak. These conversions are required for all of the alternatives outlined below, in order to reduce the overall peak load at 20H-Spryfield below the 2013/2014 peak.

Alternative 20H-A would see the replacement of 103H-T63 with a transformer with a 60MVA rating. In replacing this transformer with one of a larger rating, the current overload condition (on 103H-T63) would be removed for the foreseeable future. This alternative would also allow for the continued load growth in the 20H-Spryfield service area to continue for the next several years, until the cumulative load at the substation approaches 54MVA. Loading beyond this level represents a contingency violation, in that there would not be enough capacity available in the event of a failure of 20H-T2 and the installation of a mobile substation.

Alternative 20H-B would see the replacement of 103H-T63 with a transformer with a 50MVA rating. In addition to the replacement of 103H-T63, conversions of some of the 12kV load to 25kV would also occur. The conversions would continue to ensure the peak loading of 20H-Spyrfield remains below 54MVA. This alternative would allow for the continued development on the 12kV system, while at the same time ensuring the peak loading does not exceed the contingency violation at 54MVA.

Alternative 20H-C would see the complete conversion of the 12kV at 20H-Spryfield over a 15 year period. The conversion of this 12kV load to 25kV would remove a large islanded load that has no transfer capabilities with any of the adjacent substations. A new 69-25kV source would also be added to the 20H-Spryfield substation, as 12kV load is reduced. These conversions would require significant investment in both capital and resources to ensure completion.

Alternative 20H-D would see the resupply of 20H-Spryfield at 138kV. This alternative would require the temporary installation of a new 138-69kV transformer at 103H-Lakeside. This alternative would also require the installation of a new tap off of the L-6033 and rebuilding of L-5039 from 34H-Geizers Hill to 20H-Spryfield to a 138kV standard. Two new 138-12kV 15/20/25MVA transformers would need to be installed. This alternative would require significant capital investment, through the construction of line tap and rebuilding of the L-5039 to 138kV. Additional significant investments would be required to rebuild the existing 20H-Spryfield substation to 138kV, while minimizing the duration of outages for the 20H-Spryfield customers.

Further detail of each alternative can be found below.

5.3.1 Alternative 20H-A Replace 103H-T63

This alternative would see the replacement of 103H-T63 (20/26.7//29.9MVA) with a larger 60MVA unit. This larger unit will provide additional capacity to the area for the foreseeable future, without consideration of the 12kV contingency capacity at 20H-Spryfield.

The replacement of 103H-T63 with a 60MVA unit would provide the additional capacity on the 69kV system that supplies 20H-Spryfield. This increase in size would also allow for a longer duration outage, for maintenance purposes of L-5004, from 90H-Sackville. This increased capacity will support load growth within the 20H-Spryfield area for the foreseeable future, given the current growth rate in the 20H-Spryfield (0.9%).

Currently, the contingency capacity at the substation is 54MVA. This value was determined through the potential loss of the largest transformer (20H-T2 15/20/25//28MVA) and the installation of a 25MVA mobile transformer. In consideration of the replacement of 103H-T63 with a 60MVA unit, it would also be recommended that 20H-T1 (currently 15/20//22.4MVA) be replaced with a 15/20/25MVA unit, as the load approaches 54MVA, in 2022. This increase in capacity of 20H-T1 would raise the contingency capacity of the 20H-Spryfield distribution to 58MVA, which is closer to the rating of the new 103H-T63.

This alternative would also include additional costs, when the load on L-5039 exceeds 60MVA. At this point of loading, the construction costs of double circuiting the current 69kV transmission line (L-5039) would be required, as per the existing looping policy. While this would not be anticipated until 2032/2033 timeframe, the significant cost in line design, construction and land make this alternative cost prohibitive.

Figure 30 **Alternative 20H-A; Replace 103H-T63**

5.3.2 Alternative 20H-B 20H-Spryfield Load Reduction

Alternative 533S-B would see the replacement of 103H-T63 with a 30/40/50MVA unit. The selection of this size transformer ensures that the 60MVA looping criteria will not be violated, as well as ensuring that the loading at 20H-Spryfield does not enter into a contingency violation.

In addition to replacing 103H-T63, a reduction of the 12kV load supplied by 20H-Spryfield through conversions to 25kV would take place. The initial conversions would reduce the 20H-Spryfield load by 3MVA. Conversions would commence at the northern end of the 20H-Spryfield service area utilizing the existing 25kV feeders, to minimize outages. Subsequent conversions would convert the eastern portions of the 20H-Spryfield load to 25kV, beginning in 2018. An overview of these conversions is outlined below in Figure 31.

The initial conversion will create additional feeder ties between 2H-Armdale and 103H-Lakeside. The overall benefit of these conversions will localize the 12kV around the 20H-Spryfield substation, while enabling greater diversity of configurations of the 25kV feeders.

Figure 31 **Alternative 20H-B; 20H-Spryfield Load Reduction**

5.3.3 Alternative 20H-C 20H-Spryfield Conversions

Alternative 20H-C would see the complete conversion of the 20H-Spryfield substation from 12kV to 25kV. This would be accomplished through an initial conversion of the 20H-T1 load and replacing 20H-T1 with a 69kV-25kV 25/33/42MVA unit. Upon installation of the new 25kV source, conversions would be continued until the eventual removal of 20H-T2.

The initial conversions of this alternative would be supplied via 2H-Armdale, until the installation of the new 25kV source at 20H-Spryfield.

This alternative would require significant capital investment not only in through the conversion of the 12kV load to 25kV, but also in the substantial upgrades required to the 20H-Spryfield substation. This alternative would require the removal of a portion of the 12kV bus and switchgear, to enable the installation of the 25kV equipment, all while serving the remaining 12kV customers.

This alternative would add an additional 25kV source adjacent to the Halifax Peninsula, adding more transfer capacity to the peninsula and to 103H-Lakeside.

5.3.4 Alternative 20H-D Resupply 20H-Spryfield at 138kV

Alternative 20H-D would see the supply of 20H-Spryfield changed from 69kV to 138kV. This would be accomplished by rebuilding the existing 69kV structures between 34H-Geizer’s Hill and 20H-Spryfield to a 138kV standard. This would include the off road structures, as well as the roadside structures within the existing routing.

A temporary replacement of 103H-T63 would be required until the L-5039 between 34H-Geizer’s Hill and 20H-Spryfield is completed. At that point in time, the 138-69kV transformer could be utilized in another application. Additionally, the two substation transformers at 20H-Spryfield would need to be replaced. It is recommended that the transformers be replaced with two 15/20/25MVA 138kV-13.2kV units. In ensuring that both units are similarly sized, the primary contingency for the substations would increase from 54MVA to 58MVA.

5.3.5 Recommended Alternative Replace 103H-T63

Alternative 20H-B 20H-Spryfield load reduction has been chosen of the selected alternative. This alternative enables the creation of additional feeder ties between 2H-Armdale and 103H-Lakeside, while reducing the present and future loading at 20H-Spryfield through planned conversions.

This alternative will also see the replacement of 103H-T63 with a 138kV-69kV 30/40/50MVA unit, in 2015. In an effort to reduce overloading of the existing 103H-T63, it is further recommended that the initial conversions be completed prior to the 2014/2015 winter peak.

This alternative will allow for continued load growth to occur for the foreseeable future, without the need for the implementation of the more costly alternatives outlined above.

A detailed outline of the 20H-Spryfield load reduction is outlined in the recommendations section of this study.

5.4 23H-Rockingham Load Growth

The area supplied by 23H-Rockingham is seeing continued growth. This growth is occurring in Clayton Park, as well as in Fairview. Considering that 23H-Rockingham is islanded 12kV, similar to 20H-Spryfield, there is a need to monitor the load growth within the area, so as to no overload the existing transformer 23H-T51, to a point of failure.

Similar to 20H-Spryfield, the alternatives to avoid prolonged overloading of 23H-T51 are limited to load reductions (through conversions to 25kV) or increasing the capacity at 23H-Rockingham.

Alternative 23H-A would see the replacement of 23H-T51 with a larger unit (30MVA). This additional capacity would be capable of supplying the 23H-Rockingham growth for the foreseeable future. Given the size of the substation property, the replacement of the existing transformer is possible with minor substation alterations.

Increasing the capacity of this islanded 12kV substation beyond the rating of the largest mobile substation (25MVA) would require additional contingency capacity be available in the event of a failure of the substation transformer. This additional capacity would be located at the 8H-Fairview substation and supplied via the 25kV from 104H-Kempt Road (104H-433). This 5MVA stepdown transformer would ensure enough capacity is available, in the event of a failure of 23H-T51.

Alternative 23H-B would see the placement of an additional 69kV-12kV transformer at the 23H-Rockingham substation. This additional transformer would be capable of providing enough capacity for the foreseeable future.

Alternative 23H-C would see the conversion of 12kV to 25kV, as new load develops, maintaining the current level of loading at 23H-Rockingham. These conversions can occur in a planned manor so as to not exceed the nameplate rating of 23H-T51.

Alternative 23H-D would see the total conversion of 23H-Rockingham to 25kV over a number of years. These conversions would enable the retirement of 23H-Rockingham, a section islanded 12kV.

Further details of each alternative can be found below.

5.4.1 Alternative 23H-A Replace 23H-T51

Alternative 23H-A considers the anticipated load growth in the area supplied by 23H-Rockingham. This alternative would increase the size of the existing transformer (15/20/25MVA) to a larger unit (30MVA), providing enough capacity for the foreseeable future. This replacement would coincide with the next significant development to commence in the 23H-Rockingham service area.

With the additional capacity add to the substation, an additional feeder would be added. This new feeder would be routed along the existing 23H-302 from the 23H-Rockingham substation to the Bedford Highway. This new feeder would assume the loading along this routing. Additionally, a small portion of the Bedford Highway would be rebuilt in a double circuit configuration, to reduce load on 23H-301. An overview of this new feeder can be seen in Figure 32 below.

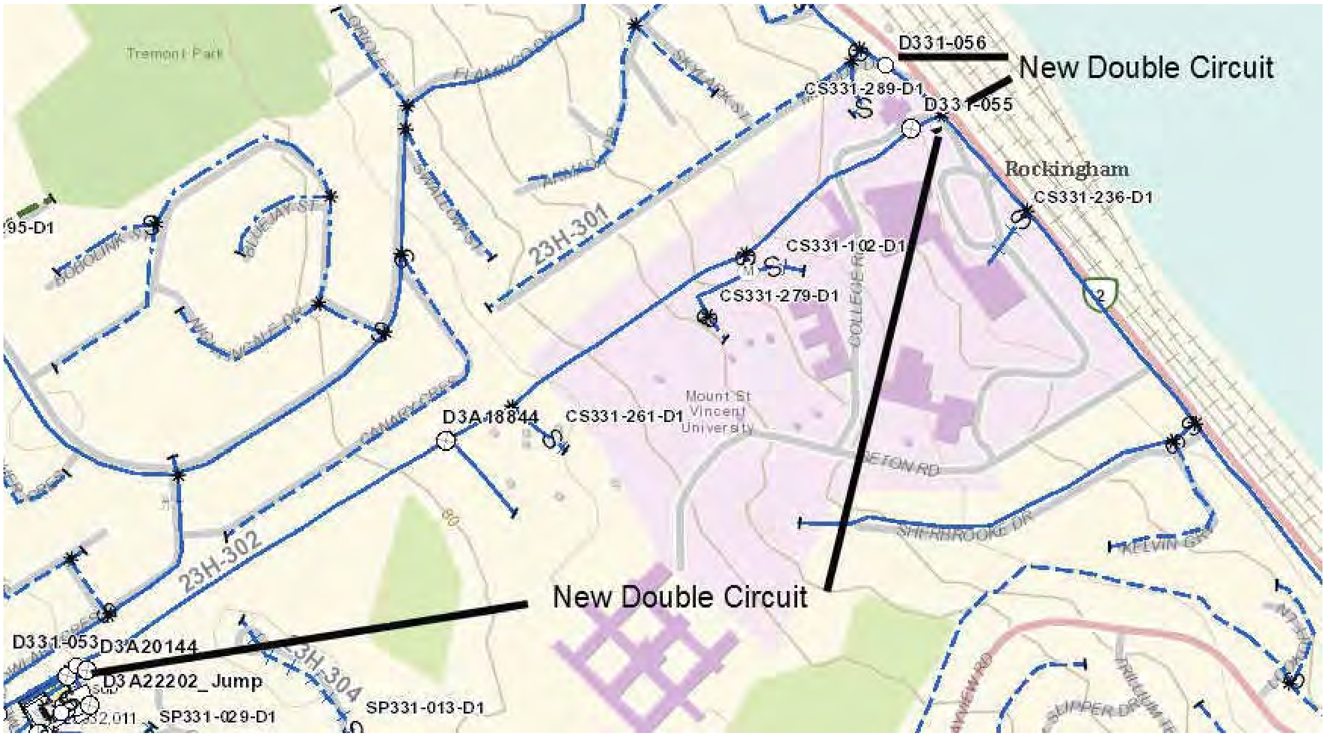


Figure 32 **Alternative 23H-A; New 23H-Rockingham Feeder**

While this alternative would offer enough capacity to meet the anticipated growth, there is potential that the anticipated growth exceeds these expectations and the new transformer enters into an overload state under peak loading conditions. To offset this potential overload, conversions to 25kV would also need to be considered in the future.

Given that the 12kV load supplied by 23H-Rockingham is islanded, there are no other 12kV supplies adjacent to 23H-Rockingham to transfer load in the event of a transformer failure. In replacing the existing 23H-T51 with a larger unit, consideration of the existing mobile transformer fleet needs to be considered. Currently the largest mobile transformer is 25MVA. Replacement of 23H-T51 with a larger unit would exceed the available capacity of the largest mobile transformers (5P and 6P) in the mobile substation fleet.

Alternatively, a 25-12kV 5MVA stepdown transformer could be installed at the 8H-Fairview substation to provide additional capacity, in the event of a failure of 23H-T51, under peak loading conditions. This transformer would be supplied by 103H-433, in a similar configuration to the previous 25-4kV transformer that was in-service, at this substation. The lone 12kV feeder would be capable of supplying 23H-302, via Deal Street. A general overview of this new stepdown placement can be seen in Figure 33 below.

Figure 33 **Alternative 23H-A; 25-12kV Stepdown at 8H-Fairview**

5.4.2 Alternative 23H-B Additional Transformer at 23H-Rockingham

Alternative 23H-B would see a 15/20/25MVA 69kV-13.2kV transformer added to the 23H-Rockingham substation. This additional capacity would be capable of meeting the anticipated load growth in the 23H-Rockingham service area for the foreseeable future. Each of these transformers would be capable of providing the contingency capacity for the other, in the event of a transformer failure. This second transformer would not be required until the peak load at 23H-Rockingham exceeds 25MVA. It is anticipated that this will occur during the 2015/2016 loading peak.

With the additional capacity added to the 23H-Rockingham substation, an additional three feeders would be added to the substation. Two of these feeders, would be routed along the existing 23H-302. Similar to Alternative 23H-A, one of these feeders would assume the 23H-302 load along this routing and continue north on the Bedford Highway. The second feeder would extend south on the Bedford Highway to Bayview Drive. This section of feeder would assume the existing load along 23H-302 and also be available to meet the forthcoming load developments in the area. An overview of these two feeders can be seen in Figure 34 below.

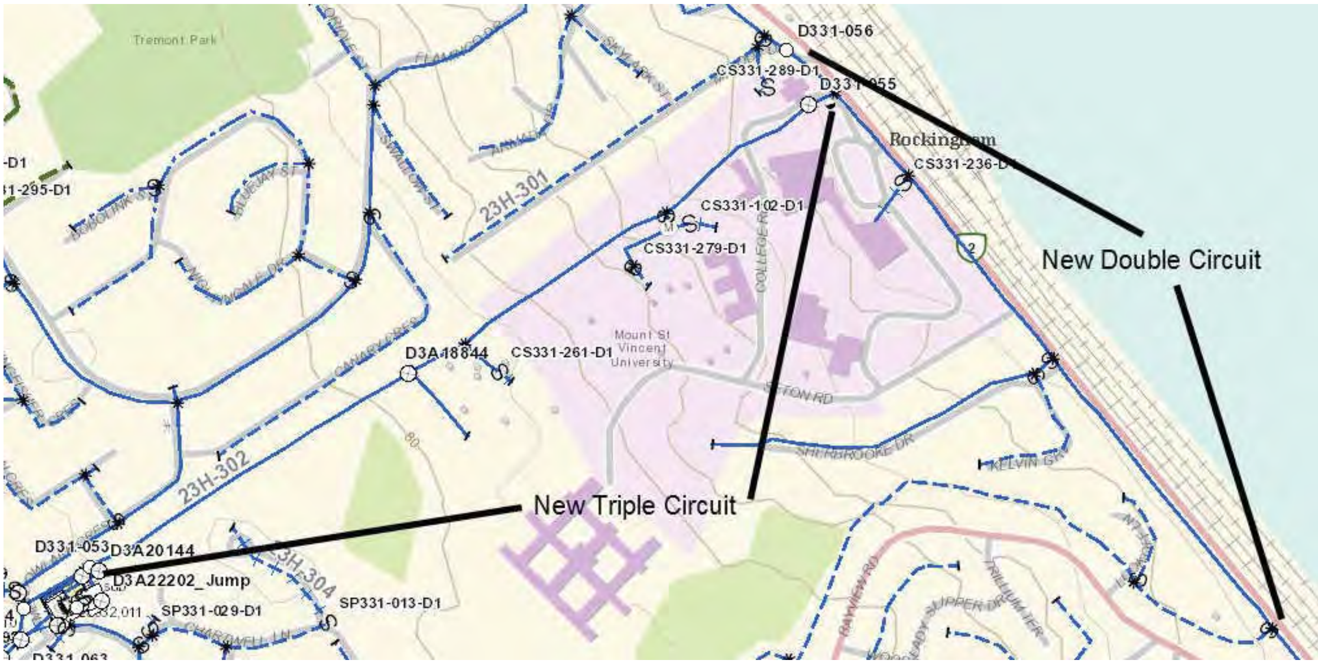


Figure 34 **Alternative 23H-B; Two New 23H-Rockingham Feeders**

The third new feeder to be created would extend in a double circuit configuration along Radcliffe Drive, to the transmission ROW. This new double circuit would then extend to just beyond the tap after D331-065, as indicated in Figure 35 below. This new feeder would enable the load transfers from either 23H-303 or 23H-304, as required.

Figure 35 **Alternative 23H-B; Third New 23H-Rockingham Feeder**

The additional capacity would allow for maintenance to be completed on 23H-T51, during low load periods, without the need for the mobile substation. The additional capacity would be largely unused capacity, until the bulk of the anticipated load materializes.

Unfortunately, given the size of existing 23H-Rockingham substation property, the ability to add an additional transformer would be very difficult and make for a congested area within the substation. In consideration of the above, the installation of an additional transformer at 23H-Rockingham would be difficult to implement and would also create a stranded asset for the foreseeable future.

5.4.3 Alternative 23H-C Retire 23H-Rockingham

Alternative 23H-C would see the planned reduction of 12kV load through conversion to 25kV. These conversions would commence as the forecasted peak loading at 23H-Rockingham exceeds the nameplate rating of 23H-T51 (25MVA) in 2015. Conversions would continue on a planned basis over an 8 year period, with the 23H-Rockingham substation decommissioned and retired in 2025.

These conversions will initially be supplied by the current Halifax Peninsula feeders and create a variety of new feeder ties, as the progress of conversions continue. With this in mind, it is recommended that these conversions commence in Fairview, as indicated in Figure 36.

The conversion of 23H-Rockingham, similar to the 20H-Spryfield conversions would see portions of the existing 12kV infrastructure rebuilt to 25kV standards. This would include pole and transformer replacements, as well as reconductoring, as the future feeder configurations would dictate.

While this alternative requires significant capital investment, it enhances the reliability in the 23H-Rockingham service area, through these conversions and the increased ability to reconfigure the feeders, from different 25kV sources.

Upon completion of the conversions and the retirement of 23H-Rockingham substation, L-5032 could be retired, as there is no requirement for 69kV into the Rockingham area. This alternative could also enable the upgrade of L-5004 from 90H-Sackville to 34H-Geizer's Hill, from 69kV to 138kV when required, as there would be no other substations. This future requirement of L-5004 would need to be fully studied, prior to implementation.

Figure 36 Alternative 23H-C; 23H-Rockingham Initial Load Reduction

5.4.4 Alternative 23H-D Convert 23H-Rockingham to 25kV

Alternative 23H-D would see the retirement of the existing 12kV equipment at 23H-Rockingham and the installation of a new 69-25kV 25/33/42MVA transformer at the 23H-Rockingham substation. This would be accomplished through the conversion of the existing 12kV distribution load to 25kV over a four year period.

The conversions would be accelerated, in comparison to those outlined in Alternative 23H-C, to add additional capacity to the area, to enable load transfers between 23H-Rockingham and 129H-Kearney Lake. Unlike Alternative 23H-C the conversion of the existing 12kV load to 25kV would only be supplied by adjacent 25kV sources, for a short period of time, prior to the installation of the new 25kV source at 23H-Rockingham.

Similar to Alternative 23H-C, this alternative would require significant capital investment, albeit in a shorter timeframe than alternative 23H-C. Additional capital investment would be required through the retirement of the 12kV substation equipment and the installation of 25kV equipment.

While costly to implement, over a four year period, the enhanced configurability of the 25kV load, not only in the 23H-Rockingham area, but also the adjacent areas, would enhance reliability to all customers within the area.

5.4.5 Recommended Alternative Retire 23H-Rockingham

While this alternative, Alternative 23H-C, does not add the configurability that one of the other alternatives, nor does it add additional capacity to the 23H-Rockingham substation, it will reduce the 12kV load at 23H-Rockingham near the anticipated load growth rate, to ensure the peak loading on 23H-T51 does not exceed its nameplate rating.

It is recommended that the initial conversions commence in 2015, as previously indicated. Subsequent conversions will be determined through an examination of the peak loading data, as well as load forecasts.

6.0 RECOMMENDATIONS

In summary, the following provide the impetus for the recommendations contained herein:

- The forecasted load growth in Peninsular Halifax and adjacent areas is anticipated to continue growing at a rate of 0.87% per year for the foreseeable future. Consideration of the proposed developments before HRM council and those that are in various stages of construction may cause a slight increase to the calculated growth rate.
- Additional capacity on the Halifax Peninsula will enable the ability to supply the transfer load and avoid the installation of a mobile substation on the Peninsula for the foreseeable future.
- The loading on 103H-T63 has peaked above 133% of its nameplate rating.
- The loading at 20H-Spryfield is approaching its contingency capacity with limited ability to add additional capacity to the 12kV system in the area.
- The load at 23H-Rockingham is approaching the limits of the largest mobile substation in the NSPI fleet.

Accordingly, this study recommends several large capital investments beginning in 2014 through to 2028. These recommendations include the installation of new substation transformers, as well as the reduction of 12kV load through conversions to 25kV. The recommendations of this study will also yield the creation of new feeder ties, which will enable greater feeder flexibility in the future. The justification for these capital investments can be found in section 5 of this report, as well as in the Economic Assessment Models (EAM) found in Appendices C through F.

The Economic Assessment Model in reference to the increased Halifax Peninsula loading can be found in Appendix C. The results of this EAM indicate the need for additional transformation at 2H-Armdale, in 2015. The EAM also coincides with the recommendation to add four new feeders to the 2H-Armdale substation. The details of the new substation transformer and feeders are indicated in the following sections of this report.

The Economic Assessment Model in reference to the increased load growth in the 103H-Lakeside and 129H-Kearney Lake area can be found in Appendix D. The results of this EAM indicate the need for additional transformation at 103H-Lakeside, prior to the 2018/2019 peak loading period. The EAM also recommends the initial addition of three new feeders at 103H-Lakeside, with the potential to add another if required. This will enable load transfers from 129H-Kearney Lake. The details of the new substation transformer and feeders are indicated in the following sections of this report.

The Economic Assessment Model in reference to the replacement of 103H-T63 and 20H-Spryfield load reductions can be found in Appendix E. The results of this EAM indicate that the 103H-T63 be replaced in 2015 and initial 20H-Spryfield load reductions be completed in 2014. These initial load reductions are required to offset the continued load growth on the 20H-Spryfield 12kV system, while reducing the potential 2014/2015 winter peak below the 2013/2014 level. The 20H-Load reductions and 103H-T63 transformer replacement are further outlined in the following sections of this report.

The Economic Assessment Model in reference to the retirement of 23H-Rockingham can be found in Appendix F. The results of this EAM indicate that the conversion of 23H-Rockingham load to 25kV should commence in 2015 and continue until the retirement of the substation in 2025. The details and scope of each section of conversion are further outlined in the following sections of this report.

A detailed outline of the components of each of these alternatives is outlined below, organized by capital year completion. The advancement or deferment of these projects may be influenced by factors including; residential/commercial development, feeder reconfigurations and/or ranking of capital projects within the ACE plan.

Feeder reconfigurations will be at the discretion of Central Regional Engineering, to enable accommodation of any unforeseen circumstances outside of the scope of this study.

6.1 Recommendations by Capital Year

6.1.1 2014 Capital Year

The capital items recommended to be completed in 2014 include are required to reduce the overall loading on 103H-T63, prior to the 2014/2015 winter peak. Additionally, the preliminary engineering and design for the replacement of 103H-T63 and the new transformer to be installed at 2H-Armdale will occur.

6.1.1.1 20H-Spryfield Load Reduction Part-1

This portion of the project will reduce the load at 20H-Spryfield through conversion of a large section of 20H-302. This newly converted load will be initially supplied via 2H-411. Refer to Figure 37 below. The details of this work are as follows:

- Convert St. Margaret's Bay Road from the end of the 12kV to Chocolate Lake Road, including takeoffs

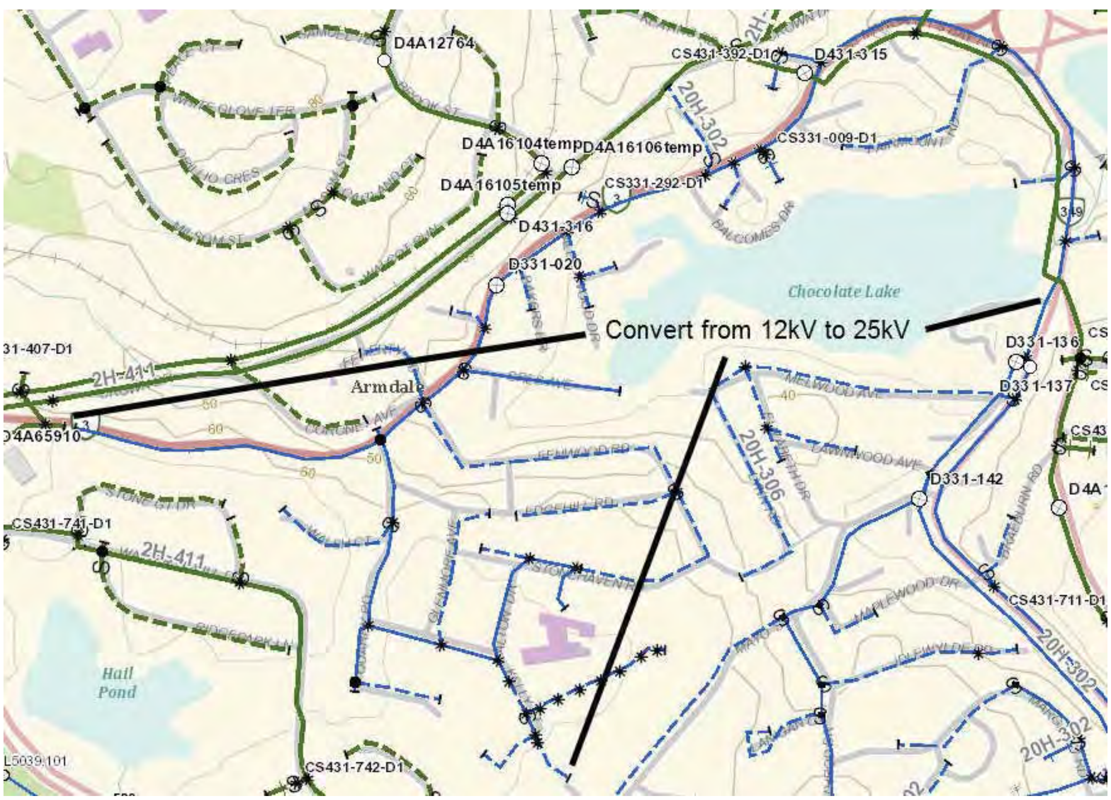


Figure 37 **2014 20H-Spryfield Load Reduction, Part-1**

6.1.1.2 20H-Spryfield Load Reduction Part-2

This portion of the project will continue to reduce the loading on 20H-Spryfield, through continued conversions to 25kV. This section of conversion will be supplied via the conversions in Part-1 and/or Tamarack Drive (2H-411). Refer to Figure 38 below. The details are as follows;

- Convert Mountain Road and Withrod Drive
- Convert Herring Cove Road, from Chocolate Lake Road to Winchester Avenue

Figure 38 **2014 20H-Spryfield Load Reduction, Part-2**

6.1.2 2015 Capital Year

The 2015 capital year will see the installation of a new transformer at 2H-Armdale with four new feeder exits. This new added capacity will allow for the reconfiguration of the Spryfield and Regency Park supplies. This new added capacity will also enable feeder reconfigurations at 103H-Lakeside, reducing the overall load between feeders.

Additionally, in 2015 the 23H-Rockingham conversions to 25kV will commence. The initial conversions will see the conversion of the southern portion of Fairview. The converted area will also create an additional feeder tie between Dutch Village Road and Northwest Arm Drive.

6.1.2.1 103H-T63 Replacement

This portion of the project will see the replacement of 103H-T63, to meet the load requirements at 20H-Spryfield.The current load on 103H-T63 (20H-Spryfield) will need to be transferred to L-5004, from L-5039 for the duration of this portion of the project. Refer to Figure 39 below. The details are as follows:

- Switch 20H-Spryfield supply to L-5004 at 34H-Geizer's Hill.
- Remove 103H-T63.
- Prepare location for the installation of new unit.
- Install new 138-69kV 30/40/50MVA transformer.

Figure 39 103H-T63 Replacement

6.1.2.2 New 2H-Armdale Transformer

This portion of the project will see the addition of a new 138-25kV 25/33/42MVA transformer at 2H-Armdale. The addition of this transformer to the 2H-Armdale substation will require additional work to both the existing 138kV and 25kV buses. Additionally, four new feeder exits will be created. The routing of these new feeders will be outlined in the next portion of this project. The details are as follows:

- Prepare 2H-Armdale substation for the addition of a new transformer, including pad and buswork installation
- Install new 138-25kV 25/33/42MVA transformer
- Create four new feeder exits, with terminations outside of the 2H-Armdale substation

6.1.2.3 2H-Armdale New Feeders

This portion of the project will create four new feeders, as outlined in the previous section of work. These new feeders will provide additional capacity to both the area and reduce load on adjacent feeders. The balancing of the new feeders will be completed by Central Regional Engineering. The details are as follows:

6.1.2.3.1 2H-Armdale –New Feeder A

This first new feeder will reduce loading on 104H-423, through initially transferring the 104H-423G section to the new feeder. Refer to Figure 40 below. The creation of this new feeder will be accomplished by the following:

- Double circuit existing feeder to the northwest of the substation along the transmission ROW, to the first tap.
- Extend Double circuit along Clinton Avenue, to Joseph Howe Drive
- Change Joseph Howe Drive tap to new feeder and close D431-190 (on Joseph Howe Drive)
- Open R4A05791 recloser on Mumford Road

Figure 40 2H-Armdale -New Feeder A

6.1.2.3.2 2H-Armdale –New Feeder B&C

These two new feeders will provide additional supplies to the St. Margaret's Bay Road and Herring Cove Road area via the Armdale Rotary. These feeders will supply the converted 20H-Spryfield 25kV load, a portion of 2H-411, as well as provide an additional feeder tie along St. Margaret's Bay Road. The supply to the Regency Park area will be changed from 103H-Lakeside to 2H-Armdale through changing the open points on St. Margaret's Bay Road. Refer to Figure 41 below. The creation of this new feeder will be accomplished by the following:

- Construct new feeder ducts along Chebucto Road to the Armdale Rotary and utilize the existing ducts around the rotary, to route feeders.
- Install a new N/O point on the upper circuit (currently 2H-411), on St. Margaret's Bay Road between existing 2H-411 supply and new.
  - Close D4A20364 and open D431-309 on St. Margaret's Bay Road.

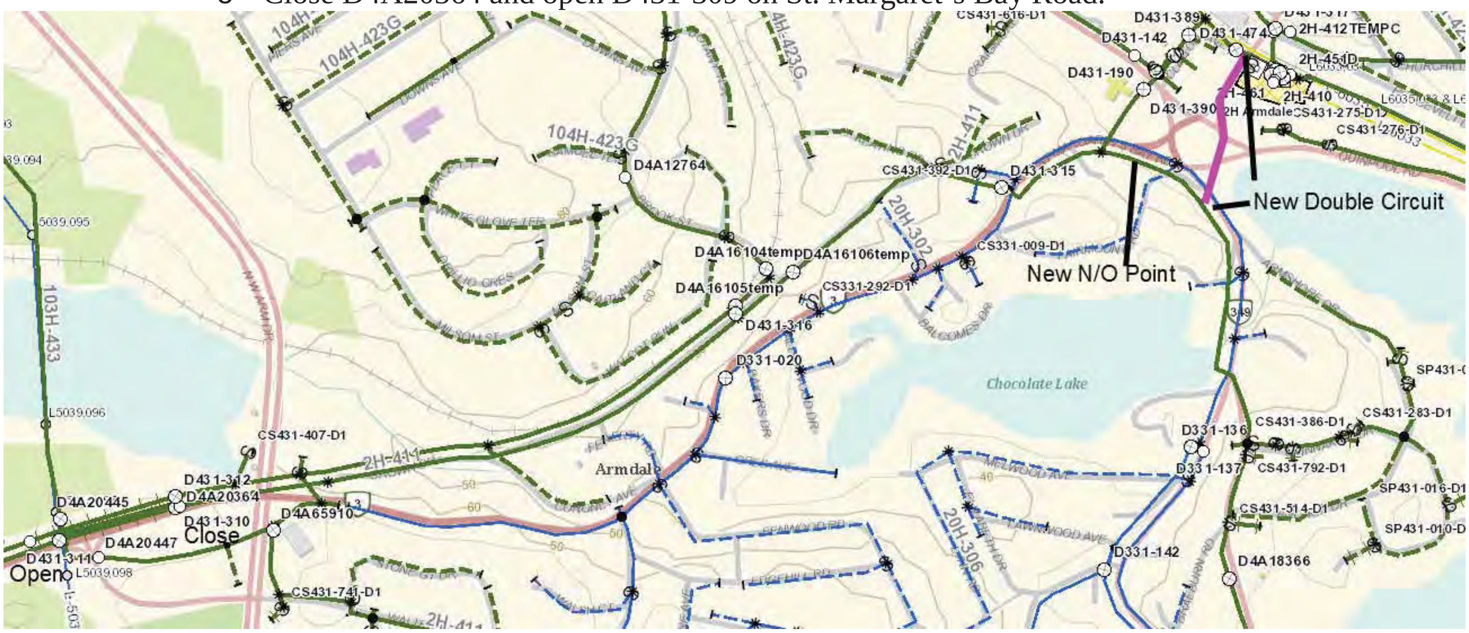


Figure 41 **2H-Armdale -New Feeders B&C**

6.1.2.3.3 2H-Armdale –New Feeder D

This new feeders will provide an additional feeder along Quinpool Road. This new feeder will be capable of reducing load on existing 2H-Armdale feeders, as well as 104H-Kempt Road feeders in the area. Refer to Figure 42 below. The creation of this new feeder will be accomplished by the following:

- Utilizing the ducts installed in 6.1.2.3.2, install new feeder to the Quinpool Road and Chebucto Road intersection.
- Extend new feeder to the end of Quinpool Road feeder.
- Remove tap from 2H-413, on the transmission structures, where it crosses Quinpool Road.
- Create a new N/O point on MacDonald Street, at the Quinpool Road intersection.

Figure 42 **2H-Armdale -New Feeder D**

6.1.2.4 23H-Rockingham Conversions Part-1

This portion of the project will reduce the 12kV loading at 23H-Rockingham, through initial conversions to 25kV. These initial conversions will create a new feeder tie between Dutch Village Road and Northwest Arm Drive. Refer to Figure 43 below. This will be accomplished by:

- Rebuild Rosedale Avenue, from Dutch Village Road to North West Arm Drive, with three phase 336, to a 25kV standard.
- Replace all transformers downline of D331-090, with 25kV units, as required.
- Open D331-090 and convert area downline.

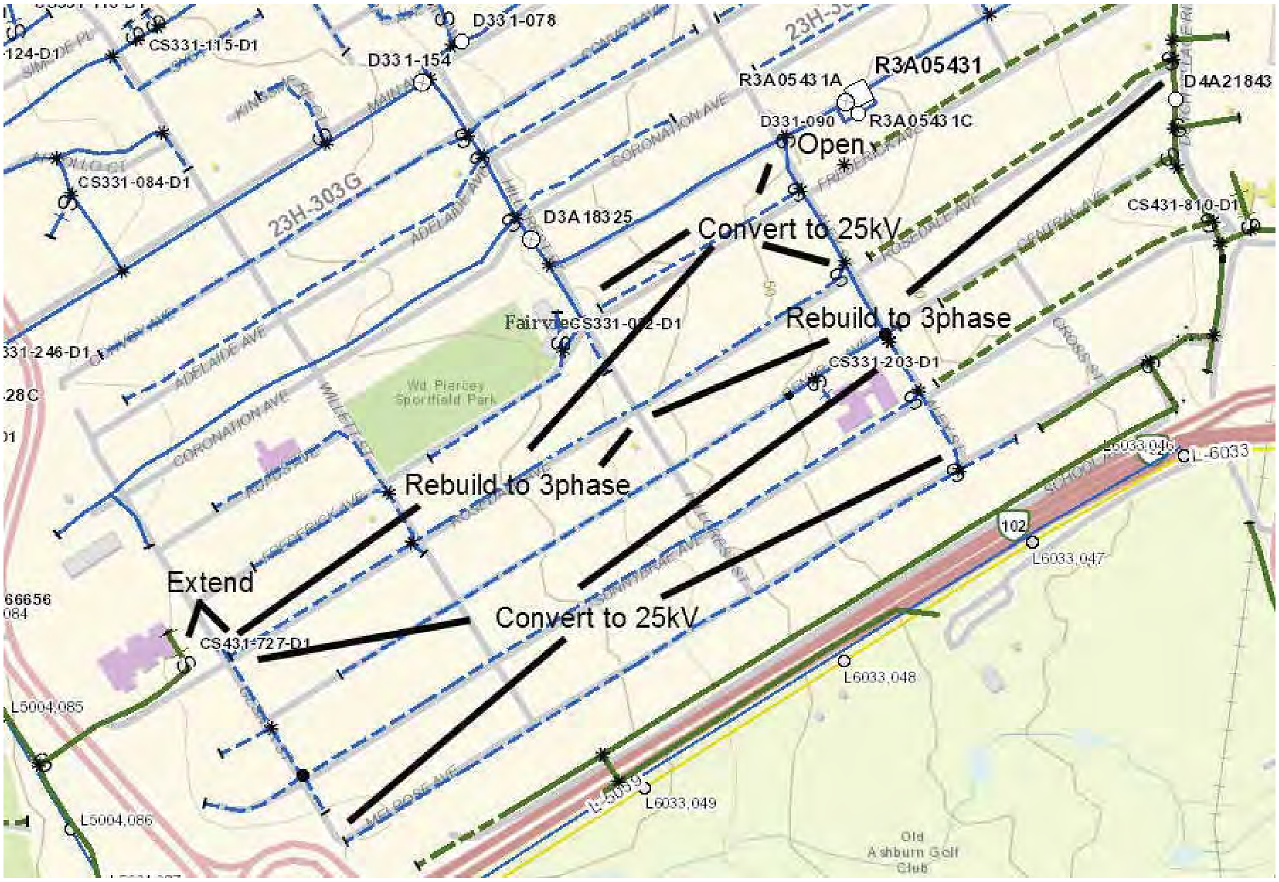


Figure 43 **23H-Rockingham Conversions Part-1**

6.1.3 2016 Capital Year

For 2016, the capital work includes feeder reconfigurations at 103H-Lakeside and 129H-Kearney Lake reducing the loading on heavily loaded feeders, through load transfers to other feeders.

Additionally, the second portion of 23H-Rockingham 12kV load conversions will occur. This portion of conversion will see the conversion of 23H-303G. This newly converted section will be supplied via Regency Park

6.1.3.1 103H-Lakeside Feeder Reconfiguration Part-1

This portion of the project will reduce loading on a heavily loaded radial 103H-Lakeside feeder through an extension of the existing double circuit on St. Margaret's Bay Road. This extension will transfer load from 103H-432 to 103H-431. Refer to Figure 44 below. This will be accomplished by:

- Extend 103H-431 in a double circuit configuration along St. Margarets Bay Road, to Greenhead Road.
- Transfer taps to new feeder.

Figure 44 103H-Lakeside Feeder Reconfigurations Part-1

6.1.3.2 103H-Lakeside Feeder Reconfiguration Part-2

This portion of the project will continue to cascade the feeder load reductions realized with the transfer of Regency Park to one of the new 2H-Armdale Feeders. With consideration of the load reduction on 103H-433, a portion of 129H-412 along Lacewood Drive can now be transferred to 103H-433. Refer to Figure 45 below. This will be accomplished by:

- Install new N/O point on Rackcliffe Drive, at the intersection with Lacewood Drive.
- Close D4A08144.

Figure 45 103H-Lakeside Feeder Reconfigurations Part-2

6.1.3.3 103H-Lakeside Feeder Reconfiguration Part-3

This portion of the project will reduce loading on 103H-434, through extending the double circuit along Prospect Road, from Ragged Lake Boulevard to Mills Drive. The new circuit in the double circuit will be supplied from 103H-431 (Ragged Lake Boulevard) initially. Refer to Figure 46 below. This will be accomplished by:

- Construct double circuit on Prospect Road, from Ragged Lake Boulevard to Mills Road.
- Transfer load along routing from 103H-434 to new feeder.

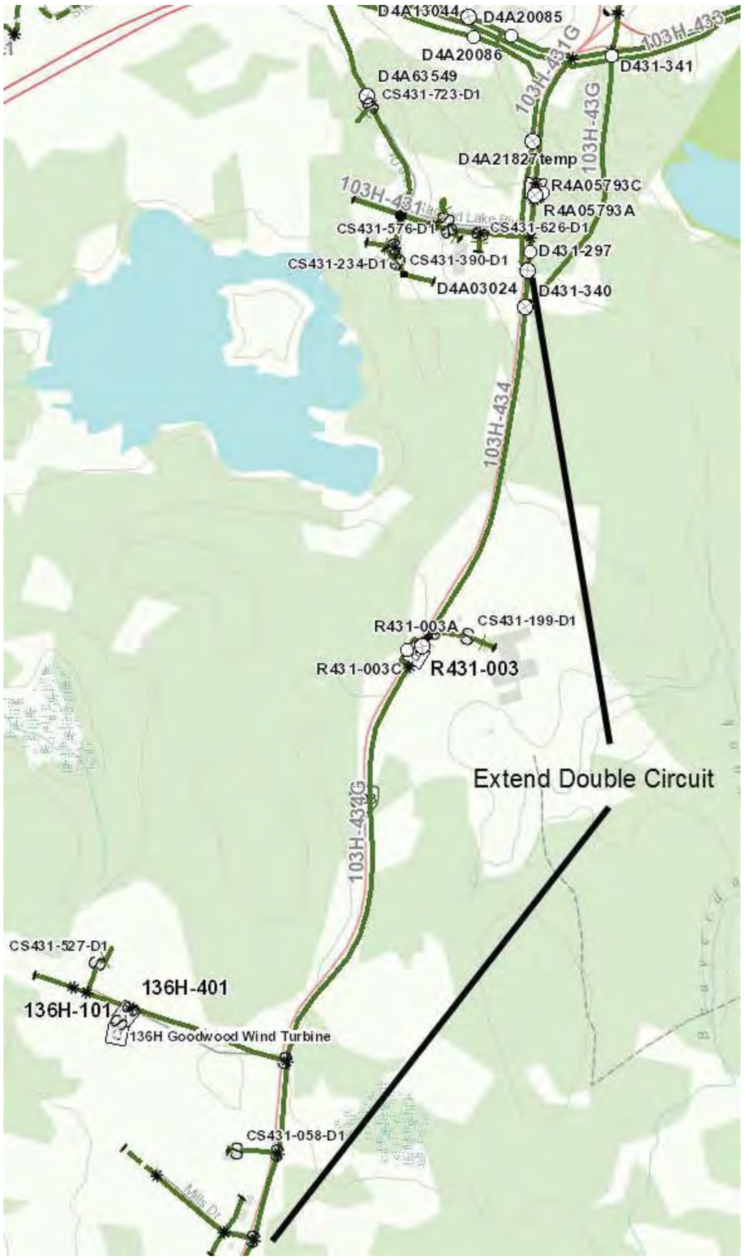


Figure 46 **103H-Lakeside Feeder Reconfigurations Part-3**

6.1.3.4 129H-Kearney Lake New Feeder

This portion of the project will create a new feeder at 129H-Kearney Lake. This new feeder will provide a feeder tie to 129H-413 and provide the necessary capacity to meet the anticipated load growth in the area. Refer to Figure 47 and below. This will be accomplished by:

- Add a new feeder and exit to the 129H-Kearney Lake substation.
- Extend the new feeder to Kearney Lake Road and continue down Kearney Lake Road to Castle Hill Drive, in a double circuit configuration with 129H-413.
- Supply Castle Hill Drive via the new feeder, installing a new N/O point with 129H-412.
- Install new N/O point at the Kearney Lake Road and Dunbrack Street intersection.

Figure 47 129H-Kearney Lake; New Feeder

6.1.3.5 129H-Kearney Lake Feeder Reconfiguration

This portion of the project will reconfigure 129H-413 and the new feeder, reducing load on 129H-413. This new will assume the load along the Bedford Highway, from Kearney Lake Road to Hammonds Plains Road. Refer to Figure 48 and below. This will be accomplished by:

- Open D4A16887 on the Bedford Highway, near the intersection with Larry Uteck Boulevard.
- Open D4A17000 on Larry Uteck Boulevard.
- Close D4A18644 on Southgate Drive, near the intersection with Larry Uteck Boulevard.
- Open D4A21226 on Southgate Drive, near the intersection with the Bedford Highway.

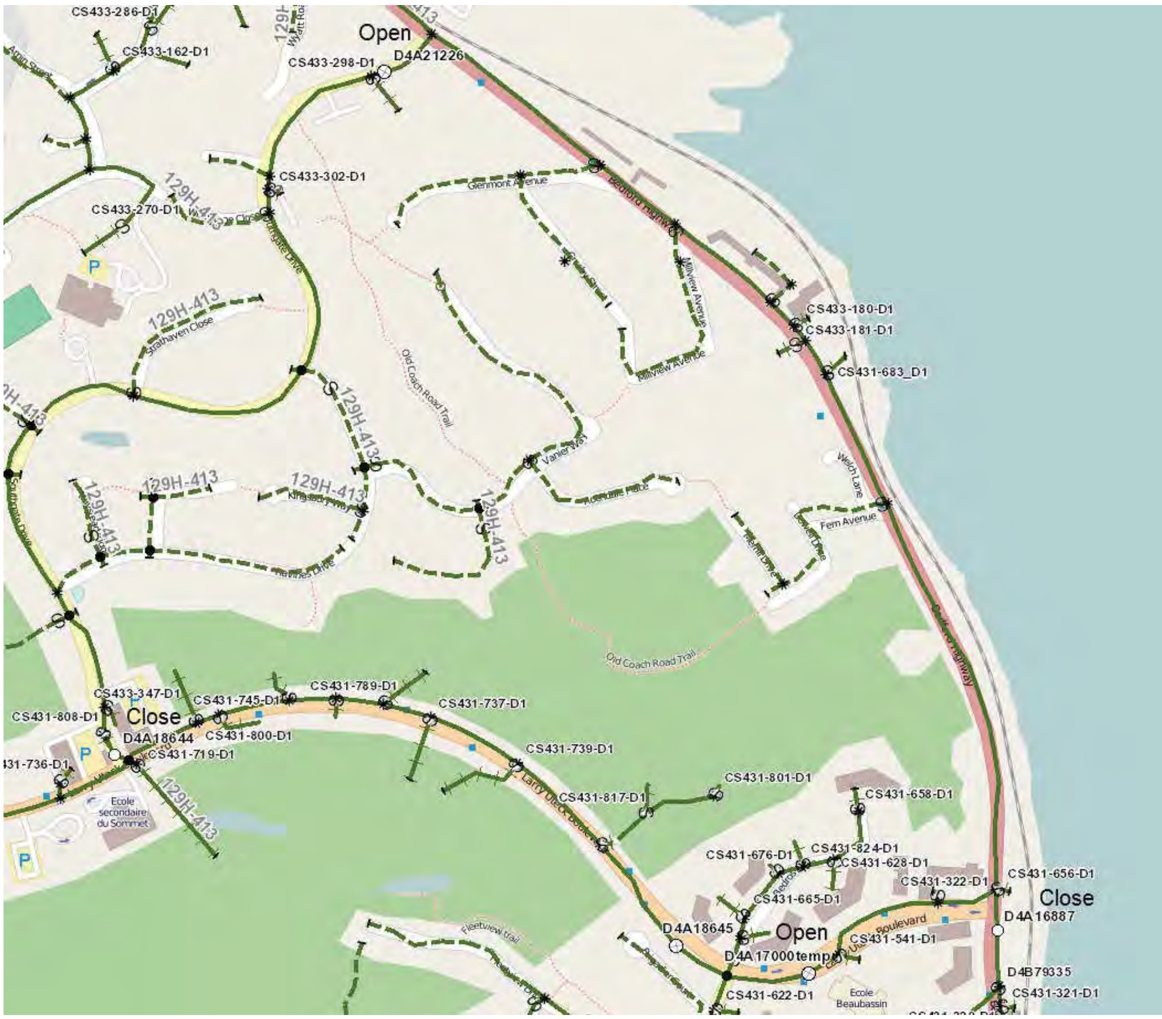


Figure 48 129H-Kearney Lake Feeder Reconfigurations

6.1.3.6 23H-Rockingham Conversions Part-2

This portion of the project will convert 23H-303G from 12kV to 25kV. This newly converted section will be supplied via Regency Park. Refer to Figure 49 below. This will be accomplished by:

- Open D221-068 along the L-5004 ROW.
- Create new N/C open point at the intersection of Birch Hill Drive and Upper Prince Street.
- Convert Main Avenue (from D331-068 to D331-078), including side streets, from 12kV to 25kV and supply via Washmill Lake Drive.

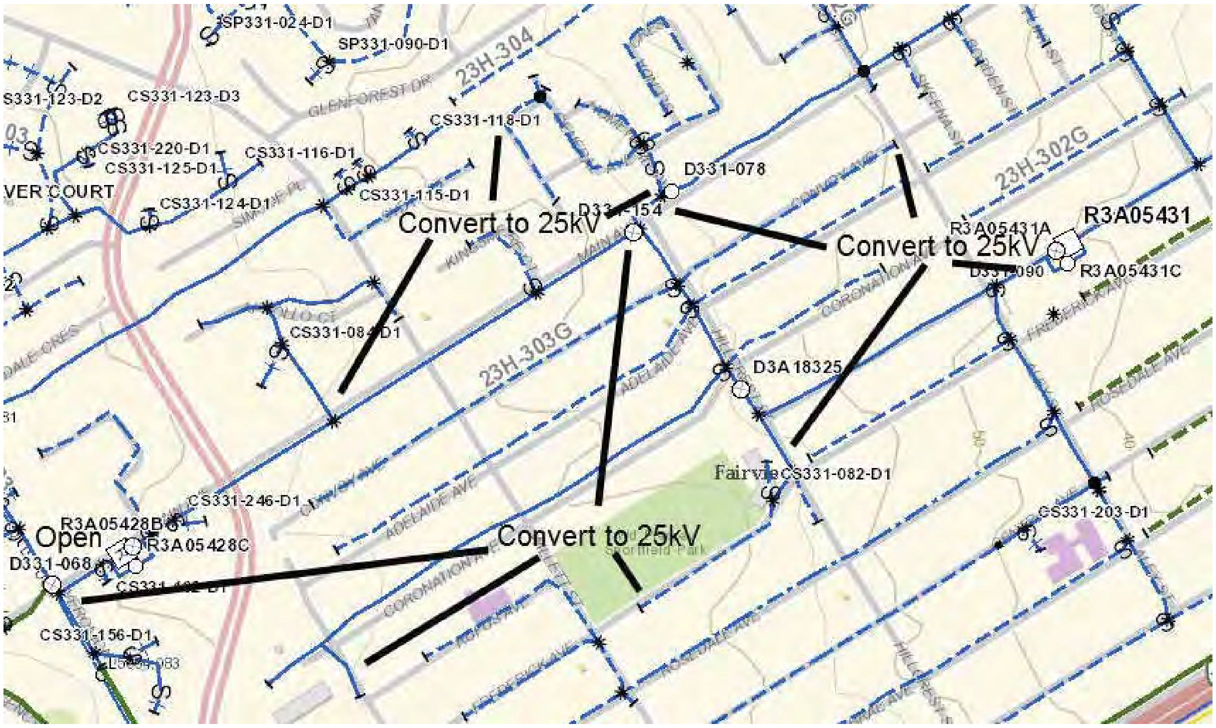


Figure 49 **23H-Rockingham Conversions Part-2**

6.1.4 2017 Capital Year

For 2017, the capital work includes the continuation of load reduction at 23H-Rockingham through conversion of 23H-302G to 25kV. These conversions will be supplied via Regency Park.

In addition to the conversion work, preparation for the installation of a new transformer at 103H-Lakeside will commence.

6.1.4.1 23H-Rockingham Conversions Part-3

This portion of the project will convert 23H-302G, around the former Halifax West School site. The area will be supplied via Dutch Village Road (currently 104H-433). Refer to Figure 50 below. This will be accomplished by:

- Open R3A0543.
- Ensure D331-078 is open on Main Avenue.
- Convert 23H-302G, from R3A0543 to the end of the feeder, as indicated below.

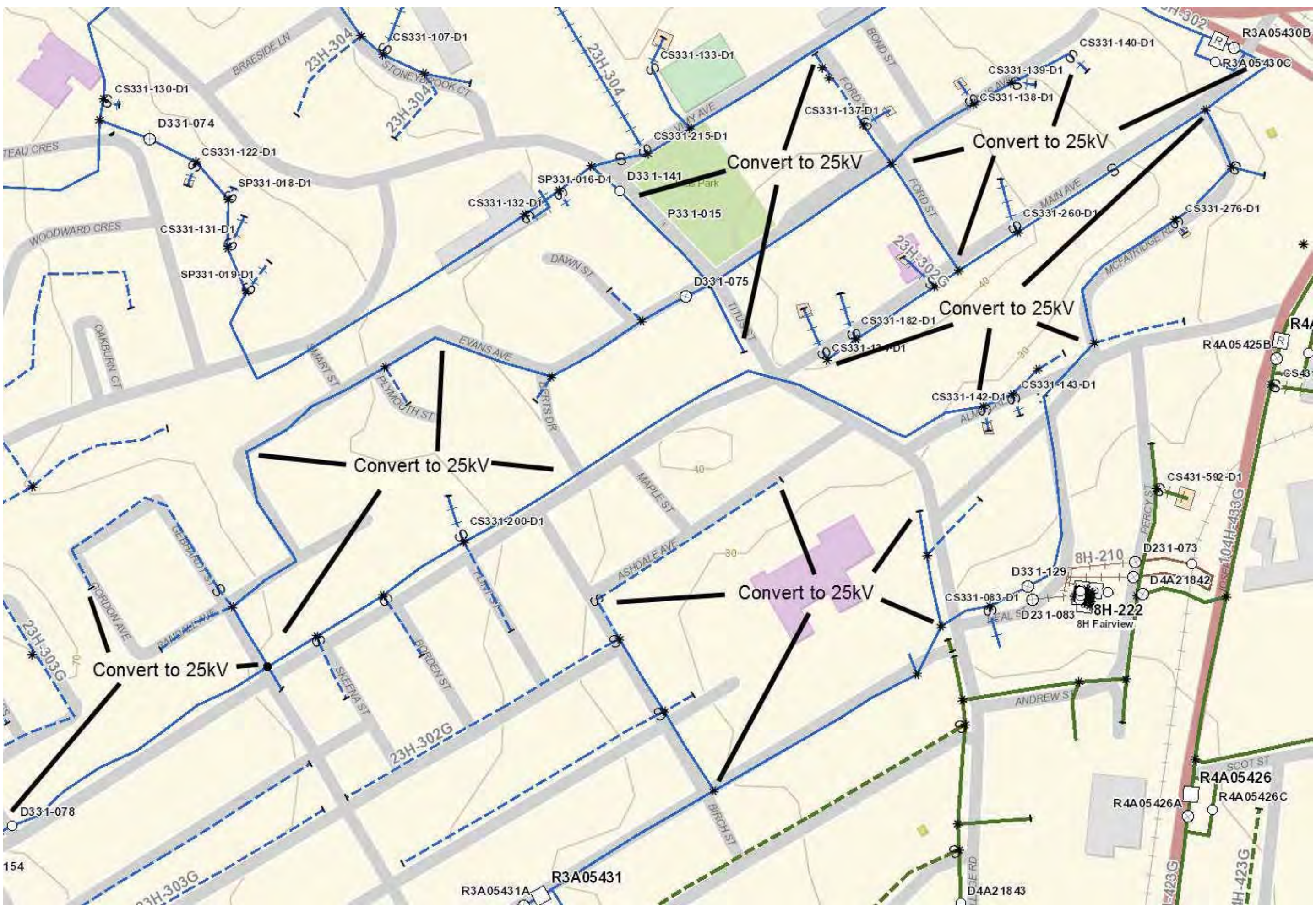


Figure 50 23H-Rockingham Conversions Part-3

6.1.5 2018 Capital Year

For 2018, the capital work includes the installation of a new 138-25kV transformer at 103H-Lakeside, with three additional feeders.

In addition to the new transformer installation, the continuation of the 12kV load reductions at 23H-Rockingham continue with the conversion of 23H-302, along the Bedford Highway, to 25kV.

6.1.5.1 Installation of New 138-25kV Transformer at 103H-Lakeside

This portion of the project will see the installation of an additional 138-26.4kV 25/33/42MVA transformer at 103H-Lakeside. Four new feeder exits will be created, with three being utilized initially. This will be accomplished by:

- Extend the current 25kV bus to accommodate the new feeders.
- Prepare new pad for transformer and install.
- Create four new feeder exits, with reclosers.

6.1.5.2 Installation of New 103H-Lakeside Feeders

This portion of the project will see the creation of three new feeders to supply the Bayers Lake and Clayton Park area, utilizing the existing transmission corridor to extend the feeders into Bayers Lake. Two of the feeders will continue on Horseshoe Lake Drive to Chain Lake Drive, via double circuit. The third feeder will supply the remaining portion of the Bayers Lake Industrial Park. Refer to Figure 51 below. This will be accomplished by:

- Construct three new feeders along the transmission corridor to Bayer's Lake Industrial Park.
- Construct a double circuit along Horseshoe Lake Drive, from where the new feeders exit the transmission corridor, to Chain Lake Drive via Susie Lake Crescent.
- Install a new N/O point on Chain Horseshoe Lake Drive, where feeders exit transmission corridor.
- Open D4A11245 on Chain Lake Drive, at the intersection with Susie Lake Crescent.
- Install new N/O Point on Chain Lake Drive, on the single feeder section after the Susie Lake Crescent intersection.
- Close D431-299 (Chain Lake Drive) and D4A111444 (Hobson Lake Drive). Open D431-296 (off of Chain Lake Drive, near the Chester Spur Line Trail).

Figure 51 **103H-Lakeside New Feeders**

6.1.5.3 103H-Lakeside Feeders Reconfiguration Part-3

This portion of the project will reconfigure two of the new 103H-Lakeside feeders through transferring load from two 129H-Kearney Lake Feeder (129-411 and 129H-412). This load reduction will modify a previous recommendation, as outlined in 103H-Lakeside Feeder Reconfiguration Part-2, through closing the new N/O point previously recommended. The reduction in load on these 129H-Kearney Lake feeders will enable a future reconfiguration of the 129H-Kearney Lake feeders. Refer to Figure 52 below. This will be accomplished by:

- Open R4A05775 on Parkland Drive.
- Open R4A05769 on Langbrae Drive.
- Close the N/O Point that was installed as part of recommendation 103H-Feeder Reconfiguration Part-2.
- Close D4A20565 on Lacewood Drive.

Figure 52 103H-Lakeside Feeder Reconfigurations Part-3

6.1.5.4 23H-Rockingham Conversions Part-4

This portion of the project will convert the remaining portion of 23H-302, along the Bedford Highway. The area will be supplied via the previous conversions along the Bedford Highway. Refer to Figure 53 below. This will be accomplished by:

- Open D3A18844, as well as the 23H-302 breaker.
- Ensure D331-056 (on the Bedford Highway) and D331-163 (off of Bedford Highway) are both open.
- Convert the areas, as indicated below.

Figure 53 **23H-Rockingham Conversions Part-4**

6.1.6 2019 Capital Year

For the 2019 capital year, load reductions continue at both 20H-Spryfield, as well as 23H-Rockingham. The 23H-Rockingham service area will be further reduced with the conversion of the remaining 12kV section along the Bedford Highway. Due to the size of this portion of the project, work will be completed over a two year period.

The conversions at 20H-Spryfield include the conversion of the Cowie Hill area.

6.1.6.1 23H-Rockingham Conversions Part-5

This portion of the project will convert 23H-301, along the Bedford Highway. The area will initially be supplied via 129H-412. Refer to Figure 54 below. This will be accomplished by:

- Close D4A11704, on the Bedford Highway.
- Open Breaker 23H-301, at the 23H-Rockingham substation.
- Open D331-123 on the Bedford Highway.
- Convert 23H-301 as indicated below, along the Bedford Highway.

Figure 54 **23H-Rockingham Conversions Part-5**

6.1.6.2 20H-Spryfield Conversions Part-3

This portion of the project will further reduce the loading at 20H-Spryfield through the conversion of the Cowie Hill area. These conversions will commence from the end point of the conversions outlined in 20H-Spryfield Conversions Part-2 above. These conversions will be supplied via the Herring Cove Road feeders. Refer to Figure 55 below. This will be accomplished by:

- Convert Herring Cove Road to 25kV, from Winchester Avenue to Mont Street.
- Convert Cowie Hill Road to 25kV.
- Convert Highfield Street to 25kV.

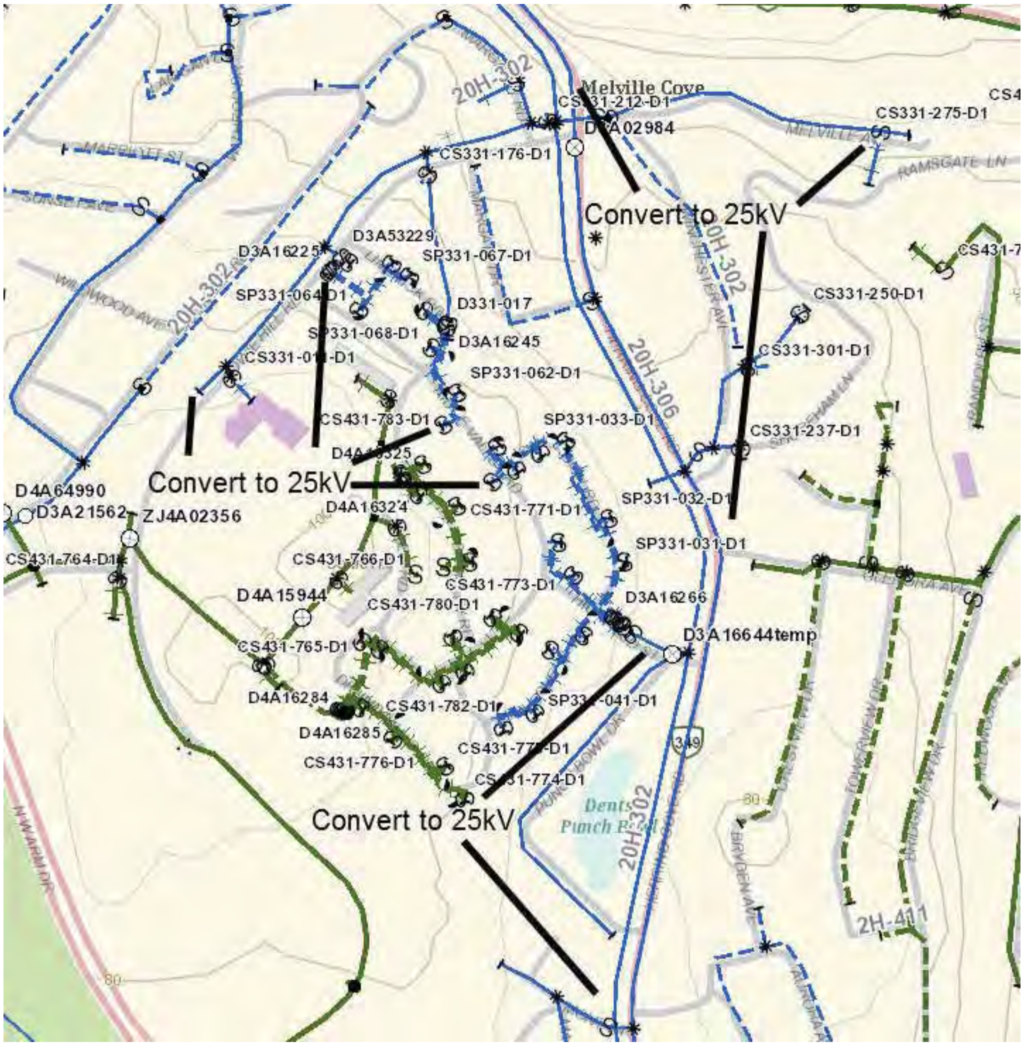


Figure 55 **20H-Spryfield Conversions Part-3**

6.1.7 2021 Capital Year

For the 2021 capital year, the 23H-Rockingham load reductions continue with the conversion of a portion of 23H-304, from the Bedford Highway to Dunbrack Street.

6.1.7.1 23H-Rockingham Conversions Part-6

This portion of the project will convert a portion of 23H-304, from the Bedford Highway to Dunbrack Street. This section of conversion has a significant portion of rear lot distribution, requiring conversion. The area will initially be supplied via the Bedford Highway (converted in the 23H-Rockingham Conversions Part-4). Refer to Figure 56 below. This will be accomplished by:

- Close D4A11704, on the Bedford Highway.
- Open Breaker 23H-301, at the 23H-Rockingham substation.
- Open D331-123 on the Bedford Highway.
- Convert 23H-301 as indicated below, along the Bedford Highway.

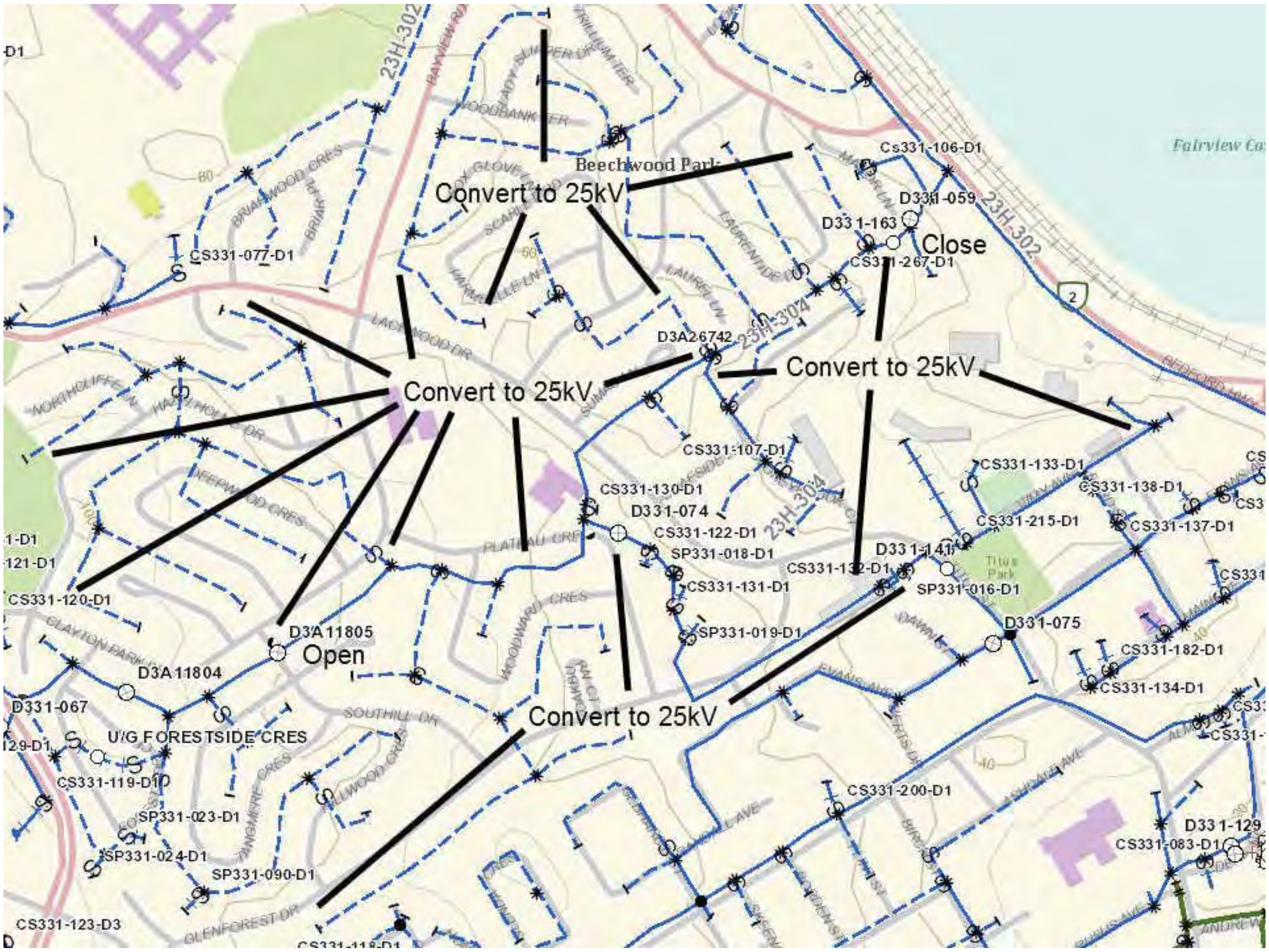


Figure 56 23H-Rockingham Conversions Part-6

6.1.8 2022 Capital Year

In the 2022 capital year, the 23H-Rockingham load reductions continue with the conversion of the remaining 12kV south of Lacewood Drive. Due to the size of this portion of the project, work will be completed over a two year period.

Additionally, further 12kV load reductions at 20H-Spryfield will be completed through commencing part 1 of the conversions on Purcell's Cove Road. The remaining conversions along Purcell's Cove Road will be completed in 2023.

6.1.8.1 23H-Rockingham Conversions Part-7

This portion of the project will convert 23H-301, along the Bedford Highway. The area will initially be supplied via 129H-412. Refer to Figure 57 below. This will be accomplished by:

- Close D4A11704, on the Bedford Highway.
- Open Breaker 23H-301, at the 23H-Rockingham substation.
- Open D331-123 on the Bedford Highway.
- Convert 23H-301 as indicated below, along the Bedford Highway.

Figure 57 23H-Rockingham Conversions Part-7

6.1.8.2 20H-Spryfield Conversions Part-4

This portion of the project will further reduce the loading at 20H-Spryfield through the conversion of a portion of Purcell's Cove, from the current end point to D331-046. These conversions will be supplied via the 25kV feeder currently on Purcell's Cove Road (presently 2H-411). The remaining portion of Purcell's Cove Road, south of D331-046 will be supplied via 20H-303 (John Brackett Drive). Refer to Figure 58 and Figure 59 below. This will be accomplished by:

- Install new open point on Williams Lake Road, prior to Purcell's Cove Road.
- Open D331-046 on Purcell's Cove Road and close D331-028 on John Brackett Drive.
- Extend 25kV on Purcell's Cove Road and convert area, as indicated below.

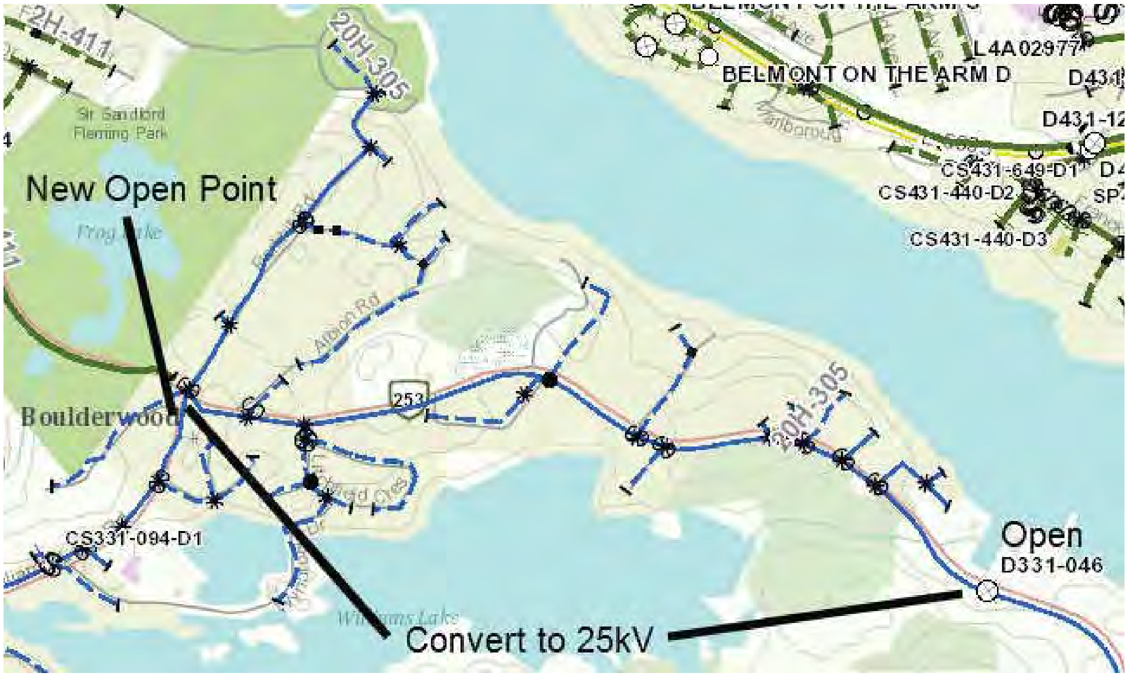


Figure 58 20H-Spryfield Conversions Part-4

Figure 59 20H-Spryfield Conversions Part-4

6.1.9 2023 Capital Year

Additionally, further 12kV load reductions at 20H-Spryfield will be completed through completing the conversions on Purcell's Cove Road that were started during the 2021 capital year.

6.1.9.1 20H-Spryfield Conversions Part-5

This portion of the project will further reduce the loading at 20H-Spryfield through the conversion of a portion of Purcell's Cove, from D331-046 to D331-028. These conversions will be supplied via the 25kV feeder currently on Purcell's Cove Road (presently 2H-411). Refer to Figure 60 and Figure 61 below. This will be accomplished by:

- Close D331-028 on John Brackett Drive and open D331-046 on Purcell's Cove Road.
- Extend 25kV on Purcell's Cove Road and convert area, as indicated below.

Figure 60 20H-Spryfield Conversions Part-5

Figure 61 20H-Spryfield Conversions Part-5

6.1.10 2024 Capital Year

2024 will see the last portion of 23H-Rockingham 12kV load converted to 25kV.

6.1.10.1 23H-Rockingham Conversions Part-8

This portion of the project will convert the remaining two portions of 12kV supplied by 23H-Rockingham. This includes the Radcliffe Drive area and Lincoln Cross, near the substation. The Radcliffe Drive area will be supplied via the distribution along L-5004 (near Lacewood Drive crossing), while the Lincoln Cross area will be supplied via Lacewood Drive. Refer to Figure 62 below. This will be accomplished by:

- Open D331-063 on Lincoln Cross, prior to Dunbrack Street intersection.
- Close Open Point installed as part of 23H-Rockingham Conversions Part-7, at the intersection of the 69kV transmission ROW and Lacewood Drive.
- Convert the remaining 12kV in 23H-303 on the Radcliffe Drive area, as indicated below.
- Open D331-071 on Lincoln Cross, near Meadowlark Crescent.
- Close Open Point installed as part of 23H-Rockingham Conversions Part-7, on Lincoln Cross and Lacewood Drive.
- Convert the remaining 12kV on 23H-304 in the Lincoln Cross area, as indicated below.

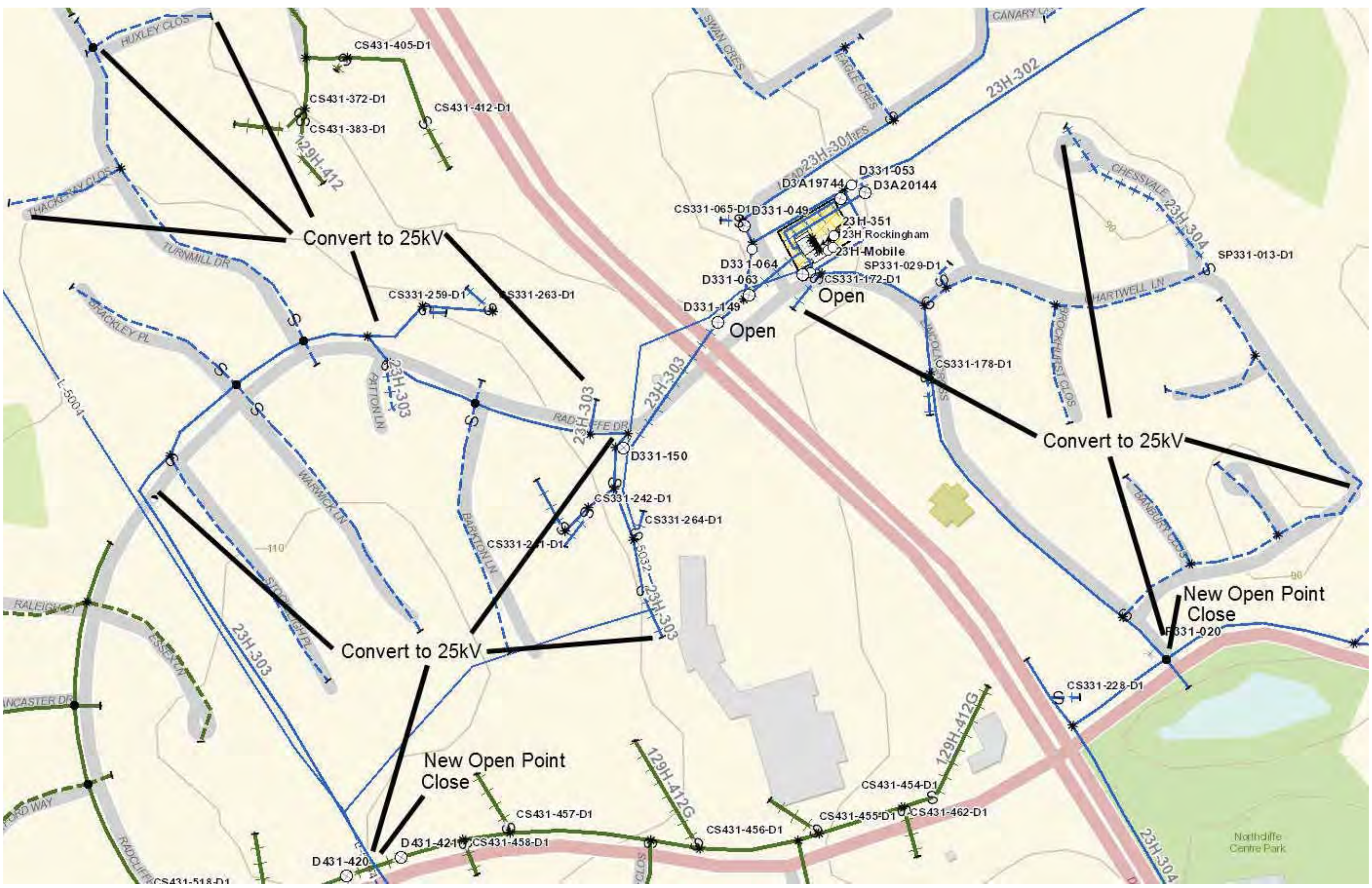


Figure 62 23H-Rockingham Conversions Part-8

6.1.11 2025 Capital Year

For the 2025 capital year, the 23H-Rockingham substation will be decommissioned and the substation equipment removed, including the underground feeder exits. The 69kV transmission line supplying the substation, L-5032, will also be removed from the L-5004 tap.

6.1.11.1 23H-Rockingham Conversions Part-9

This portion of the project will see the decommissioning of the 23H-Rockingham substation, including all equipment. This portion of the project will maintain the feeder ties, around the 23H-Rockingham substation, as well as decommission and remove L-5032 (the 69kV tap) from L-5004 to the substation. Refer to Figure 63 below. This will be accomplished by:

- Remove L-5032, from L-5004 tap to 23H-Rockingham substation.
- Remove 23H-Rockingham substation equipment, including underground feeder exits.
- Prepare lot for potential sale.

Figure 63 23H-Rockingham Conversions Part-9

6.1.12 2026 Capital Year

For the 2026 capital year, further 12kV load reductions at 20H-Spryfield will be realized with the conversion of the Williams Lake Road area.

6.1.12.1 20H-Spryfield Conversions Part-6

This portion of the project will convert the Williams Lake Road portion of the 12kV supplied by 20H-Spryfield. This portion of the project will create a new feeder tie between Purcell's Cove Road and Herring Cove Road. The top circuit of the Herring Cove Road (currently 20H-302), from Mont Street St. Michaels Avenue, will be converted to 25kV and supplied via the upper circuit prior to Mont Street. A new open point on the top circuit will be installed near the Williams Lake Road tap. Refer to Figure 64 below. This will be accomplished by:

- Change tap to Williams Lake Road from lower to top feeder.
- Install new N/O point on top feeder of Herring Cove Road, between Williams Lake Road and Lois Lane.
- Open Circle Drive tap from Herring Cove Road.
- Convert Williams Lake Road including Ravenscraig area, as outlined below.

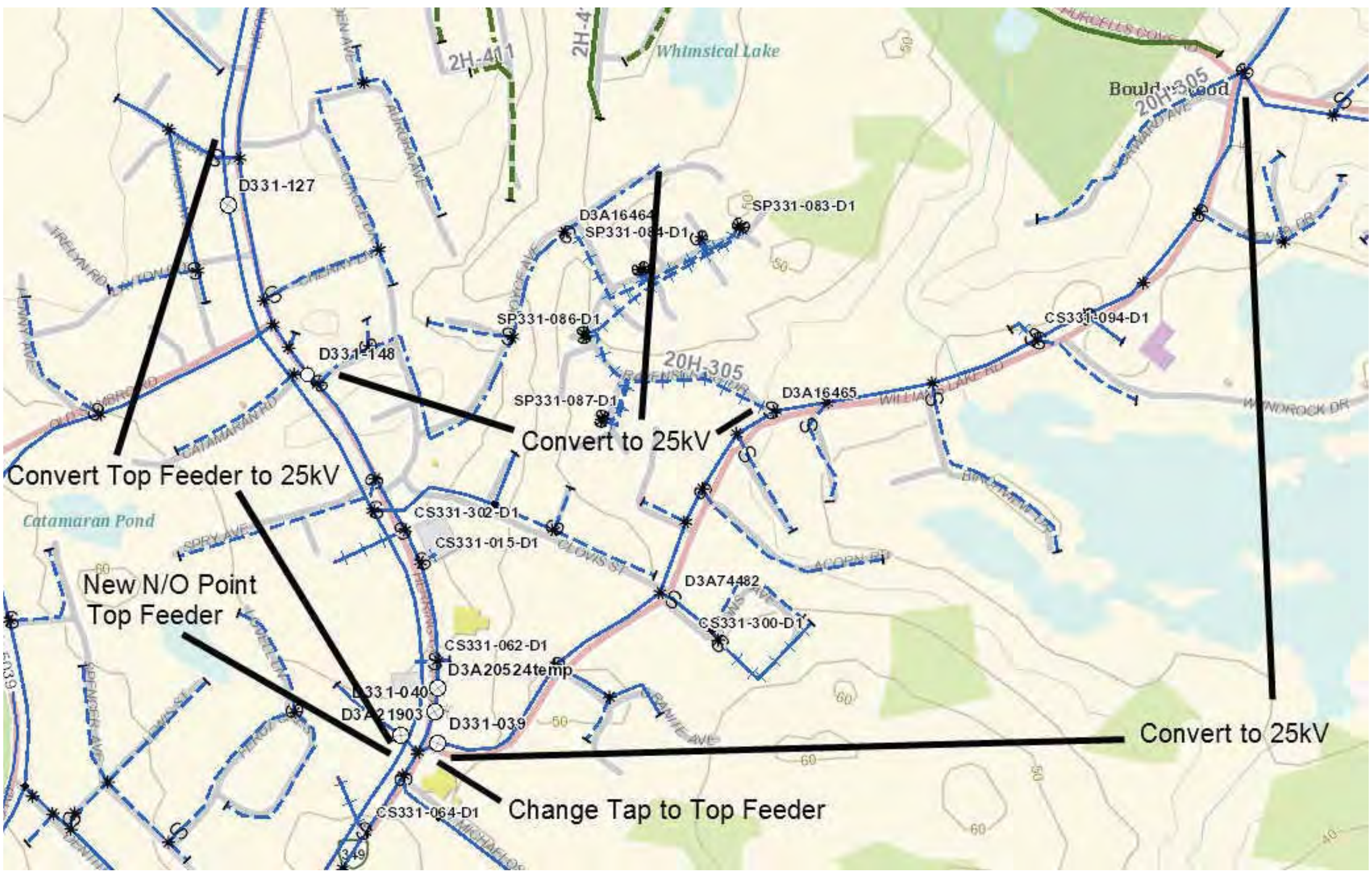


Figure 64 **20H-Spryfield Conversions Part-6**

APPENDIX A

System Operating Diagrams

Pages 86-94 have been removed due to confidentiality.

APPENDIX B

Load History and Forecast

Note:

- Due to the variety of changes in feeder configurations, feeder load forecasts will not be presented in this report.
- Please refer to section 3.2 Load Forecast for the 90th Percentile Data values

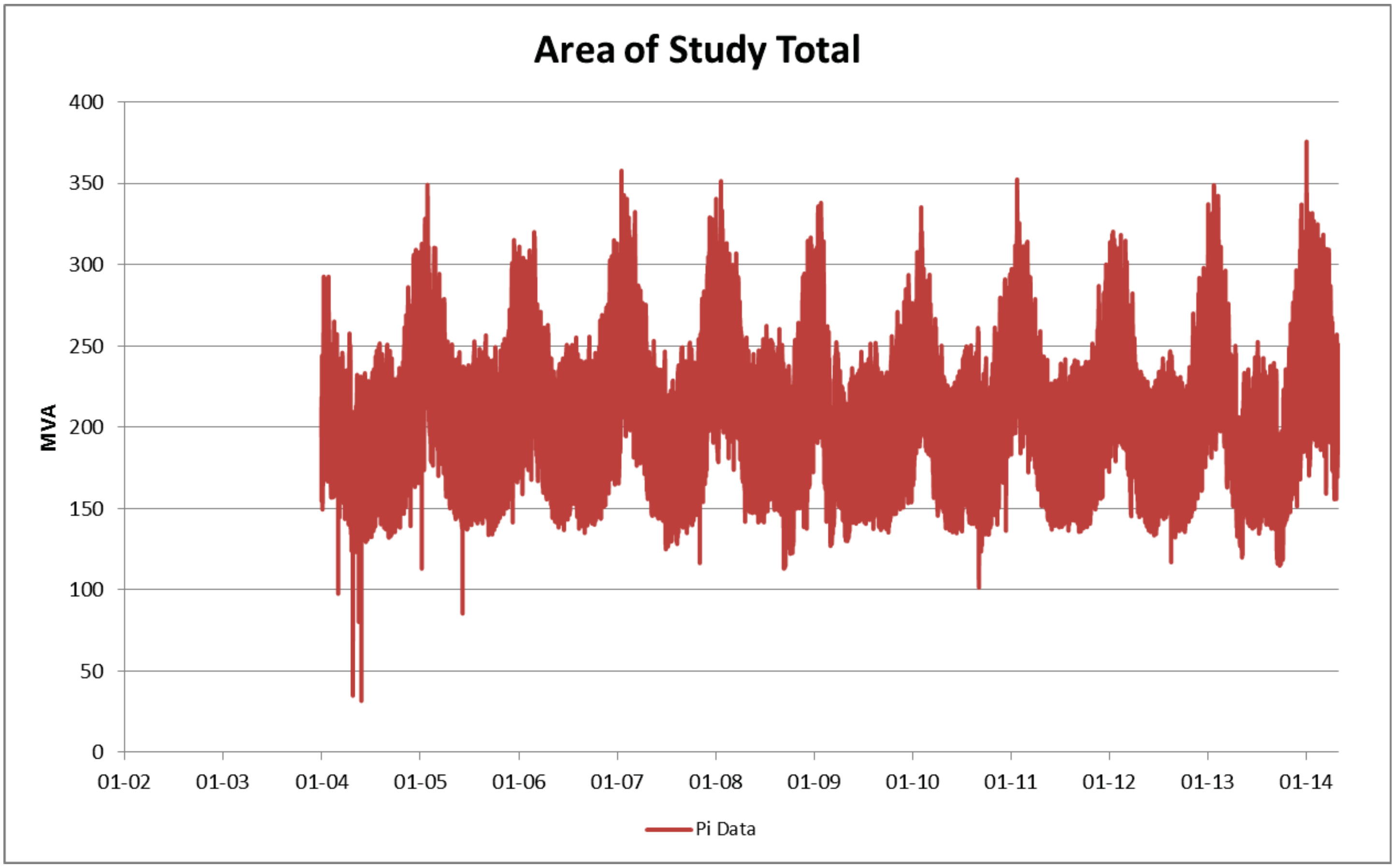


Figure 74 **Area of Study Load History**

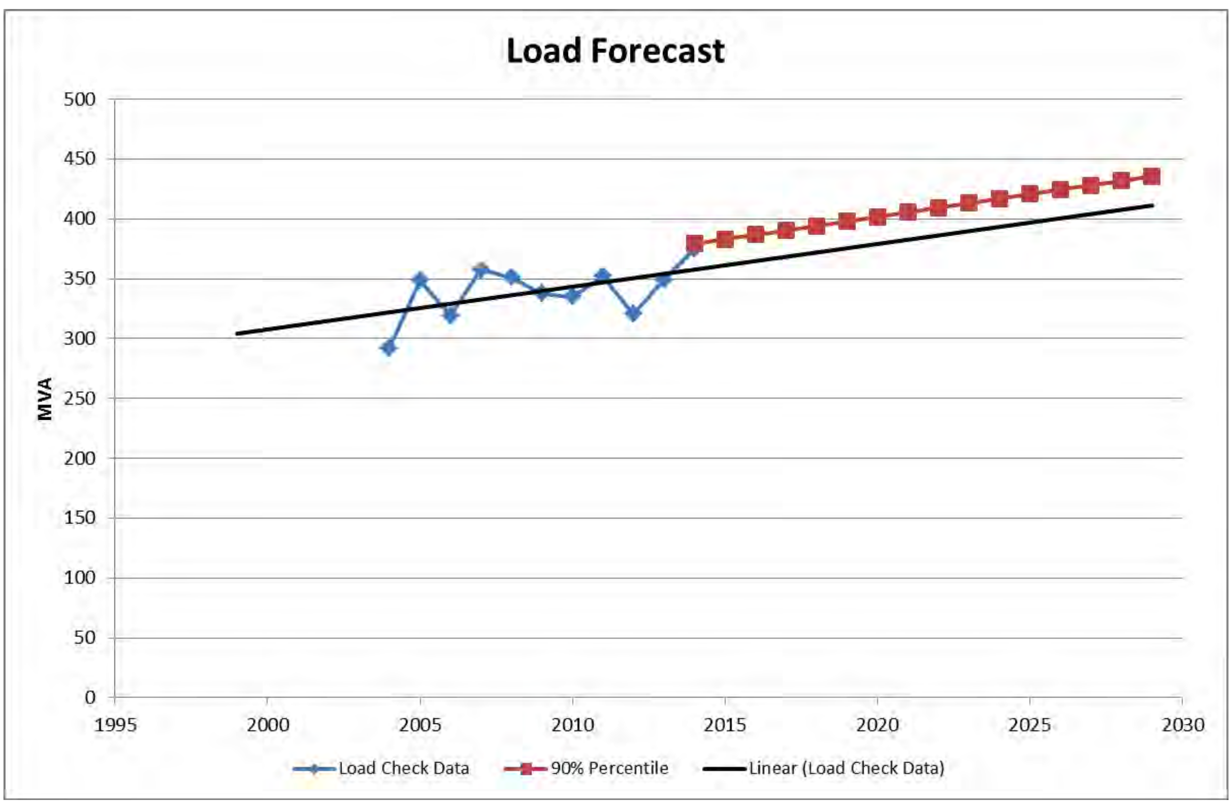


Figure 75 **Area of Study Load Forecast**

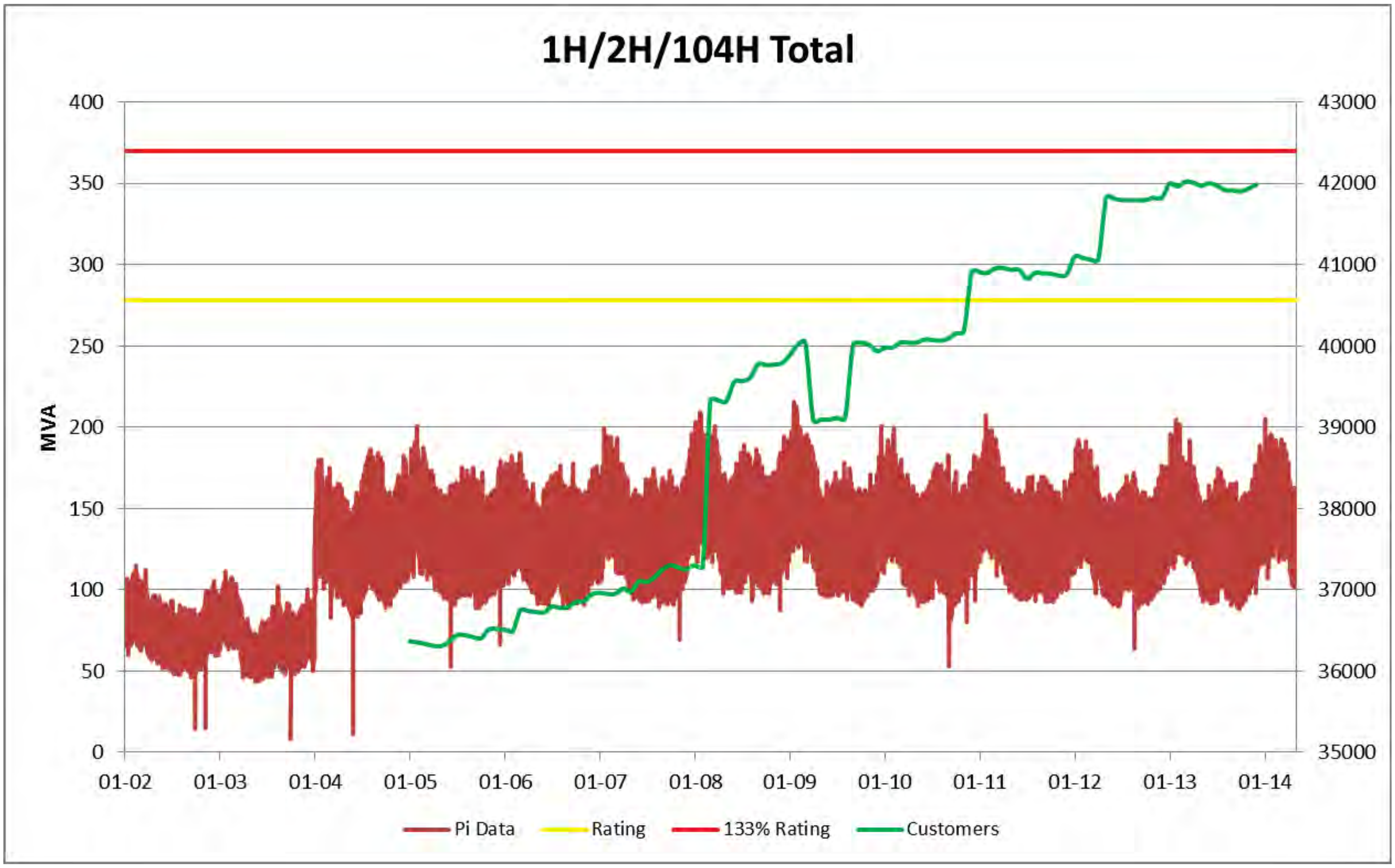


Figure 76 1H / 2H / 104H Load History

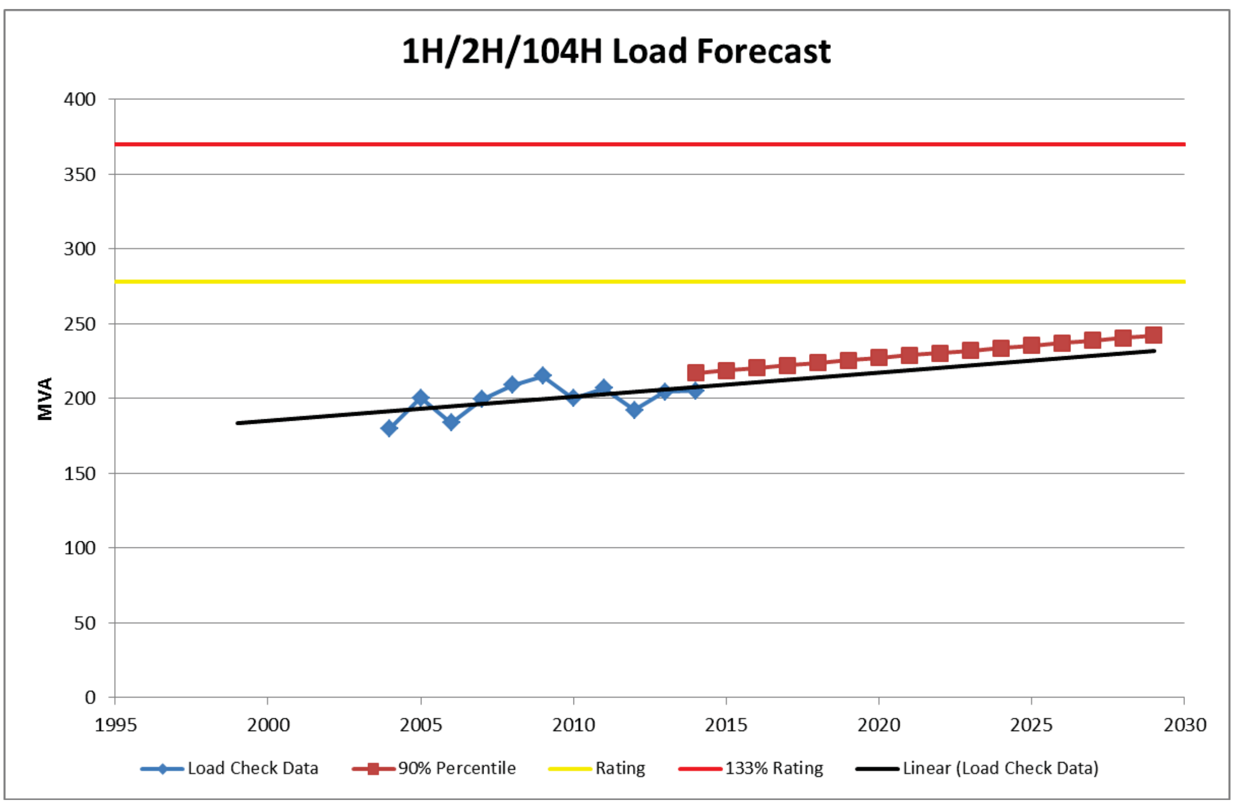


Figure 77 1H / 2H / 104H Load Forecast

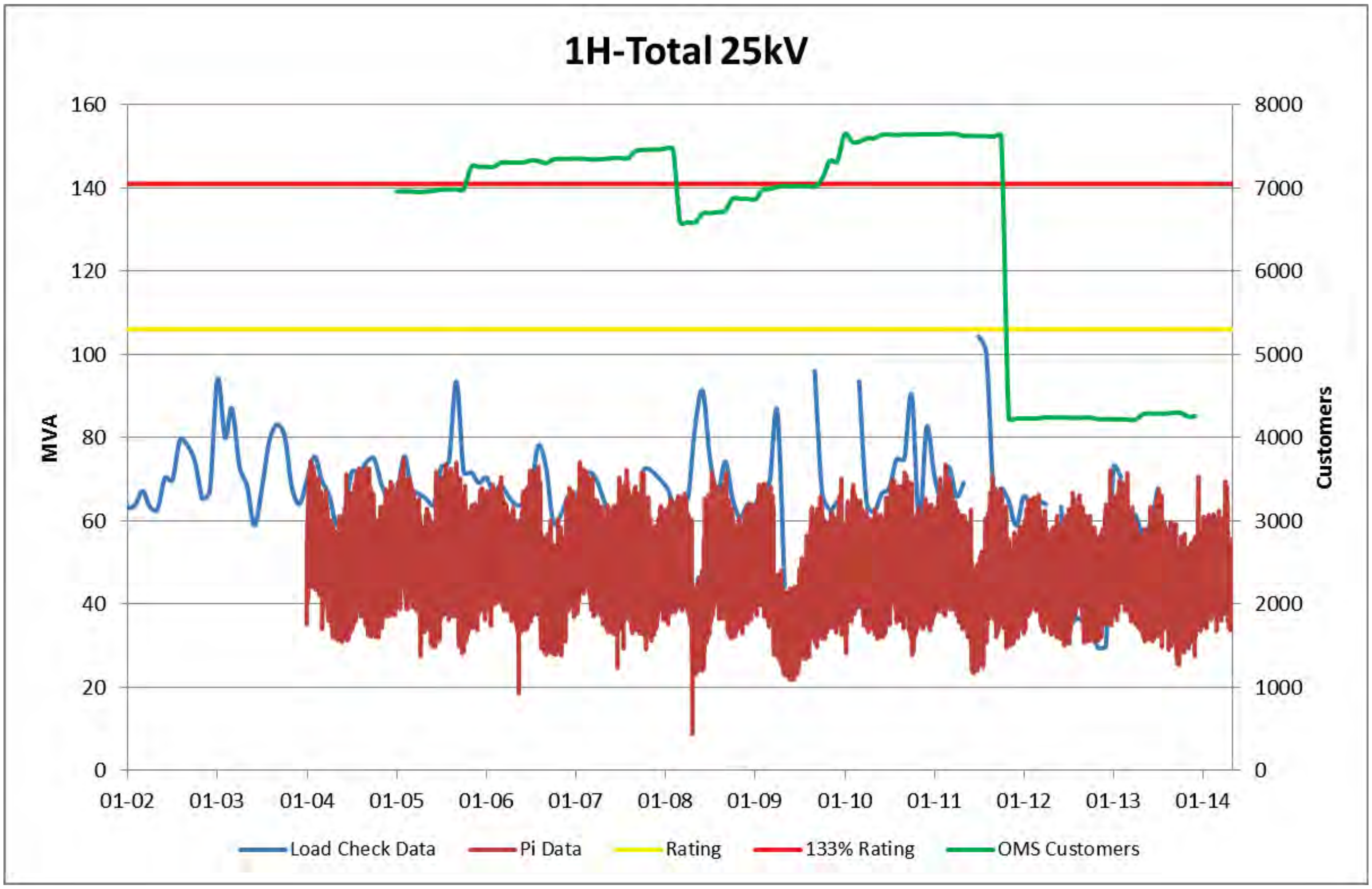


Figure 78 1H-Water Street 25kV Load History

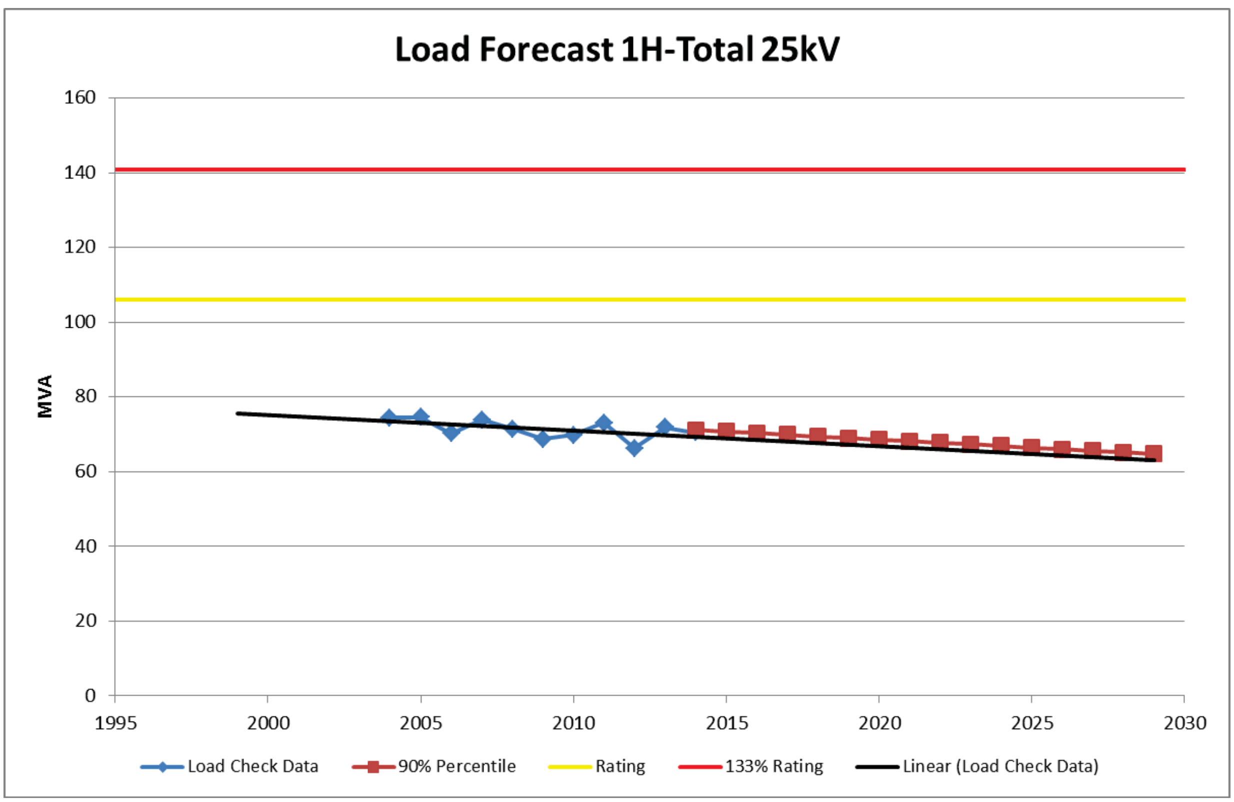


Figure 79 1H-Water Street 25kV Load Forecast

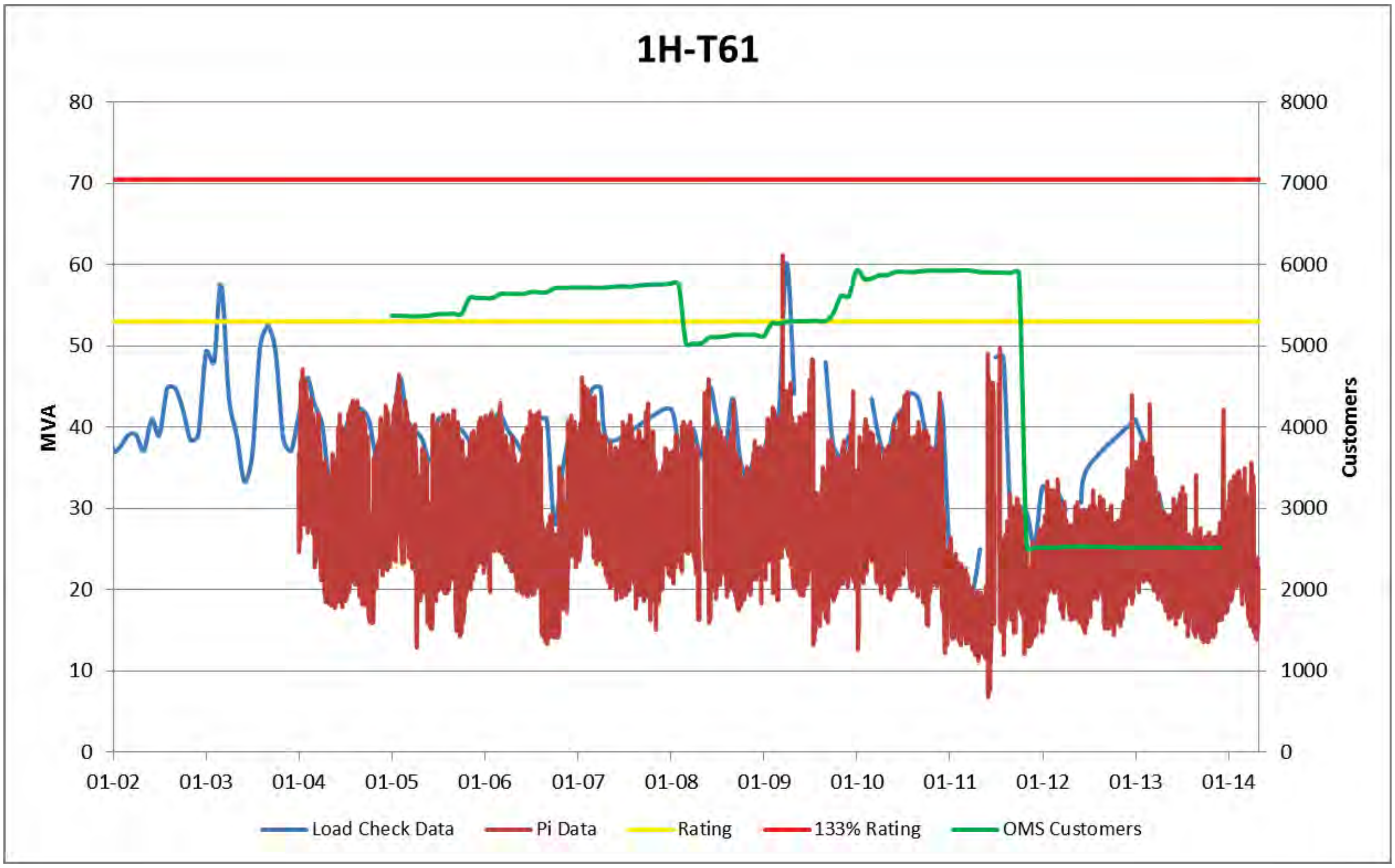


Figure 80 **1H-T61 Load History**

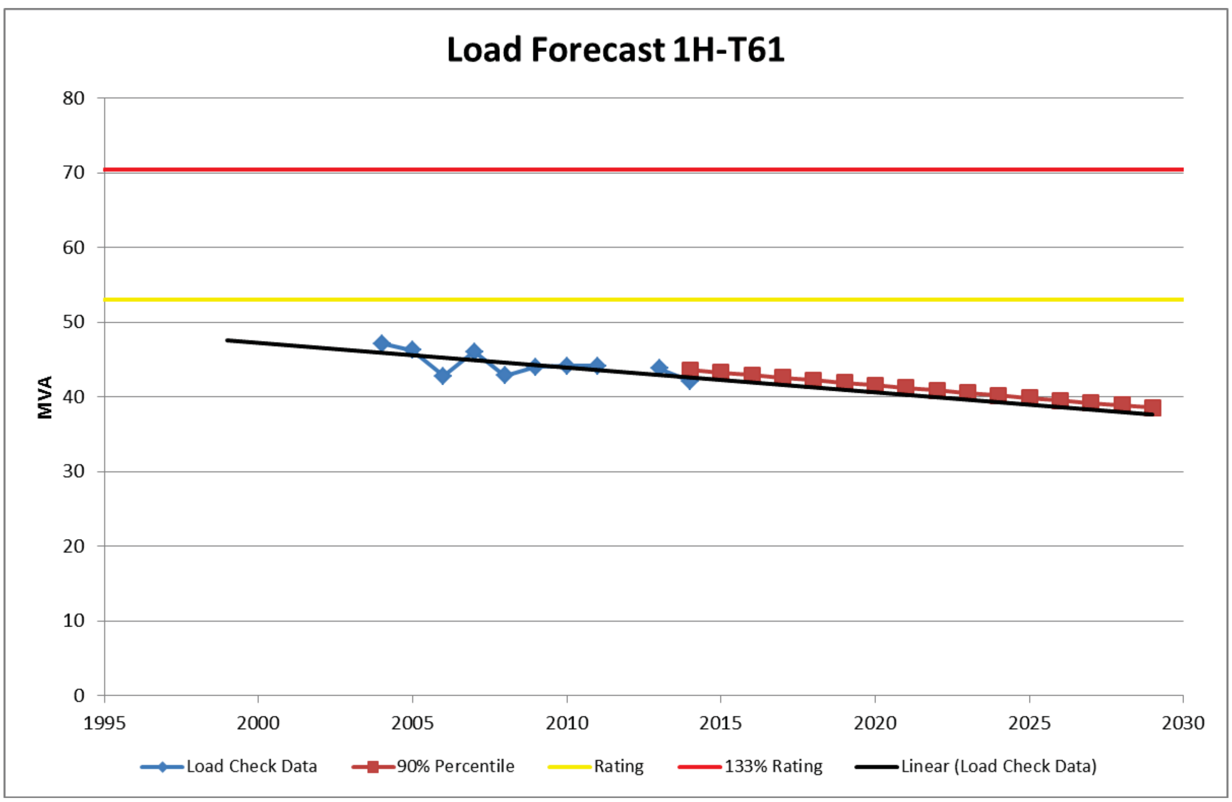


Figure 81 **1H-T61 Load Forecast**

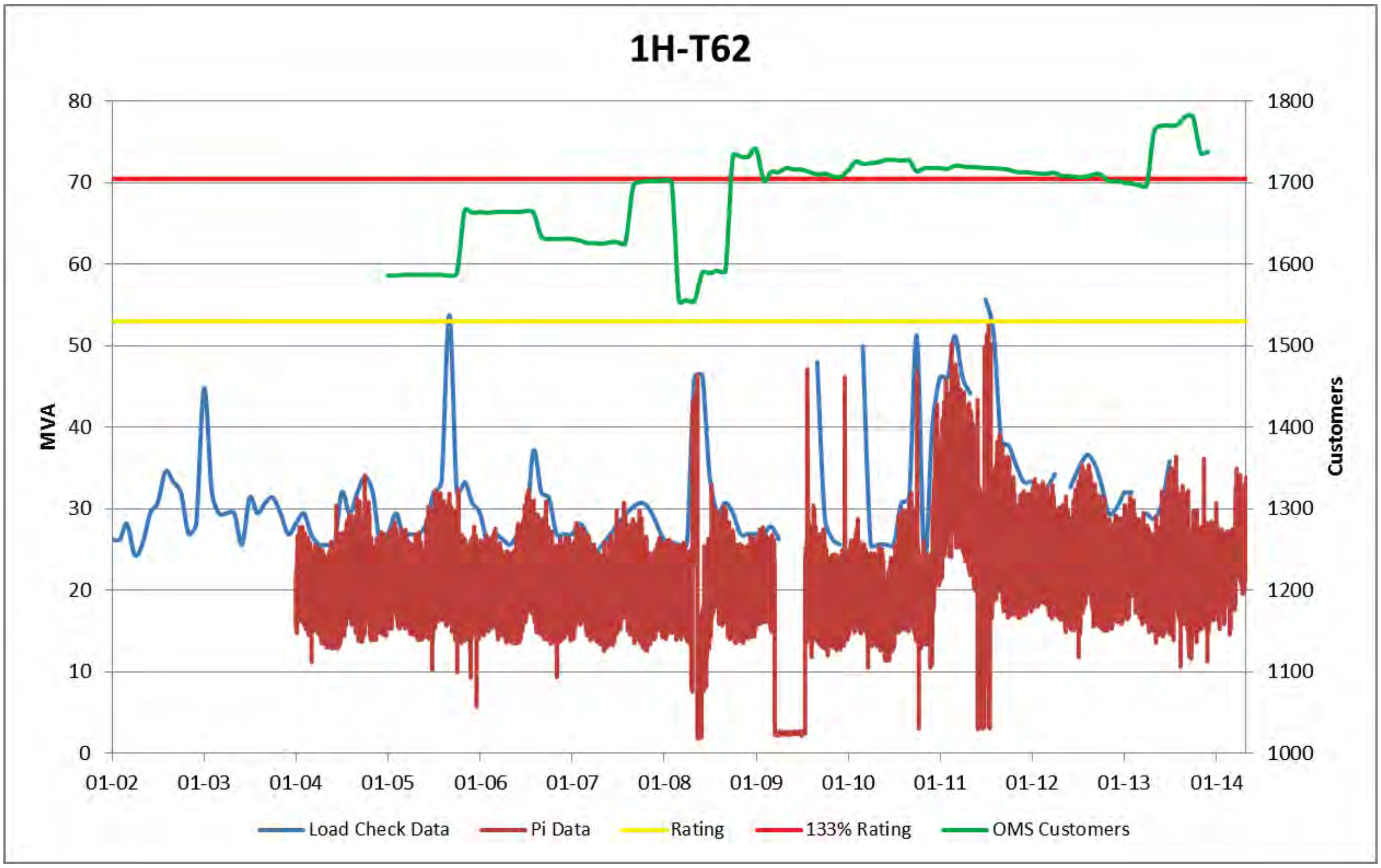


Figure 82 1H-T62 Load History

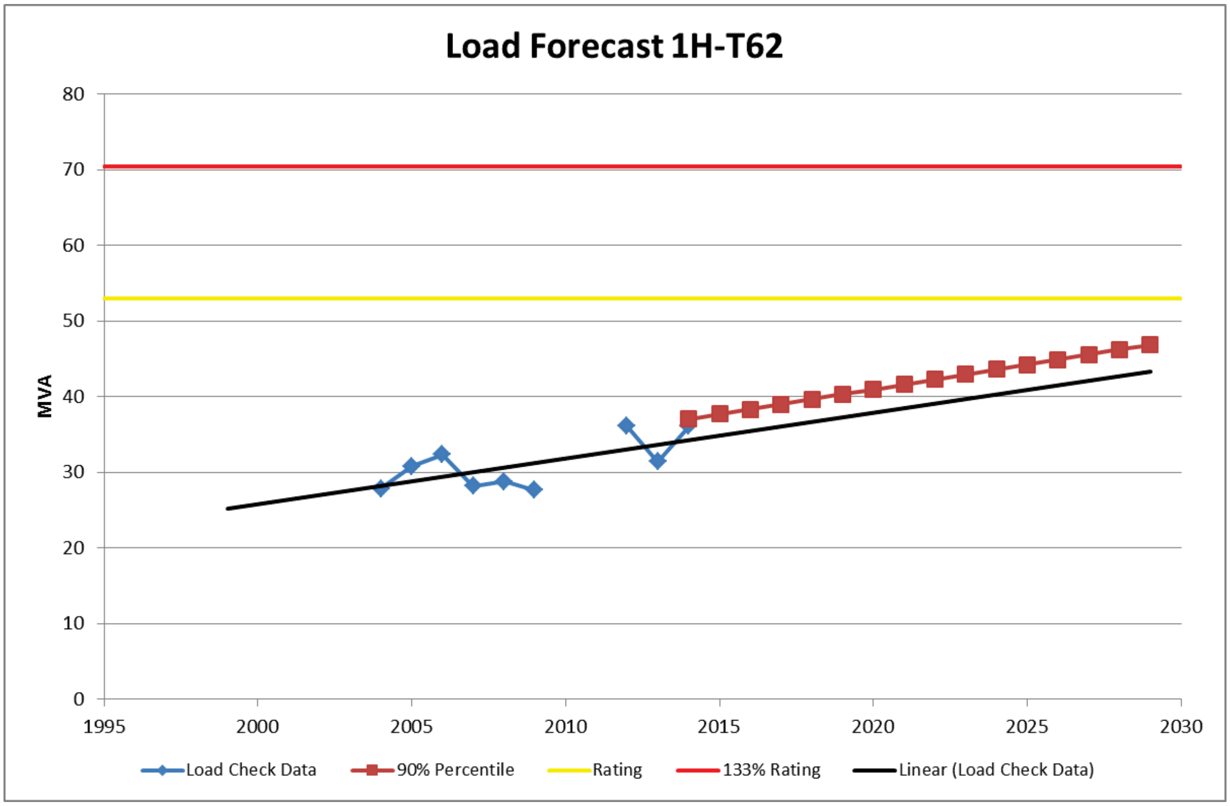


Figure 83 1H-T62 Load Forecast

Appendix B: Load History and Forecast

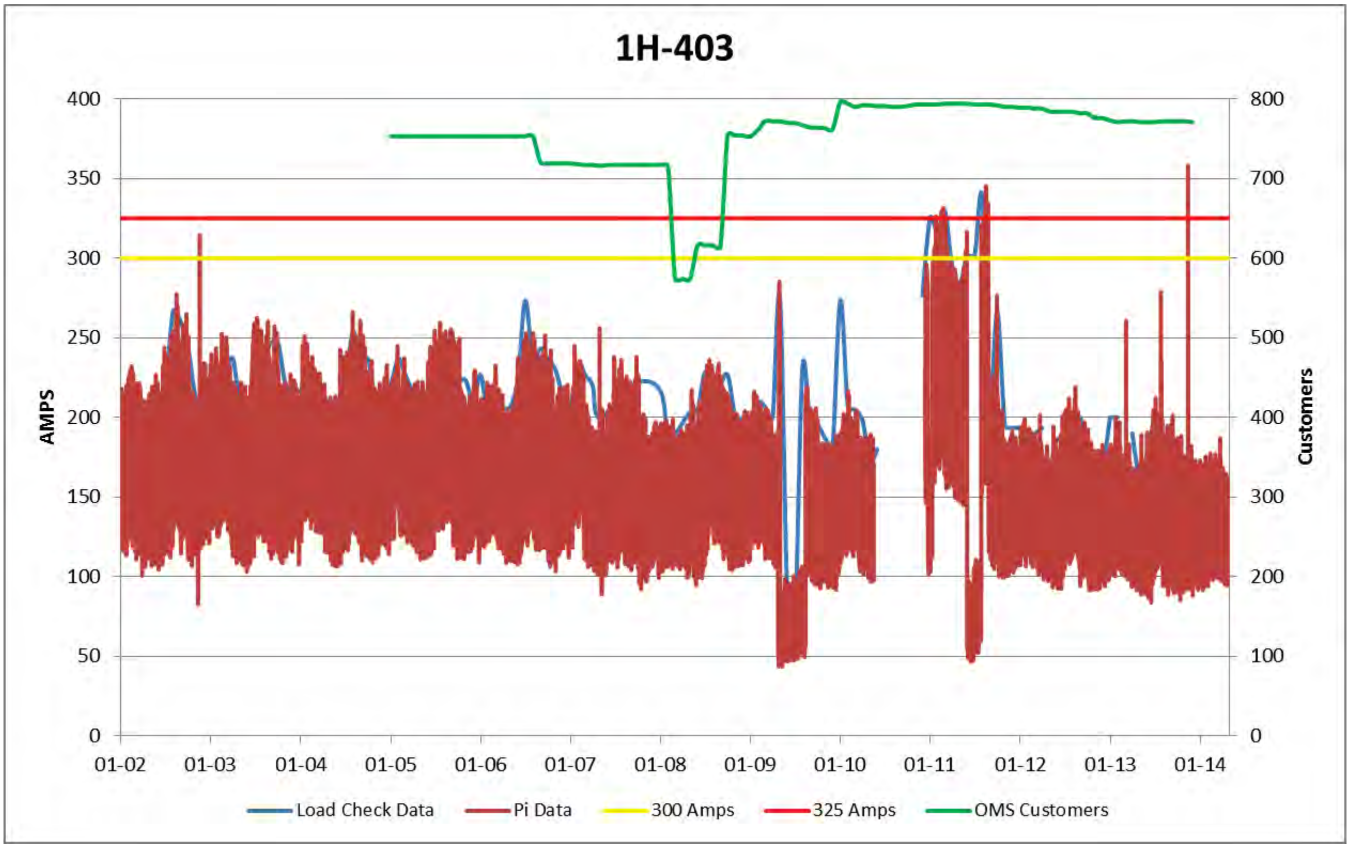


Figure 84 1H-403 Load History

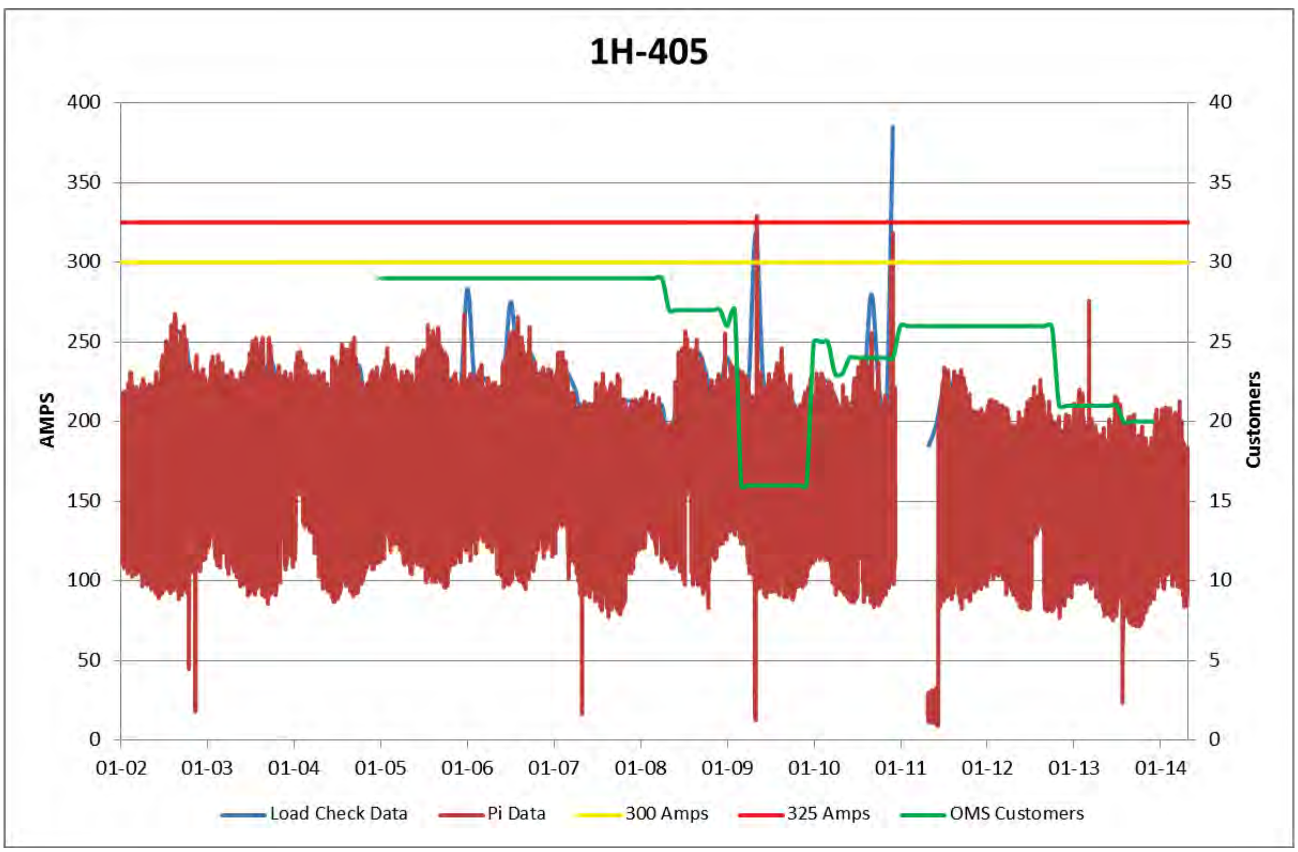


Figure 85 1H-405 Load History

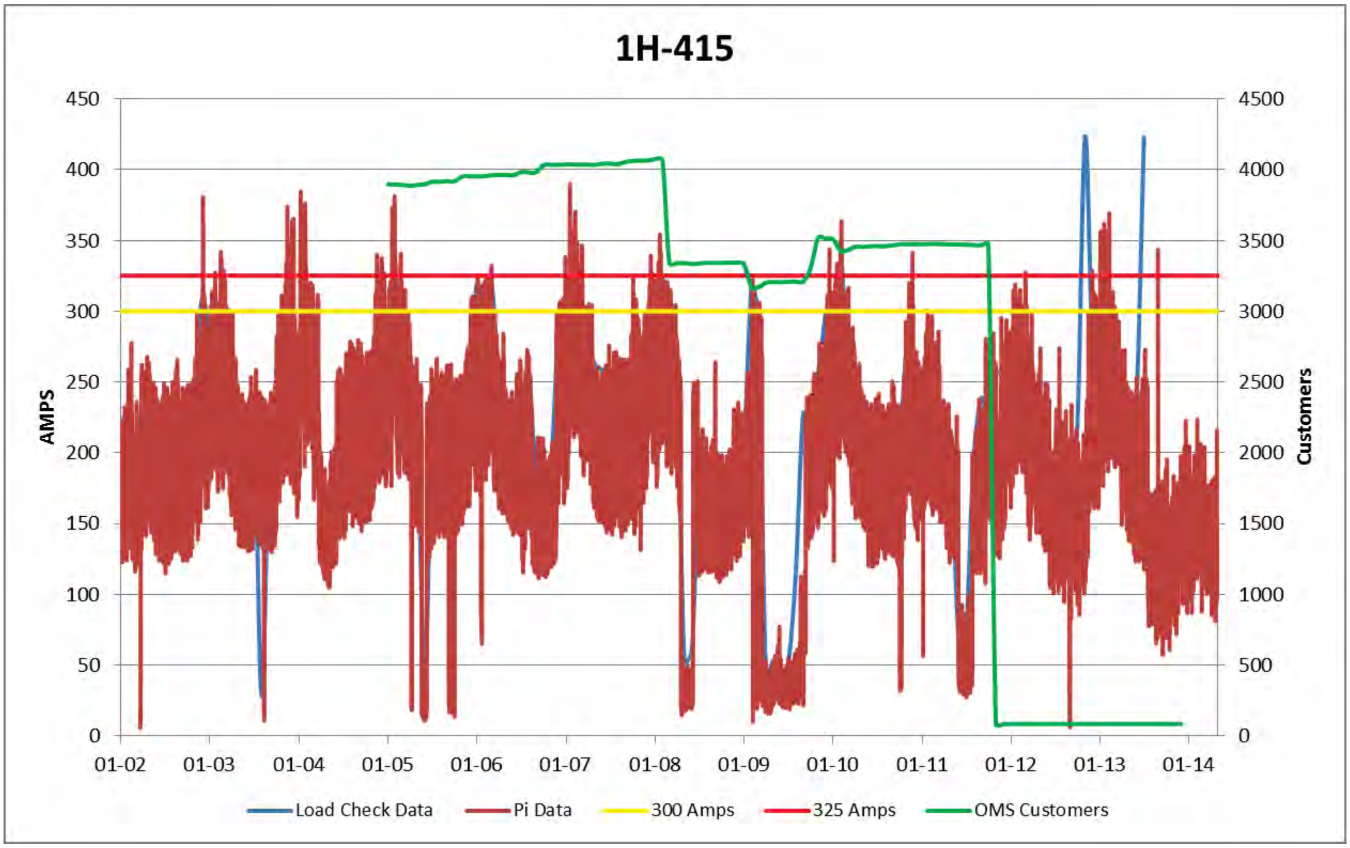


Figure 86 1H-415 Load History

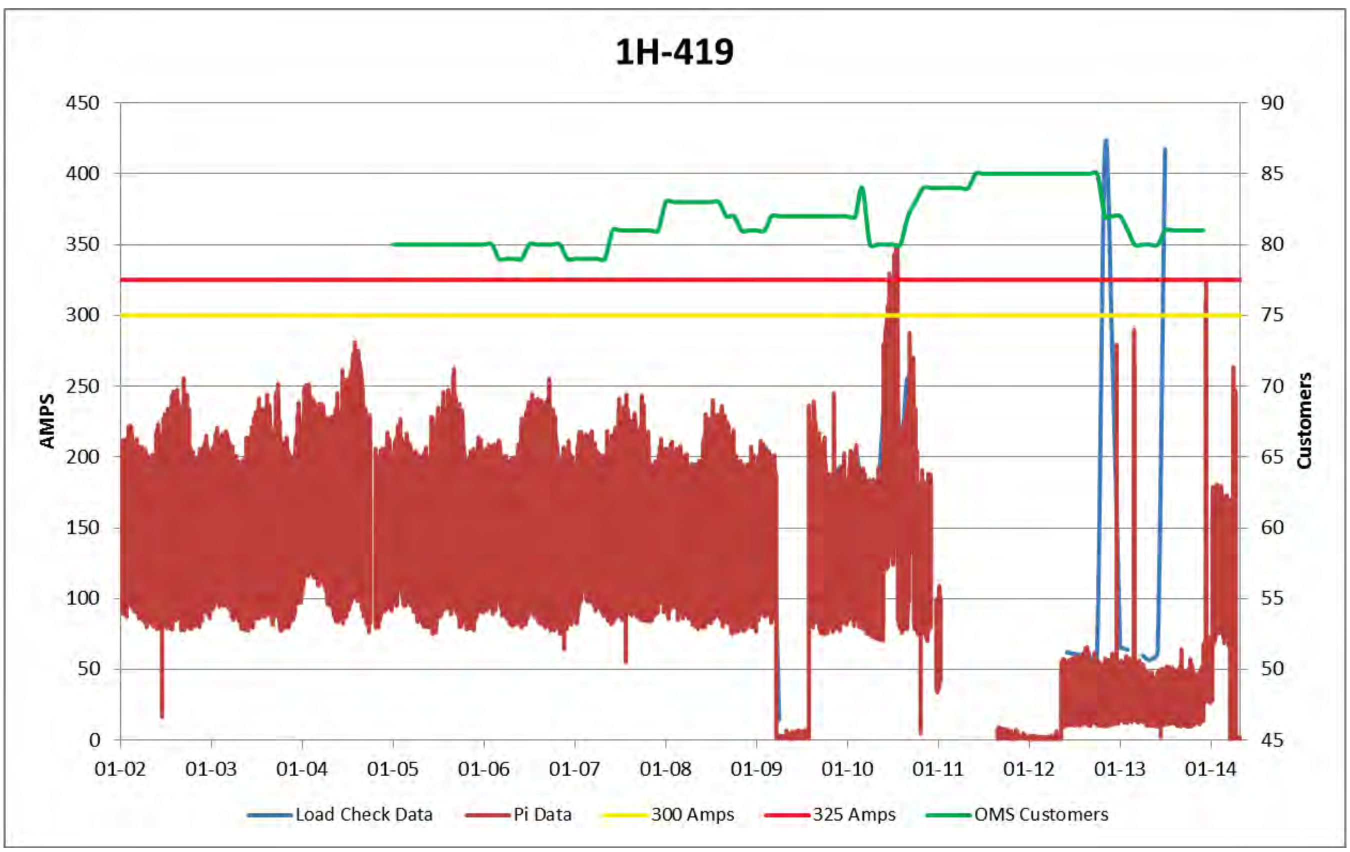


Figure 87 1H-419 Load History

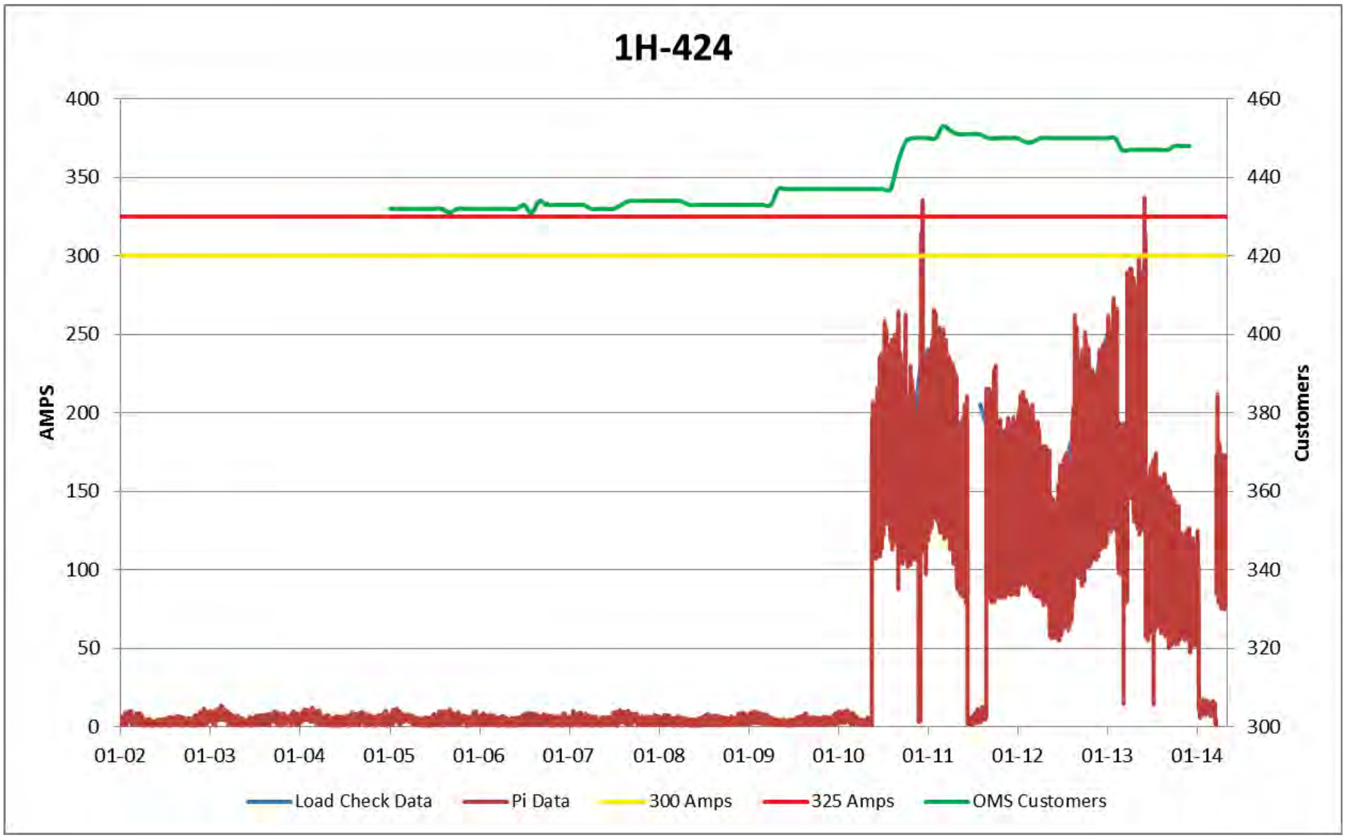


Figure 88 1H-424 Load History

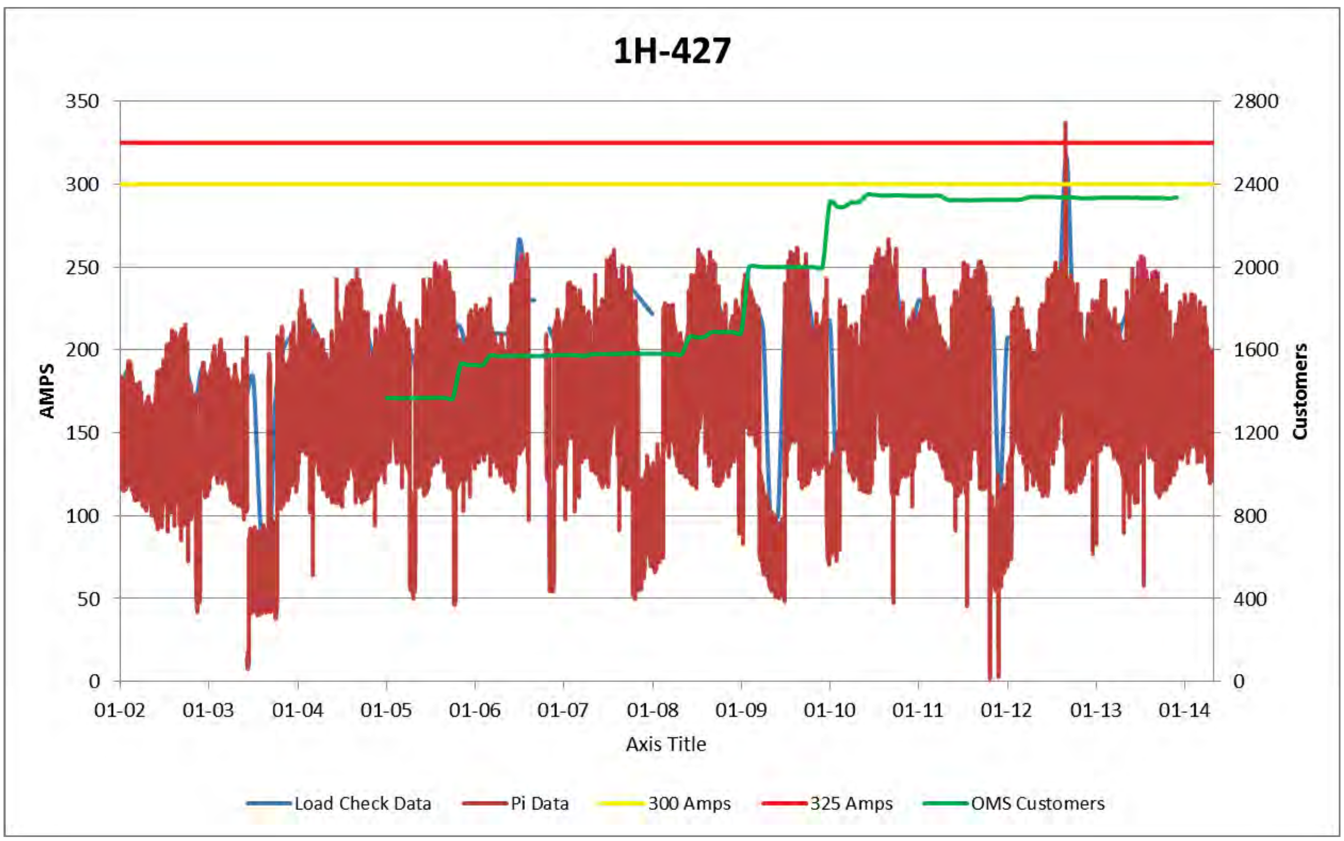


Figure 89 1H-427 Load History

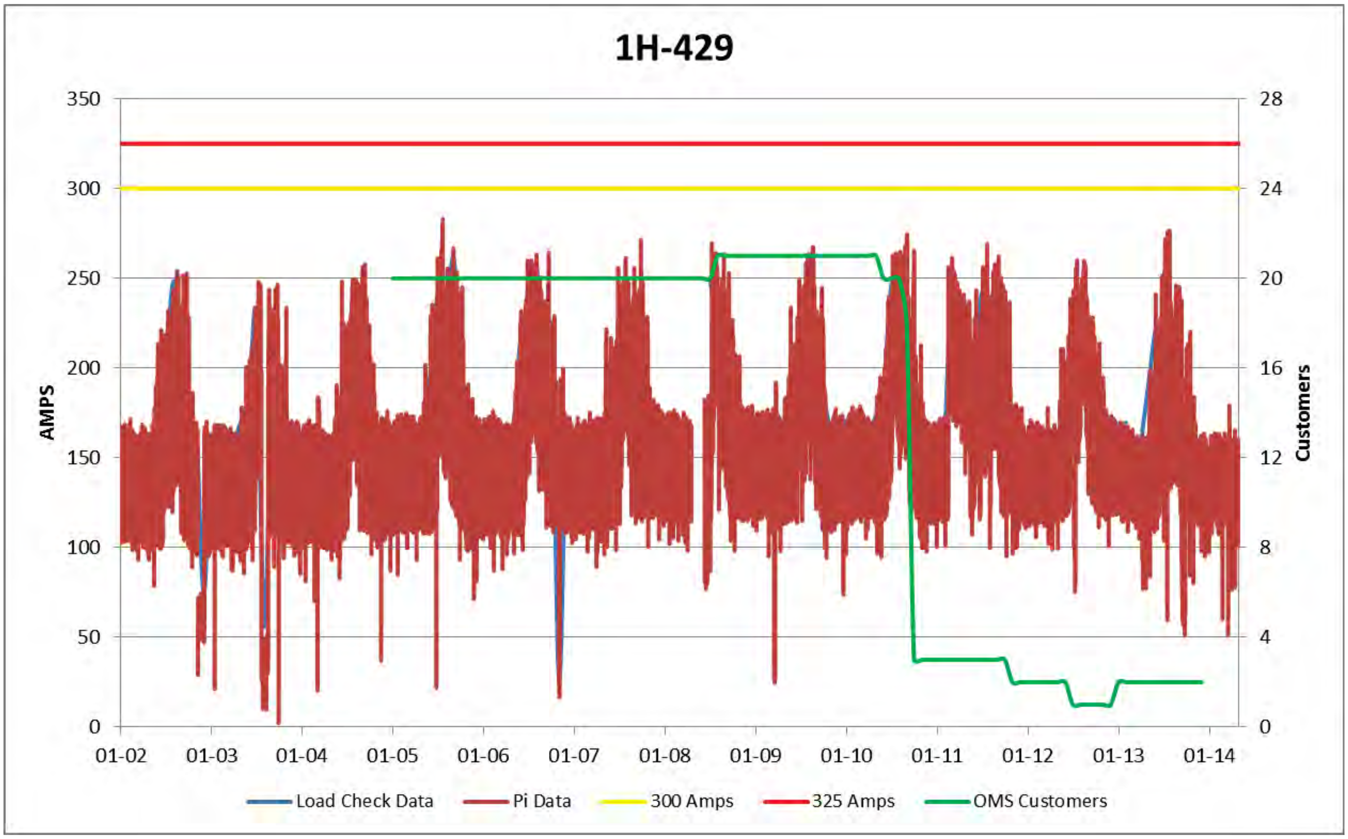


Figure 90 1H-429 Load History

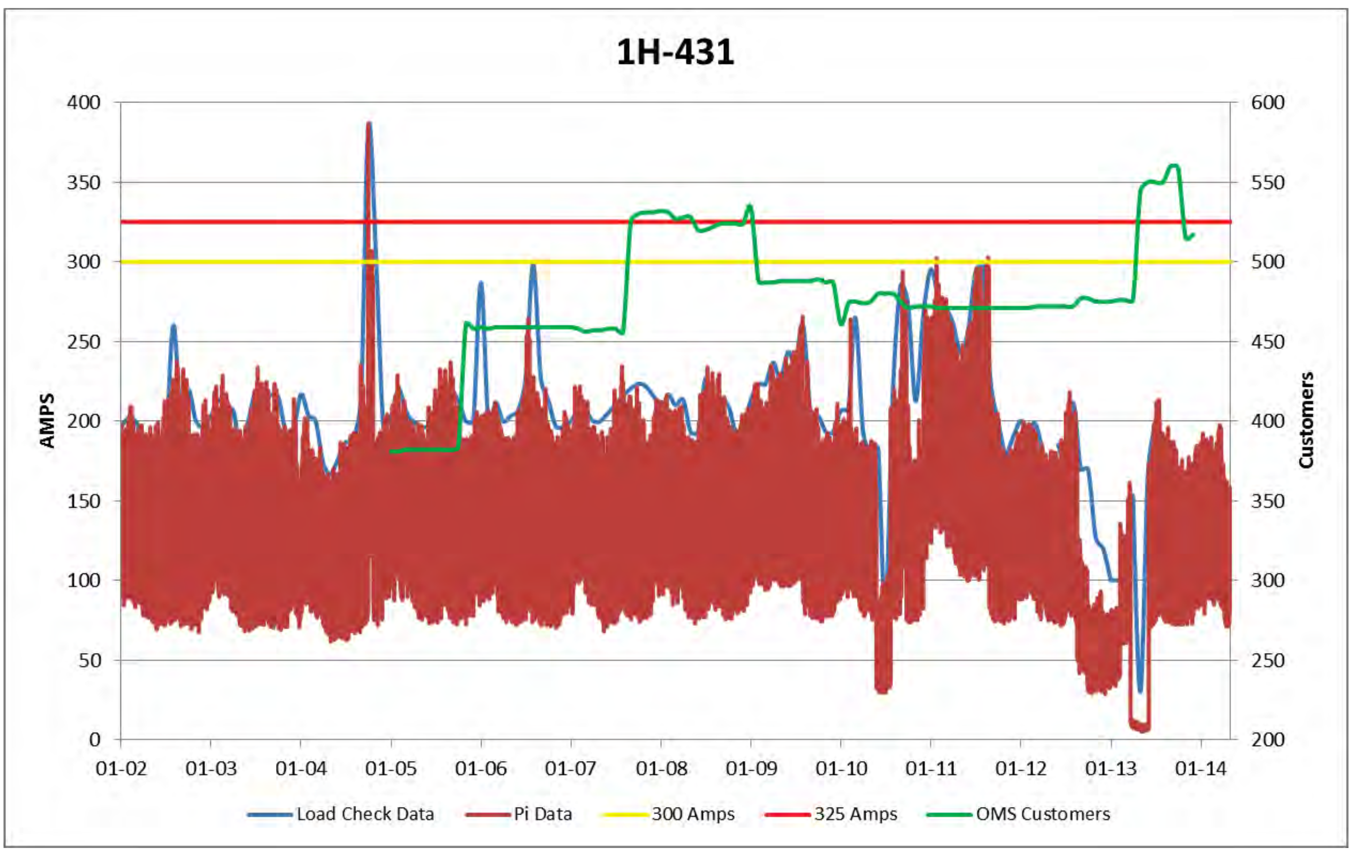


Figure 91 1H-431 Load History

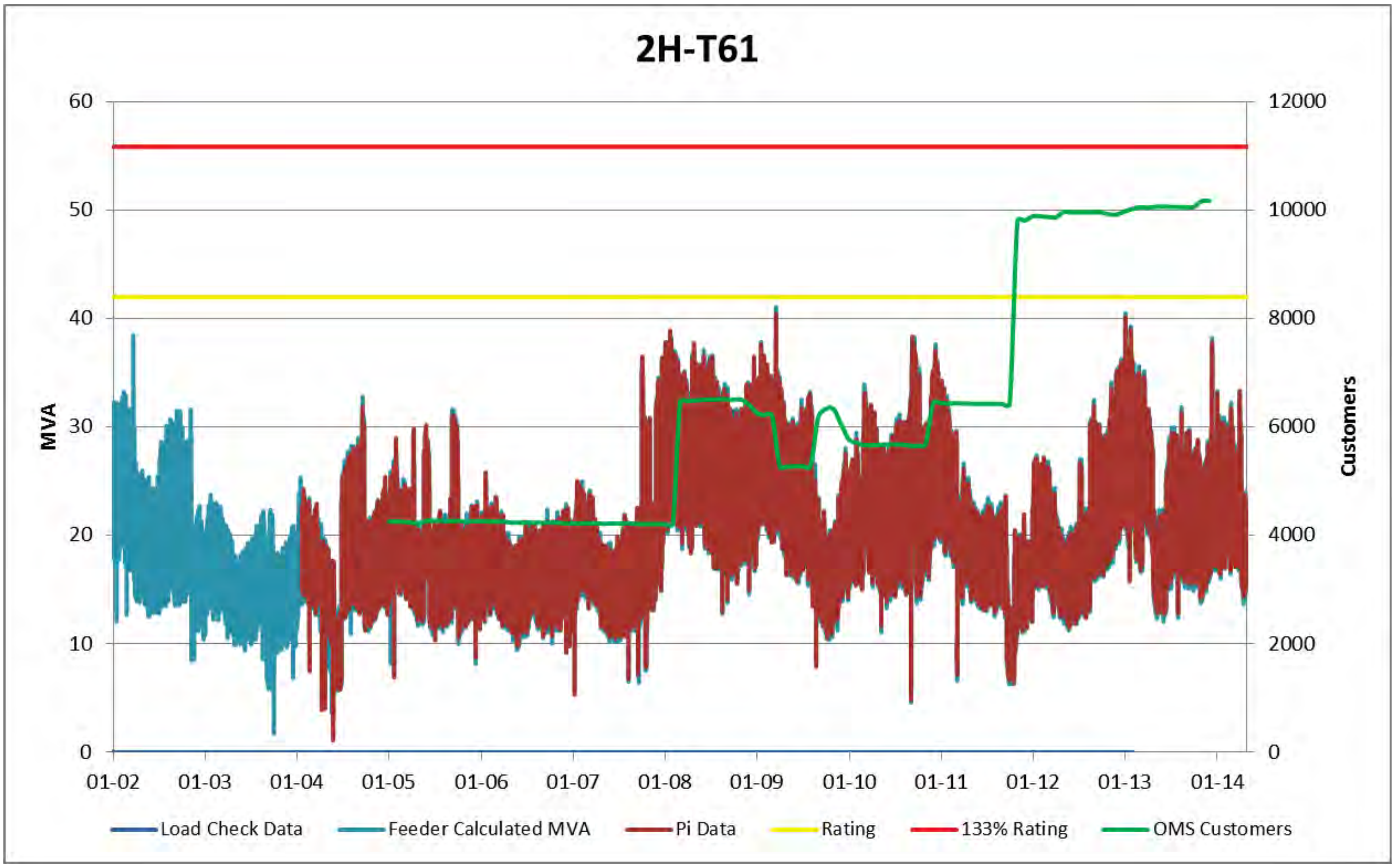


Figure 92 **2H-T61 Load History**

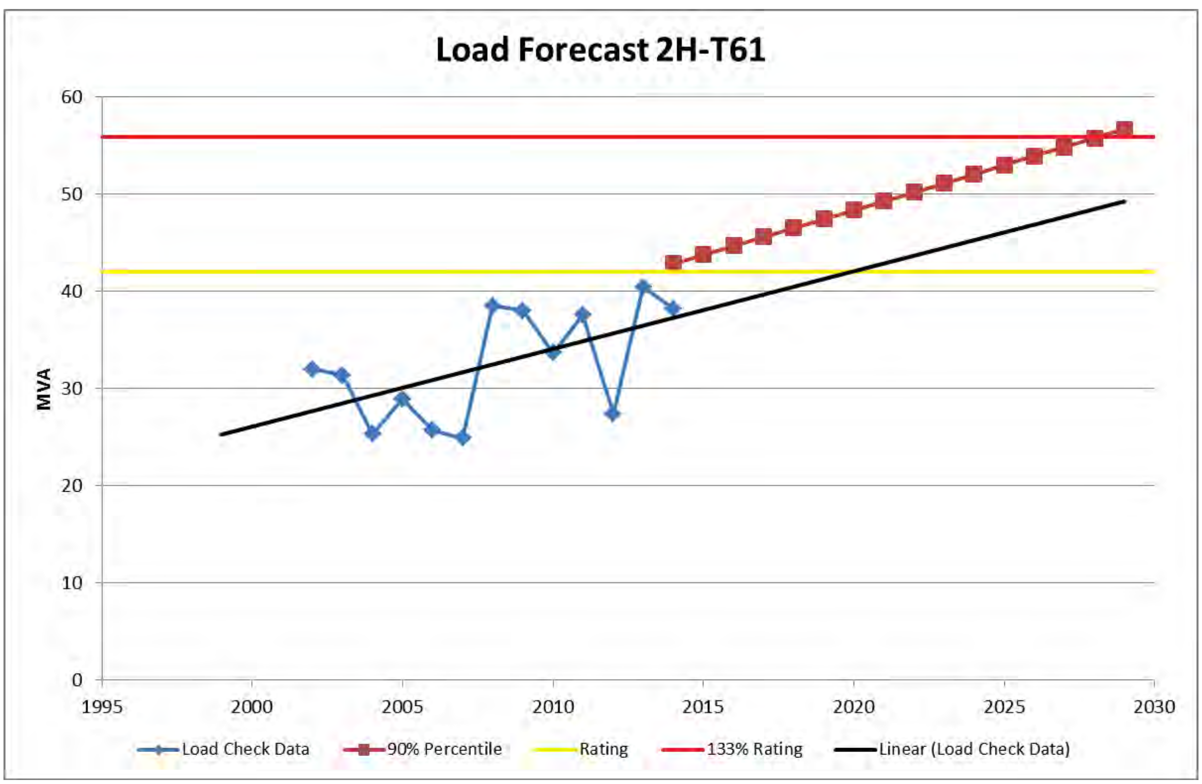


Figure 93 **2H-T61 Load Forecast**

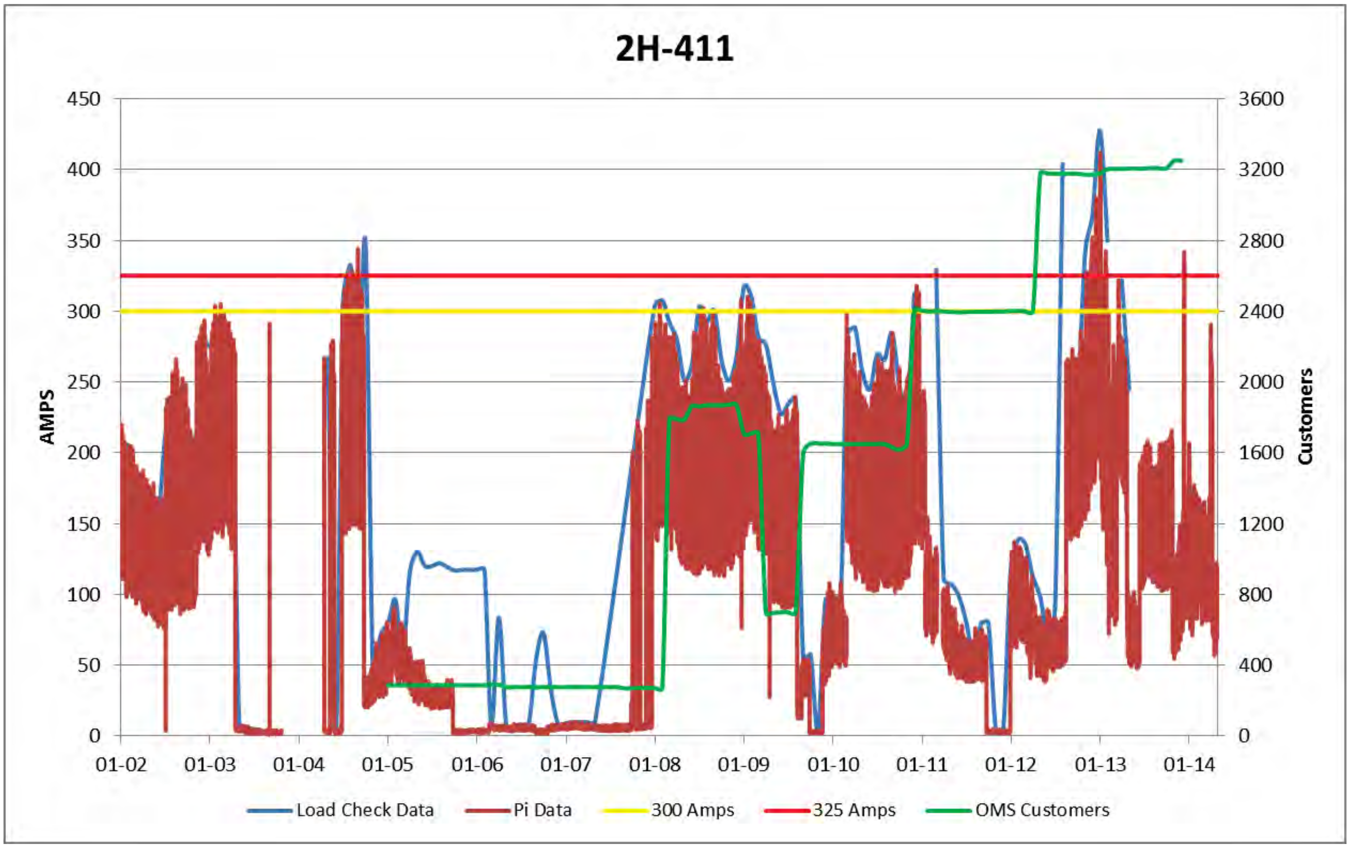


Figure 94 **2H-411 Load History**

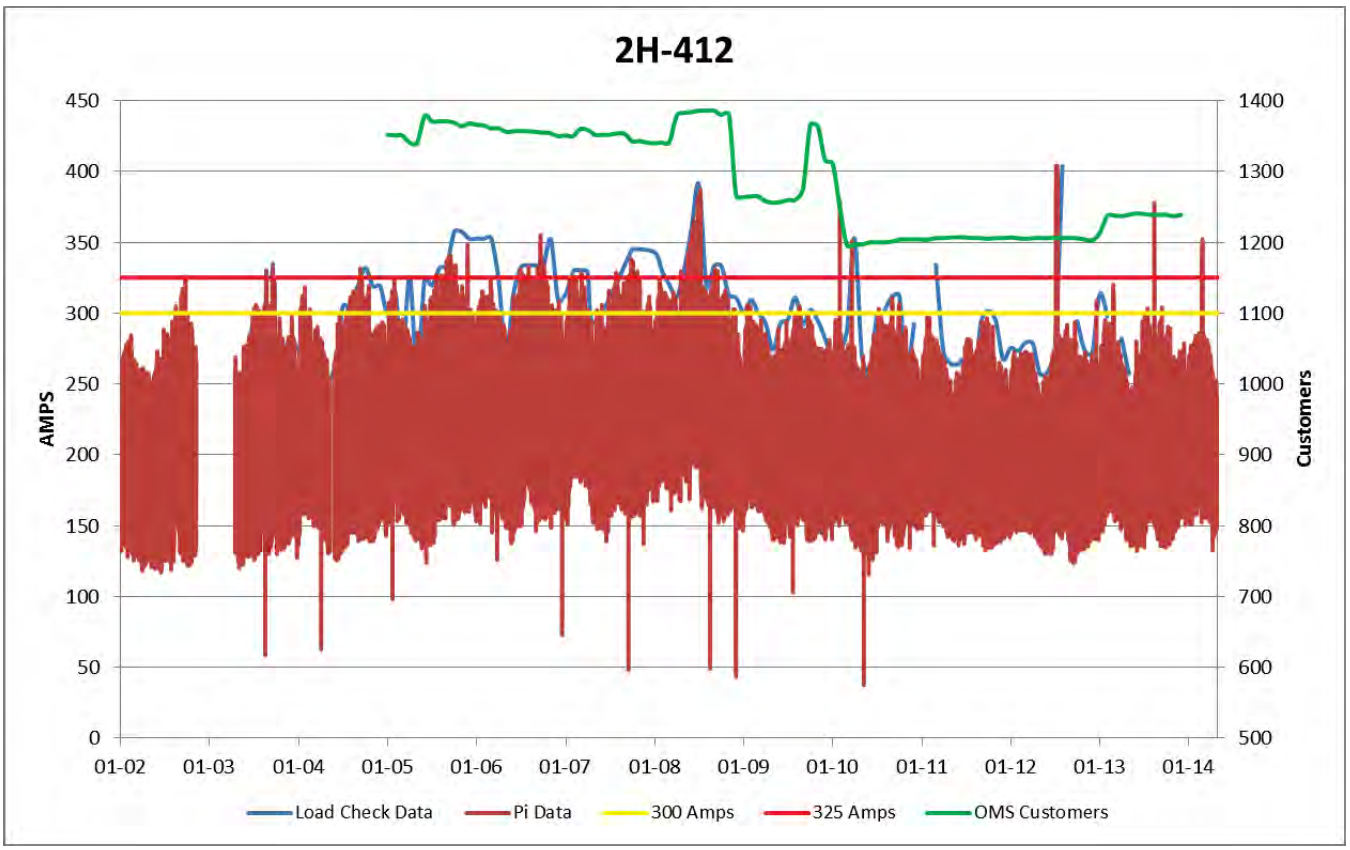


Figure 95 **2H-412 Load History**

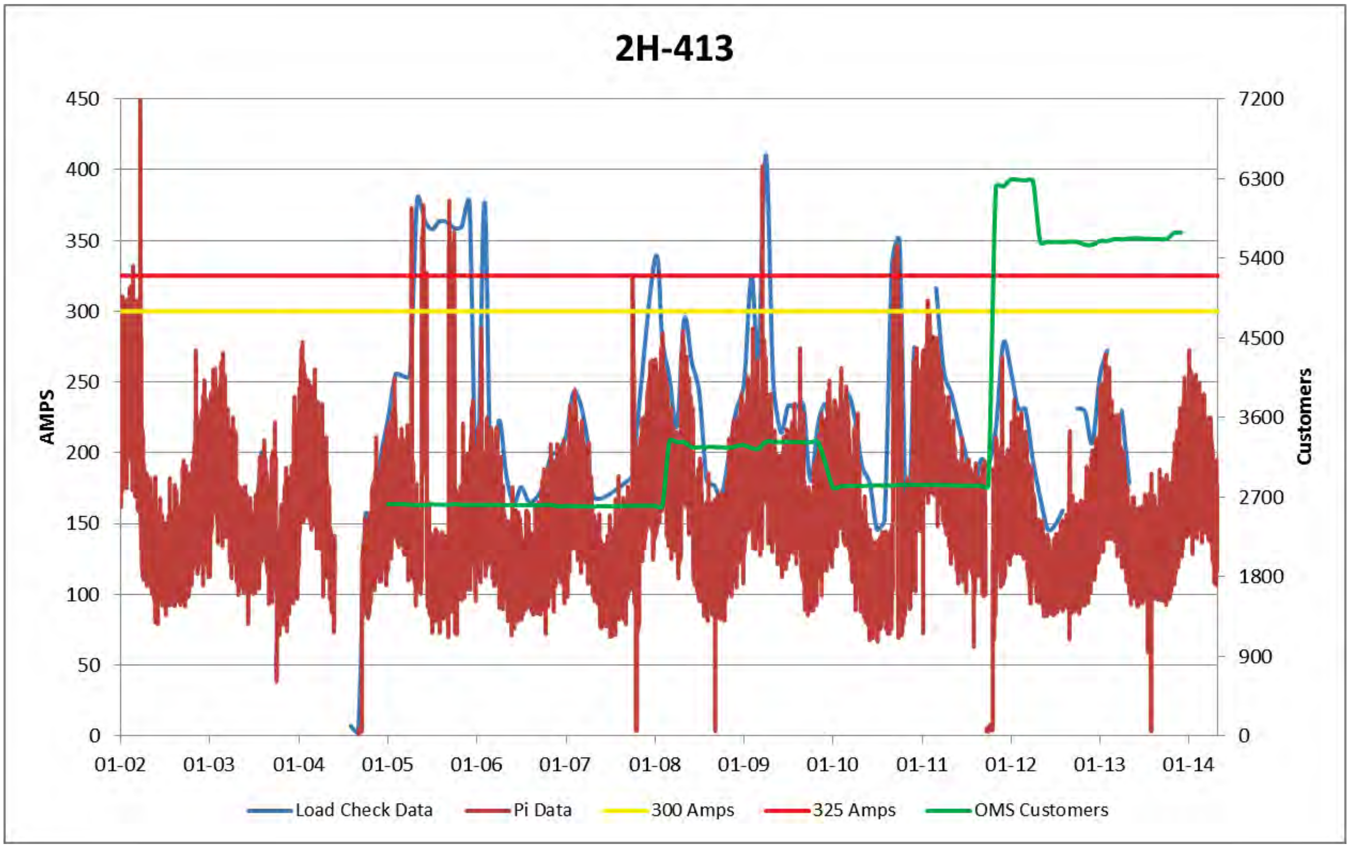


Figure 96 **2H-413 Load History**

Appendix B: Load History and Forecast

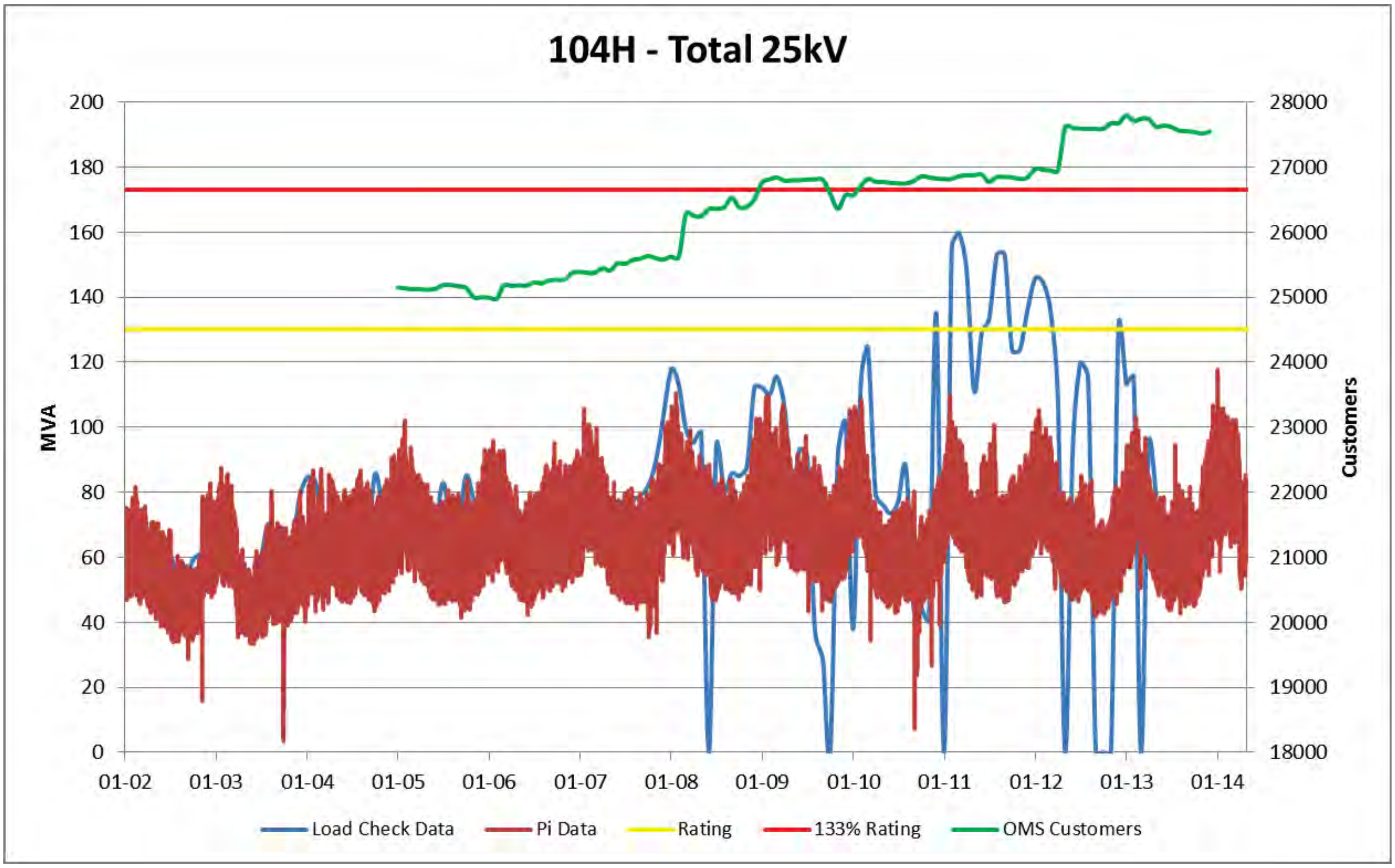


Figure 97 **104H-Kempt Road Total 25kV**

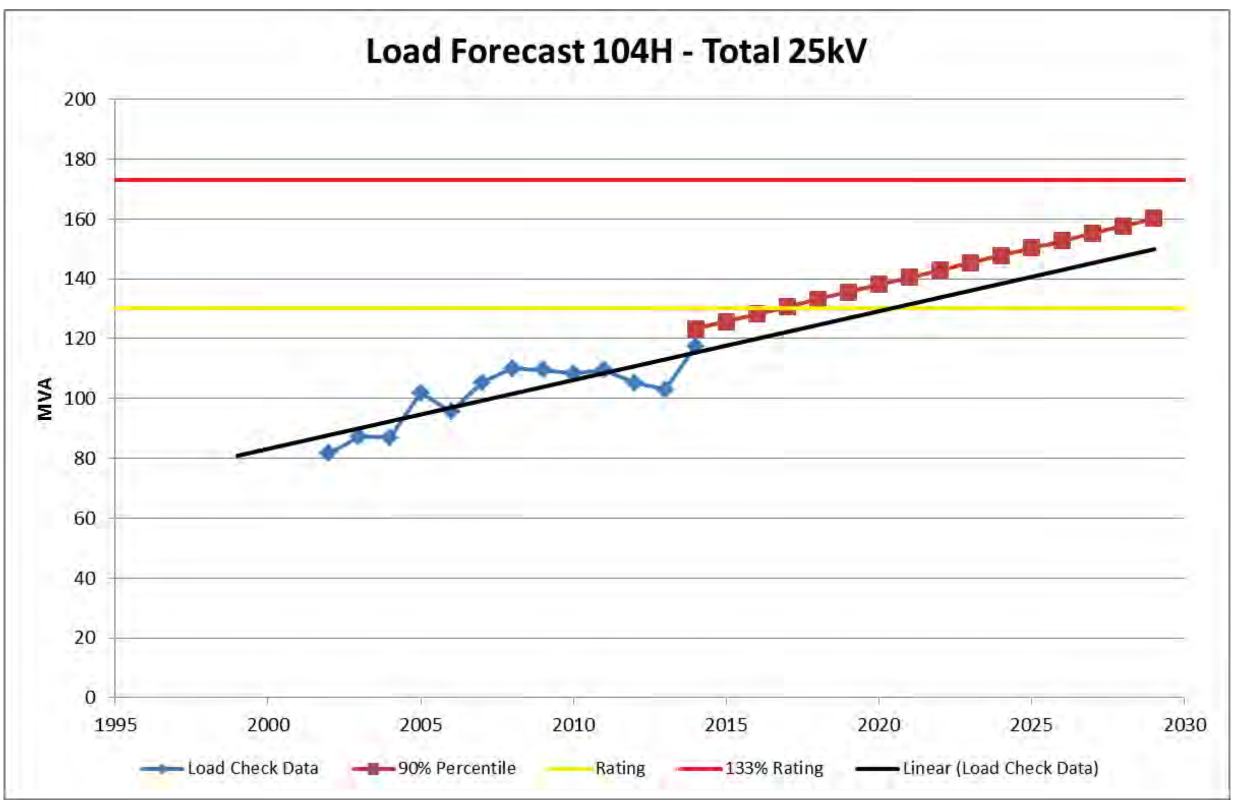


Figure 98 **104H-Kempt Road Load Forecast**

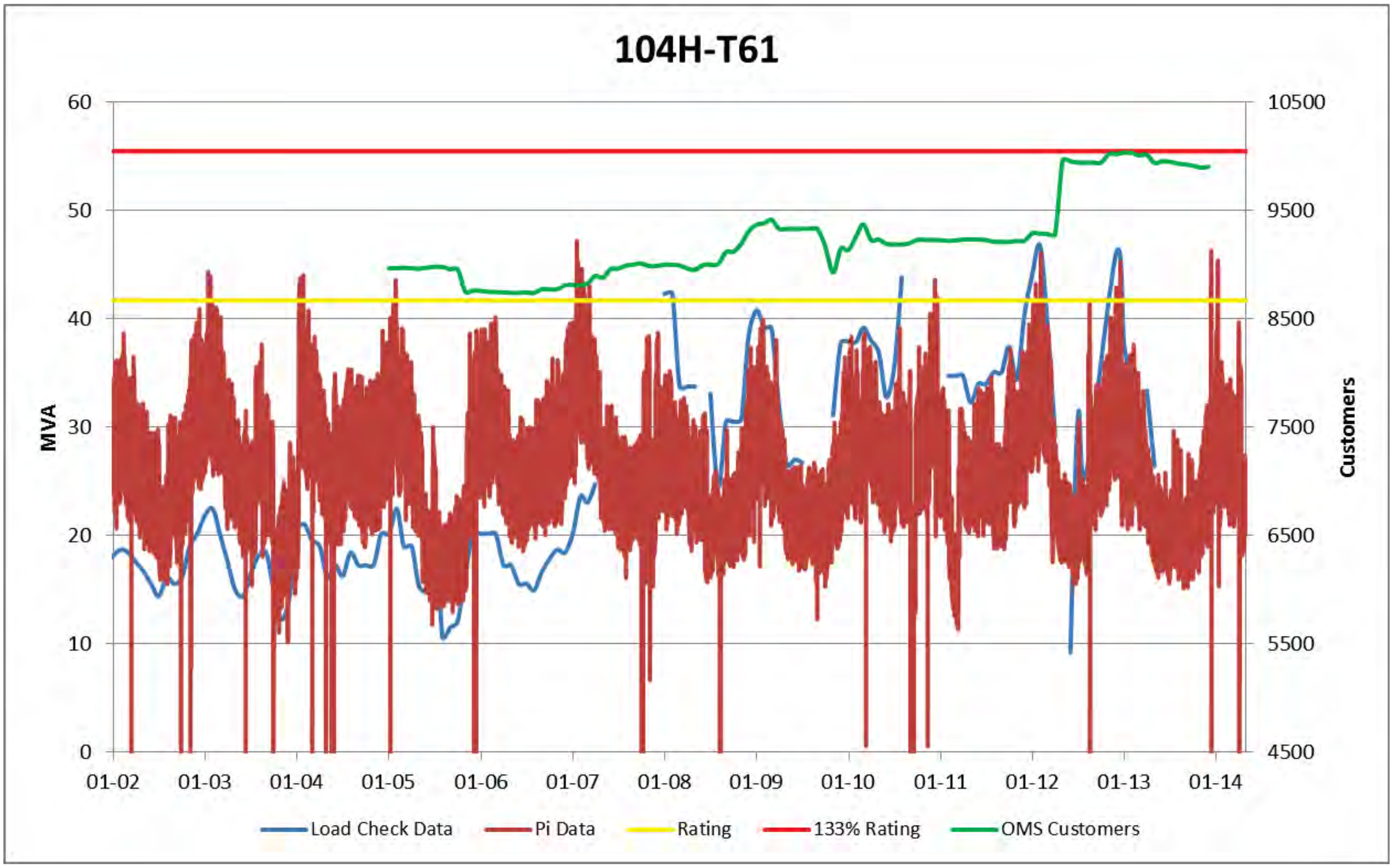


Figure 99 104H-T61 Load History

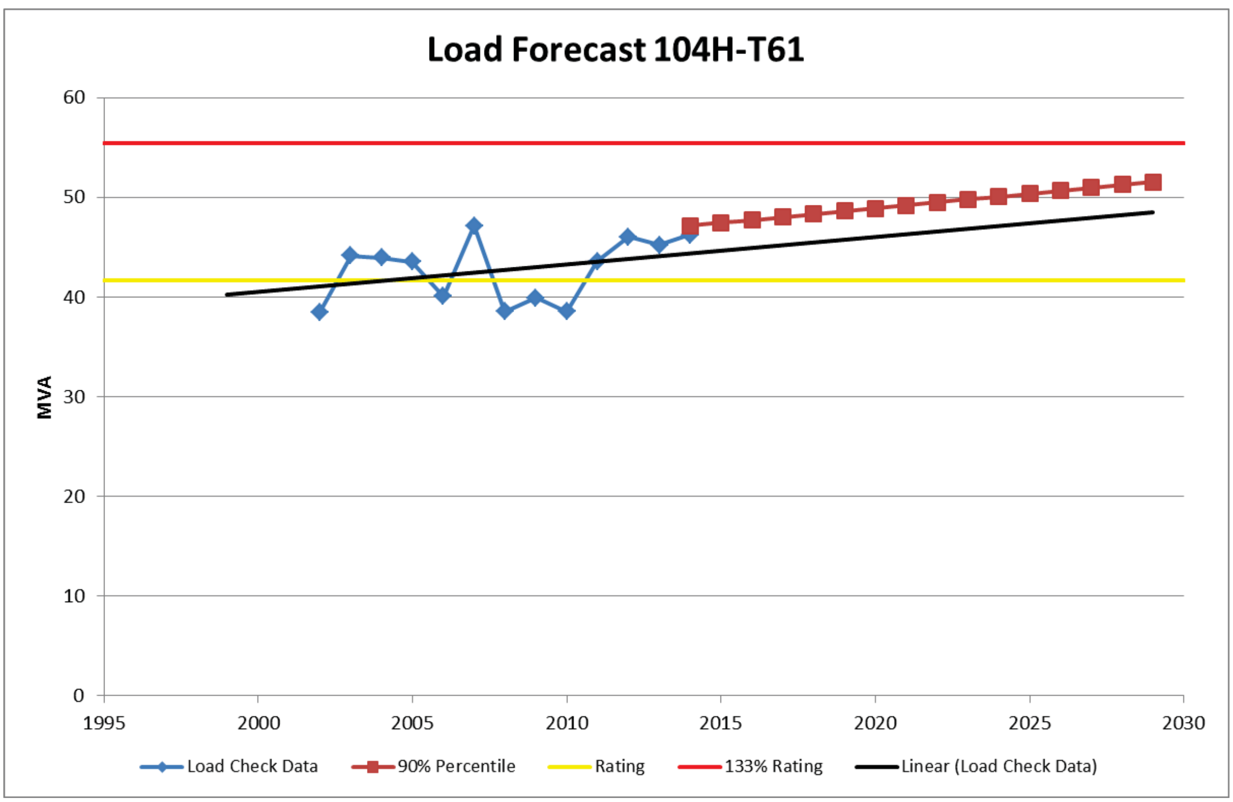


Figure 100 104H-T61 Load Forecast

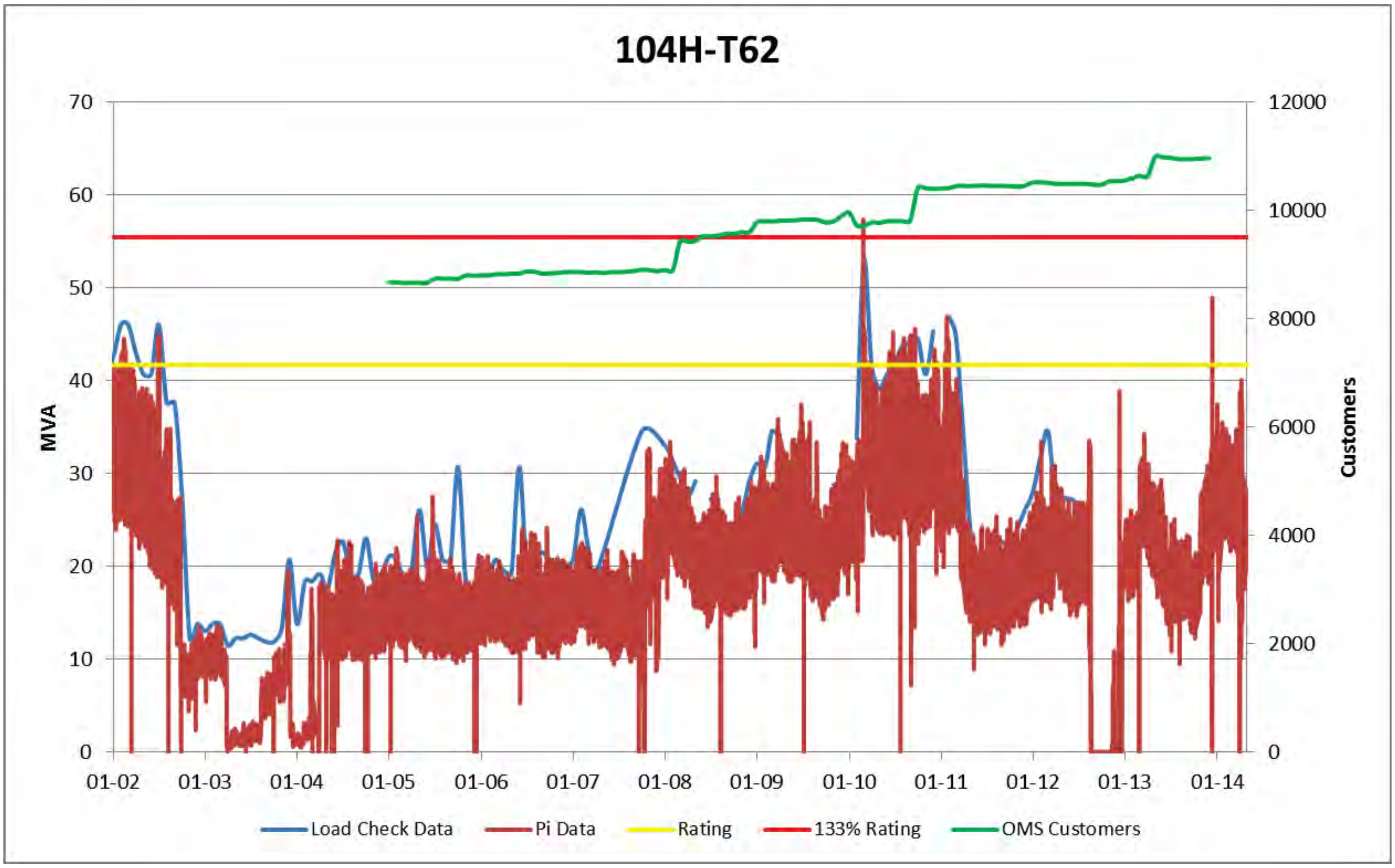


Figure 101 **104H-T62 Load History**

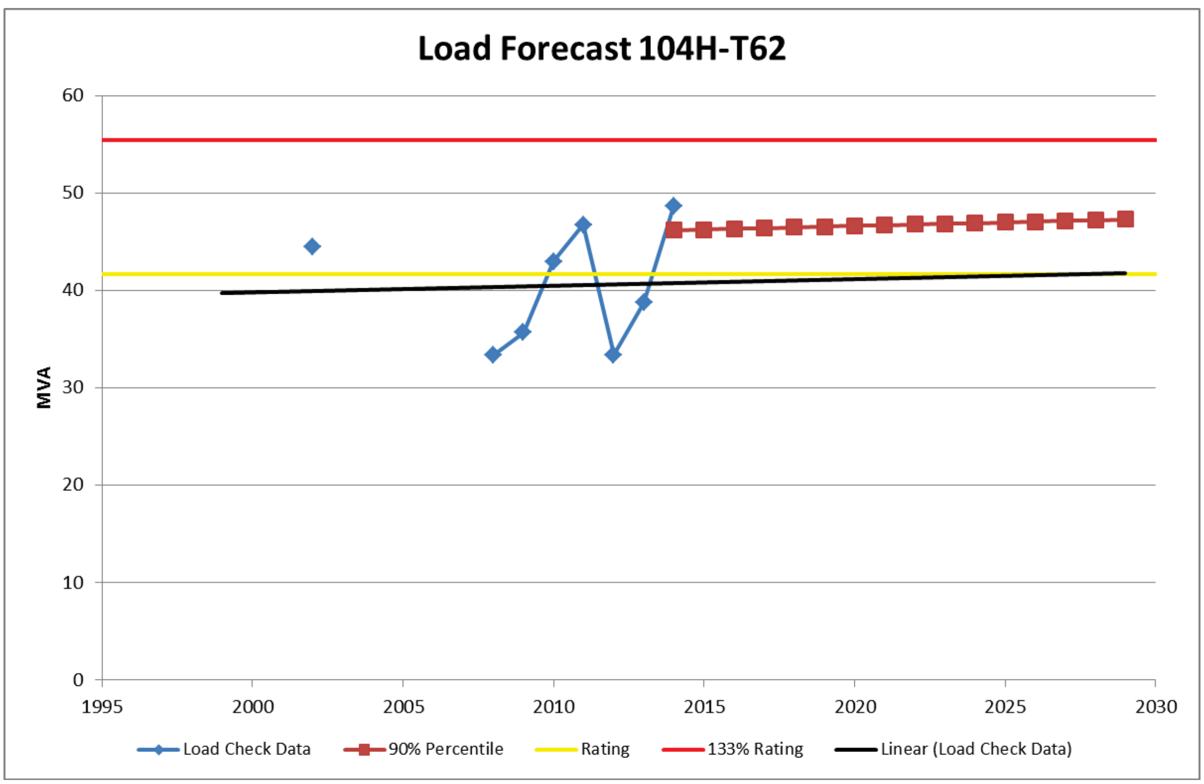


Figure 102 **104H-T62 Load Forecast**

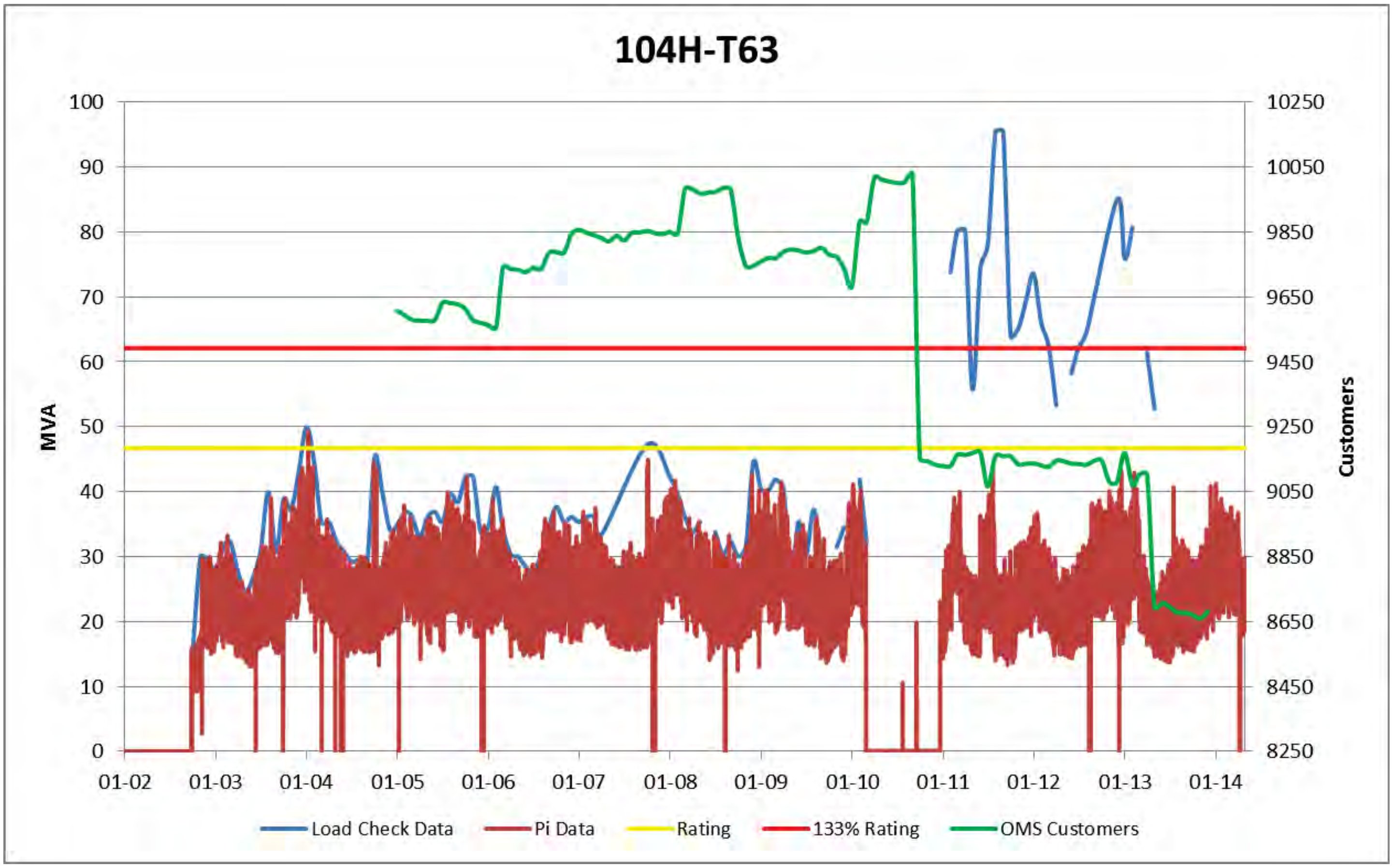


Figure 103 104H-T63 Load History

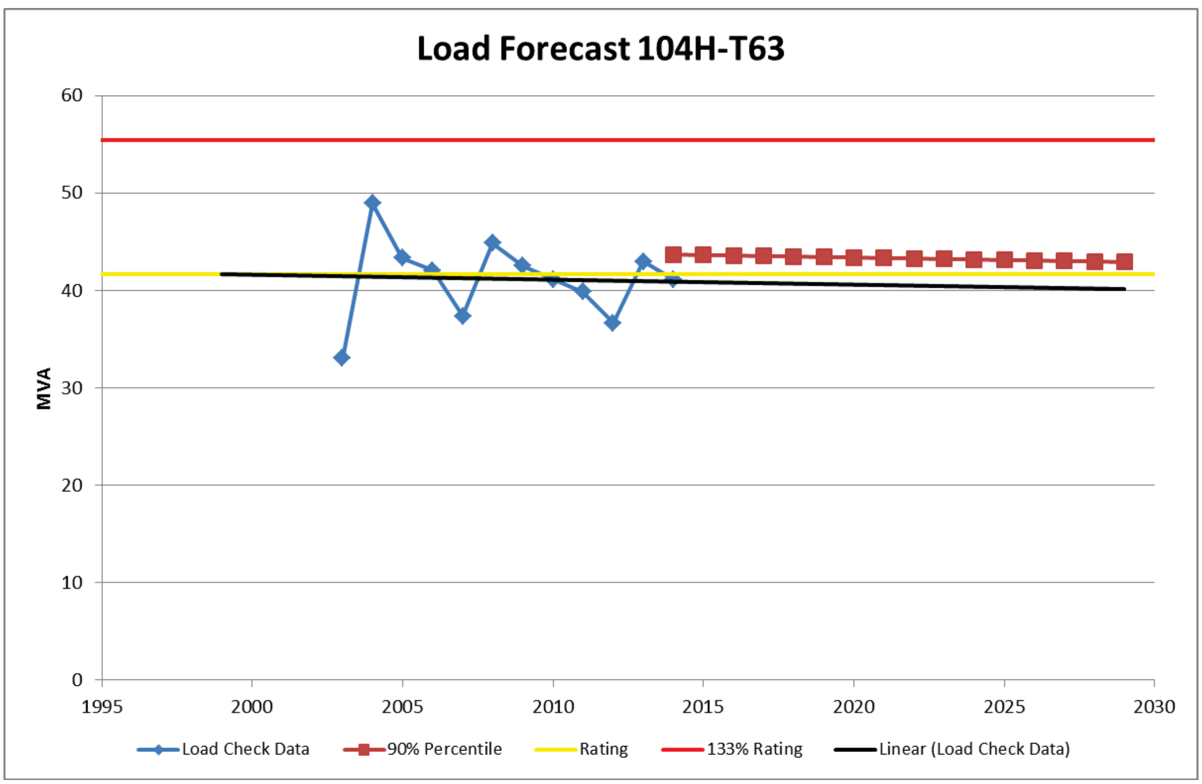


Figure 104 104H-T63 Load Forecast

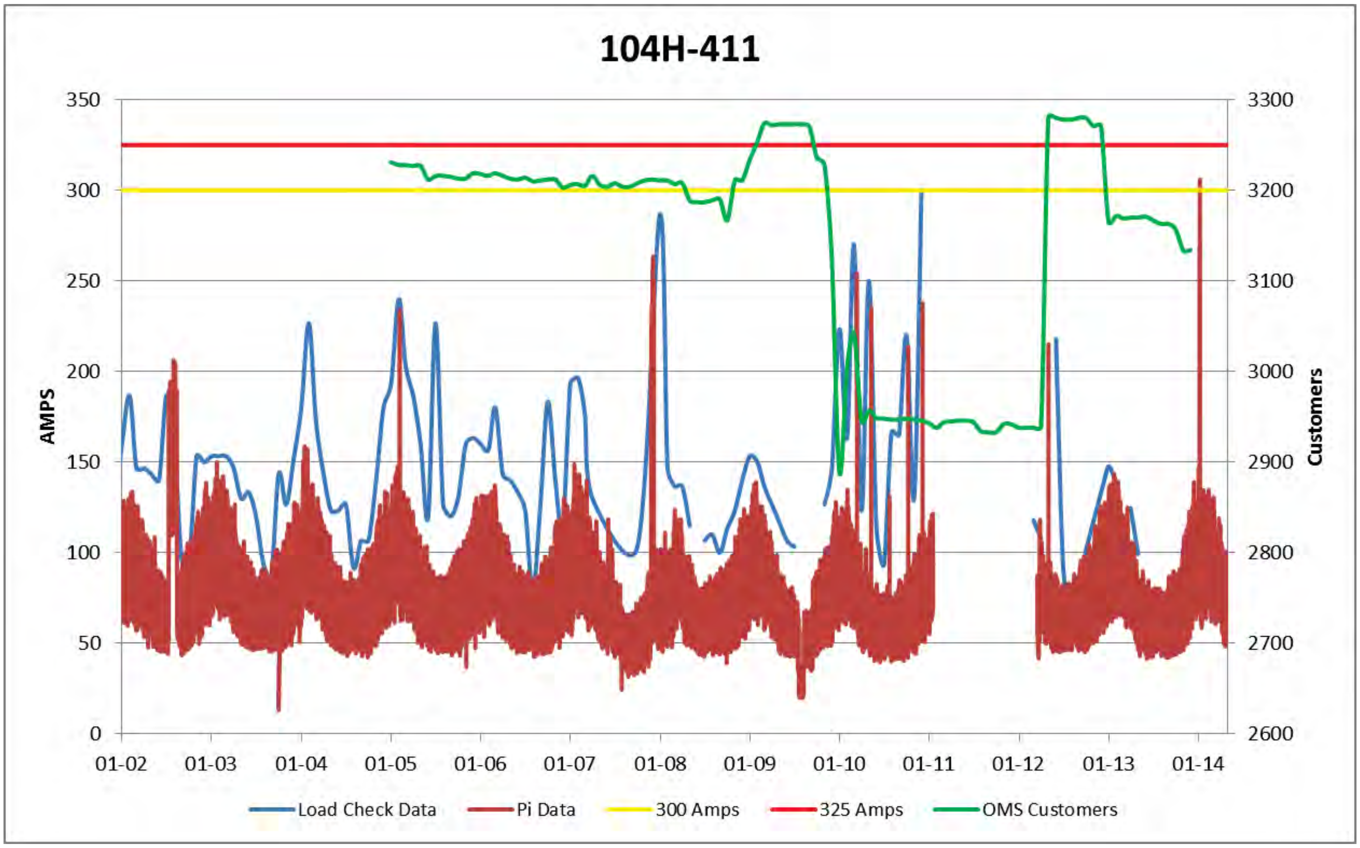


Figure 105 104H-411 Load History

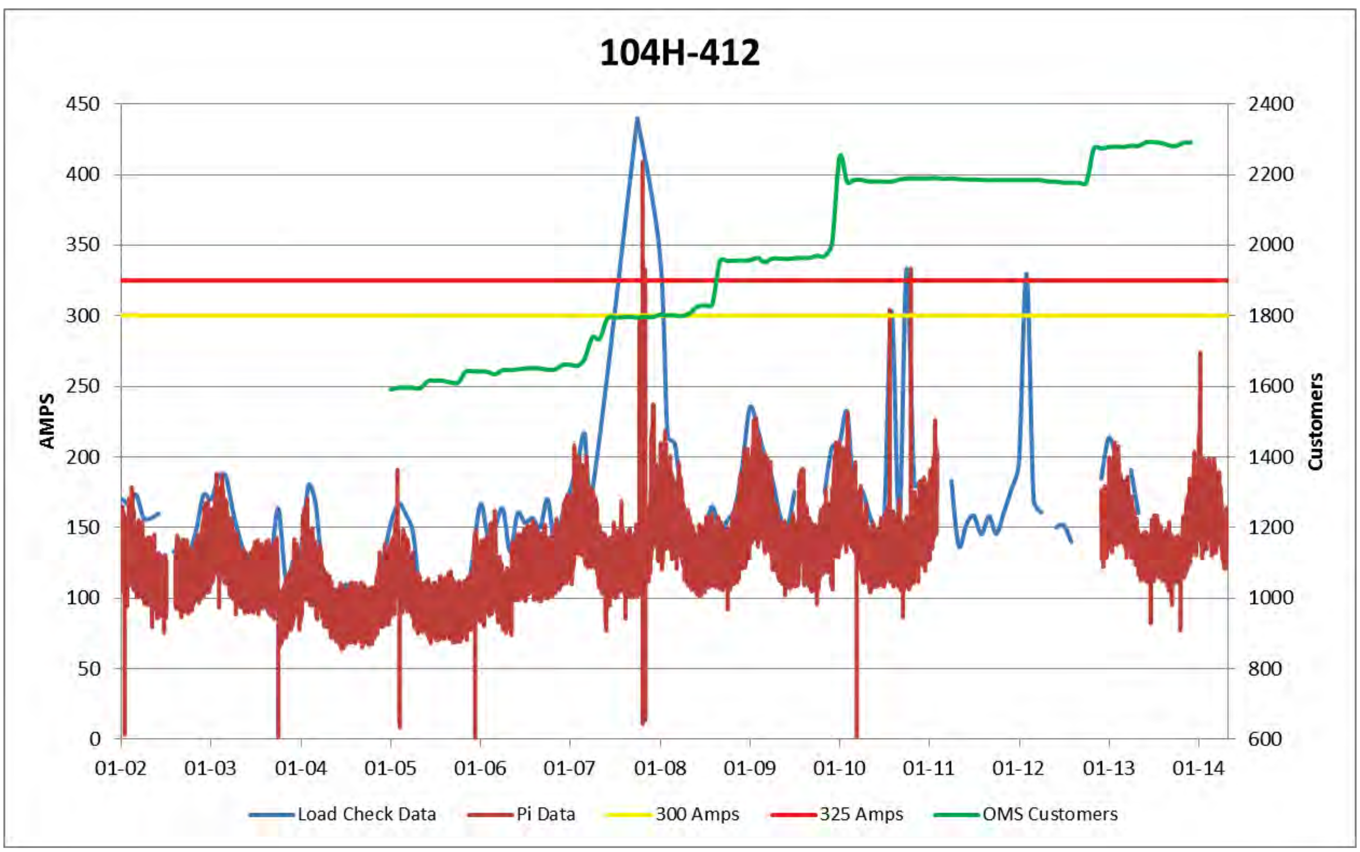


Figure 106 104H-412 Load History

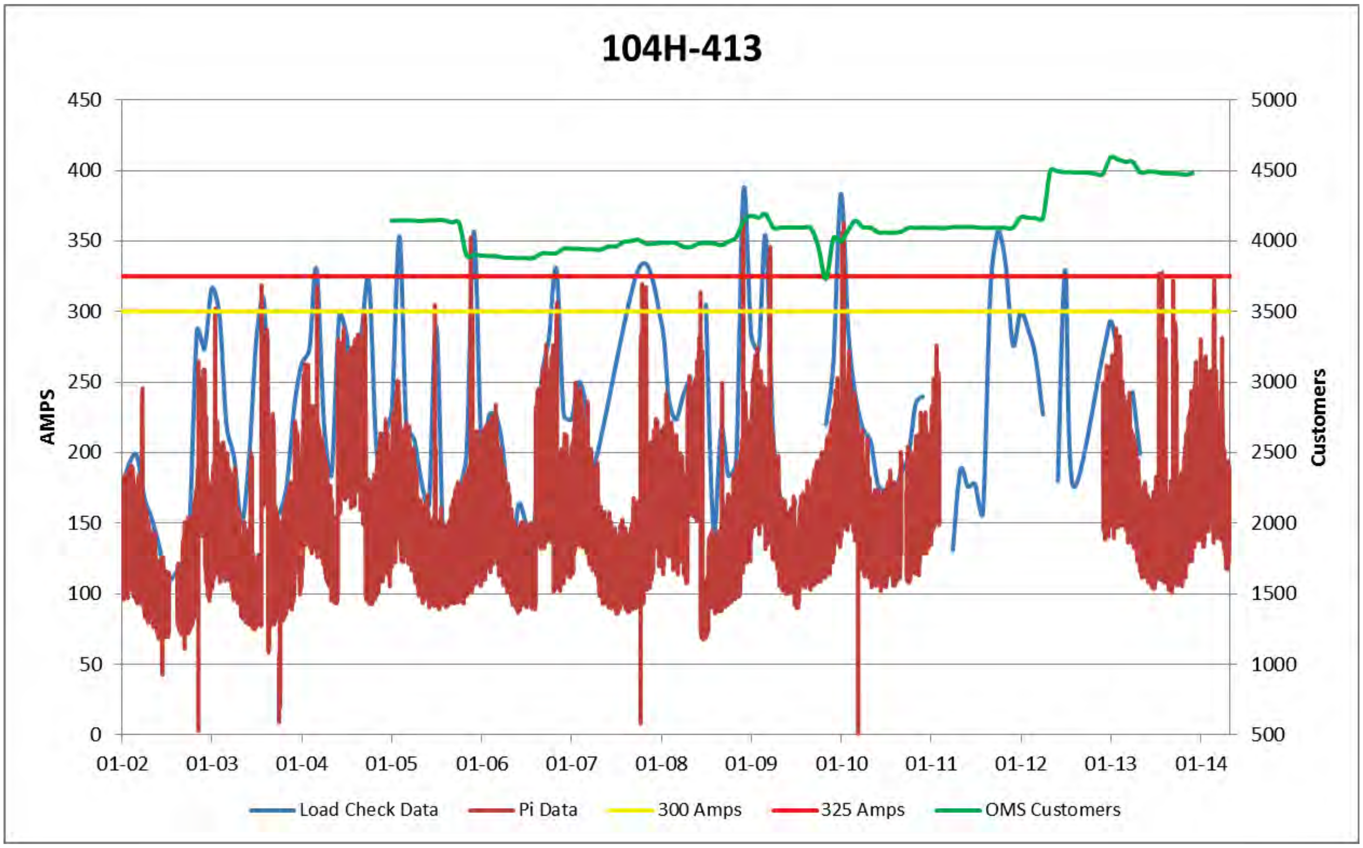


Figure 107 104H-413 Load History

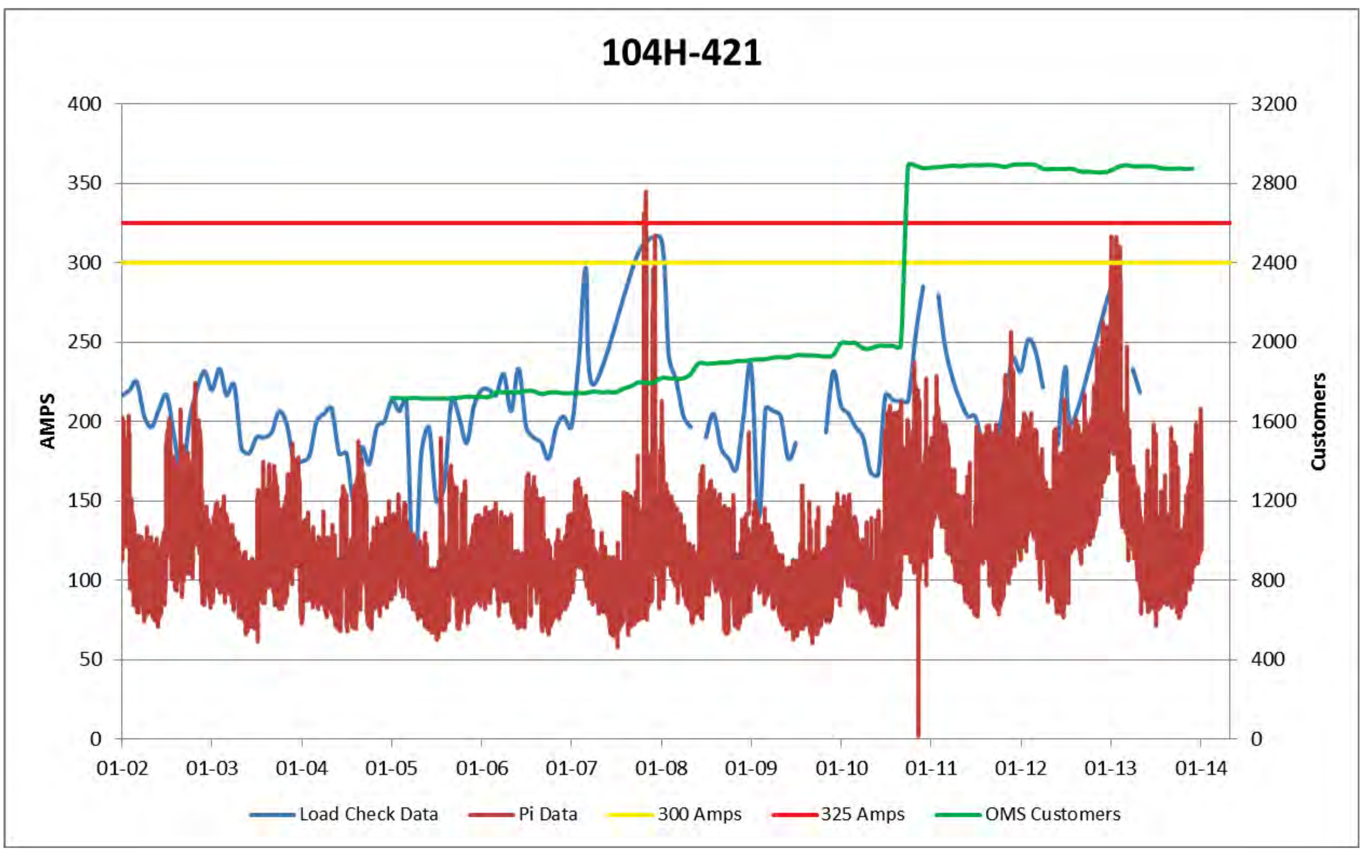


Figure 108 104H-421 Load History

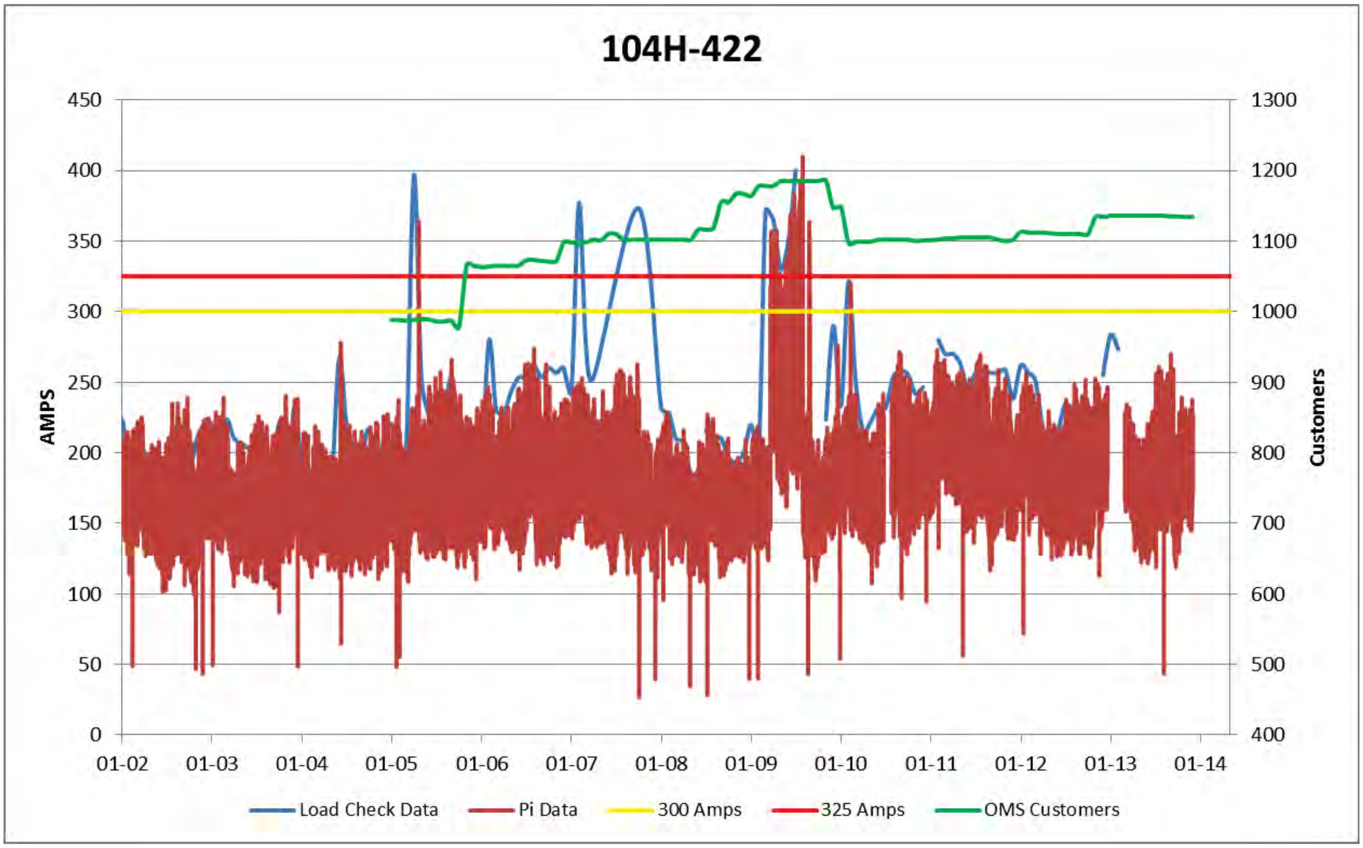


Figure 109 **104H-422 Load History**

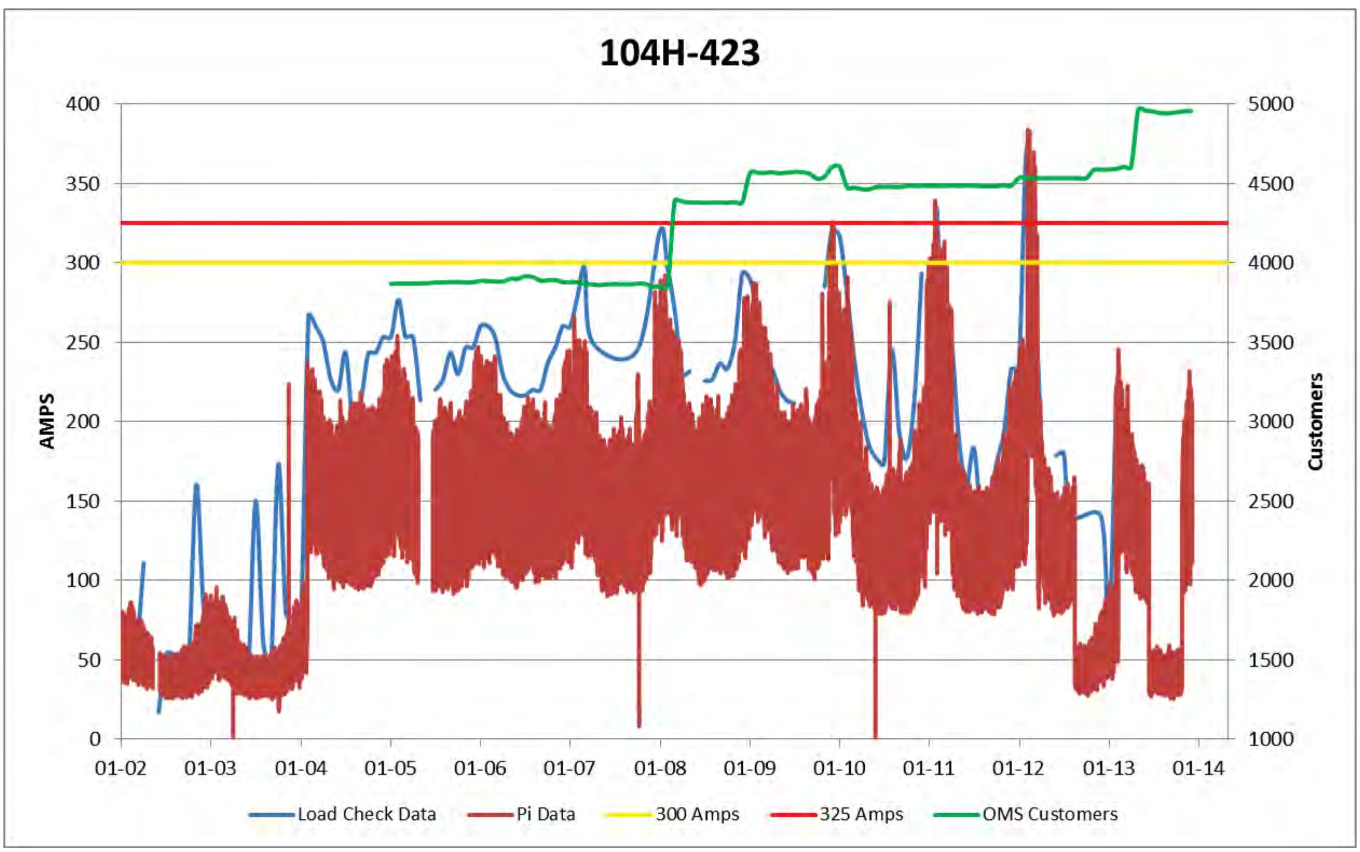


Figure 110 **104H-423 Load History**

Appendix B: Load History and Forecast

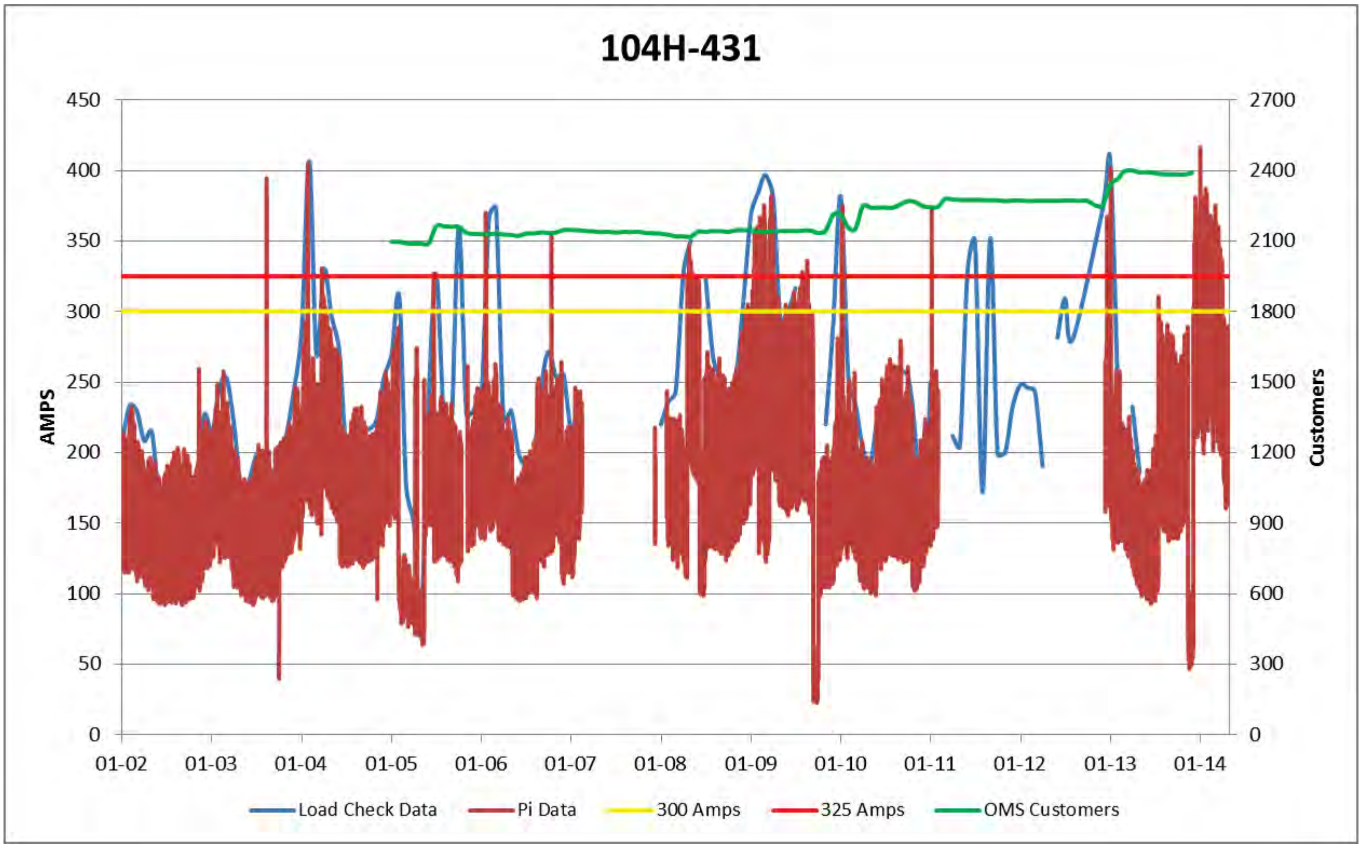


Figure 111 104H-431 Load History

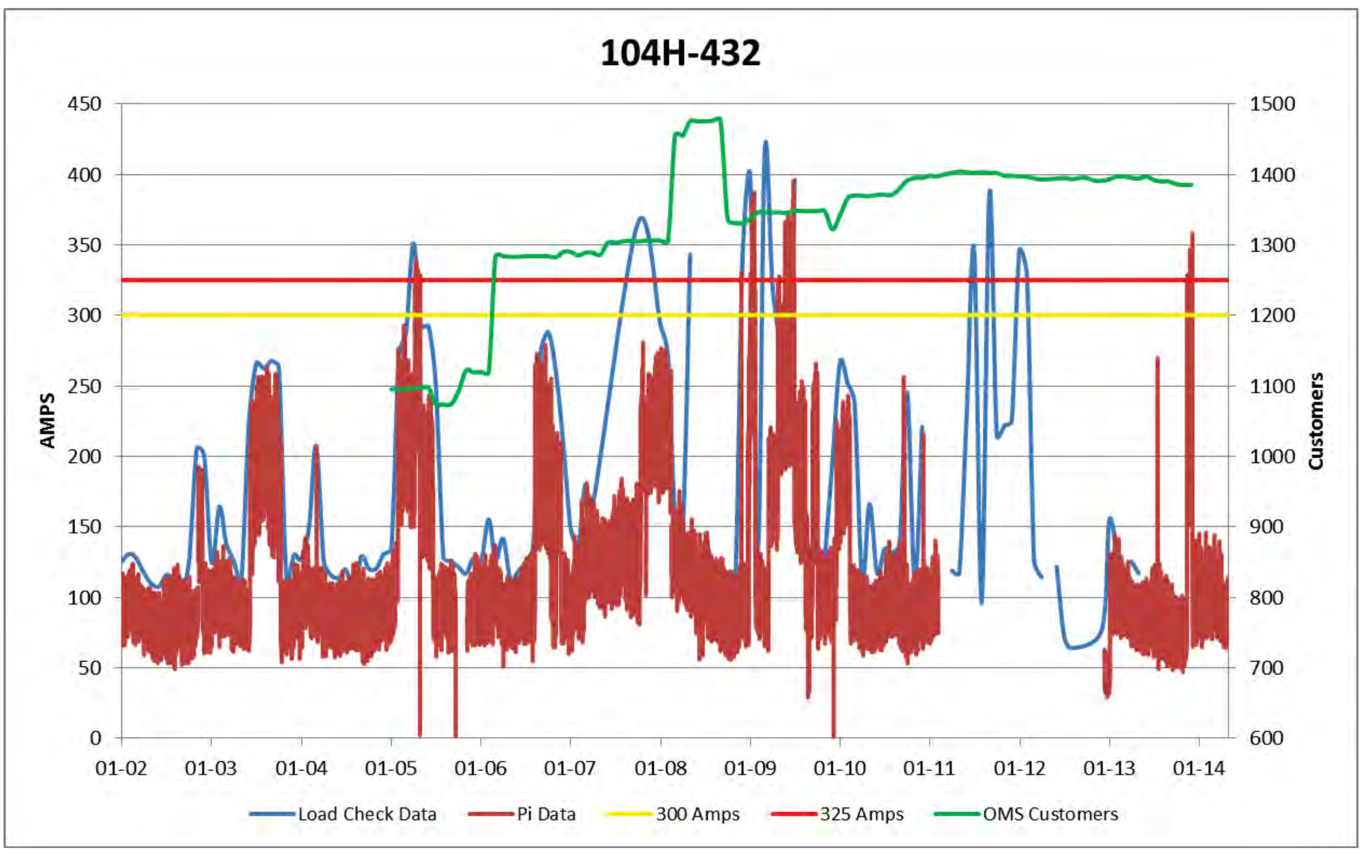


Figure 112 104H-432 Load History

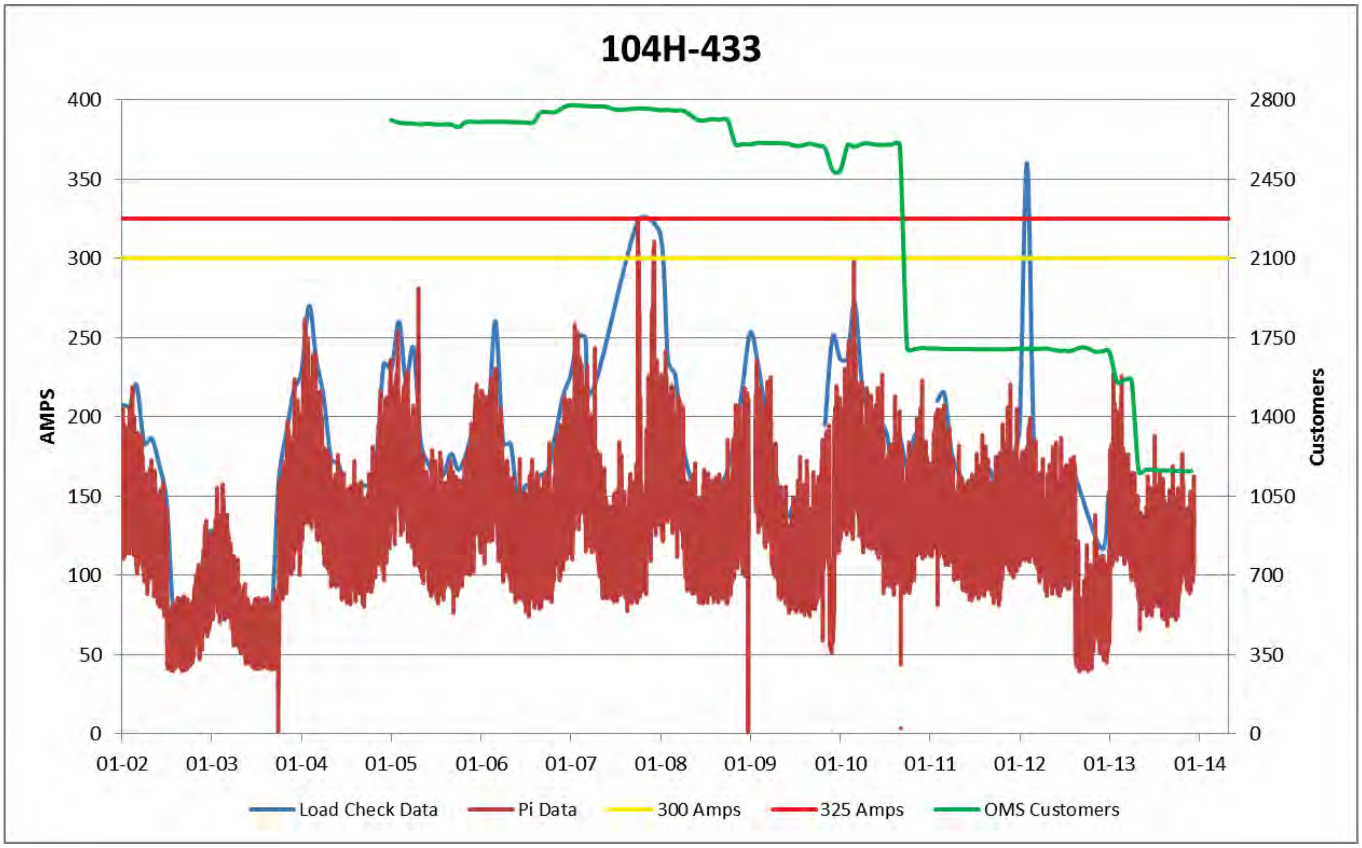


Figure 113 **104H-433 Load History**

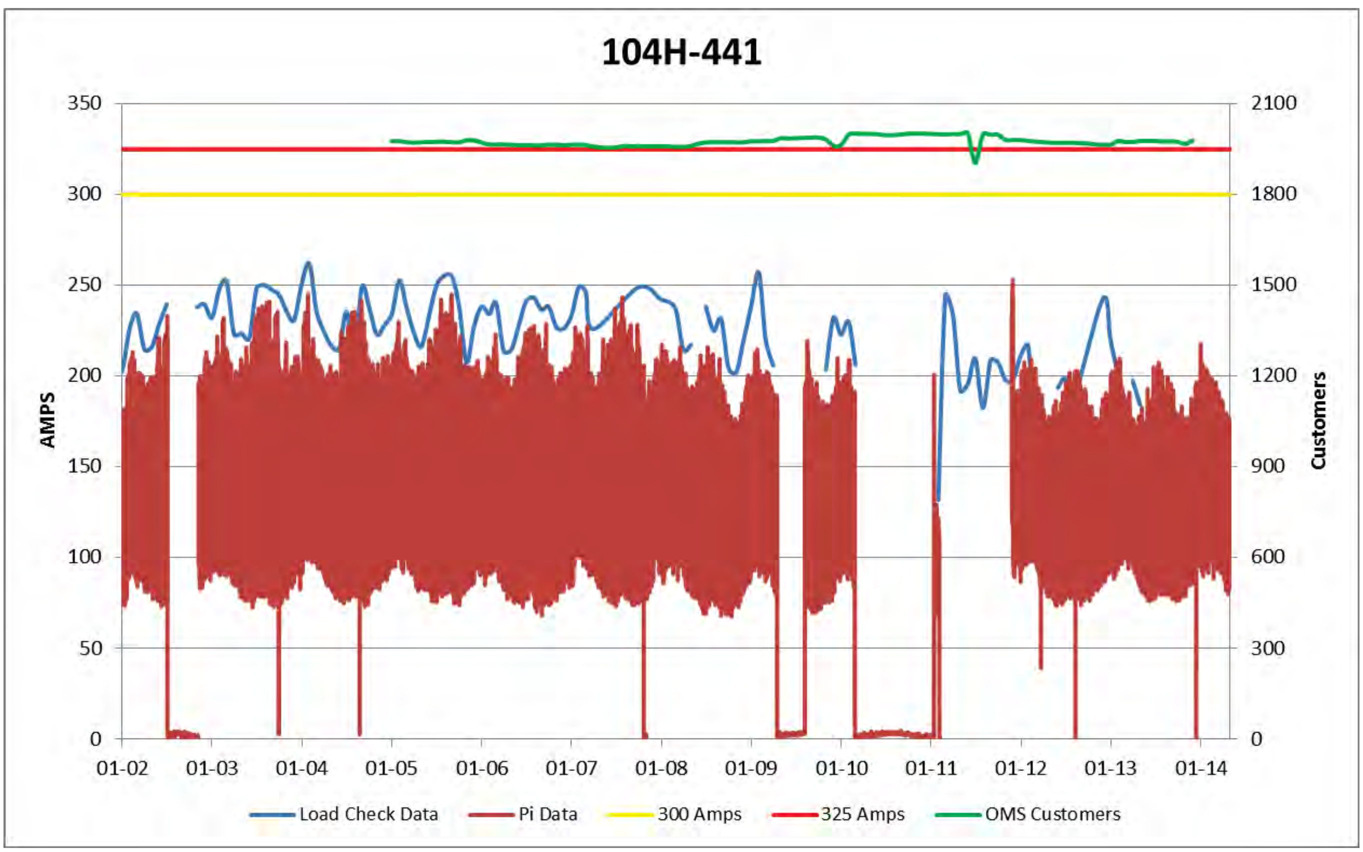


Figure 114 **104H-441 Load History**

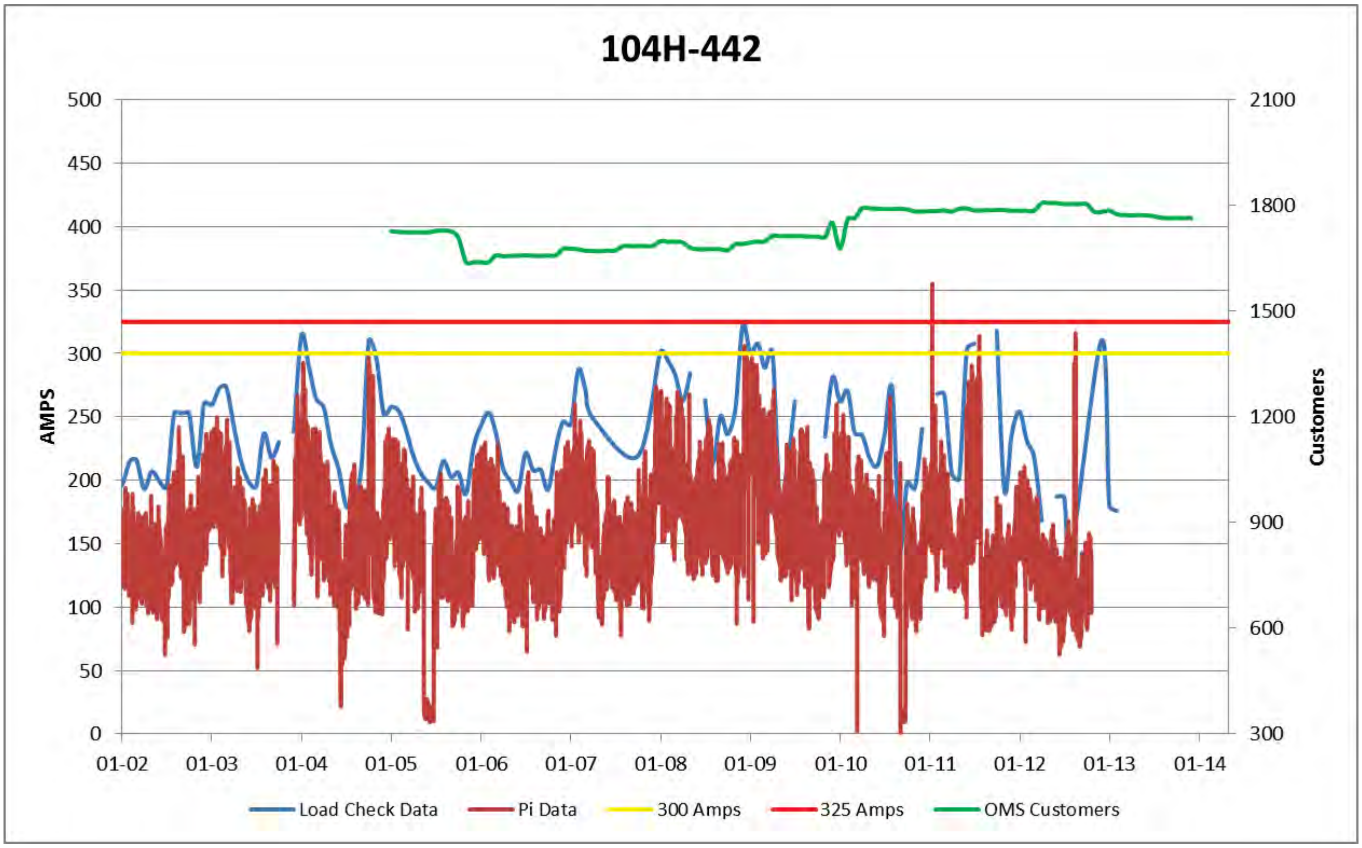


Figure 115 104H-442 Load History

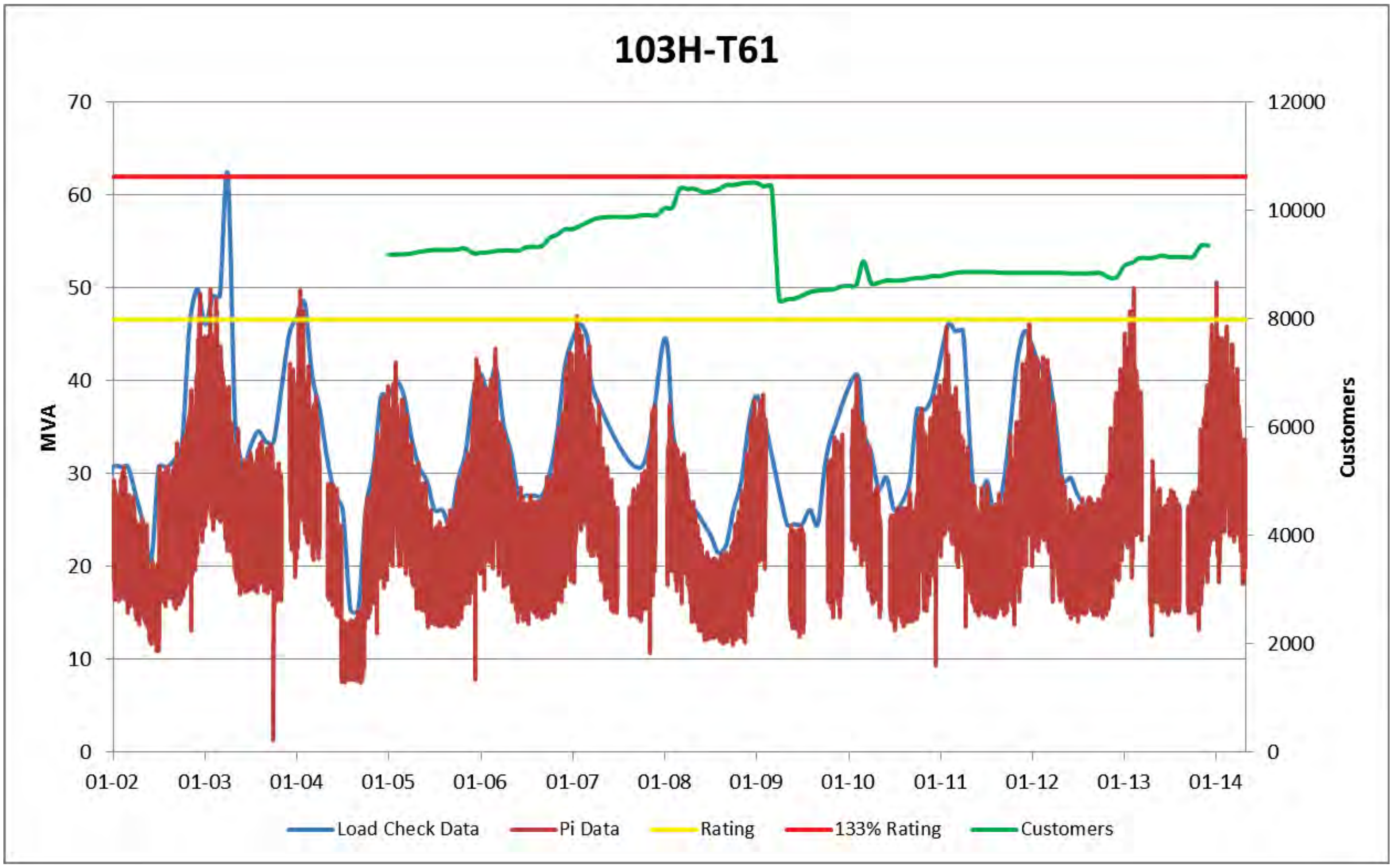


Figure 116 103H-T61 Load History

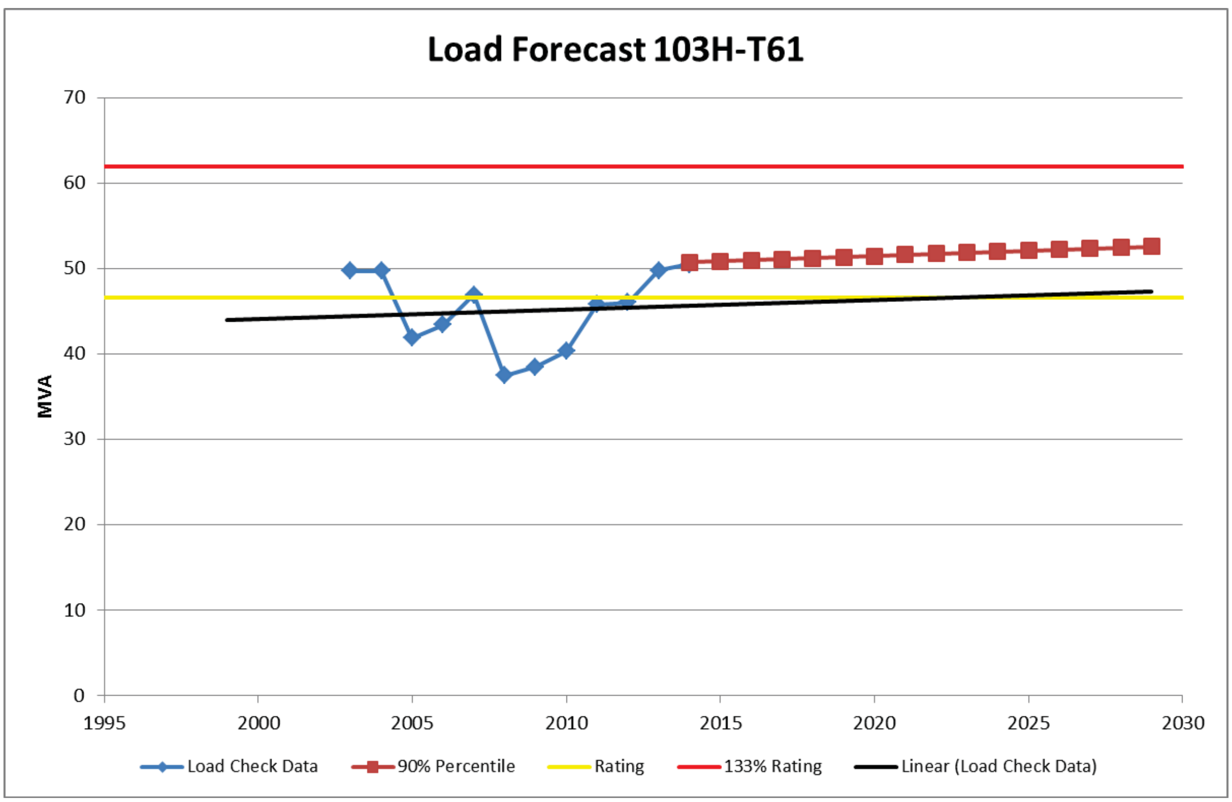


Figure 117 103H-T61 Load Forecast

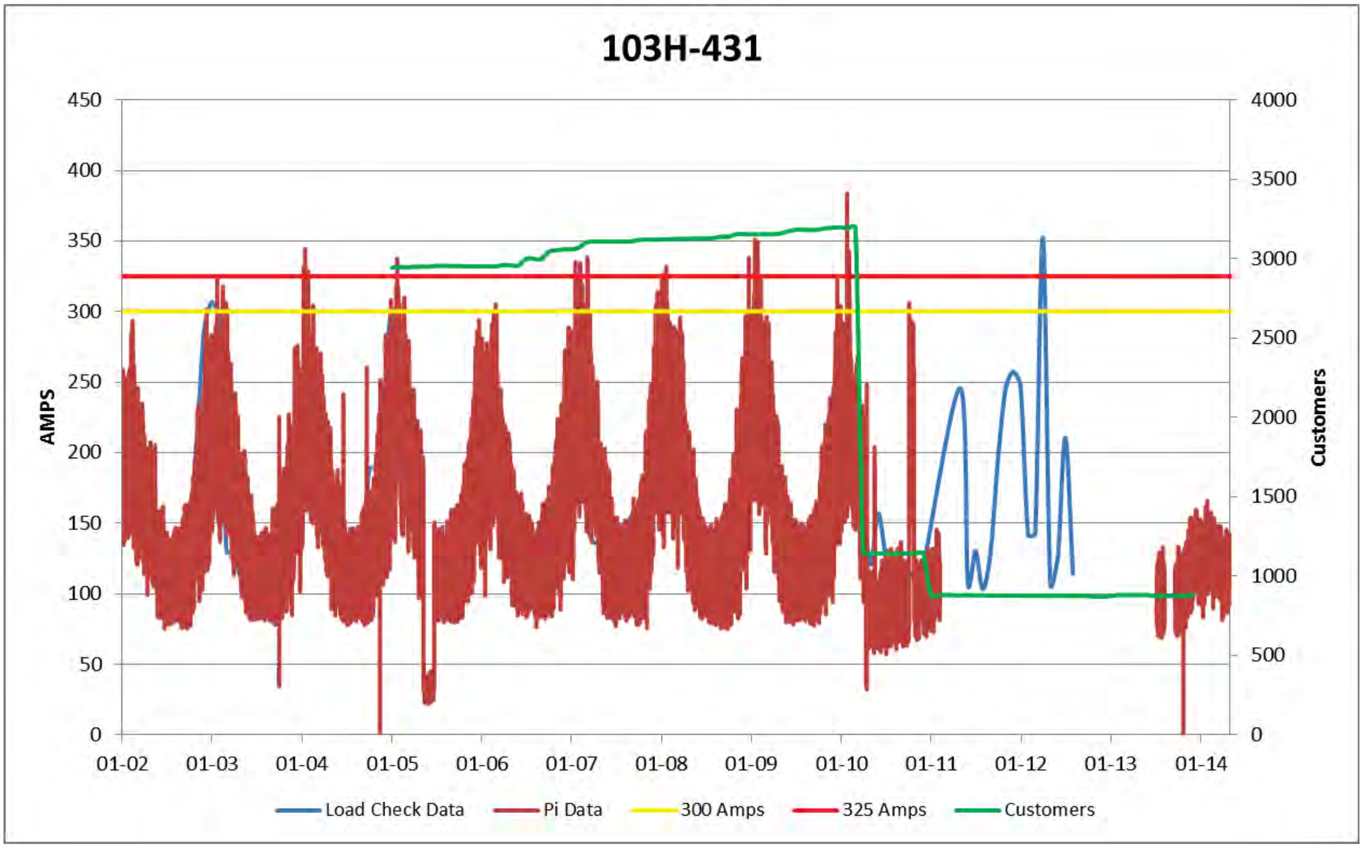


Figure 118 103H-431 Load History

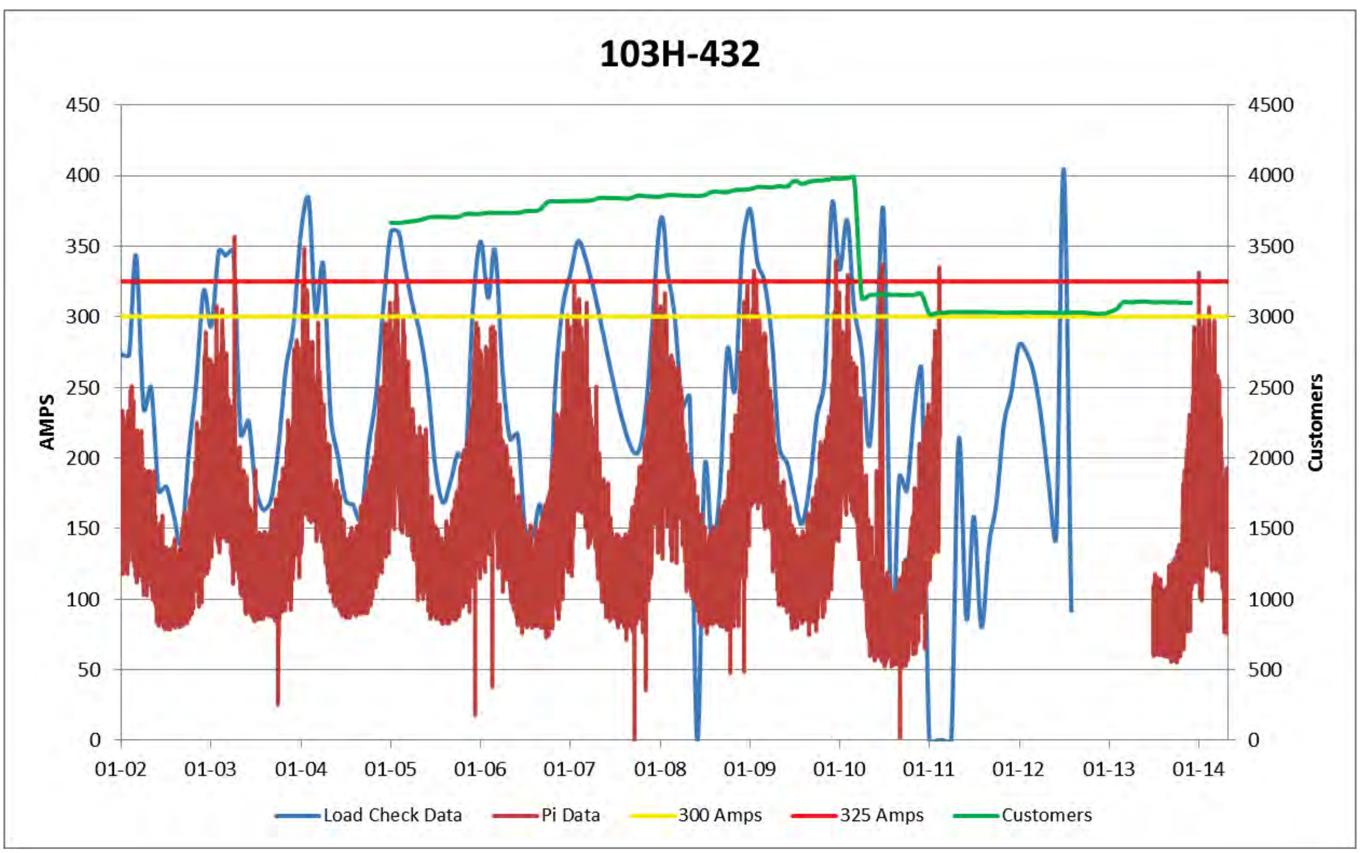


Figure 119 103H-432 Load History

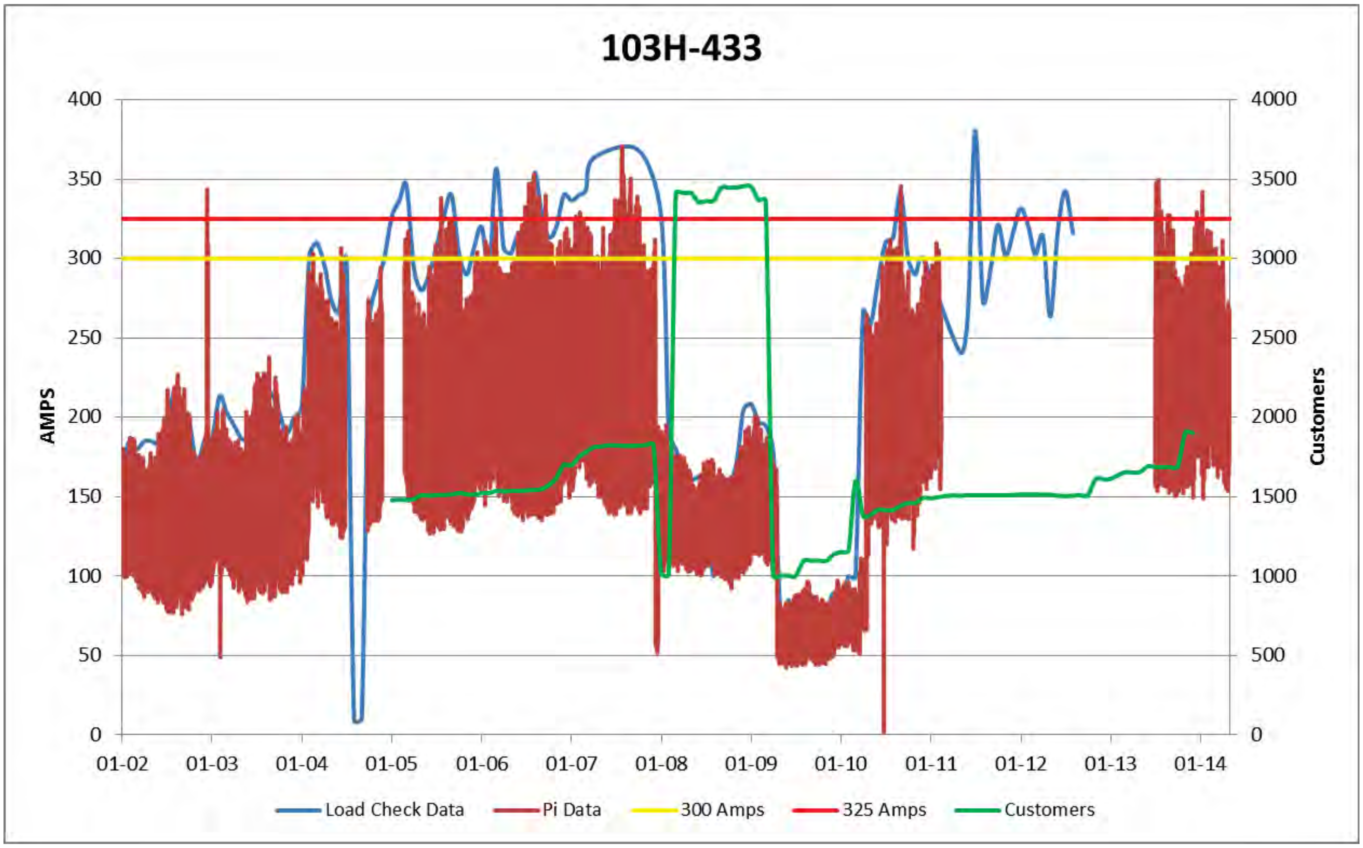


Figure 120 103H-433 Load History

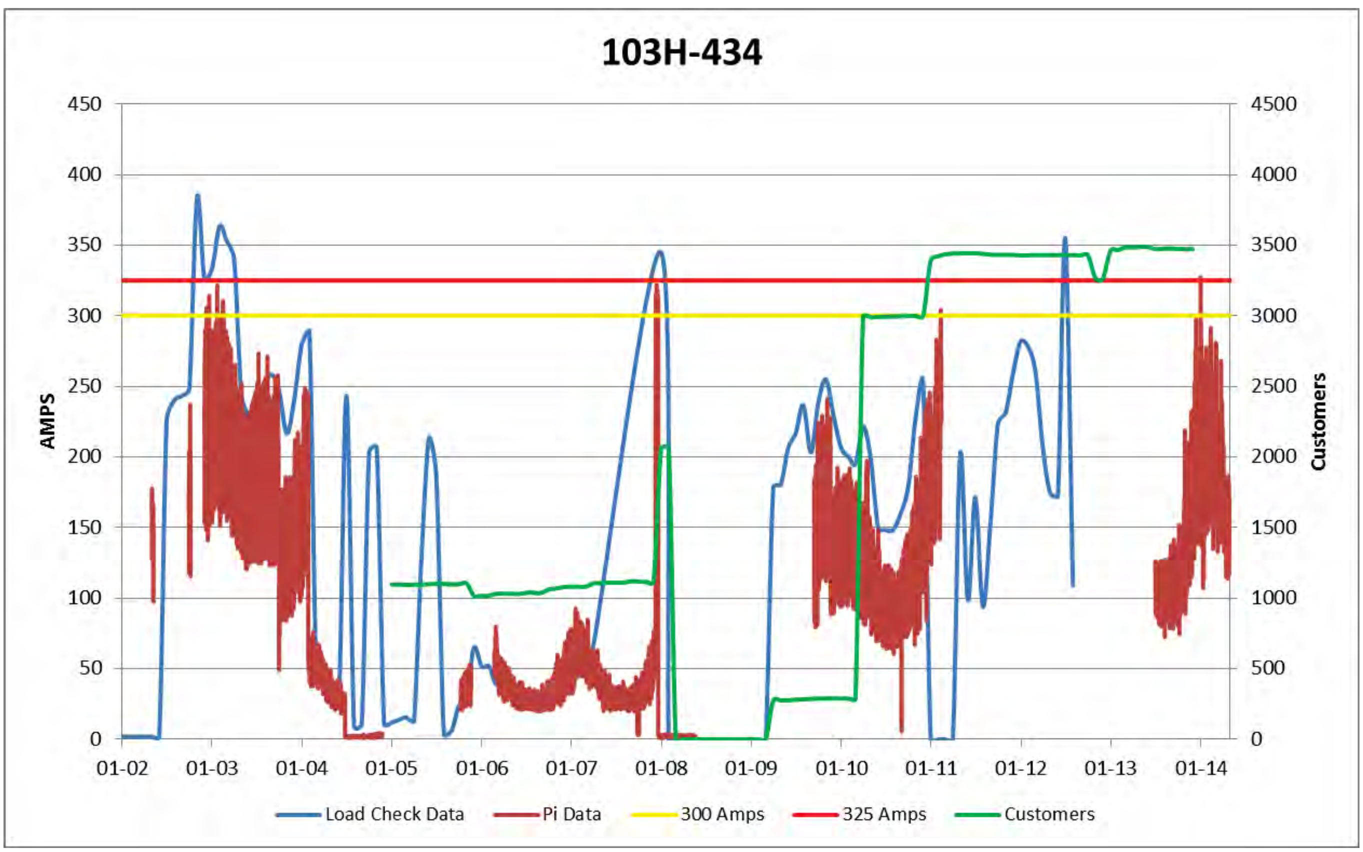


Figure 121 103H-434 Load History

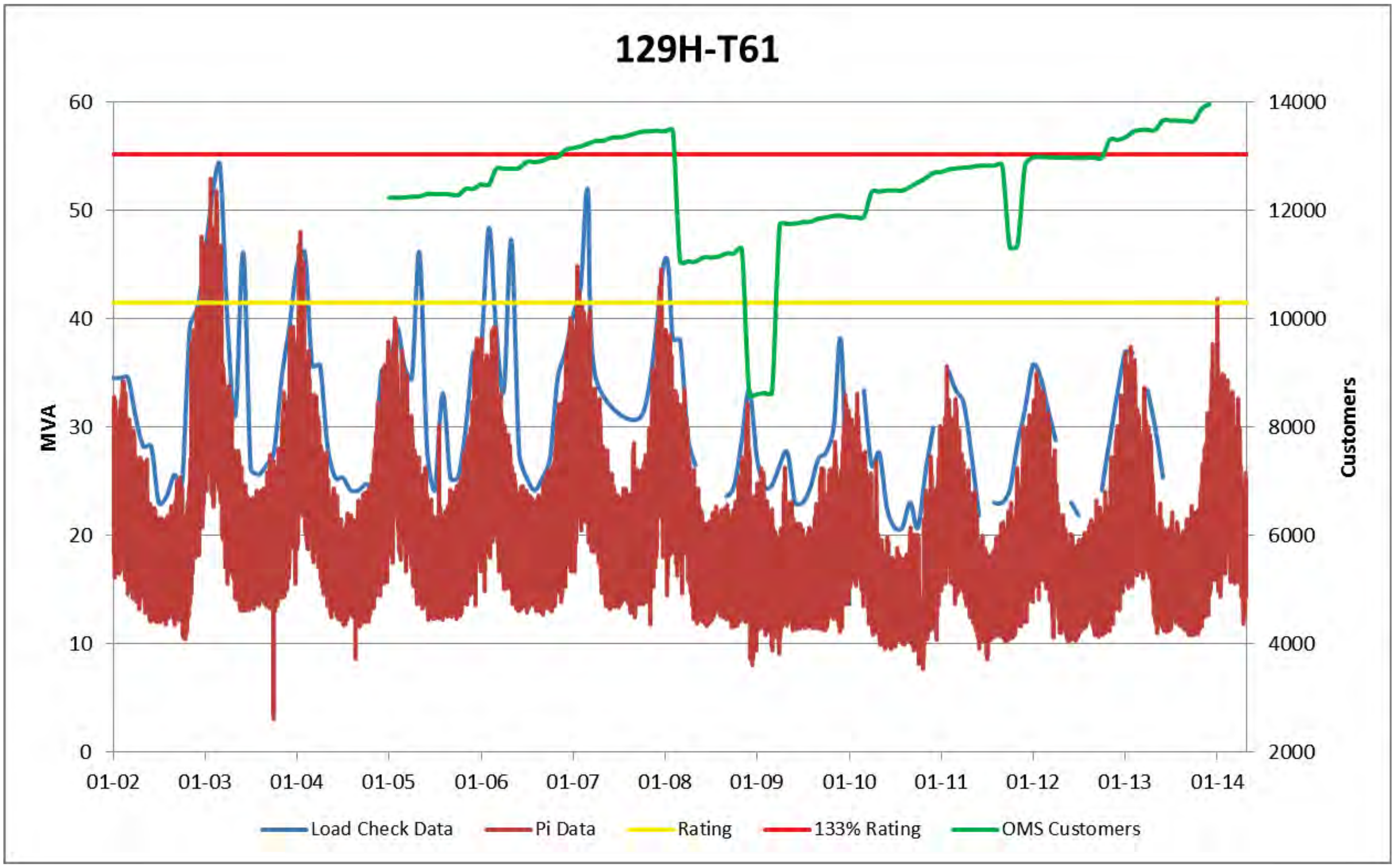


Figure 122 **129H-T61 Load History**

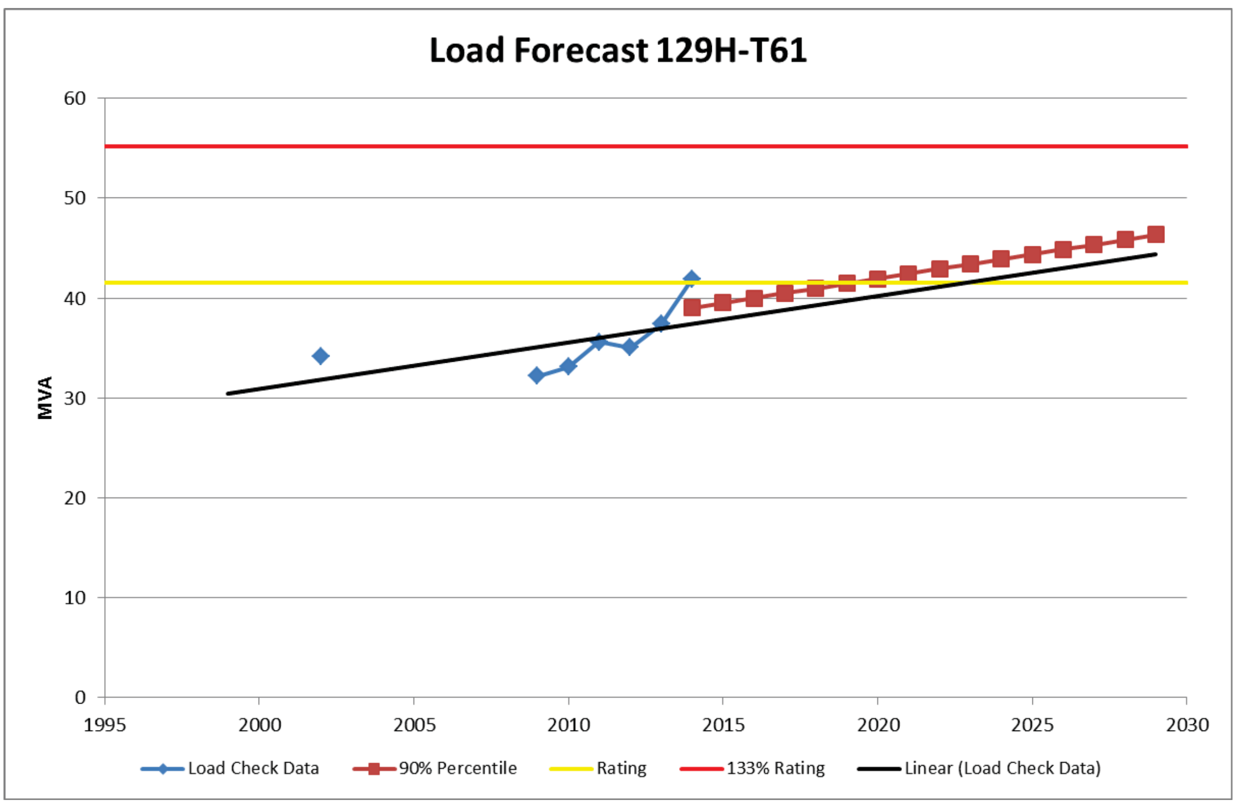


Figure 123 **129H-T61 Load Forecast**

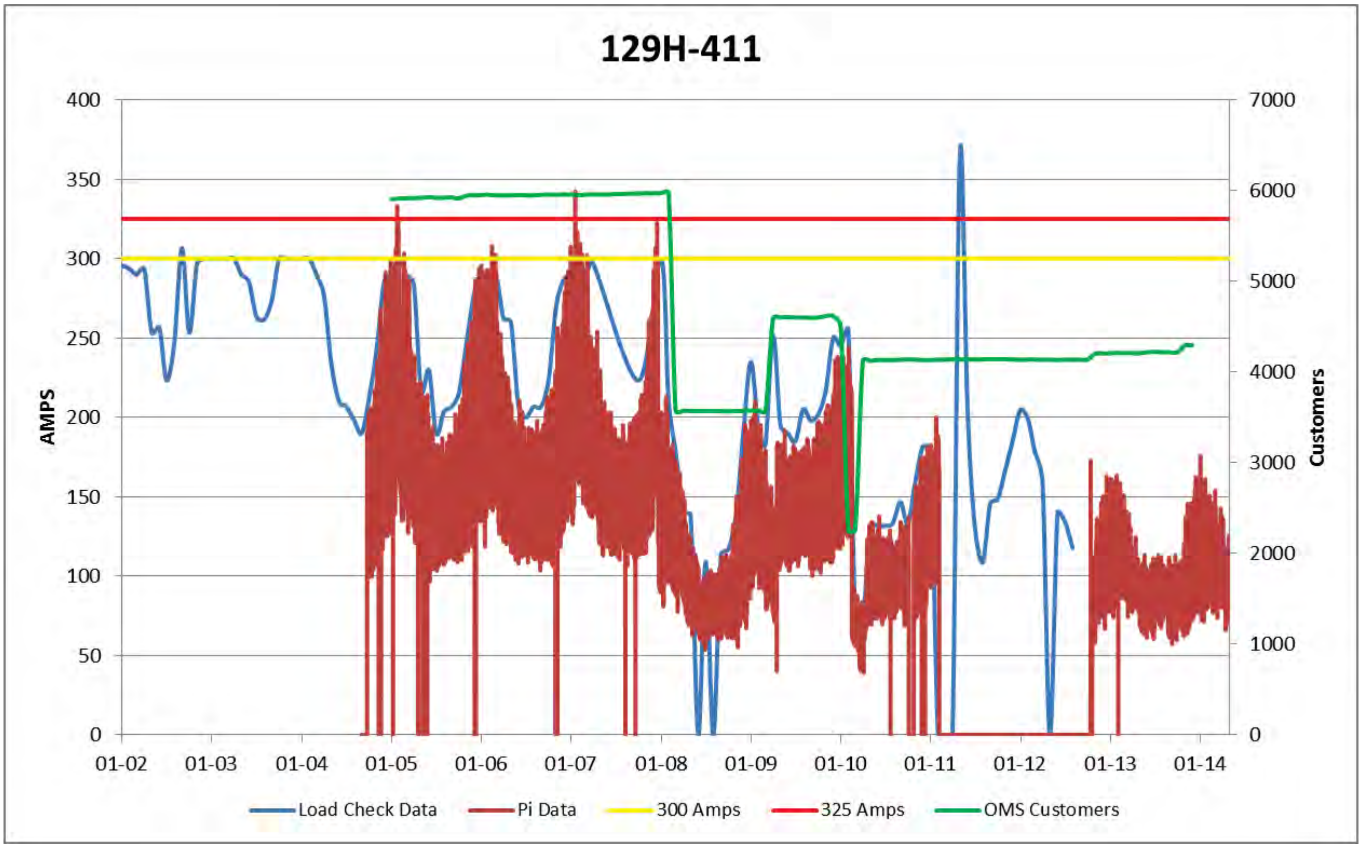


Figure 124 **129H-411 Load History**

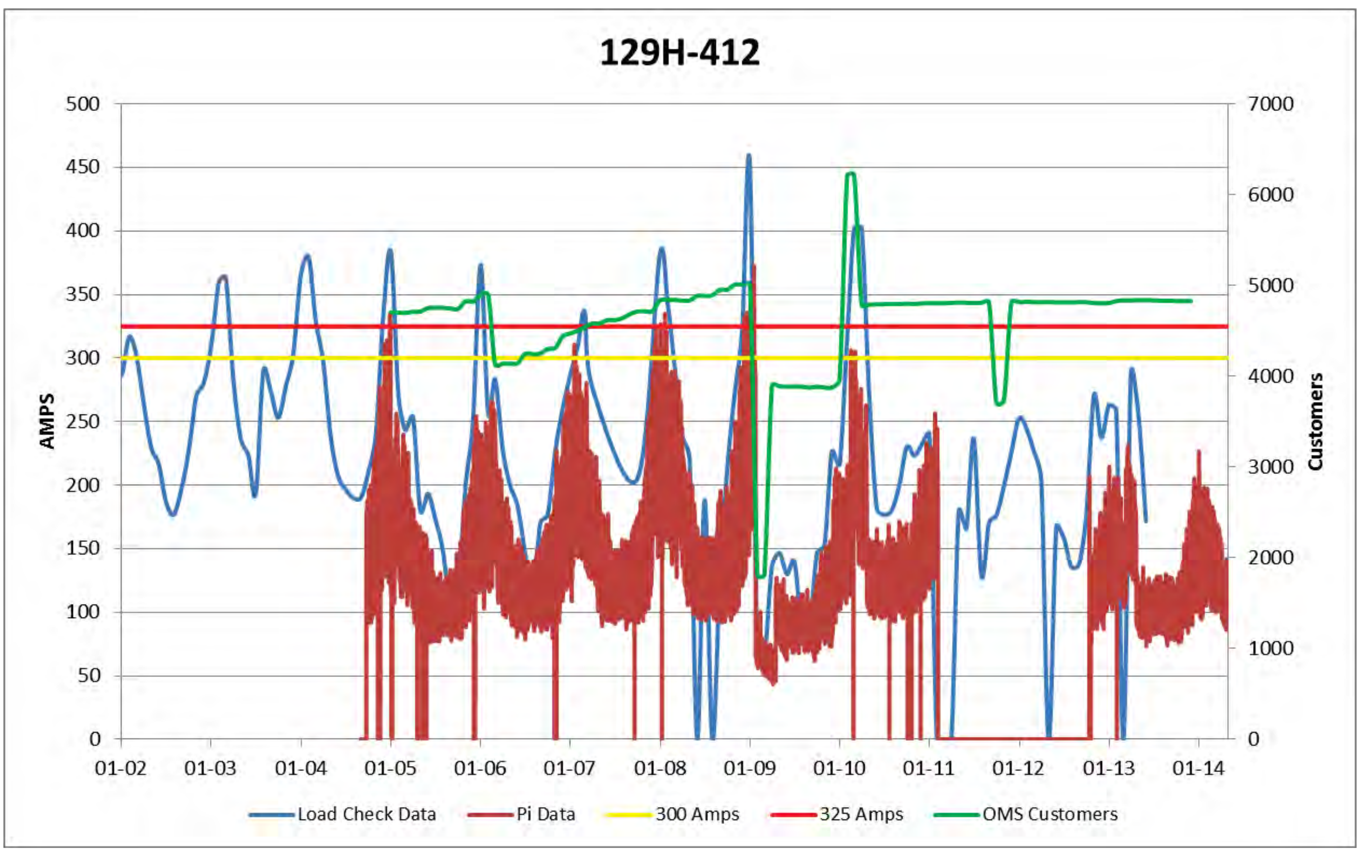


Figure 125 **129H-412 Load History**

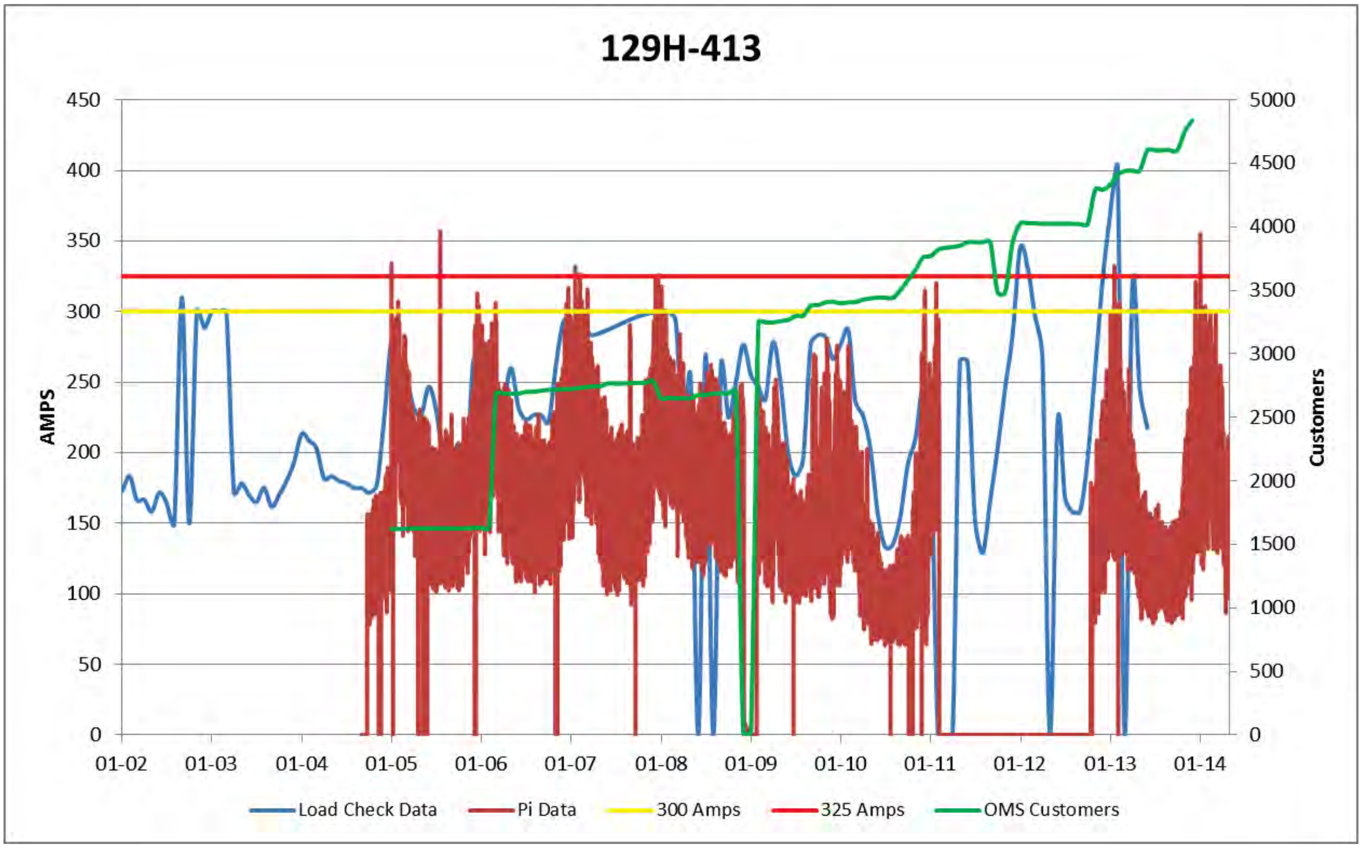


Figure 126 **129H-413 Load History**

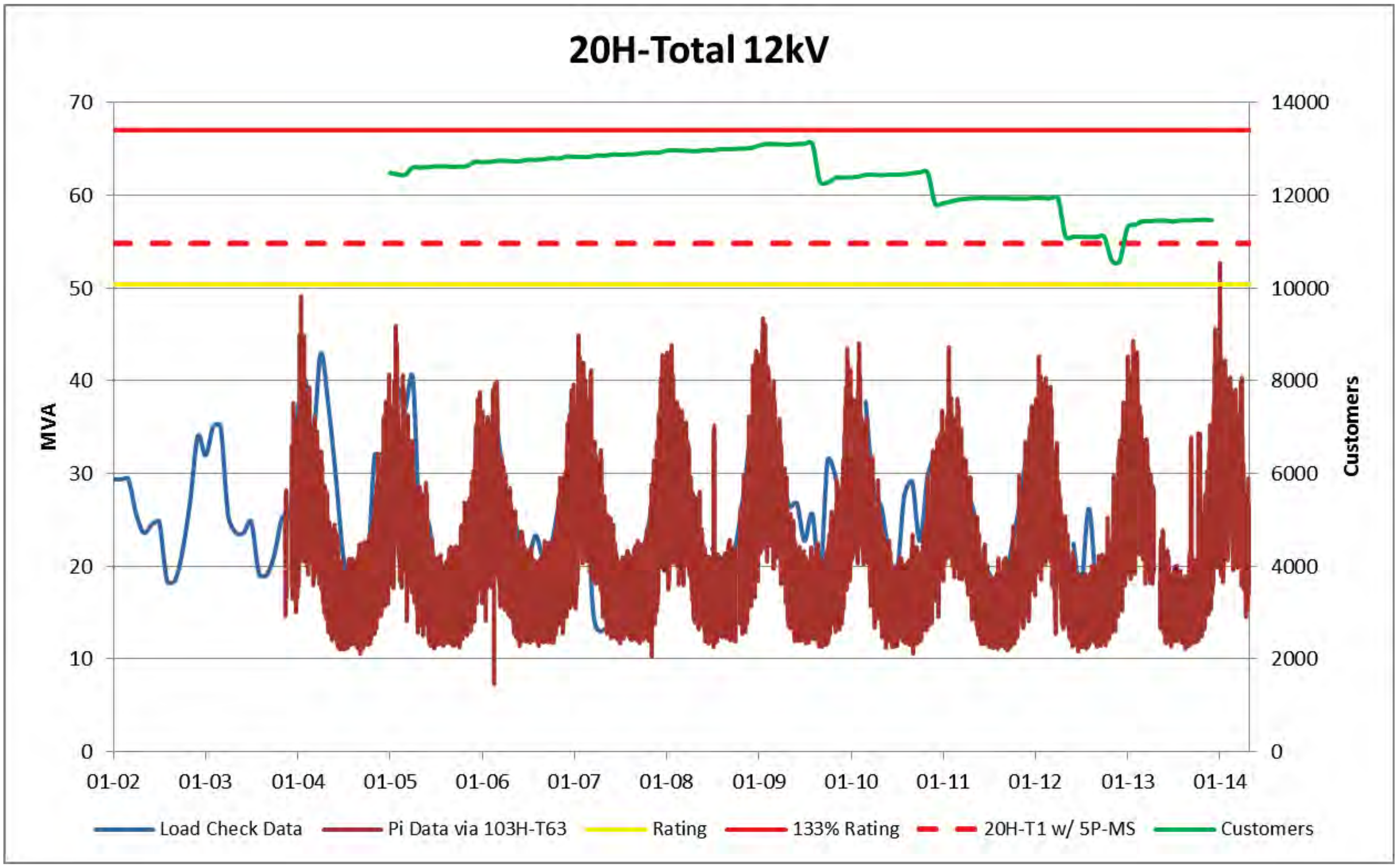


Figure 127 **20H-Spryfield Load History**

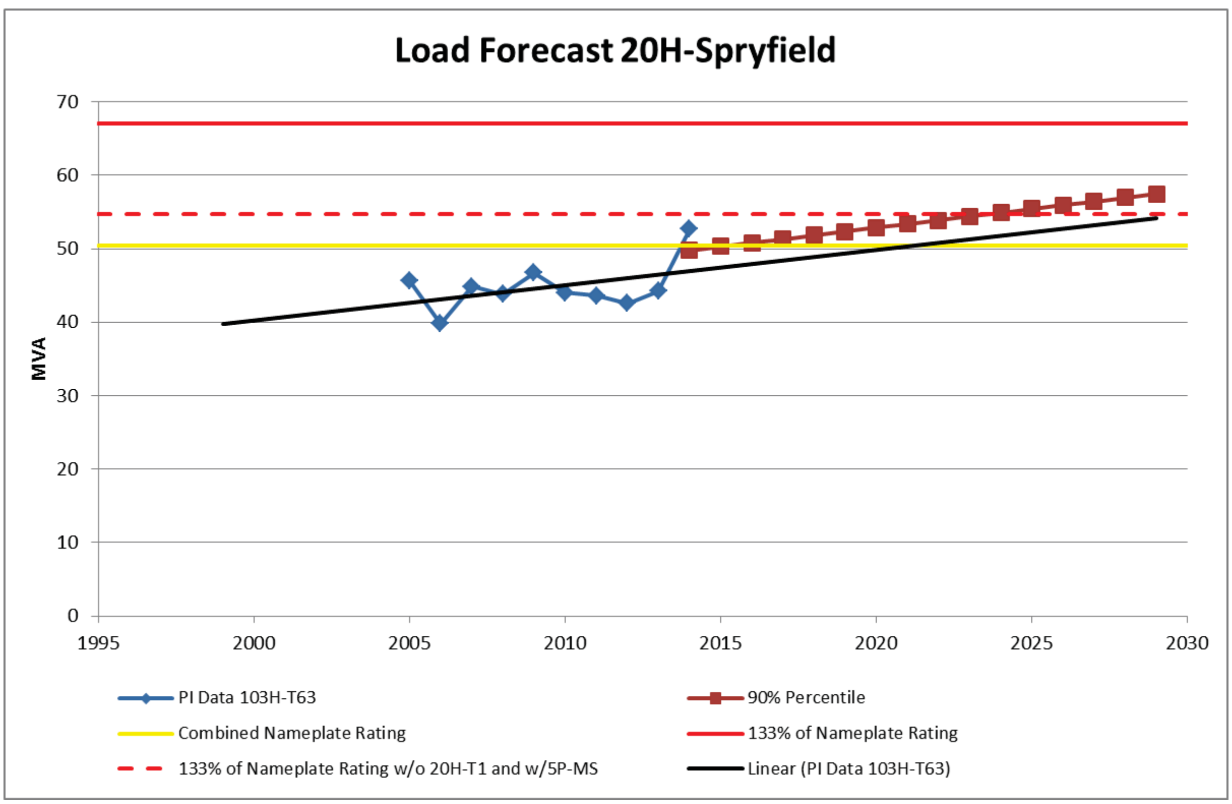


Figure 128 **20H-Spryfield Load Forecast**

Appendix B: Load History and Forecast

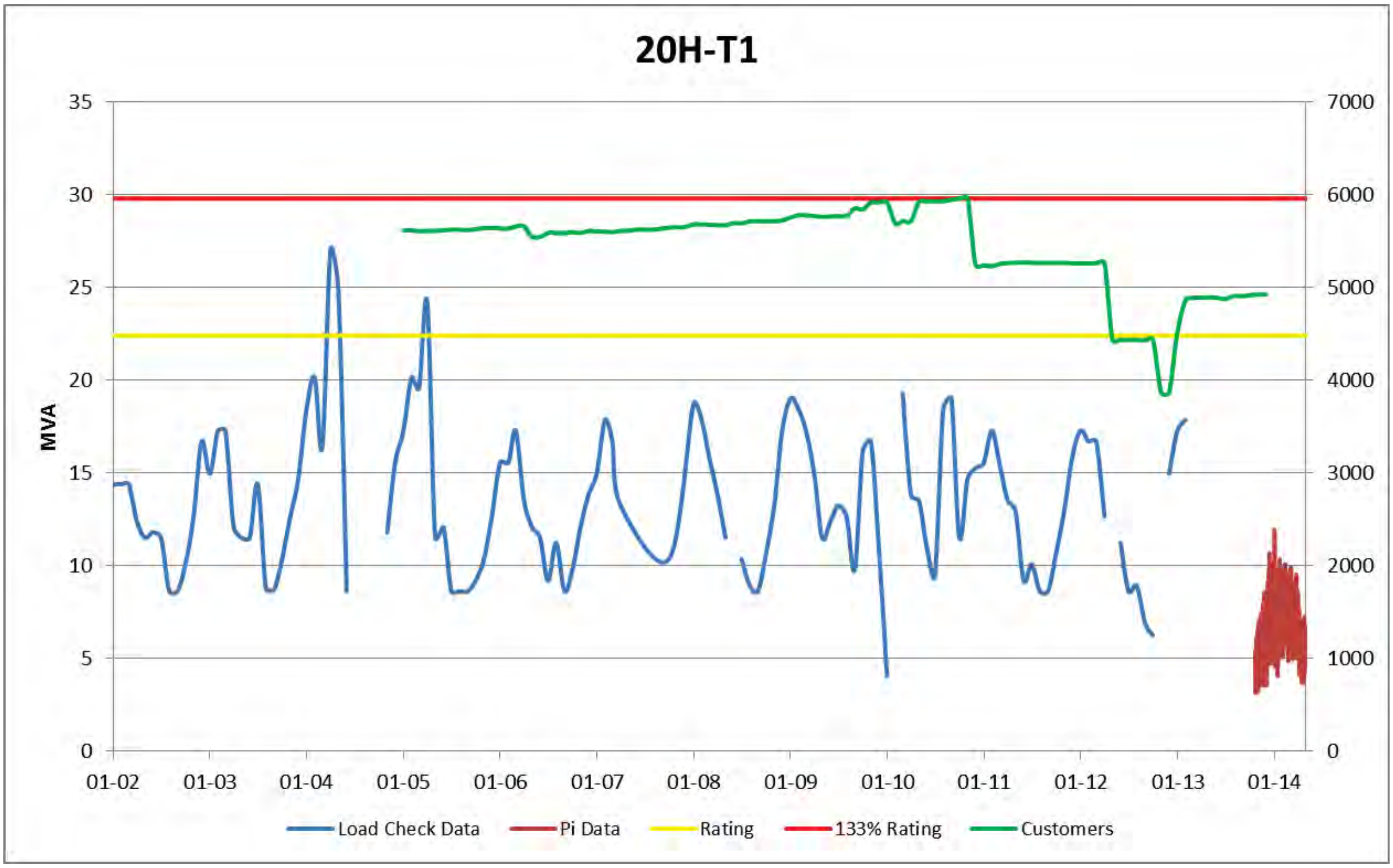


Figure 129 20H-T1 Load History

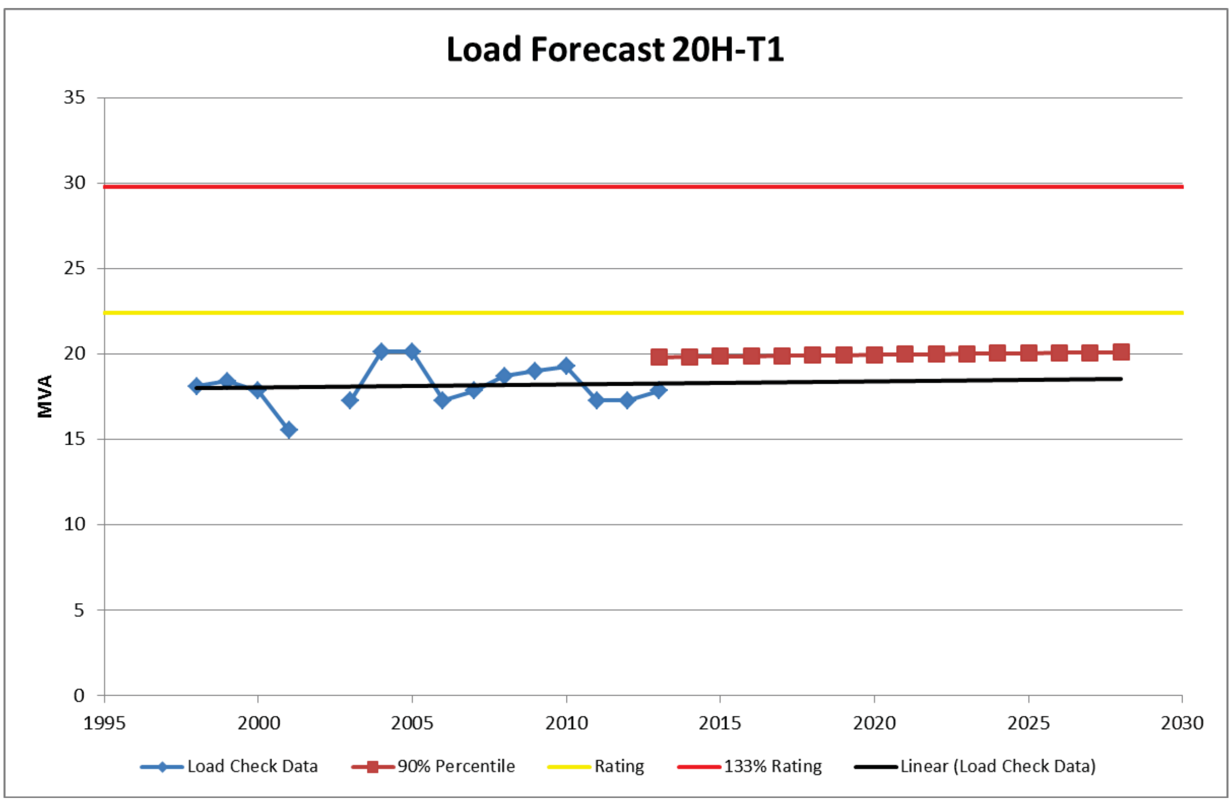


Figure 130 20H-T1 Load Forecast

Appendix B: Load History and Forecast

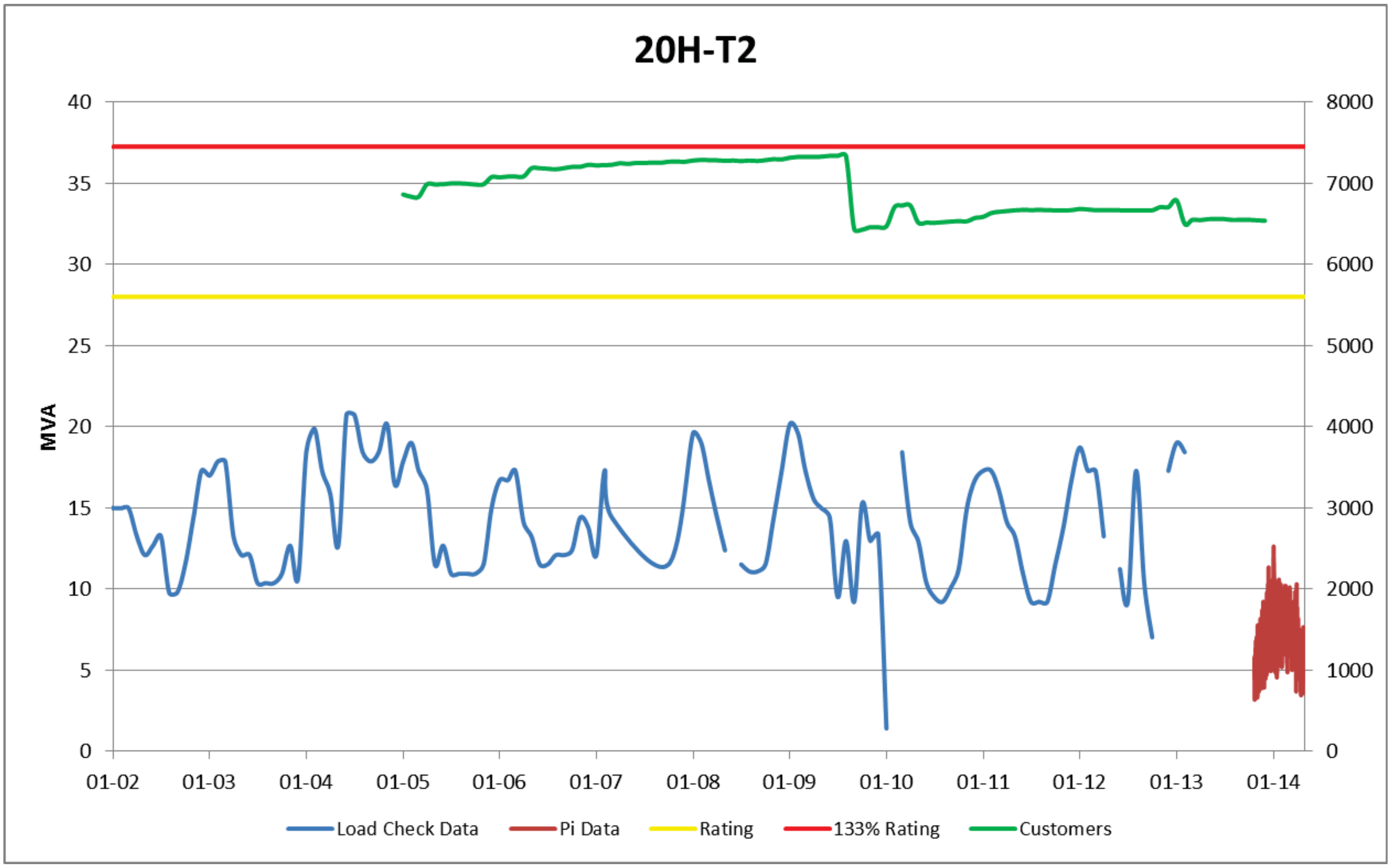


Figure 131 20H-T2 Load History

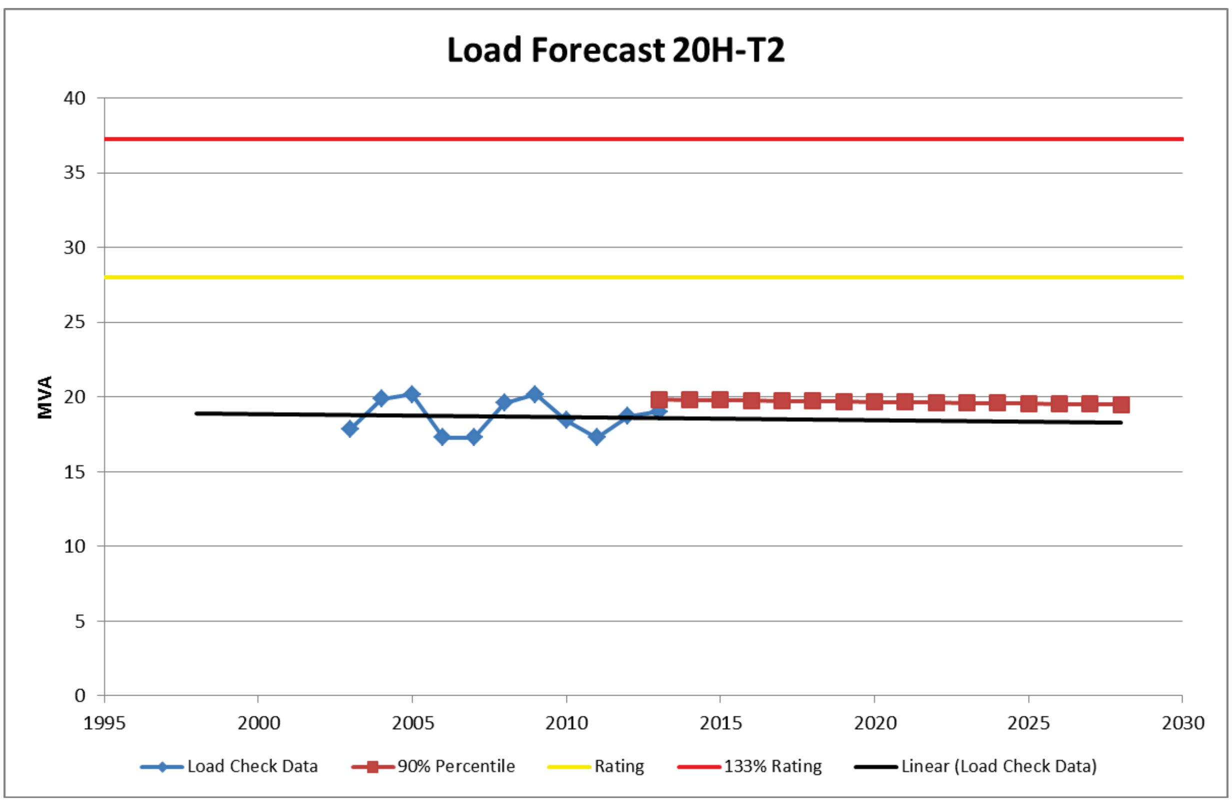


Figure 132 20H-T2 Load Forecast

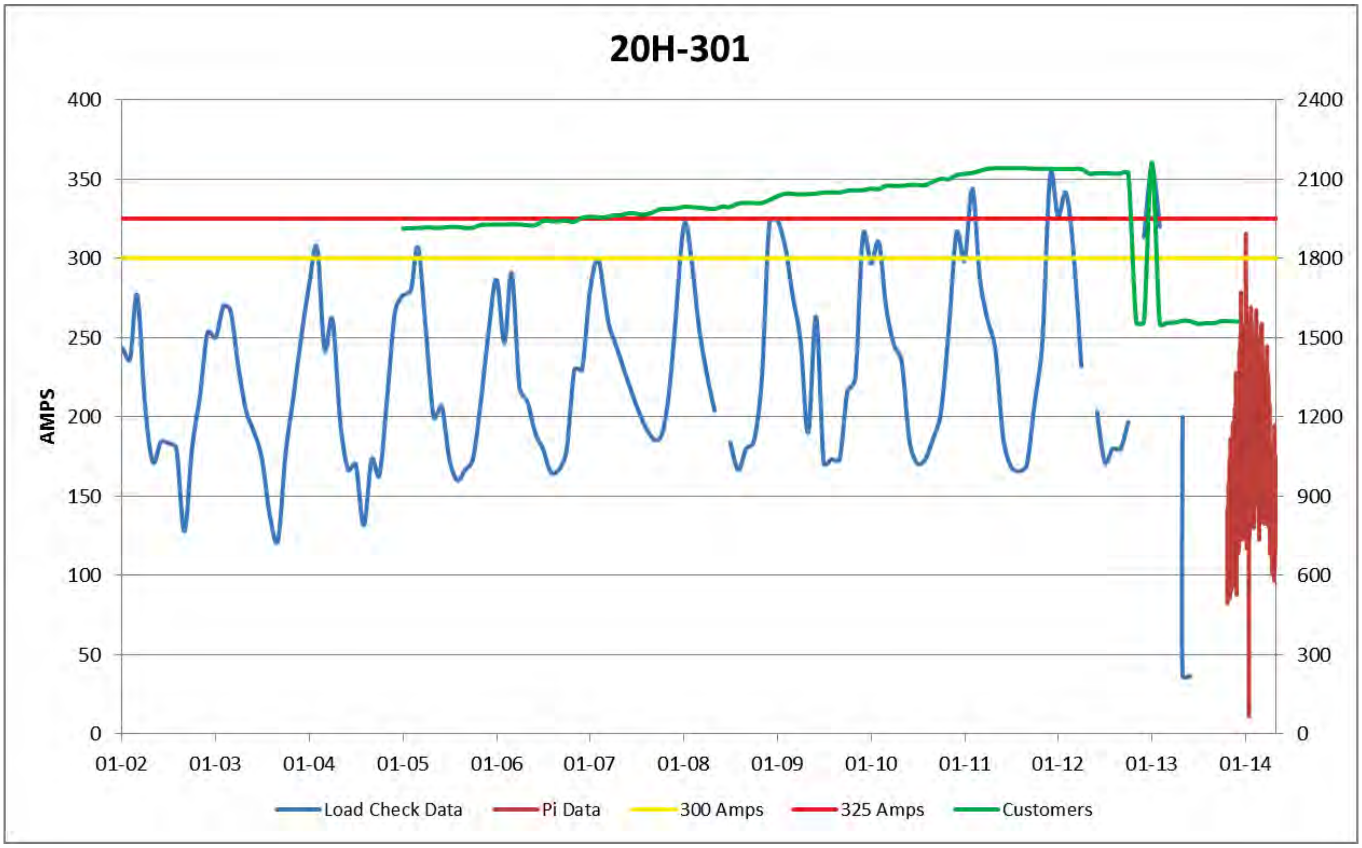


Figure 133 20H-301 Load History

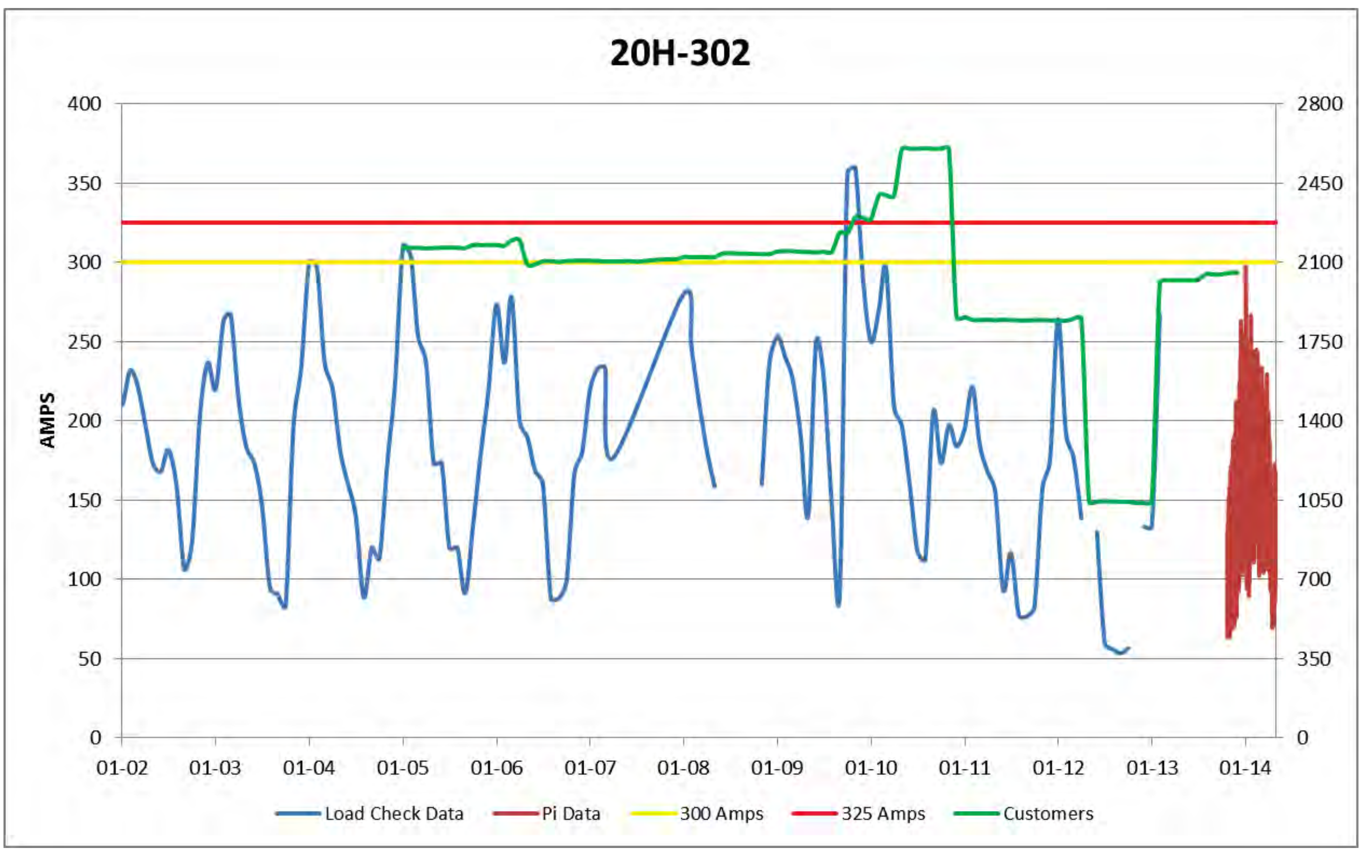


Figure 134 20H-302 Load History

Appendix B: Load History and Forecast

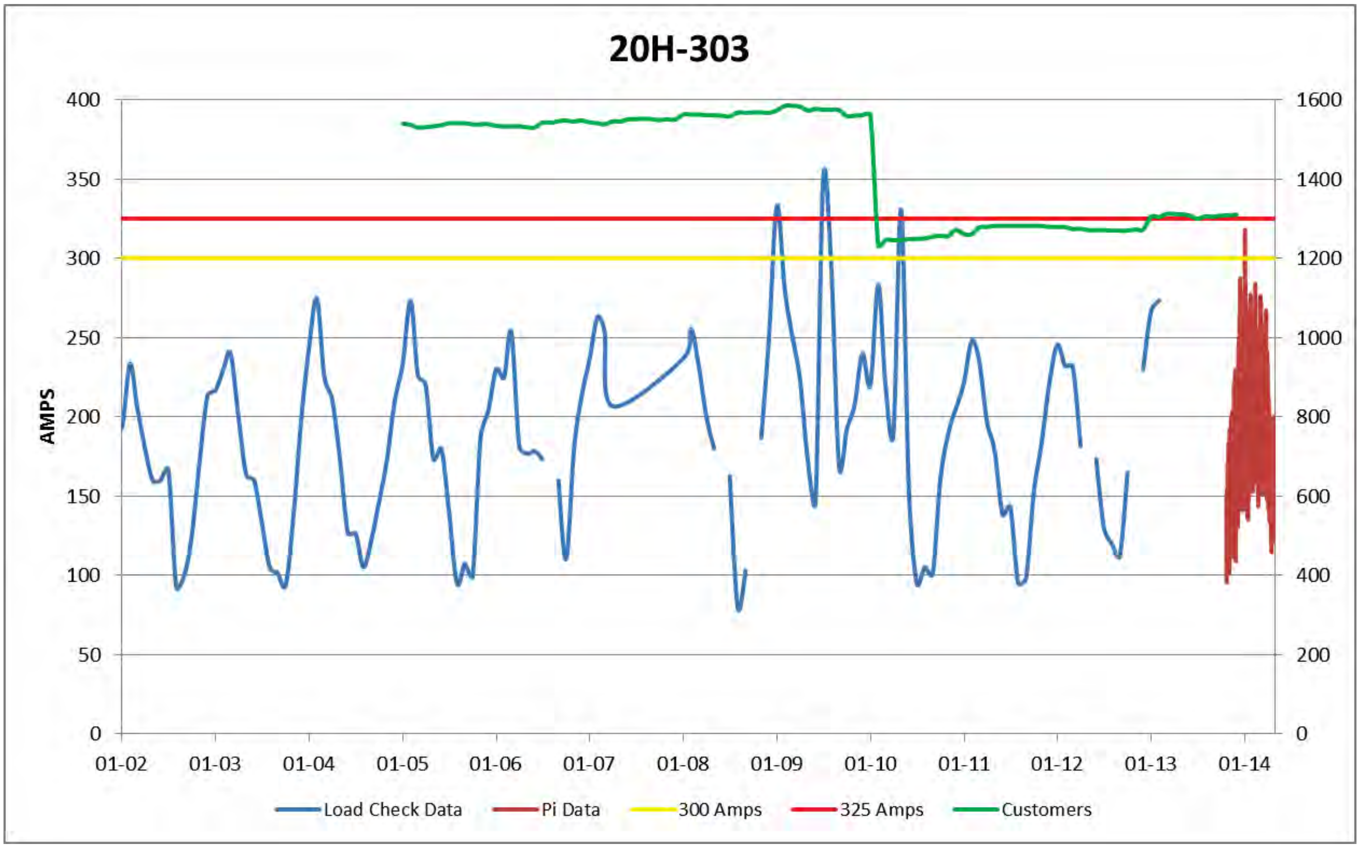


Figure 135 20H-303 Load History

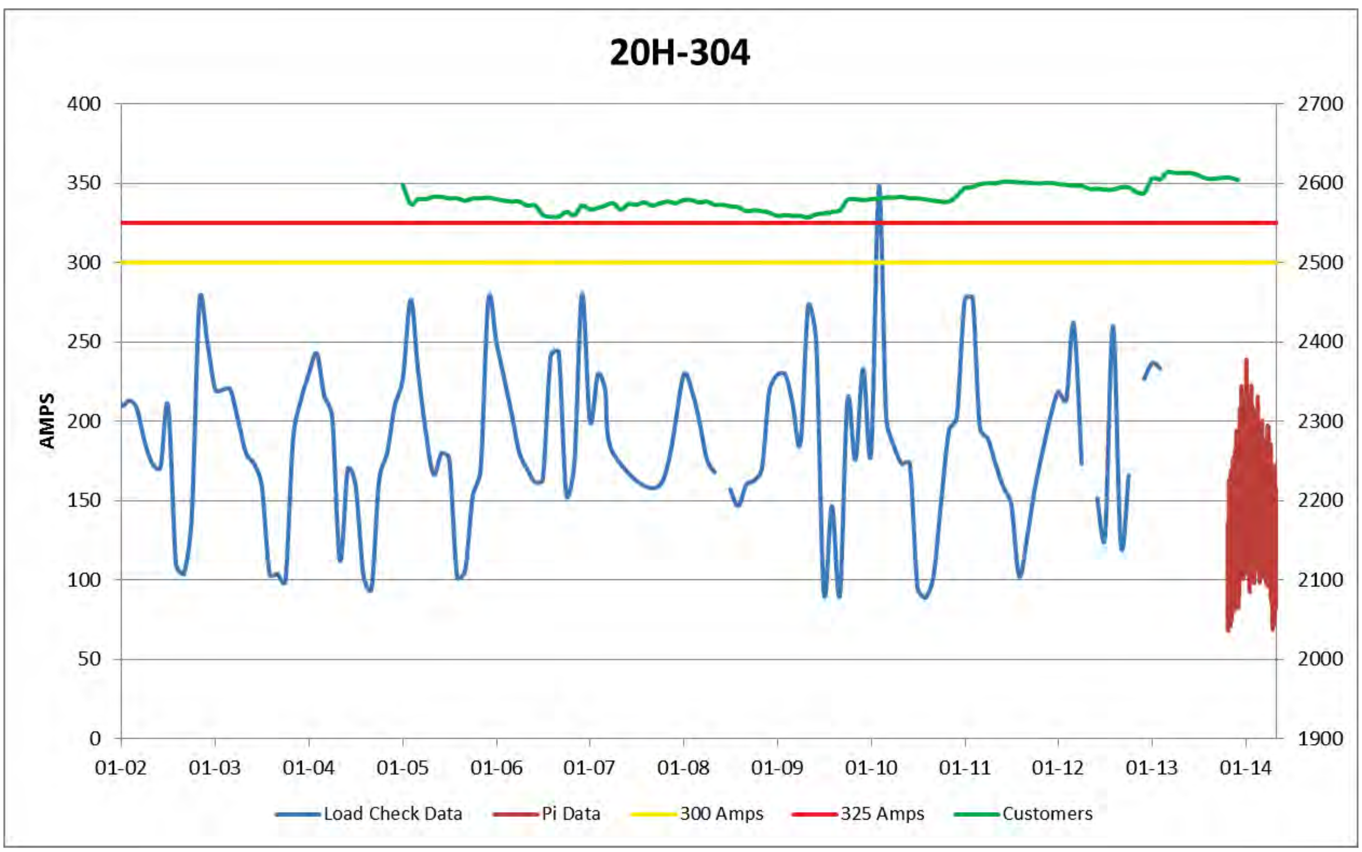


Figure 136 20H-304 Load History

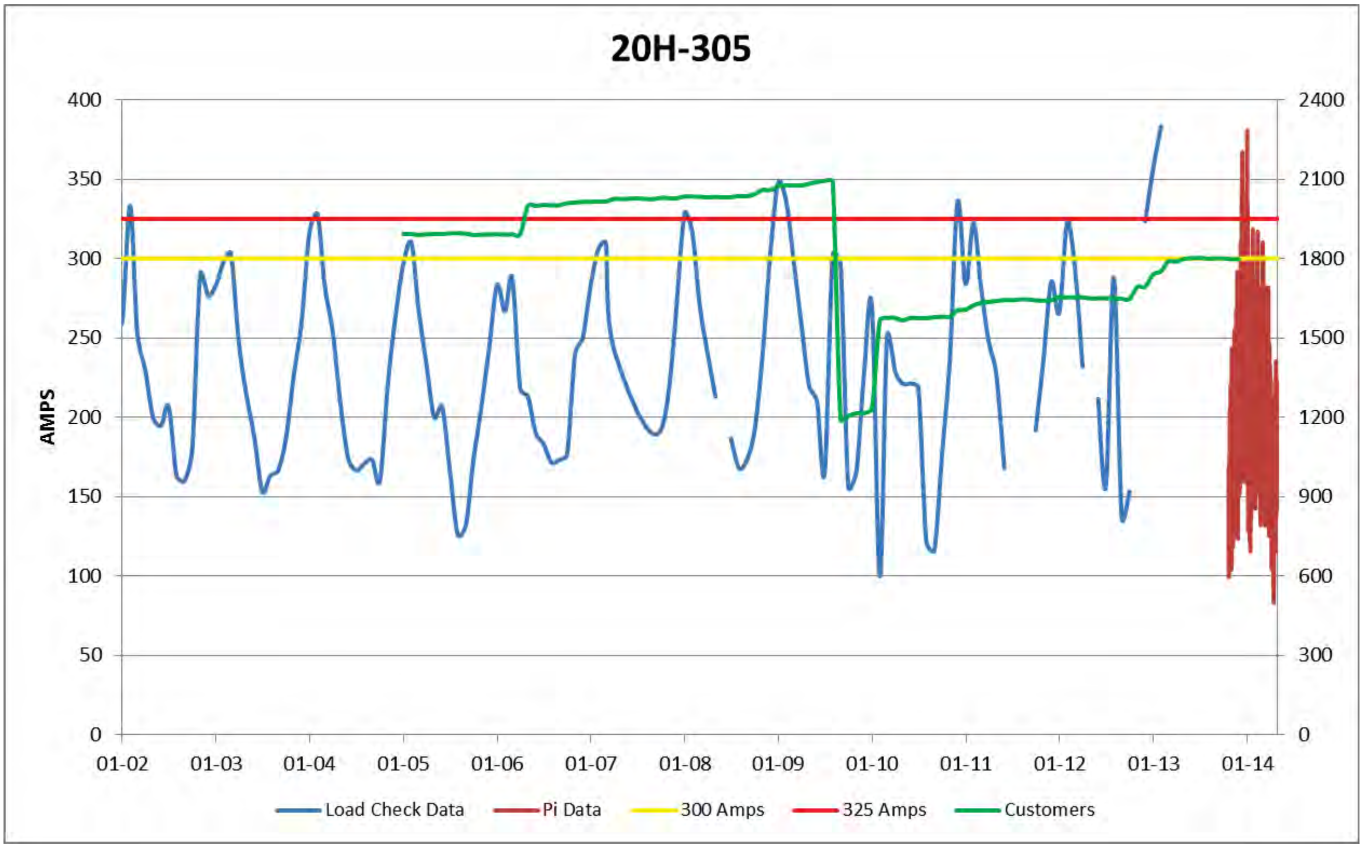


Figure 137 20H-305 Load History

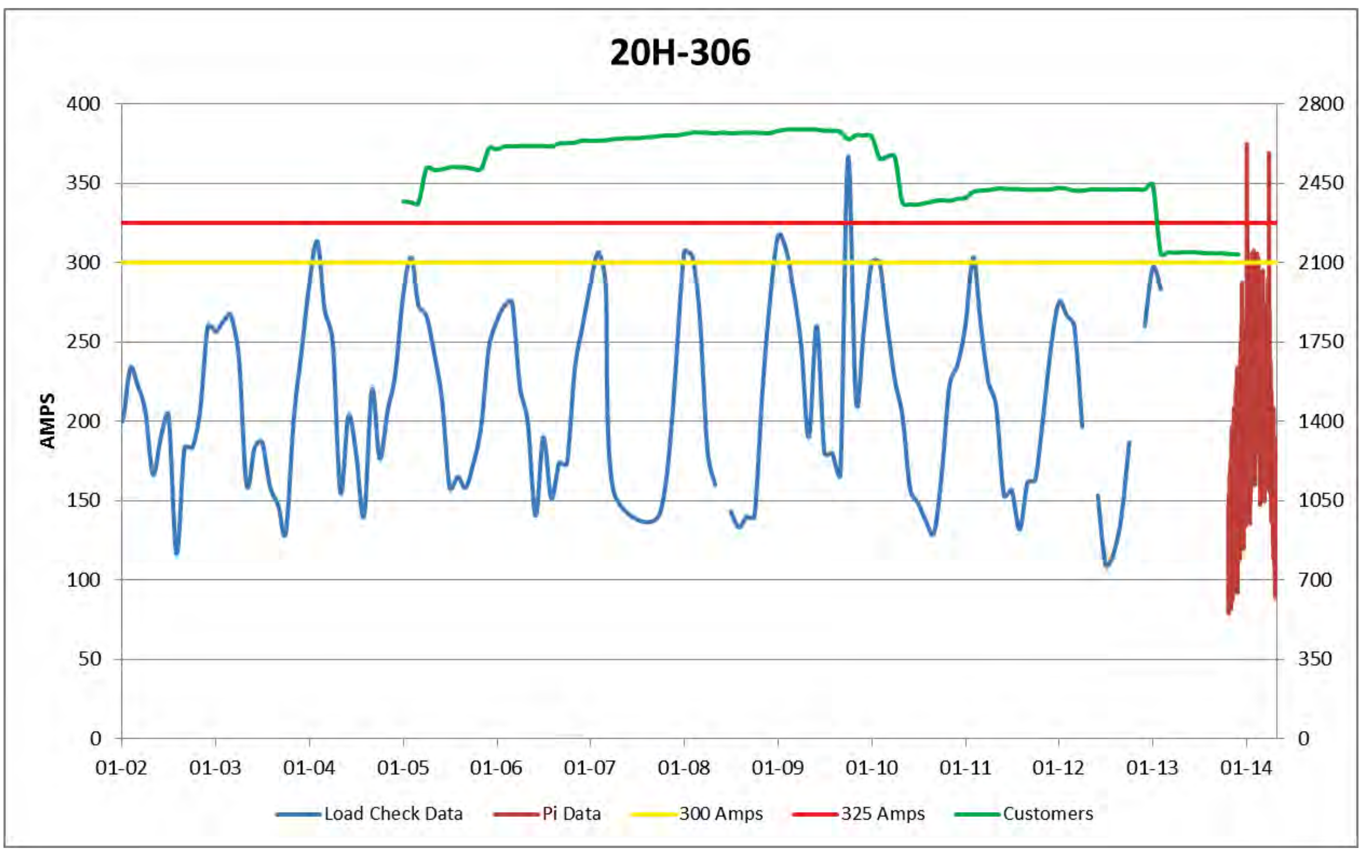


Figure 138 20H-306 Load History

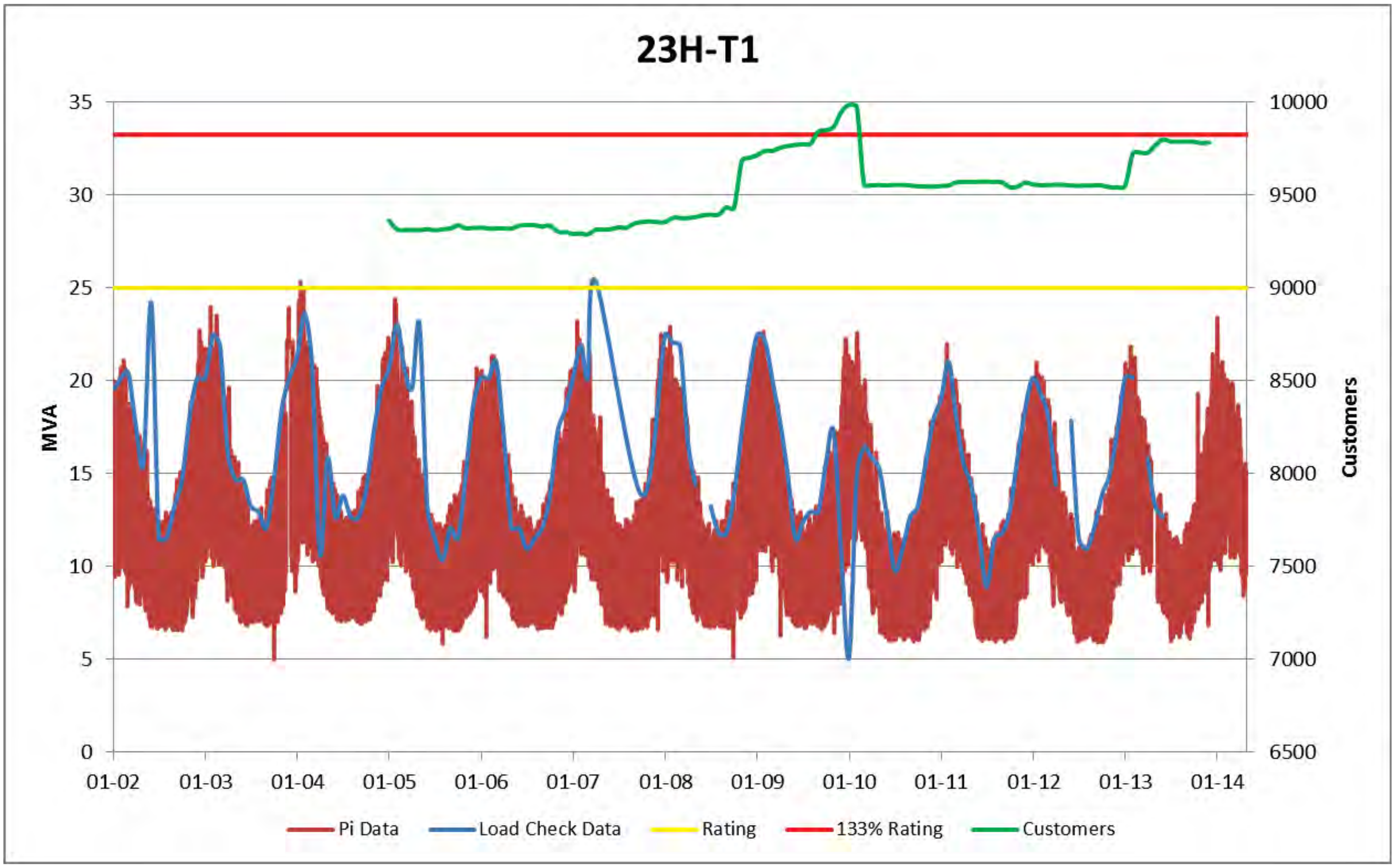


Figure 139 23H-Rockingham Load History

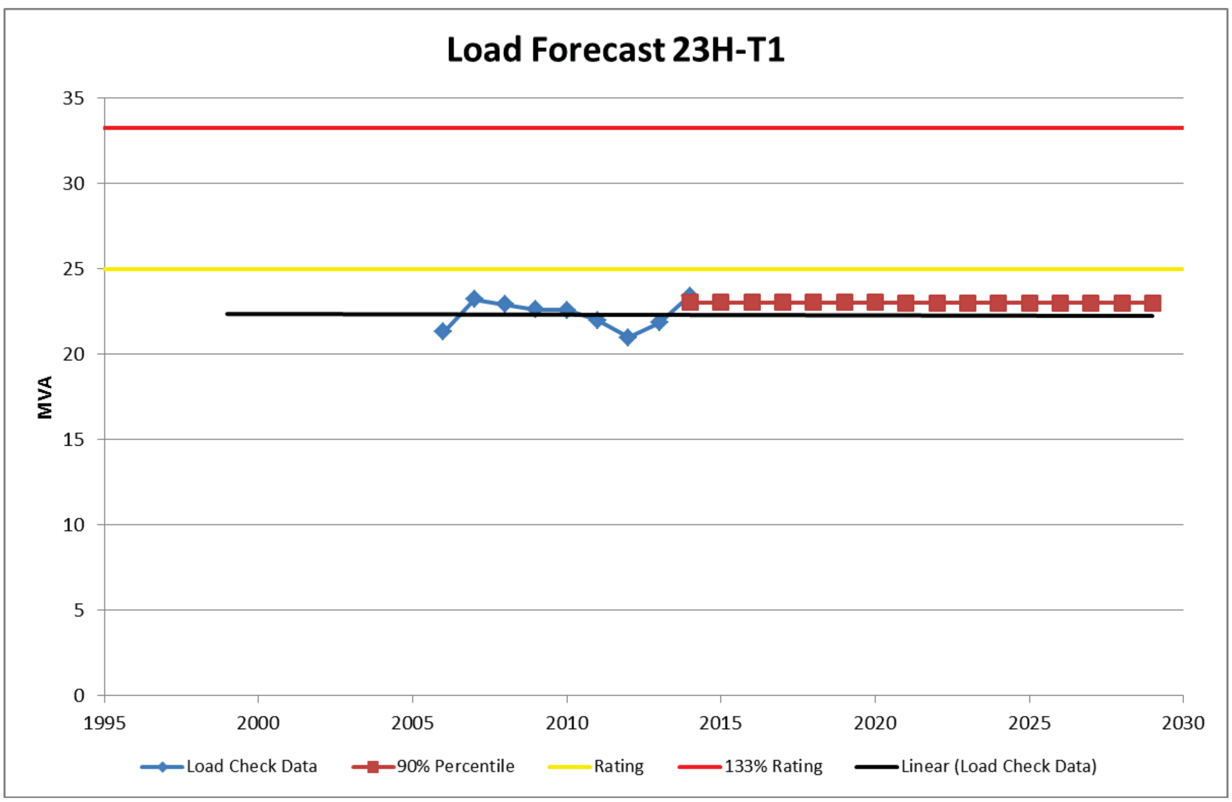


Figure 140 23H-Rockingham Load Forecast

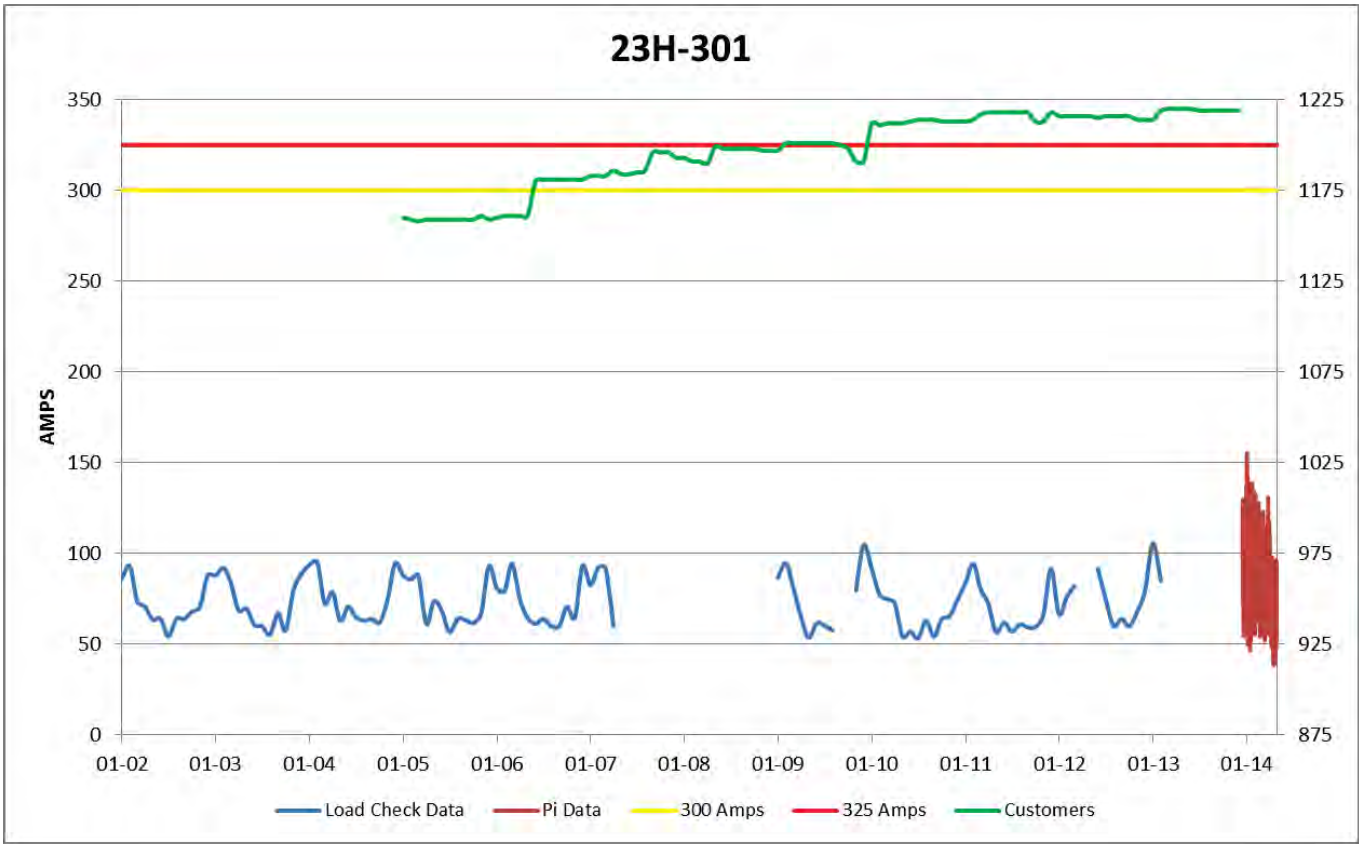


Figure 141 **23H-301 Load History**

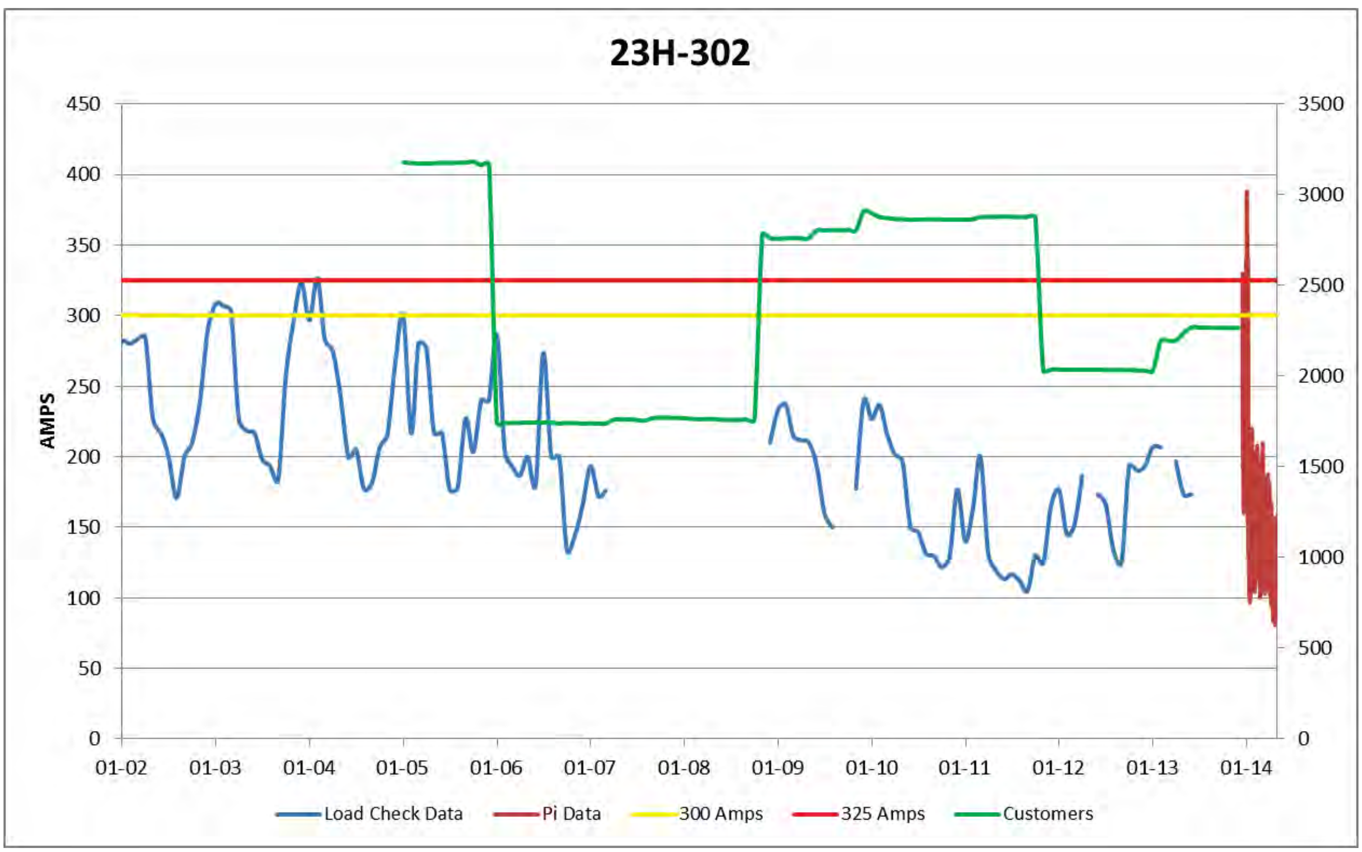


Figure 142 **23H-302 Load History**

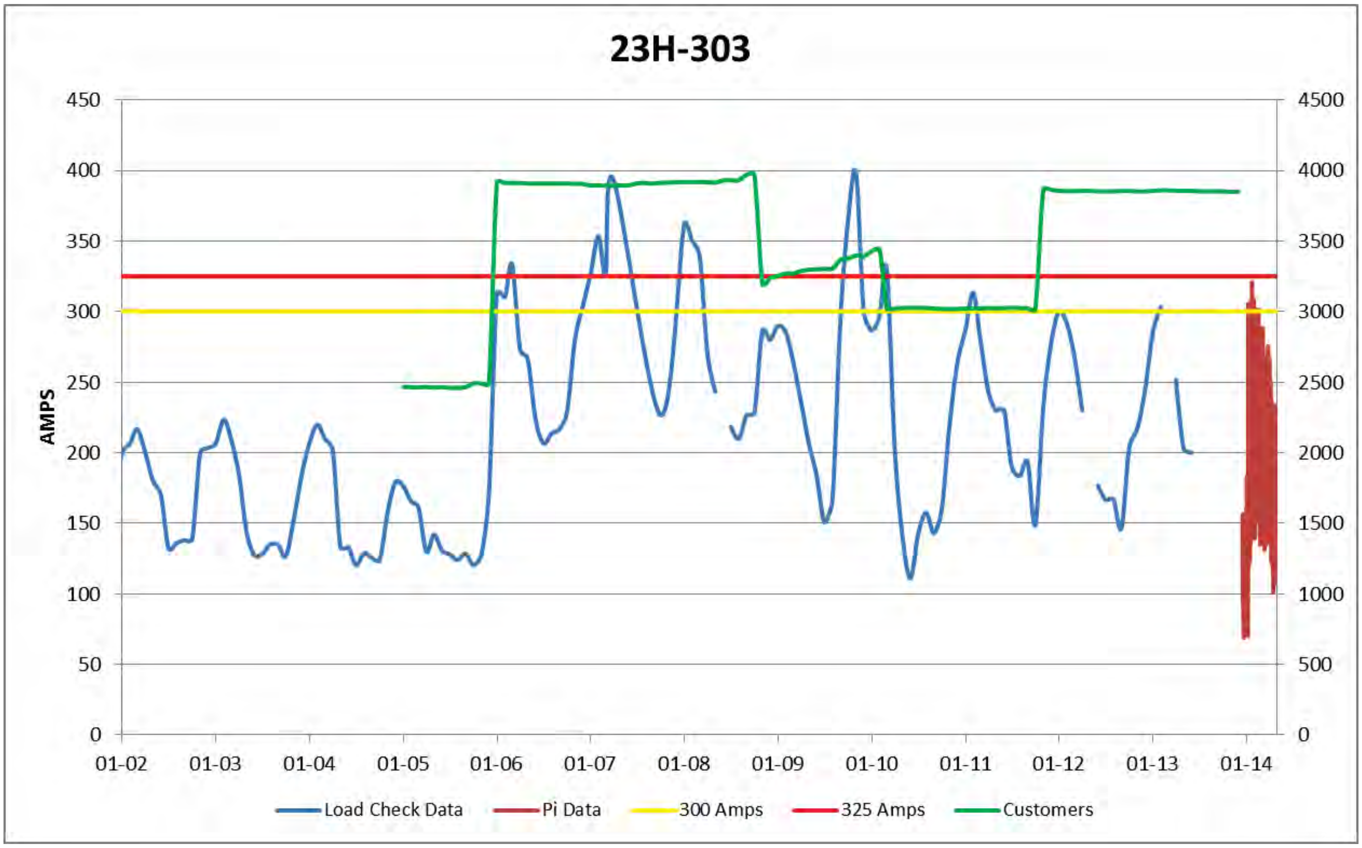


Figure 143 **23H-303 Load History**

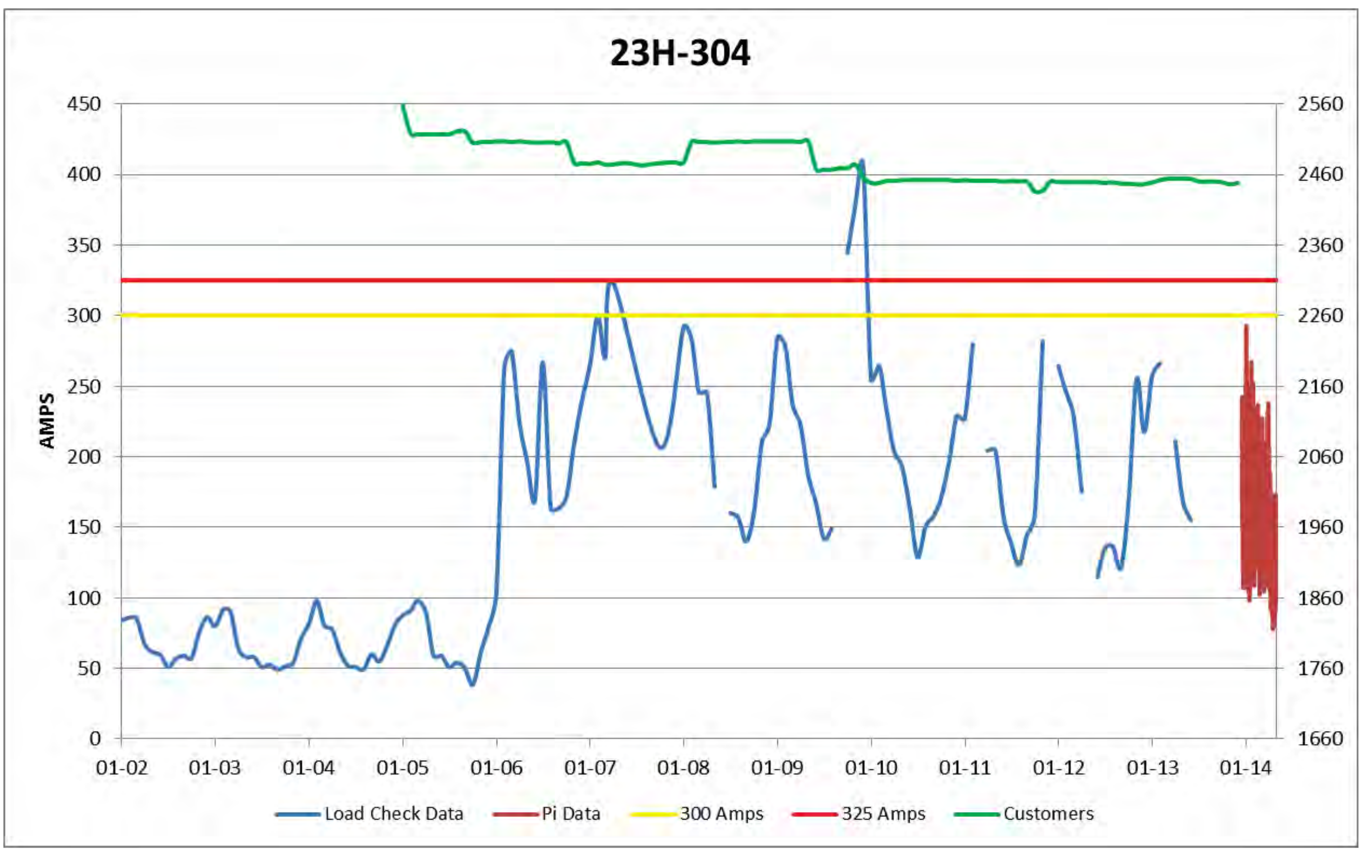


Figure 144 **23H-304 Load History**

APPENDIX C

Economic Analysis

New Substation Transformer on the Halifax Peninsula

Summary of Alternatives

Halifax Peninsula Alternatives
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :		Date :	30-Sep-14
Department :	Distribution Planning	CI Number:	
Originator :	James MacQueen	Project No. :	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	New Transformer at 104H-Kempt Road	6.49%	3,665,855	-2,862,439	2	-7.90%	0.0 years
B	New Transformer at 2H-Armdale	6.49%	3,561,509	-2,804,417	1	-7.90%	0.0 years
	0	NA	NA	NA	NA	#NUM!	0.0 years
	0	NA	NA	NA	NA	#NUM!	0.0 years

Recommendation :

This EAM concludes that the installation of the new transformer at 2H-Armdale is the least cost alternative.

Notes/Comments :

New Transformer at 104H-Kempt Road

This alternative includes the following:
- Install a new 25/33/42MVA 138-25kV transformer at 104H-Kempt Road
- Install three new feeders at 104H-Kempt Road

New Transformer at 2H-Armdale

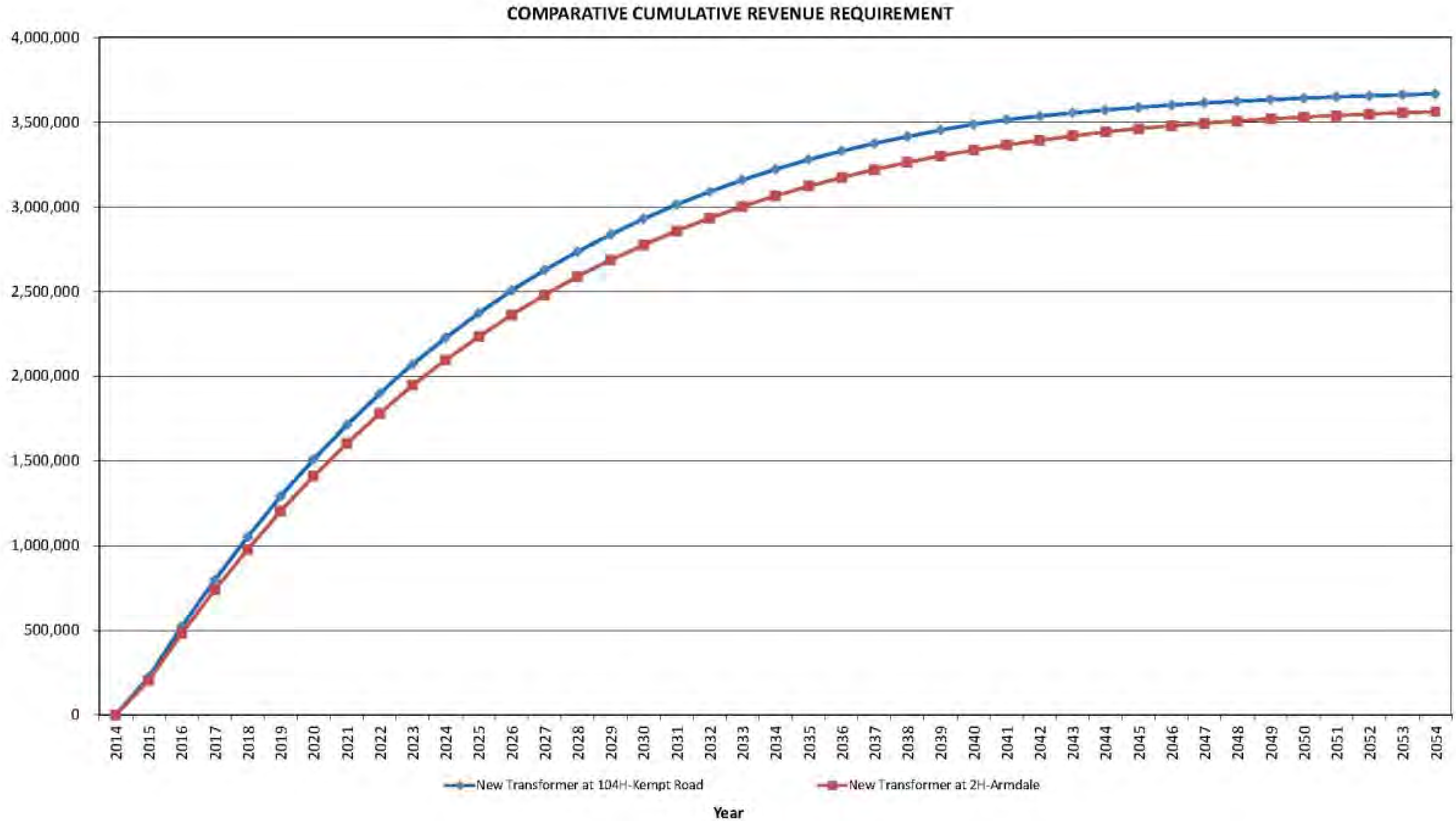
This alternative includes the following:
- Install a new 25/33/42MVA 138-25kV transformer at 2H-Armdale
- Install four new feeders at 2H-Armdale

0

0

Peninsula EAM -2015 9/30/2014

NPV Comparison



Alternative New Transformer A; Install New Transformer at 104H-Kempt Road

Halifax Peninsula Alternati
New Transformer at 104H-Kempt Road

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Capital Invested														
1. New 25/33/42MVA 138-25kV transformer		750,000												
2. Site preparations at 104H-Kempt Road		1,225,000												
3. Installation of new Transformer		500,000												
4. Feeder Exits and Reclosers		300,000												
5. Distribution Upgrades		925,000												
6.														
7.														
8.														
9.														
10.														
11.														
12.														
13.														
14.														
15.														
16.														
17.														
18.														
19.														
20.														
Total Direct Capital Invested by Year		3,700,000												
AFUDC (entered as a positive value)														
AO (entered as a positive value)														
Total Indirect Capital Invested by Year														
Total Capital Invested by Year		**3,700,000**												

Alternative New Transformer B; Install New Transformer at 2H-Armdale

Halifax Peninsula Alternati
New Transformer at 2H-Armdale

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. New 25/33/42MVA 138-25kV transformer		750,000												
2. Site preparation and new unit install		2,350,000												
3. Feeder Exits		350,000												
4. Distribution Upgrades		175,000												
5.														
6.														
7.														
8.														
9.														
10.														
11.														
12.														
13.														
14.														
15.														
16.														
17.														
18.														
19.														
20.														
Total Direct Capital Invested by Year		3,625,000												
AFUDC (entered as a positive value)														
AO (entered as a positive value)														
Total Indirect Capital Invested by Year														
Total Capital Invested by Year		**3,625,000**												

APPENDIX D

Economic Analysis

103H-Lakeside and 129H-Kearney Lake Alternatives

Summary of Alternatives

103H-Lakeside and 129H-Kearney Lake Alternatives
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :		**Date :**	3-Oct-14
Department :	Distribution Planning	**CI Number:**	
Originator :	James MacQueen	**Project No. :**	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace 103H-T61	6.49%	2,504,136	-2,120,289	3	-8.99%	0.0 years
B	New 103H-Lakeside Transformer	6.49%	1,740,578	-1,411,446	1	-8.40%	0.0 years
C	New 129H-Kearney Lake Transformer	6.49%	1,784,473	-1,447,934	2	-8.40%	0.0 years
	0	NA	NA	NA	NA	#NUM!	0.0 years

Recommendation :

Alternative B: New 103H-Lakeside Transformer has been identified as the least cost alternative.

Notes/Comments :

Replace 103H-T61

This alternative includes the following:
- Replace 103H-T61 (25/33/42MVA) transformer with a 53MVA, similar to the 1H-Water Street Units, in 2015
- Create one new feeder from 103H-Lakeside, in 2015
- Create one new feeder at 129H-Kearney Lake, in 2016
- Install additional transformer at 103H-Lakeside, in 2023

New 103H-Lakeside Transformer

This alternative includes the following:
- Install additional 25/33/42MVA 138-25kV transformer at 103H-Lakeside, in 2018
- Install three new feeders, with provision for a fourth in the future, at 103H-Lakeside, in 2018
- Install new feeder at 129H-Kearney Lake, in 2016

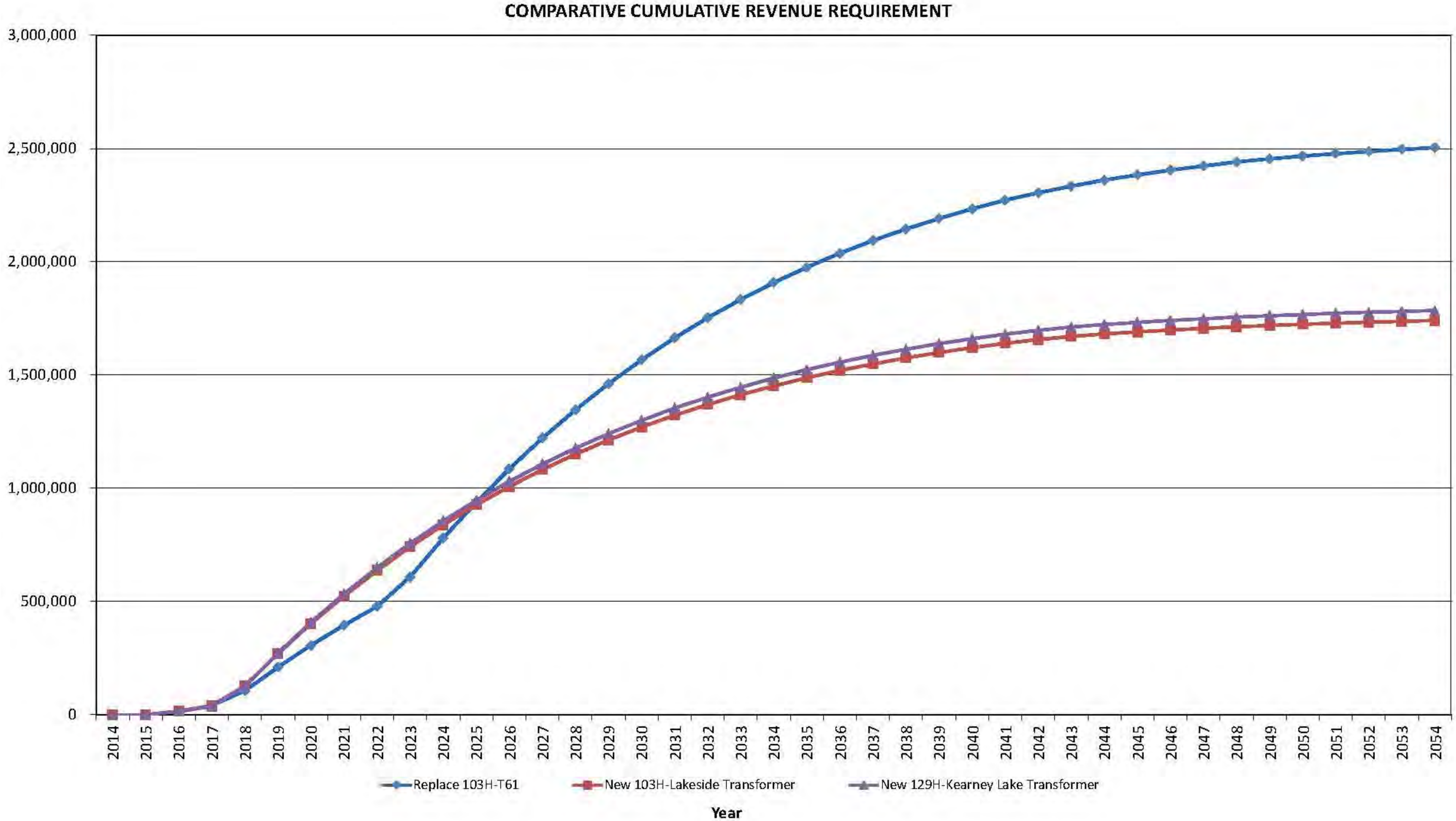
New 129H-Kearney Lake Transformer

This alternative includes the following:
- Install new feeder at 129H-Kearney Lake substation, in 2016
- Install a new 25/33/42MVA 69-25kV transformer at the 129H-Kearney Lake substation, in 2018
- Install three new feeders to the 129H-Kearney Lake substation, in 2018

0

103H-129H EAM Rev-1 10/3/2014

NPV Comparison



Alternative 103H/129HA; Replace 103H-T61

103H-Lakeside and 129H-K

Replace 103H-T61

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Capital Invested														
1. 103H-432 Load Reduction			60,000											
2. Load Transfer; 129H-412 to 103H-433			20,000											
3. 129H-Kearney Lake; New Feeder			200,000											
4. New 53MVA 138-25kV transformer					750,000									
5. Installation of new unit					375,000									
6. 103H-Lakeside; New Feeder					200,000									
7. Purchase new 25/33/42MVA 138-25kV transformer										900,000				
8. Installation of new transformer										900,000				
9. Installation of three new feeders										510,000				
10.														
11.														
12.														
13.														
14.														
15.														
16.														
17.														
18.														
19.														
20.														
Total Direct Capital Invested by Year			280,000		1,325,000					2,310,000				
AFUDC (entered as a positive value)														
AO (entered as a positive value)														
Total Indirect Capital Invested by Year														
Total Capital Invested by Year			**280,000**		**1,325,000**					**2,310,000**				

Alternative 103H-/129H-B; New 103H-Lakeside Transformer

103H-Lakeside and 129H-K
Replace 103H-T61

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. 103H-432 Load Reduction			60,000											
2. Load Transfer; 129H-412 to 103H-433			20,000											
3. 129H-Kearney Lake; New Feeder			200,000											
4. New 53MVA 138-25kV transformer					750,000									
5. Installation of new unit					375,000									
6. 103H-Lakeside; New Feeder					200,000									
7. Purchase new 25/33/42MVA 138-25kV transformer										900,000				
8. Installation of new transformer										900,000				
9. Installation of three new feeders										510,000				
10.														
11.														
12.														
13.														
14.														
15.														
16.														
17.														
18.														
19.														
20.														
Total Direct Capital Invested by Year			280,000		1,325,000					2,310,000				
AFUDC (entered as a positive value)														
AO (entered as a positive value)														
Total Indirect Capital Invested by Year														
Total Capital Invested by Year			**280,000**		**1,325,000**					**2,310,000**				

Alternative 103H/129H-C; New 129H-Kearney Lake Transformer

103H-Lakeside and 129H-K

New 129H-Kearney Lake Transformer

Nova Scotia POWER An Emera Company

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	Capital Invested	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1.	103H-432 Load Reduction			60,000											
2.	129H-Kearney Lake; New Feeder			200,000											
3.	New 25/33/42MVA 69-25kV Transformer					700,000									
4.	Installation of new transformer and buswork					800,000									
5.	129H-Kearney Lakes; New Feeders					480,000									
6.															
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
	Total Direct Capital Invested by Year			260,000		1,980,000									
	AFUDC (entered as a positive value)														
	AO (entered as a positive value)														
	Total Indirect Capital Invested by Year														
	Total Capital Invested by Year			**260,000**		**1,980,000**									

APPENDIX E

Economic Analysis

20H-Spryfield Alternatives

Summary of Alternatives

20H-Spryfield Alternatives
Summary of Alternatives

Division :		Date :	30-Sep-14
Department :	Distribution Planning	CI Number:	
Originator :	James MacQueen	Project No. :	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace 103H-T63 with 60MVA unit	6.49%	4,708,030	-3,745,113	2	-8.68%	0.0 years
B	Replace 103H-T63 with 50MVA unit and	6.49%	4,505,195	-3,551,705	1	-8.71%	0.0 years
C	20H-Spryfield Conversions to 25kV	6.49%	13,319,494	-10,942,287	4	-9.32%	0.0 years
D	Resupply 20H-Spryfield at 138kV	6.49%	7,255,504	-5,775,897	3	-8.47%	0.0 years

Recommendation :

Alternative B: Replace 103H-T63 and reduce the 12kV load at 20H-Spryfield has been identified as the least cost alternative. The converted 12kV will be supplied by 2H-Armdale.

Notes/Comments :

Replace 103H-T63 with 60MVA unit

This alternative includes the following:
- Replace 103H-T63 with a 60MVA 138-69kV transformer
- Reduce the loading on overloaded feeders through conversion of load to 25kV and reconfiguration of feeders

Replace 103H-T63 with 50MVA unit and Reduce 12kV Load

This alternative includes the following:
- Replace 103H-T63 with a 30/40/50MVA 138-69kV transformer
- Reduce the loading on overloaded feeders through conversion of load to 25kV and reconfiguration of feeders

20H-Spryfield Conversions to 25kV

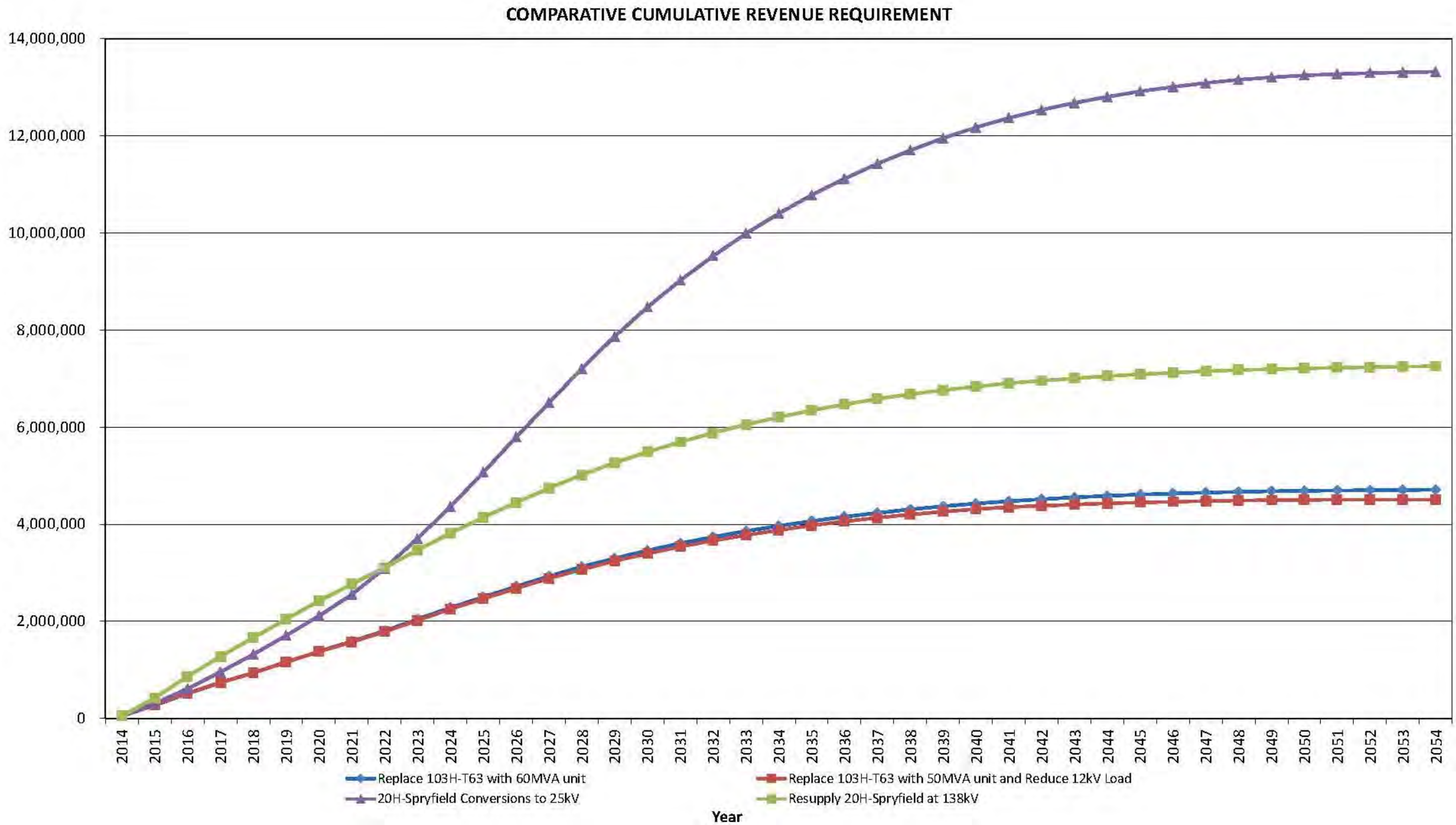
This alternative includes the following:
- Conversion of the 12kV load supplied by 20H-Spryfield to 25kV, by 2028.
- Installation of a new 25/33/42MVA 69-25kV transformer, in 2022.

Resupply 20H-Spryfield at 138kV

This alternative includes the following:
- Construction of a new 138kV tap at 34H-Geizer's Hill
- Construction of a new 138kV transmission line from 34H-Geizer's Hill to 20H-Spryfield
- Replacing the existing 69-12kV transformers with two 15/20/25MVA 138-12kV transformers
- Retimrement of L-5039, from 34H-Geizer's Hill to 20H-Spryfield

20H-Spryfield EAM 9/30/2014

NPV Comparison



Alternative 20H-A; Replace 103H-T63 with 60MVA Unit

20H-Spryfield Alternatives
Replace 103H-T63 with 60MVA unit

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1. Conversions Part 1	650,000														
2. Conversions Part 2	345,000														
3. Purchase new 138-69kV 60MVA transformer		1,250,000													
4. Installation of new transformer		700,000													
5. Conversions Part 3						680,000									
6. Conversions Part 4									690,000						
7. Conversions Part 5										850,000					
8. Conversions Part 6													680,000		
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year	995,000	1,950,000				680,000			690,000	850,000			680,000		
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year	**995,000**	**1,950,000**				**680,000**			**690,000**	**850,000**			**680,000**		

Alternative 20H-B; Replace 103H-T63 with 50MVA Unit

20H-Spryfield Alternatives
Replace 103H-T63 with 50MVA unit and Redı

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1. Conversions Part 1	650,000														
2. Conversions Part 2	345,000														
3. Purchase new 138-69kV 30/40/50MVA transformer		1,000,000													
4. Installation of new transformer		700,000													
5. Conversions Part 3						680,000									
6. Conversions Part 4									690,000						
7. Conversions Part 5										850,000					
8. Conversions Part 6													680,000		
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year	995,000	1,700,000				680,000			690,000	850,000			680,000		
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year	**995,000**	**1,700,000**				**680,000**			**690,000**	**850,000**			**680,000**		

Alternative 20H-C; 20H-Spryfield Conversions to 25kV

20H-Spryfield Alternatives
20H-Spryfield Conversions to 25kV

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item
Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Capital Invested																
1. Conversions Part 1	650,000															
2. Conversions Part 2	345,000															
3. Purchase new 138-69kV 30/40/50MVA transformer		1,000,000														
4. Installation of new transformer		700,000														
5. Conversions Part 3		600,000														
6. Conversions Part 4			575,000													
7. Conversions Part 5				715,000												
8. Conversions Part 6					540,000											
9. Conversions Part 7						710,000	730,000									
10. Conversions Part 8								1,375,000								
11. Conversions Part 9									1,240,000	1,280,000						
12. Retire 20H-T1 and site preparations for new transformer									600,000							
13. Purchase new 69-25kV 25/33/42MVA transformer									750,000							
14. Install new transformer and switchgear									800,000							
15. Conversions Part 10											2,135,000	2,200,000				
16. Conversions Part 11													1,320,000			
17. Conversions Part 12														1,140,000	1,175,000	
18. Retire 20H-T2 and remove remaining 12kV equipment																300,000
19.																
20.																
Total Direct Capital Invested by Year	995,000	2,300,000	575,000	715,000	540,000	710,000	730,000	1,375,000	3,390,000	1,280,000	2,135,000	2,200,000	1,320,000	1,140,000	1,175,000	300,000
AFUDC (entered as a positive value)																
AO (entered as a positive value)																
Total Indirect Capital Invested by Year																
Total Capital Invested by Year	**995,000**	**2,300,000**	**575,000**	**715,000**	**540,000**	**710,000**	**730,000**	**1,375,000**	**3,390,000**	**1,280,000**	**2,135,000**	**2,200,000**	**1,320,000**	**1,140,000**	**1,175,000**	**300,000**

Alternative 20H-D; Resupply 20H-Spryfield at 138kV

20H-Spryfield Alternatives
Resupply 20H-Spryfield at 138kV

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item
Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1. Conversions Part 1	650,000														
2. Conversions Part 2	345,000														
3. 138kV tap; 34H-Geizer's Hill		1,500,000													
4. Rebuild L-5039 off road structures to 138kV		625,000													
5. Rebuild L-5039 roadside structures to 138kV		300,000													
6. Purchase two 138-12kV 15/20/25MVA transformers		1,250,000													
7. 20H-Spryfield substation upgrades and install new transformers		900,000													
8. Conversions Part 3						680,000									
9. Conversions Part 4									690,000						
10. Conversions Part 5										850,000					
11. Conversions Part 6													680,000		
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year	995,000	4,575,000				680,000			690,000	850,000			680,000		
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year	**995,000**	**4,575,000**				**680,000**			**690,000**	**850,000**			**680,000**		

APPENDIX F

Economic Analysis

23H-Rockingham Alternatives

Summary of Alternatives

23H-Rockingham Alternatives
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :		Date :	30-Sep-14
Department :	Distribution Planning	CI Number:	
Originator :	James MacQueen	Project No. :	

	Alternative	After Tax WACC	PV of Revenue Requirement	PV of EVA / NPV	Rank (based on PV of RR)	IRR	Disc Pay
A	Replace 23H-T51	6.49%	4,869,086	-3,940,250	2	-9.08%	0.0 years
B	Add additional 15/20/25MVA transforme	6.49%	2,504,992	-1,984,506	1	-8.16%	0.0 years
C	Convert and Retire 23H-Rockingham	6.49%	6,962,144	-5,594,671	3	-8.91%	0.0 years
D	Convert 23H-Rockingham and resupply	6.49%	7,809,124	-6,382,268	4	-9.07%	0.0 years

Recommendation :

Alternative C is the recommended alternative. While this is not the least cost alternative, Alternative A would see the 23H-T51 replacement's rating exceed the largest mobile in the NSPI fleet. Alternative B would provide the capacity and contingency requirements for the forseeable future. Unfortunately, there is limited space within the 23H-Rockingham substation, as well as limited ability to install any new feeders, to be supplied by the substation.

Notes/Comments :

Replace 23H-T51

This alternative would see the following:
- Replace 23H-T51 (15/20/25MVA) with a larger unit
- Install fourth feeder at 23H-Rockingham
- Conversion of 12kV load to 25kV as load increase
- Install 5MVA 25-12kV padmount stepdown at 8H-Fairview

Add additional 15/20/25MVA transformer at 23H-Rockingham

This alternative would see the following:
- Install additional 15/20/25MVA 69-12kV transformer at 23H-Rockingham
- Install 3 new feeders at 23H-Rockingham

Convert and Retire 23H-Rockingham

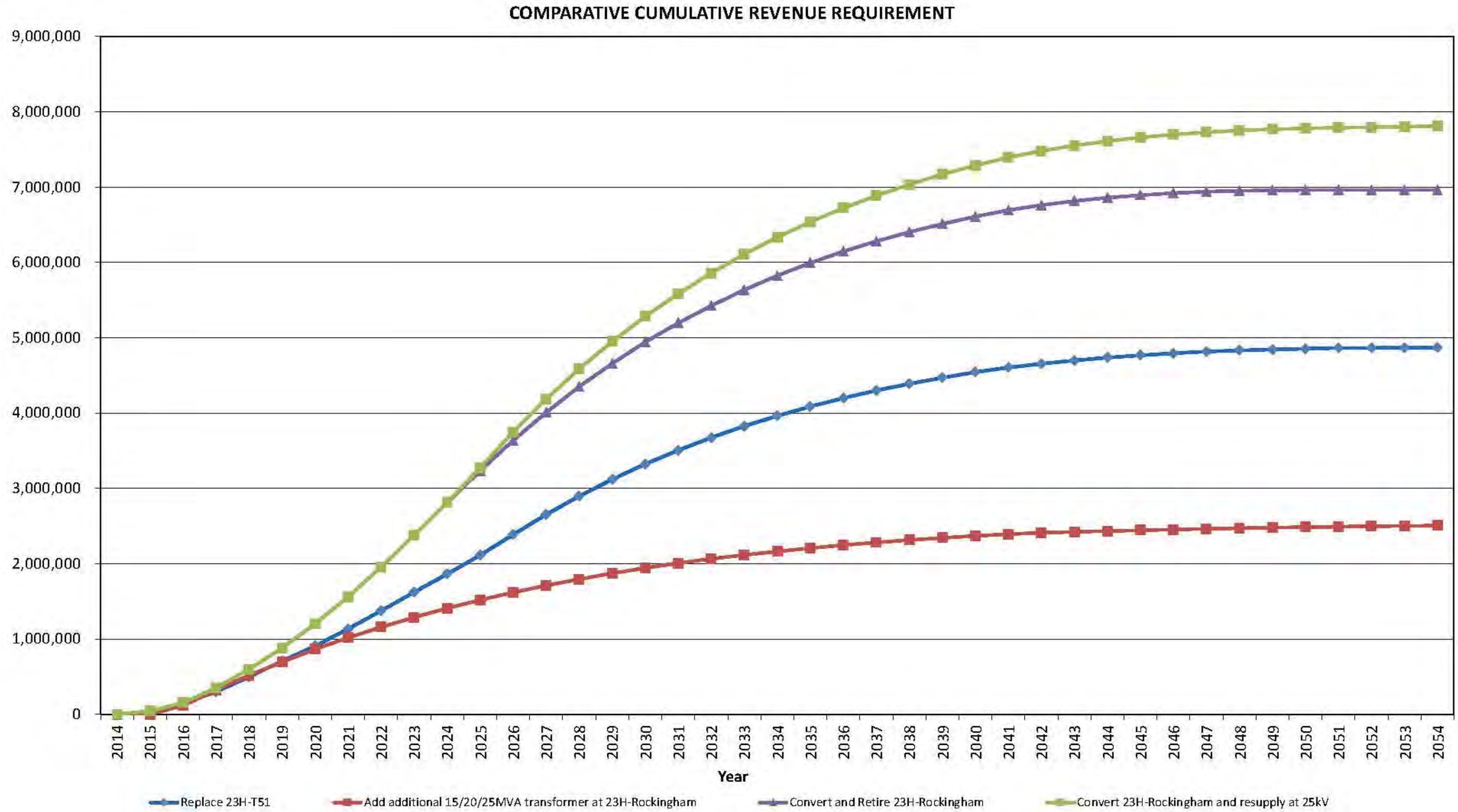
This alternative would see the following:
- Conversion of the existing 12kV load to 25kV, by 2025
- Retire 23H-Rockingham substation in 2026
- Retire L-5032 from L-5004 to 23H-Rockingham

Convert 23H-Rockingham and resupply at 25kV

This alternative would see the following:
- Conversion of the existing 12kV load to 25kV, by 2025
- Remove existing 12kV equipment and install 25kV equipment, in 2025
- Install new 25/33/42MVA 69-25kV transformer at 23H-Rockingham

23H-Rockingham EAM 9/30/2014

NPV Comparison



Alternative 23H-A; Replace 23H-T51

23H-Rockingham Alternati
Replace 23H-T51

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Capital Invested	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1. Conversions Part 1		570,000													
2. New 69-12kV 30MVA transformer			650,000												
3. Installation of new transformer			350,000												
4. Conversions Part-2					1,010,000										
5. Conversions Part-3								1,255,000							
6. Conversions Part-4										730,000					
7. Conversions Part 5												995,000	1,025,000		
8. New 23H-Rockingham Feeder			245,000												
9. Install 5MVA 25-12kV stepdown at 8H-Fairview				225,000											
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year		570,000	1,245,000	225,000	1,010,000			1,255,000		730,000		995,000	1,025,000		
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year		**570,000**	**1,245,000**	**225,000**	**1,010,000**			**1,255,000**		**730,000**		**995,000**	**1,025,000**		

Alternative 23H-B; Add Additional Transformer at 23H-Rockingham

23H-Rockingham Alternati Go to: Working Capital
Add additional 15/20/25MVA transformer at Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Capital Invested															
1. Purchase new 69-12kV 15/20/25MVA transformer			650,000												
2. New 12kV switchgear			800,000												
3. Installation of new transformer			400,000												
4. 1x New 23H-Rockingham Feeder			450,000												
5. 2x New Rockingham Feeders			450,000												
6.															
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year			2,750,000												
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year			**2,750,000**												

Alternative 23H-C; Convert and Retire 23H-Rockingham

23H-Rockingham Alternati\
Convert and Retire 23H-Rockingham

Nova Scotia POWER An Emera Company

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Capital Invested															
1. Conversions Part 1		570,000													
2. Conversions Part 2			1,030,000												
3. Conversions Part 3				1,115,000											
4. Conversions Part 4					630,000										
5. Conversions Part 5a						835,000									
6. Conversions Part 5b							860,000								
7. Conversions Part 6								1,080,000							
8. Conversions Part 7a									1,090,000						
9. Conversions Part 7b										1,120,000					
10. Conversions Part 8a											610,000				
11. Conversion Part 8b												630,000			
12. Retire 23H-Rockingham													300,000		
13.															
14.															
15.															
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year		570,000	1,030,000	1,115,000	630,000	835,000	860,000	1,080,000	1,090,000	1,120,000	610,000	630,000	300,000		
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year		**570,000**	**1,030,000**	**1,115,000**	**630,000**	**835,000**	**860,000**	**1,080,000**	**1,090,000**	**1,120,000**	**610,000**	**630,000**	**300,000**		

Alternative 23H-D; Convert 23H-Rockingham and Resupply at 25kV

23H-Rockingham Alternati Go to: Working Capital
Convert 23H-Rockingham and resupply at 25l Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2015

Nova Scotia POWER
An Emera Company

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Capital Invested															
1. Conversions Part 1		570,000													
2. Conversions Part 2			1,030,000												
3. Conversions Part 3				1,115,000											
4. Conversions Part 4					630,000										
5. Conversions Part 5a						835,000									
6. Conversions Part 5b							860,000								
7. Conversions Part 6								1,080,000							
8. Conversions Part 7a									1,090,000						
9. Conversions Part 7b										1,120,000					
10. Conversions Part 8a											610,000				
11. Conversions Part 8b												630,000			
12. Retirement of 23H-Rockingham 12kV												300,000			
13. Purchase new 69-25kV 25/33/42MVA transformer												750,000			
14. Purchase new 25kV Switchgear												650,000			
15. Installation of new equipment												500,000			
16.															
17.															
18.															
19.															
20.															
Total Direct Capital Invested by Year		570,000	1,030,000	1,115,000	630,000	835,000	860,000	1,080,000	1,090,000	1,120,000	610,000	2,830,000			
AFUDC (entered as a positive value)															
AO (entered as a positive value)															
Total Indirect Capital Invested by Year															
Total Capital Invested by Year		570,000	1,030,000	1,115,000	630,000	835,000	860,000	1,080,000	1,090,000	1,120,000	610,000	2,830,000			

CI Number: 47950

Title: L-5017 Replacements and Upgrades

Start Date:	2016/05
In-Service Date:	2016/09
Final Cost Date:	2017/09
Function:	Transmission
Forecast Amount:	$2,182,142

DESCRIPTION:

L-5017 is an 18 kilometer 69kV transmission line that connects 43V Canaan Road and 20V Five Points substations. This transmission line was constructed in 1963. This project is required to replace deteriorated assets identified through NS Power's inspection program. This project's scope includes the replacement of assets on approximately 110 structures. This project also includes structure replacements to ensure Canadian Standards Association (CSA) clearance requirements are met for all conditions. The scope of this project includes the replacement of 219 poles and the complete replacement of 105 structures.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant - Various

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line.

Why do this project now?

This work has been prioritized based on transmission inspection results. The assets on the line to be addressed by this project have reached the end of their service lives and if replacements are not completed, the reliability of the line will be compromised.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47950 - L5017 Replacements & Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		26,256	0	26,256
094		094 - Interest Capitalized		12,198	0	12,198
095		095-COPS Regular Labour AO		38,900	0	38,900
095		095-COPS Contracts AO		273,091	0	273,091
013	007	013 - COPS Contracts	007 - TP - Environmental	67,882	0	67,882
012	035	012 - Materials	035 - TP - Wood Poles	288,363	0	288,363
013	035	013 - COPS Contracts	035 - TP - Wood Poles	733,475	0	733,475
012	038	012 - Materials	038 - TP - Insulators	637	0	637
013	038	013 - COPS Contracts	038 - TP - Insulators	3,807	0	3,807
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	2,022	0	2,022
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	491,441	0	491,441
001	085	001 - Regular Labour (No AO)	085 Design	5,780	0	5,780
013	085	013 - COPS Contracts	085 Design	50,000	0	50,000
066	085	066 - Other Goods & Services	085 Design	134,660	0	134,660
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	53,629	0	53,629
			Total Cost:	2,182,142	0	2,182,142
			Original Cost:	239,448		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 47950
Title: L-5017 Replacements and Upgrades
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	6	$ 354	$ 2,022		
T&D Labour - Site Supervision	PD	144	$ 373	$ 53,629		
Procurement / Financial Support	Lot	1	$ 5,780	$ 5,780		
			Sub-Total	$ 61,431		
012 Materials						
Poles, Anchors, and Guys	Lot	1	$ 288,363	$ 288,363		
Insulators	Lot	1	$ 637	$ 637		
			Sub-Total	$ 289,001		
013 Contracts						
Contract Line Work	Hrs	[redacted]	[redacted]	$ 1,164,922		
Environmental Bridges and Mats	Lot	1	$ 67,882	$ 67,882		
Flaggers	Lot	1	$ 10,000	$ 10,000		
Pole-Haulage	Lot	1	$ 43,800	$ 43,800		
Waste Disposal	Lot	1	$ 10,000	$ 10,000		
Survey	Lot	1	$ 50,000	$ 50,000		
			Sub-Total	$ 1,346,605		
066 Other Goods & Services						
Contingency	%	10%	$ 1,346,605	$ 134,660		
			Sub-Total	$ 134,660		
094 Interest Capitalized						
AFUDC				$ 12,198		
			Sub-Total	$ 12,198		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 26,256		
			Sub-Total	$ 26,256		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 38,900		
COPS Contract AO				$ 273,091		
			Sub-Total	$ 311,992		
			SUB-TOTAL (no AO, AFUDC)	$ 1,831,697		
			TOTAL (AO, AFUDC included)	$ 2,182,142		
Original Cost				$ 239,448		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 44981

Title: 2C Port Hastings Transformer Replacement

Start Date:	2016/03
In-Service Date:	2017/04
Final Cost Date:	2017/10
Function:	Transmission
Forecast Amount:	$2,053,799

DESCRIPTION:

The scope of this project is to add a new 138-25kV power transformer at 2C Port Hastings substation to supply existing 2C-401 and 2C-402 feeders. A new steel structure will be constructed to supply feeders 2C-401 and 2C-402. The project also includes the removal and retirement of 69-25kV transformer 2C-T2, 138-69kV auto-transformer 2C-T1, 25kV reclosers 2C-401 & 402 and line breakers 2C-511 & 512.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 & 2018

Depreciation Class: Transmission Plant

Estimate Useful Life: 45 Years

JUSTIFICATION:

Justification Criteria: Environment

Why do this project?

The primary driver for this project is that transformer 2C-T1 has a slow oil leak and this insulating oil has a PCB concentration of 15mg/kg. Soil clean-up efforts and localized containment have been undertaken to mitigate the environmental impact, but this transformer should be replaced due to these environmental concerns.

The secondary driver for this project is that much of the equipment has reached the end of its service life. The existing bus structures and two 69kV breakers were manufactured in 1961. The remaining equipment was manufactured in 1964-1969.

Why do this project now?

This project should be completed now because this project will eliminate the environmental risks of PCB releases to the environment. The lead time associated with procuring a transformer is such that 2017 is the earliest that this project can be completed. The substation equipment including the wood pole structures is deteriorated and needs to be retired. Delays to this project would jeopardize the reliability of this substation.

Why do this project this way?

Replacing the existing two transformers with one new transform will eliminate the environmental risks associated with PCB releases to the environment. The reliability of this station will also improve by replacing two deteriorated transformers with one new transformer.

CI Number : 44981 - 2C Port Hastings Transformer Replacement **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		65,355	0	65,355
092		092-Vehicle T&D OT Labour AO		6,546	0	6,546
094		094 - Interest Capitalized		29,232	0	29,232
095		095-COPS Contracts AO		66,821	0	66,821
095		095-COPS Overtime Labour AO		9,699	0	9,699
095		095-COPS Regular Labour AO		96,827	0	96,827
095		095 - Proj Supp Regular Labour AO		24,699	0	24,699
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	37,996	0	37,996
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	160,790	0	160,790
001	007	001 - T&D Regular Labour	007 - TP - Environmental	1,414	0	1,414
012	007	012 - Materials	007 - TP - Environmental	13,430	0	13,430
013	007	013 - COPS Contracts	007 - TP - Environmental	16,100	0	16,100
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	13,080	0	13,080
002	022	002 - T&D Overtime Labour	022 - TP - Elec Contr.Equip.	3,535	0	3,535
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	34,440	0	34,440
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	16,000	0	16,000
001	023	001 - T&D Regular Labour	023 - TP - Power Equip.-Station S	2,651	0	2,651
002	023	002 - T&D Overtime Labour	023 - TP - Power Equip.-Station S	884	0	884
012	023	012 - Materials	023 - TP - Power Equip.-Station S	10,200	0	10,200
012	035	012 - Materials	035 - TP - Wood Poles	16,800	0	16,800
013	035	013 - COPS Contracts	035 - TP - Wood Poles	9,600	0	9,600
001	038	001 - T&D Regular Labour	038 - TP - Insulators	360	0	360
012	038	012 - Materials	038 - TP - Insulators	1,800	0	1,800
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	47,546	0	47,546
002	043	002 - T&D Overtime Labour	043 - TP - Substn Dev.	3,535	0	3,535
012	043	012 - Materials	043 - TP - Substn Dev.	194,734	0	194,734
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	19,200	0	19,200
001	044	001 - T&D Regular Labour	044 - TP - Substn.Transf.	34,644	0	34,644
002	044	002 - T&D Overtime Labour	044 - TP - Substn.Transf.	19,796	0	19,796
011	044	011 - Travel Expense	044 - TP - Substn.Transf.	7,000	0	7,000
012	044	012 - Materials	044 - TP - Substn.Transf.	700,600	0	700,600
013	044	013 - COPS Contracts	044 - TP - Substn.Transf.	107,800	0	107,800
014	044	014 - Overtime Meals	044 - TP - Substn.Transf.	750	0	750
028	044	028 - Consulting	044 - TP - Substn.Transf.	15,000	0	15,000

CI Number : 44981 - 2C Port Hastings Transformer Replacement **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
041	044	041 - Meals & Entertainment	044 - TP - Substn.Transf.	1,000	0	1,000
001	046	001 - T&D Regular Labour	046 - TP - U/G Conductor	2,828	0	2,828
012	046	012 - Materials	046 - TP - U/G Conductor	13,600	0	13,600
001	085	001 - Regular Labour (No AO)	085 Design	5,118	0	5,118
001	085	001 - Proj Supp Regular Labour	085 Design	40,664	0	40,664
011	085	011 - Travel Expense	085 Design	456	0	456
041	085	041 - Meals & Entertainment	085 Design	225	0	225
066	085	066 - Other Goods & Services	085 Design	159,046	0	159,046
001	086	001 - T&D Regular Labour	086 Commissioning	18,162	0	18,162
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	17,837	0	17,837
011	087	011 - Travel Expense	087 Field Super.& Ops.	6,000	0	6,000
			Total Cost:	2,053,799	0	2,053,799
			Original Cost:	330,621		

Capital Project Detailed Estimate

Location: **Transmission**
CI# / FP#: 44981
Title: 2C New 138-25kV Transformer
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - PLT	PD	1	$ 360	$ 360		
T&D Labour - Electrician/Technician	PD	340	$ 354	$ 120,325		
T&D Labour - Site Supervision	PD	48	$ 373	$ 17,837		
Procurment / Financial Support	Lot	1	$ 5,118	$ 5,118		
Project Support AO - Engineering Design	PD	105	$ 387	$ 40,664		
				$ -		
			Sub-Total	$ 184,304		
002 OT Labour						
T&D Labour - Electrician/Technician	PD	39	$ 707	$ 27,750		
			$ -	$ -		
			Sub-Total	$ 27,750		
011 Travel Expense						
Travel	$	1	$ 13,456	$ 13,456		
			Sub-Total	$ 13,456		
012 Materials						
Structural Steel (Bus Support)	Lot	1	$ 37,996	$ 37,996		
Oil Water Separator and Oil Containment	Lot	1	$ 13,430	$ 13,430		
Protection Panel and Control Cables	Lot	1	$ 34,440	$ 34,440		
Station Service 25 kV Transformer	ea	3	$ 3,400	$ 10,200		
Wood Poles, Anchors and Framing	Lot	1	$ 16,800	$ 16,800		
Insulators	Lot	1	$ 1,800	$ 1,800		
138 kV Conductor Devices	Lot	1	$ 33,324	$ 33,324		
25 kV Conductor Devices	Lot	1	$ 161,410	$ 161,410		
138-25 kV Dist. Transformer (15/20/25 MVA)	ea	1	$ 700,600	$ 700,600		45306 - Prime Brook
Underground 25 kV Cable	Lot	1	$ 13,600	$ 13,600		
			Sub-Total	$ 1,023,600		
013 Contracts						
Concrete Foundations	Lot	1	$ 160,790	$ 160,790		
Oil / Water Seperator Tank Installation	Lot	1	$ 16,100	$ 16,100		
Protection Panel Construction	Lot	1	$ 16,000	$ 16,000		
Pole Installation	hrs	96	$ 100	$ 9,600		
Boom Truck Services	Lot	1	$ 8,400	$ 8,400		
Transformer Off Loading & Transportation	Lot	1	$ 25,000	$ 25,000		
Boom Truck Services	Lot	1	$ 6,800	$ 6,800		
Transportation for Disposal	Lot	1	$ 6,000	$ 6,000		
Transformer Dis-Assembly	Lot	1	$ 20,800	$ 20,800		
Transformer Loading and Transport	Lot	1	$ 60,000	$ 60,000		
			Sub-Total	$ 329,490		
014 Overtime Meals						
Overtime Meals	Lot	1	$ 750	$ 750		
			Sub-Total	$ 750		
028 Consulting						
Inspection and Witnessing of Tests	Lot	1	$ 15,000	$ 15,000		
			Sub-Total	$ 15,000		
041 Meals & Entertainment						
Meals	Lot	1	$ 1,225	$ 1,225		
			Sub-Total	$ 1,225		
066 Other Goods & Services						
Contingency	%	10%	$ 1,590,457	$ 159,046		
				$ -		
			Sub-Total	$ 159,046		
094 Interest Capitalized						
AFUDC				$ 29,232		
				$ -		
			Sub-Total	$ 29,232		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 65,355		
Vehicle T&D Labour Overtime AO				$ 6,546		
				$ -		
			Sub-Total	$ 71,901		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 96,827		
COPS T&D Labour Overtime AO				$ 9,699		
COPS Contract AO				$ 66,821		
Project Support Regular AO				$ 24,699		
				$ -		
			Sub-Total	$ 198,045		
			SUB-TOTAL (no AO, AFUDC)	$ 1,754,621		
			TOTAL (AO, AFUDC included)	$ 2,053,799		
Original Cost				$ 330,621		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47952

Title: L-7001 Replacements (Phase 3 & 4)

Start Date:	2016/03
In-Service Date:	2016/05
Final Cost Date:	2017/01
Function:	Transmission
Forecast Amount:	$1,725,284

DESCRIPTION:

L7001 is a 73.36 kilometer 230kV transmission line that connects 67N Onslow to 120H Brushy Hill substations. This line was built in 1979. This is the third and fourth phase of a four phase project. This project is required to replace deteriorated assets that have been identified through Nova Scotia Power's inspection program. Specifically, this project addresses deteriorated spar arms. This project includes the replacement of assets on approximately 63 structures.

Summary of Related CIs +/- 2 years:
2015 CI 45033 L7001 Replacements – Phase 1 $813,226
2015 CI 46331 L7001 Replacements – Phase 2 $888,192

Depreciation Class: Transmission Plant - Various

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line.

Why do this project now?

This work has been prioritized based on transmission inspection results. The assets on the line to be addressed by this project have reached the end of their service lives and if replacements are not completed, the reliability of the line will be compromised.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47952 - L-7001 Replacements (Phase 3 & 4) **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		21,466	0	21,466
094		094 - Interest Capitalized		9,686	0	9,686
095		095-COPS Contracts AO		217,707	0	217,707
095		095-COPS Regular Labour AO		31,803	0	31,803
013	007	013 - COPS Contracts	007 - TP - Environmental	86,181	0	86,181
012	035	012 - Materials	035 - TP - Wood Poles	187,696	0	187,696
013	035	013 - COPS Contracts	035 - TP - Wood Poles	699,706	0	699,706
012	038	012 - Materials	038 - TP - Insulators	26,288	0	26,288
013	038	013 - COPS Contracts	038 - TP - Insulators	136,491	0	136,491
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	2,734	0	2,734
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	151,130	0	151,130
001	085	001 - Regular Labour (No AO)	085 Design	4,280	0	4,280
066	085	066 - Other Goods & Services	085 Design	107,351	0	107,351
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	42,764	0	42,764
			Total Cost:	1,725,284	0	1,725,284
			Original Cost:	399,623		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 47952
Title: L-7001 Replacements (Phase 3 & 4)
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	8	$ 354	$ 2,734		
T&D Labour - Site Supervision	PD	115	$ 373	$ 42,764		
Procurement / Financial Support	Lot	1	$ 4,280	$ 4,280		
			Sub-Total	$ 49,778		
012 Materials						
Poles and Spar Arms	Lot	1	$ 187,696	$ 187,696		
Insulators	Lot	1	$ 26,288	$ 26,288		
				$ -		
			Sub-Total	$ 213,984		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 923,727		
Environmental Bridges and Mats	Lot	1	$ 86,181	$ 86,181		
Flagging	Lot	1	$ 10,000	$ 10,000		
Pole-Haulage	Lot	1	$ 12,600	$ 12,600		
Backhoe	Lot	1	$ 35,000	$ 35,000		
Waste Disposal	Lot	1	$ 6,000	$ 6,000		
				$ -		
			Sub-Total	$ 1,073,508		
066 Other Goods & Services						
Contingency	%	10%	$ 1,073,508	$ 107,351		
				$ -		
			Sub-Total	$ 107,351		
094 Interest Capitalized						
AFUDC				$ 9,686		
			Sub-Total	$ 9,686		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 21,466		
			Sub-Total	$ 21,466		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 31,803		
COPS Contract AO				$ 217,707		
			Sub-Total	$ 249,511		
			SUB-TOTAL (no AO, AFUDC)	$ 1,444,621		
			TOTAL (AO, AFUDC included)	$ 1,725,284		
Original Cost				$ 399,623		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48061

Title: New Mobile Substation, 69-25/12-4kV, 6MVA

Start Date:	2016/01
In-Service Date:	2017/06
Final Cost Date:	2017/12
Function:	Transmission
Forecast Amount:	$1,728,234

DESCRIPTION:

The scope of this project is to procure a new mobile substation (69-25/12-4kV, 6MVA) to serve as a back-up to the existing 3P mobile substation.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant - Station Equipment

Estimated Life of the Asset: 40 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

A spare transformer analysis identified there are 27 units where the only available contingency is the 3P mobile. See Attachment 1 for a list of these 27 units. The 3P mobile substation is often used for maintenance which would leave several transformers without an available spare that can be quickly installed. In 2013 and 2014, the 3P mobile substation has been unavailable for spare use 37% and 53% of the time, respectively. This project is to procure a mobile transformer similar to the 3P - these units will then be operated similar to 5P and 6P mobile transformers with one unit always being available.

Why do this project now?

Doing this project now will ensure we will have a suitable spare for transformers having 12kV or 4kV secondaries whenever the 3P is in service. Delaying the project will mean customers supplied by this type of transformer are still exposed to the risk of a prolonged power outage. Executing this project now will mitigate the risk in the event of an unexpected failure.

Why do this project this way?

The only other reasonable alternative would be to purchase a spare transformer with the same characteristics as the 3P that is not mobile, but this unit would take much longer to install and would therefore leave customers without power for much longer than necessary in the event of a transformer failure.

CI Number : 48061 - New Mobile Substation, 69-25/12-kV, 6MVA **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		7,505	0	7,505
094		094 - Interest Capitalized		14,757	0	14,757
095		095-COPS Regular Labour AO		11,120	0	11,120
095		095 - Proj Supp Regular Labour AO		11,065	0	11,065
012	044	012 - Materials	044 - TP - Substn.Transf.	1,450,000	0	1,450,000
001	085	001 - Regular Labour (No AO)	085 Design	7,250	0	7,250
001	085	001 - Proj Supp Regular Labour	085 Design	18,217	0	18,217
028	085	028 - Consulting	085 Design	40,000	0	40,000
066	085	066 - Other Goods & Services	085 Design	152,412	0	152,412
001	086	001 - T&D Regular Labour	086 Commissioning	15,908	0	15,908
			Total Cost:	1,728,234	0	1,728,234
			Original Cost:			

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48061
Title: New Mobile Substn,69-25/12-kV, 6MVA
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	45	$ 354	$ 15,908		
Procurement / Financial Support	Lot	1	$ 7,250	$ 7,250		
Project Support AO - Engineering Design	PD	47	$ 387	$ 18,217		
			Sub-Total	$ 41,375		
012 Materials						
Mobile Substation (69-26.4/13.2-4.16, 6MVA)	ea	1	$ 1,450,000	$ 1,450,000		
			Sub-Total	$ 1,450,000		
028 Consulting						
Transformer Inspections	Lot	1	$ 40,000	$ 40,000		
			Sub-Total	$ 40,000		
066 Other Goods & Services						
Contingency	$	1	$ 152,412	$ 152,412		
			Sub-Total	$ 152,412		
094 Interest Capitalized						
AFUDC				$ 14,757		
			Sub-Total	$ 14,757		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 7,505		
			Sub-Total	$ 7,505		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 11,120		
Project Support Regular AO				$ 11,065		
			Sub-Total	$ 22,185		
			SUB-TOTAL (no AO, AFUDC)	$ 1,683,787		
			TOTAL (AO, AFUDC included)	$ 1,728,234		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Station	Location	Voltage (kV)	Size (MVA)	Mobile Contingency
11C	Belle Cote	25/12	2.5	3P
94S	Gisborn Lake	26.4/4.16	5.3/7	3P
54C	Sydney Road	25/4.16	5	3P
24C	Dickie Brook Hydro	26.4/2.4	4.75	3P
10C	Arichat	25/4.16	2	3P
3N	Oxford Junction	25/12.5	3.4/4.5	3P
5N	Debert	25/12	2	3P
26N	Joggins	25/4.16	0.75	3P
61N	North Provost	25/4.16	5	3P
65N	River Hebert	25/4.16	1.5	3P
519N	Drummond Road	25/4.16	1.5	3P
528N	Granville Street	25/4.16	5	3P
532N	Elms Street	25/4.16	2	3P
534N	Duchess Ave.	25/4.16	1	3P
619N	Upper Stewiacke	25/12	2	3P
647N	North Port	25/12	3/4/2005	3P
6C	Braemore	25/12	5/6.6	3P
7C	Cloverville	25/4.16	5/6.6	3P
8C	College Sub	25/12	5/6.6	3P
9H	Yale Street	23/4.16	7.5	3P
10H	Victoria General Hospital	24.9/4.16	7.5	3P
10H	Victoria General Hospital	24.9/4.16	7.5	3P
515W	New Germany	23/4.16	2	3P
35V	Falmouth(Bog Road)	25/12	5	3P
45V	Acadia University	23/4.16	5	3P
652V	Exhibition Street	25/4.16	5	3P
509V	East Ferry	25/12	3	3P

CI Number: 48114

Title: 2016 Steel Tower Life Extension - HRM

Start Date:	2016/06
In-Service Date:	2017/08
Final Cost Date:	2017/12
Function:	Transmission
Forecast Amount:	$1,477,739

DESCRIPTION:

This project is to apply protective coating to 13 lattice steel towers around the Halifax Harbour in order to extend the life of the structures. The 13 towers to be coated will be prioritized based on the latest inspection data. Current inspection results would indicate towers on L-6033/6035 should be targeted first. The cost includes the removal and collection of the existing lead paint, the proper disposal of this lead paint, working at heights up to 300ft in the air, working in proximity to energized lines, as well as material costs.

Summary of Related CIs +/- 2 years:
2015 CI 46356 2015 Sacrificial Anode Installation Program $304,612
2015 CI 43490 Steel Tower Life Extension – Halifax Harbour $1,441,709
2016 CI 48116 2016 Sacrificial Anode Installation Program $1,039,827

Depreciation Class: Transmission Equipment – Towers and Fixtures

Estimated Useful Life: 60 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

The environmental conditions that these towers are exposed to have led to the deterioration of the protective coating on the structures. These structures are showing signs of steel structure corrosion.

Why do this project now?

These towers require recoating to be completed in order to reduce the loss of metal, which will extend the life of the towers beyond their originally estimate useful life. The towers will be selected based on the age of the structures and the latest inspection data. Restoration of protective coating before failure of the paint system prevents corrosion damage to structural steel tower components.

Why do this project this way?

The most cost effective approach is to recoat the steel towers prior to the failure of the protective coating which would lead to corrosion damage to the structural steel. If corrosion damage occurs in the structural steel components of a transmission tower, costly replacement of steel members may be necessary to preserve the integrity of the tower.

This work is being completed by an external consultant.

CI Number : 48114 - 2016 Steel Tower Life Extension - HRM **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		14,958	0	14,958
094		094 - Interest Capitalized		49,823	0	49,823
095		095-COPS Regular Labour AO		22,162	0	22,162
095		095 - Proj Supp Regular Labour AO		1,175	0	1,175
095		095-COPS Contracts AO		197,730	0	197,730
012	037	012 - Materials	037 - TP - Steel Towers	30,000	0	30,000
013	037	013 - COPS Contracts	037 - TP - Steel Towers	975,000	0	975,000
001	085	001 - Regular Labour (No AO)	085 Design	2,500	0	2,500
001	085	001 - Proj Supp Regular Labour	085 Design	1,935	0	1,935
066	085	066 - Other Goods & Services	085 Design	150,750	0	150,750
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	31,705	0	31,705
			Total Cost:	1,477,739	0	1,477,739
			Original Cost:			

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48114
Title: 2016 Steel Tower Life Extension - HRM
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Site Supervision	PD	85	$ 373	$ 31,705		
Procurement / Financial Support	Lot	1	$ 2,500	$ 2,500		
Project Support AO - Engineering Design	PD	5	$ 387	$ 1,935		
			Sub-Total	$ 36,140		
012 Materials						
Paint	Lot	1	$ 30,000	$ 30,000		
				$ -		
			Sub-Total	$ 30,000		
013 Contracts						
Painting of Towers External Contractor	EA	13	$ 75,000	$ 975,000		
				$ -		
			Sub-Total	$ 975,000		
066 Other Goods & Services						
Contingency	%	15%	$ 1,005,000	$ 150,750		
				$ -		
			Sub-Total	$ 150,750		
094 Interest Capitalized						
Interest				$ 49,823		
				$ -		
			Sub-Total	$ 49,823		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 14,958		
			Sub-Total	$ 14,958		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 22,162		
COPS Contract AO				$ 197,730		
Project Support Regular AO				$ 1,175		
			Sub-Total	$ 221,067		
			SUB-TOTAL (no AO, AFUDC)	$ 1,191,890		
			TOTAL (AO, AFUDC included)	$ 1,477,739		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47914

Title: L-6537 Replacements and Upgrades

Start Date:	2016/08
In-Service Date:	2016/10
Final Cost Date:	2017/04
Function:	Transmission
Forecast Amount:	$1,382,705

DESCRIPTION:

L6537 is a 91.4 kilometer 138kV transmission line that connects 2C Port Hastings to 5S Glentosh substations. This line was built in 1971. This project is required to replace deteriorated assets and correct ground clearance issues, mainly due to conductor sag, that have been identified through Nova Scotia Power's inspection program. Specifically this addresses deteriorated structures, timbers and insulators. This project includes the replacement of assets and addresses ground clearance issues on approximately 125 structures. The scope of this project includes the replacement of 56 poles and reinsulating approximately 98 structures.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant - Various

Sub Criteria: Equipment Replacement

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line.

Why do this project now?

This work has been prioritized based on transmission inspection results. This project is required to support the reliable operation of the transmission line.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47914 - L-6537 Replacements and Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		15,773	0	15,773
094		094 - Interest Capitalized		3,428	0	3,428
095		095-COPS Regular Labour AO		23,368	0	23,368
095		095-COPS Contracts AO		174,174	0	174,174
013	007	013 - COPS Contracts	007 - TP - Environmental	112,153	0	112,153
012	035	012 - Materials	035 - TP - Wood Poles	146,713	0	146,713
013	035	013 - COPS Contracts	035 - TP - Wood Poles	291,089	0	291,089
012	038	012 - Materials	038 - TP - Insulators	37,407	0	37,407
013	038	013 - COPS Contracts	038 - TP - Insulators	184,348	0	184,348
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	1,264	0	1,264
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	266,255	0	266,255
001	085	001 - Regular Labour (No AO)	085 Design	3,682	0	3,682
013	085	013 - COPS Contracts	085 Design	5,000	0	5,000
066	085	066 - Other Goods & Services	085 Design	85,885	0	85,885
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	32,167	0	32,167
			Total Cost:	1,382,705	0	1,382,705
			Original Cost:	183,384		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 47914
Title: L-6537 Replacements and Upgrades
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	4	$ 354	$ 1,264		
T&D Labour - Site Supervision	PD	86	$ 373	$ 32,167		
Procurement / Financial Support	Lot	1	$ 3,682	$ 3,682		
			Sub-Total	$ 37,113		
012 Materials						
Poles and Guys	Lot	1	$ 146,713	$ 146,713		
Insulators	Lot	1	$ 37,407	$ 37,407		
				$ -		
			Sub-Total	$ 184,120		
013 Contracts						
Contract Line Work	Hrs	[redacted]	[redacted]	$ 698,492		
Environmental Bridges and Mats	Lot	1	$ 112,153	$ 112,153		
Flaggers	Lot	1	$ 8,000	$ 8,000		
Backhoe	Lot	1	$ 10,000	$ 10,000		
Pole-Haulage	Lot	1	$ 11,200	$ 11,200		
Waste Disposal	Lot	1	$ 10,000	$ 10,000		
Survey	Lot	1	$ 9,000	$ 9,000		
			Sub-Total	$ 858,845		
066 Other Goods & Services						
Contingency	%	10%	$ 858,845	$ 85,885		
			Sub-Total	$ 85,885		
094 Interest Capitalized						
AFUDC				$ 3,428		
			Sub-Total	$ 3,428		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 15,773		
			Sub-Total	$ 15,773		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 23,368		
COPS Contract AO				$ 174,174		
			Sub-Total	$ 197,542		
			SUB-TOTAL (no AO, AFUDC)	$ 1,165,963		
			TOTAL (AO, AFUDC included)	$ 1,382,705		
Original Cost				$ 183,384		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47935

Title: L-5040 Replacements

Start Date:	2016/06
In-Service Date:	2016/08
Final Cost Date:	2017/12
Function:	Transmission
Forecast Amount:	$1,241,298

DESCRIPTION:

L-5040 is a 43 kilometer 69kV transmission line that connects 1N Onslow and 4N Tatamagouche substations. This transmission line was constructed in 1959. This project is required to replace deteriorated assets identified through NS Power's inspection program. This project's scope includes the replacement of assets on approximately 87 structures. The scope of the project includes the replacement of 79 poles and reinsulating of 17 structures.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant - Various

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line. This transmission line is a radial supply to over 4,000 customers. Asset failures on this line would result in extended power outages.

Why do this project now?

This work has been prioritized based on transmission inspection results. The assets on the line to be addressed by this project have reached the end of their service lives and if replacements are not completed, the reliability of the line will be compromised.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47935 - L5040 Replacements **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		16,429	0	16,429
094		094 - Interest Capitalized		2,273	0	2,273
095		095-COPS Contracts AO		163,540	0	163,540
095		095-COPS Regular Labour AO		24,340	0	24,340
013	007	013 - COPS Contracts	007 - TP - Environmental	61,979	0	61,979
012	035	012 - Materials	035 - TP - Wood Poles	105,091	0	105,091
013	035	013 - COPS Contracts	035 - TP - Wood Poles	284,579	0	284,579
012	038	012 - Materials	038 - TP - Insulators	5,540	0	5,540
013	038	013 - COPS Contracts	038 - TP - Insulators	33,397	0	33,397
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	1,769	0	1,769
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	422,455	0	422,455
001	085	001 - Regular Labour (No AO)	085 Design	2,213	0	2,213
013	085	013 - COPS Contracts	085 Design	4,000	0	4,000
066	085	066 - Other Goods & Services	085 Design	80,641	0	80,641
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	33,052	0	33,052
			Total Cost:	1,241,298	0	1,241,298
			Original Cost:	130,785		

Capital Project Detailed Estimate

Location: **Transmission**
CI# / FP#: 47935
Title: L-5040 Replacements
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	5	$ 354	$ 1,769		
T&D Labour - Site Supervision	PD	89	$ 373	$ 33,052		
Procurement / Financial Support	Lot	1	$ 2,213	$ 2,213		
			Sub-Total	$ 37,034		
012 Materials						
Poles, Anchors, and Guys	Lot	1	$ 105,092	$ 105,092		
Insulators	Lot	1	$ 5,540	$ 5,540		
			Sub-Total	$ 110,631		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 715,531		
Environmental Bridges and Mats	Lot	1	$ 61,979	$ 61,979		
Flagging	Lot	1	$ 7,000	$ 7,000		
Pole-Haulage	Lot	1	$ 7,900	$ 7,900		
Waste Disposal	Lot	1	$ 10,000	$ 10,000		
Survey	Lot	1	$ 4,000	$ 4,000		
			Sub-Total	$ 806,411		
066 Other Goods & Services						
Contingency	%	10%	$ 806,411	$ 80,641		
			Sub-Total	$ 80,641		
094 Interest Capitalized						
AFUDC				$ 2,273		
			Sub-Total	$ 2,273		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 16,429		
			Sub-Total	$ 16,429		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 24,340		
COPS Contract AO				$ 163,540		
			Sub-Total	$ 187,880		
			SUB-TOTAL (no AO, AFUDC)	$ 1,034,717		
			TOTAL (AO, AFUDC included)	$ 1,241,298		
Original Cost				$ 130,785		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47949

Title: L-5028 Replacements and Upgrades

Start Date:	2016/08
In-Service Date:	2016/10
Final Cost Date:	2017/10
Function:	Transmission
Forecast Amount:	$1,144,355

DESCRIPTION:

L5028 is a 28.7 kilometer 69kV transmission line that connects 1N Onslow to 16N Stewiacke substations. This line was built in 1964. This project is required to replace deteriorated assets and ground clearance issues, mainly due to conductor sag, that have been identified through Nova Scotia Power's inspection program. This project includes the replacement of assets and addressing of ground clearance issues on approximately 47 structures.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant- Various

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line. This transmission line is a radial feed that supplies 2,500 customers. Asset failures on this line would result in extended power outages.

Why do this project now?

This work has been prioritized based on transmission inspection results. This project is required to support the reliable operation of the transmission line.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47949 - L-5028 Replacements and Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		14,102	0	14,102
094		094 - Interest Capitalized		2,679	0	2,679
095		095-COPS Regular Labour AO		20,894	0	20,894
095		095-COPS Contracts AO		148,340	0	148,340
013	007	013 - COPS Contracts	007 - TP - Environmental	72,014	0	72,014
012	035	012 - Materials	035 - TP - Wood Poles	120,615	0	120,615
013	035	013 - COPS Contracts	035 - TP - Wood Poles	362,323	0	362,323
012	038	012 - Materials	038 - TP - Insulators	802	0	802
013	038	013 - COPS Contracts	038 - TP - Insulators	6,560	0	6,560
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	2,634	0	2,634
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	274,561	0	274,561
001	085	001 - Regular Labour (No AO)	085 Design	2,428	0	2,428
013	085	013 - COPS Contracts	085 Design	16,000	0	16,000
066	085	066 - Other Goods & Services	085 Design	73,146	0	73,146
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	27,257	0	27,257
			Total Cost:	1,144,355	0	1,144,355
			Original Cost:	111,082		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 47949
Title: L-5028 Replacements and Upgrades
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	7	$ 354	$ 2,634		
T&D Labour - Site Supervision	PD	73	$ 373	$ 27,257		
Procurement / Financial Support	Lot	1	$ 2,428	$ 2,428		
			Sub-Total	$ 32,319		
012 Materials						
Poles, Guys, Anchors	Lot	1	$ 120,615	$ 120,615		
Insulators	Lot	1	$ 802	$ 802		
			Sub-Total	$ 121,417		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 584,645		
Environmental Bridges and Mats	Lot	1	$ 72,014	$ 72,014		
Flaggers	Lot	1	$ 8,000	$ 8,000		
Pole-Haulage	Lot	1	$ 16,800	$ 16,800		
Mobile Transformer	Lot	1	$ 30,000	$ 30,000		
Waste Disposal	Lot	1	$ 4,000	$ 4,000		
Survey	Lot	1	$ 16,000	$ 16,000		
			Sub-Total	$ 731,459		
066 Other Goods & Services						
Contingency	$	1	$ 73,146	$ 73,146		
			Sub-Total	$ 73,146		
094 Interest Capitalized						
AFUDC				$ 2,679		
			Sub-Total	$ 2,679		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 14,102		
			Sub-Total	$ 14,102		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 20,894		
COPS Contract AO				$ 148,340		
			Sub-Total	$ 169,233		
			SUB-TOTAL (no AO, AFUDC)	$ 958,340		
			TOTAL (AO, AFUDC included)	$ 1,144,355		
Original Cost				$ 111,082		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47912

Title: L-6552 Replacements and Upgrades

Start Date:	2016/02
In-Service Date:	2016/05
Final Cost Date:	2016/11
Function:	Transmission
Forecast Amount:	$1,054,326

DESCRIPTION:

L6552 is a 19.7 kilometer 138kV transmission line that connects 93N Glen Dhu to 4C Lochaber Road substations. This line was built in 1958. This project is required to replace deteriorated assets and correct ground clearance issues, mainly due to conductor sag, that have been identified through Nova Scotia Power's inspection program. Specifically, this addresses deteriorated structures, timbers, insulators and overhead ground wire. This project includes the replacement of assets and addressing of ground clearance issues on approximately 79 structures including the reinsulating of 60 structures and replacement of 42 poles.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

Depreciation Class: Transmission Plant - Various

Estimated Life of the Asset: 45 years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

The transmission inspection program identified deteriorated assets that require replacement to avoid transmission interruptions. Not completing this project would compromise the reliable operation of this line.

Why do this project now?

This work has been prioritized based on transmission inspection results. This project is required to support the reliable operation of the transmission line.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than rebuilding the entire line.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 47912 - L-6552 Replacements and Upgrades **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		12,486	0	12,486
094		094 - Interest Capitalized		8,740	0	8,740
095		095-COPS Contracts AO		133,965	0	133,965
095		095-COPS Regular Labour AO		18,499	0	18,499
013	007	013 - COPS Contracts	007 - TP - Environmental	72,604	0	72,604
012	035	012 - Materials	035 - TP - Wood Poles	99,428	0	99,428
013	035	013 - COPS Contracts	035 - TP - Wood Poles	241,536	0	241,536
013	037	013 - COPS Contracts	037 - TP - Steel Towers	2,769	0	2,769
012	038	012 - Materials	038 - TP - Insulators	25,486	0	25,486
013	038	013 - COPS Contracts	038 - TP - Insulators	118,246	0	118,246
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	1,264	0	1,264
012	039	012 - Materials	039 - TP - O/H Cond.	125	0	125
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	210,420	0	210,420
001	085	001 - Regular Labour (No AO)	085 Design	2,501	0	2,501
013	085	013 - COPS Contracts	085 Design	15,000	0	15,000
066	085	066 - Other Goods & Services	085 Design	66,057	0	66,057
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	25,201	0	25,201
			Total Cost:	1,054,326	0	1,054,326
			Original Cost:	101,727		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47912
Title: L-6552 Replacements and Upgrades
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	4	$ 354	$ 1,264		
T&D Labour - Site Supervision	PD	68	$ 373	$ 25,201		
Procurement / Financial Support	Lot	1	$ 2,501	$ 2,501		
			Sub-Total	$ 28,966		
012 Materials						
Poles, Anchors, and Guys	Lot	1	$ 99,428	$ 99,428		
Insulators & Overhead Conductor	Lot	1	$ 25,611	$ 25,611		
				$ -		
			Sub-Total	$ 125,039		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 545,970		
Environmental Bridges and Mats	Lot	1	$ 72,604	$ 72,604		
Flagging	Lot	1	$ 5,000	$ 5,000		
Backhoe	Lot	1	$ 8,000	$ 8,000		
Pole-Haulage	Lot	1	$ 9,000	$ 9,000		
Waste Disposal	Lot	1	$ 5,000	$ 5,000		
Survey	Lot	1	$ 15,000	$ 15,000		
				$ -		
			Sub-Total	$ 660,575		
066 Other Goods & Services						
Contingency	%	10%	$ 660,575	$ 66,057		
				$ -		
			Sub-Total	$ 66,057		
094 Interest Capitalized						
AFUDC				$ 8,740		
			Sub-Total	$ 8,740		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 12,486		
Vehicle T&D Labour Overtime AO						
			Sub-Total	$ 12,486		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 18,499		
COPS Contract AO				$ 133,965		
			Sub-Total	$ 152,463		
			SUB-TOTAL (no AO, AFUDC)	$ 880,637		
			TOTAL (AO, AFUDC included)	$ 1,054,326		
Original Cost				$ 101,727		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48113

Title: 2016 Steel Tower Refurbishments

Start Date: 2016/01
In-Service Date: 2016/12
Final Cost Date: 2017/06
Function: Transmission
Forecast Amount: $1,032,578

DESCRIPTION:

This project is required to replace deteriorated steel tower components. NS Power has approximately 2,000 Steel Towers installed on the transmission system. These deteriorated steel tower components are identified through the NS Power transmission inspection program. Components that will be replaced include hardware, guys, tower legs and grillages, footings and steel members. The age profile of the steel tower fleet is illustrated in the table below.

Age Range	Kilometers of Steel Structures	% of Steel Structures
0-10	0	0%
11-20	11	2%
21-30	337	56%
31-40	211	35%
41-50	45	8%
51-55	1	0%
55+	122	20%

Summary of Related CIs +/- 2 years:
2015 CI 43490 2015 Steel Tower Life Extension $1,441,709

Depreciation Class: Transmission Equipment – Towers and Fixtures

Estimate Useful Life: 55 Years

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

NS Power's inspection program has identified deteriorated assets on steel towers that require replacement. Deteriorated assets have been identified on the following lines: L-6001, L-6003, L-6005, L-6010, L-6033, L-6038, L-6040, L-6535, L-8001 and L-8003. Work on these deficiencies will be prioritized based on inspection results and completed over multiple Steel Refurbishment projects. These lines are critical to the safe and reliable operation of the transmission system.

Why do this project now?

This work has been prioritized based on transmission inspection results. The assets on the lines mentioned above have reached the end of their service lives and if replacements are not completed, the reliability of the lines will be compromised.

Why do this project this way?

Replacing the existing deteriorated assets is more cost effective than entire steel tower replacements.

The contracts portion of this project will be sourced through NS Power's existing Power Line Technician (PLT) Service Agreement with Emera Utility Services. This is aligned with NS Power's workforce planning model which is designed to optimize the allocation and execution of PLT resources among work requirements.

CI Number : 48113 - 2016 Steel Tower Refurbishment **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D OT Labour AO		2,825	0	2,825
092		092-Vehicle T&D Reg. Labour AO		30,022	0	30,022
094		094 - Interest Capitalized		28,469	0	28,469
095		095 - Proj Supp Regular Labour AO		25,735	0	25,735
095		095-COPS Regular Labour AO		44,480	0	44,480
095		095-COPS Overtime Labour AO		4,186	0	4,186
095		095 - Proj Supp Overtime Labour AO		97	0	97
095		095-COPS Contracts AO		103,383	0	103,383
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	17,375	0	17,375
012	037	012 - Materials	037 - TP - Steel Towers	57,349	0	57,349
013	037	013 - COPS Contracts	037 - TP - Steel Towers	437,042	0	437,042
001	039	001 - T&D Regular Labour	039 - TP - O/H Cond.	22,422	0	22,422
002	039	002 - T&D Overtime Labour	039 - TP - O/H Cond.	8,077	0	8,077
001	085	001 - Proj Supp Regular Labour	085 Design	42,369	0	42,369
001	085	001 - Regular Labour (No AO)	085 Design	1,147	0	1,147
002	085	002 - Proj Supp Overtime Labour	085 Design	319	0	319
011	085	011 - Travel Expense	085 Design	845	0	845
013	085	013 - COPS Contracts	085 Design	55,364	0	55,364
028	085	028 - Consulting	085 Design	33,053	0	33,053
041	085	041 - Meals & Entertainment	085 Design	318	0	318
066	085	066 - Other Goods & Services	085 Design	72,125	0	72,125
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	41,212	0	41,212
002	087	002 - T&D Overtime Labour	087 Field Super.& Ops.	3,900	0	3,900
041	087	041 - Meals & Entertainment	087 Field Super.& Ops.	464	0	464
			Total Cost:	1,032,578	0	1,032,578
			Original Cost:	99,496		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48113
Title: 2016 Steel Tower Refurbishment
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	63	$ 354	$ 22,422		
T&D Labour - Site Supervision	PD	110	$ 373	$ 41,212		
Procurement / Financial Support	Lot	1	$ 1,147	$ 1,147		
Project Support AO - Engineering Design	PD	109	$ 387	$ 42,369		
			Sub-Total	$ 107,150		
002 OT Labour						
T&D Labour - PLT	PD		$ 720	$ -		
T&D Labour - Electrician/Technician	PD	11	$ 707	$ 8,077		
Project Support AO - Engineering Design	Lot	1	$ 319	$ 319		
T&D Labour - Site Supervision	PD	10	$ 373	$ 3,900		
			Sub-Total	$ 12,296		
011 Travel Expense						
Travel	Lot	1	$ 845	$ 845		
				$ -		
			Sub-Total	$ 845		
012 Materials						
Steel Tower Components	Lot	1	$ 57,349	$ 57,349		
				$ -		
			Sub-Total	$ 57,349		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 509,780		
				$ -		
			Sub-Total	$ 509,780		
028 Consulting						
Consulting	Lot	1	$ 33,053	$ 33,053		
				$ -		
			Sub-Total	$ 33,053		
041 Meals & Entertainment						
Meals	Lot	1	$ 782	$ 782		
				$ -		
			Sub-Total	$ 782		
066 Other Goods & Services						
Contingency	%	10%	$ 721,255	$ 72,125		
				$ -		
			Sub-Total	$ 72,125		
094 Interest Capitalized						
Interest				$ 28,469		
				$ -		
			Sub-Total	$ 28,469		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 30,022		
Vehicle T&D Labour Overtime AO				$ 2,825		
			Sub-Total	$ 32,848		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 44,480		
COPS T&D Labour Overtime AO				$ 4,186		
COPS Contract AO				$ 103,383		
Project Support Regular AO				$ 25,735		
Project Support OT AO				$ 97		
			Sub-Total	$ 177,881		
			SUB-TOTAL (no AO, AFUDC)	$ 793,380		
			TOTAL (AO, AFUDC included)	$ 1,032,578		
Original Cost				$ 99,496		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48059

Title: 2016/2017 Transmission Switch & Breaker Replacements

Start Date:	2016/02
In-Service Date:	2016/02
Final Cost Date:	2017/12
Function:	Transmission
Forecast Amount:	$980,999

DESCRIPTION:

This project provides for reliability improvements on the NS Power transmission system through the replacement of deteriorated substation circuit breakers. The estimate includes the retirement and replacement of 2x69kV Breakers and 2x138kV Breakers. Engineering, design and procurement will occur throughout 2016 with replacement mostly taking place throughout 2017. This Switch & Breaker program is anticipated to continue for the next 4-5 years when it will be re-evaluated at that time to determine future investment.

Summary of Related CIs +/- 2 years:
CI 44980 2014 Transmission Switch and Breaker Replacement $1,095,553
CI 46340 2015 Transmission Switch and Breaker Replacement $1,581,599
CI TBD 2017/2018 Transmission Switch and Breaker Replacement $TBD
CI TBD 2018/2019 Transmission Switch and Breaker Replacement $TBD

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

This project will replace circuit breakers that are malfunctioning due to the effects of age. The circuit breakers evaluated for replacement have an average age of greater than 45 years.

Why do this project now?

Completing this project now will result in mitigating transmission supply interruptions and provide reliability improvements for customers.

Why do this project this way?

In the majority of cases, spare parts are no longer available for the circuit breakers that are being replaced due to the age of the devices. The breakers being replaced are often oil filled so this project also serves to remove oil filled equipment from the fleet, reducing the environmental liability.

CI Number : 48059 - 2016/2017 Transmission Switch & Breaker Replacements **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		12,224	0	12,224
095		095-COPS Contracts AO		61,495	0	61,495
095		095 - Proj Supp Regular Labour AO		18,805	0	18,805
095		095-COPS Regular Labour AO		18,110	0	18,110
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	340	0	340
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	20,430	0	20,430
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	9,840	0	9,840
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	4,800	0	4,800
012	023	012 - Materials	023 - TP - Power Equip.-Station S	5,000	0	5,000
001	035	001 - T&D Regular Labour	035 - TP - Wood Poles	7,199	0	7,199
012	043	012 - Materials	043 - TP - Substn Dev.	407,400	0	407,400
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	278,000	0	278,000
001	085	001 - Proj Supp Regular Labour	085 Design	30,960	0	30,960
001	085	001 - Regular Labour (No AO)	085 Design	8,452	0	8,452
011	085	011 - Travel Expense	085 Design	111	0	111
066	085	066 - Other Goods & Services	085 Design	79,124	0	79,124
001	086	001 - T&D Regular Labour	086 Commissioning	14,140	0	14,140
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	4,569	0	4,569
			Total Cost:	980,999	0	980,999
			Original Cost:	143,624		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48059
Title: 2016/2017 Transmission Switch & Breaker Replacements
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - PLT	PD	20	$ 360	$ 7,199		
T&D Labour - Electrician/Technician	PD	40	$ 354	$ 14,140		
T&D Labour - Site Supervision	PD	12	$ 373	$ 4,569		
Procurement / Financial Support	Lot	1	$ 8,452	$ 8,452		
Project Support AO - Engineering Design	PD	80	$ 387	$ 30,960		
			Sub-Total	$ 65,320		
011 Travel Expense						
Travel - Design	Lot	1	$ 111	$ 111		
			Sub-Total	$ 111		
012 Materials						
Grounding Equipment	Lot	1	$ 340	$ 340		
Control Cables	Lot	1	$ 9,840	$ 9,840		
Secondary Panel and cable	Lot	1	$ 5,000	$ 5,000		
138 kV Surge Arrester	ea	6	$ 9,000	$ 54,000		
138 kV Circuit Breaker	ea	2	$ 98,000	$ 196,000		
138 kV Small Components	Lot	1	$ 2,500	$ 2,500		
69 kV Surge Arrester	ea	6	$ 1,200	$ 7,200		
69 kV Circuit Breaker	ea	2	$ 72,000	$ 144,000		
69 kV Small Components	Lot	1	$ 3,700	$ 3,700		
			Sub-Total	$ 422,580		
013 Contracts						
Concrete Foundations	Lot	1	$ 20,430	$ 20,430		
Installation of Electrical Control Equipment	Lot	1	$ 4,800	$ 4,800		
Boom Truck Services	Lot	1	$ 12,000	$ 12,000		
Crane Services	Lot	1	$ 6,000	$ 6,000		
Breaker Installation External Contractor	ea	4	$ 65,000	$ 260,000		
				$ -		
			Sub-Total	$ 303,230		
066 Other Goods & Services						
Contingency	%	10%	$ 791,241	$ 79,124		
			Sub-Total	$ 79,124		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 12,224		
			Sub-Total	$ 12,224		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 18,110		
COPS Contract AO				$ 61,495		
Project Support Regular AO				$ 18,805		
			Sub-Total	$ 98,410		
			SUB-TOTAL (no AO, AFUDC)	$ 870,366		
			TOTAL (AO, AFUDC included)	$ 980,999		
Original Cost				$ 143,624		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48116

Title: 2016 Sacrificial Anode Installation Program

Start Date: 2016/06
In-Service Date: 2016/06
Final Cost Date: 2017/12
Function: Transmission
Forecast Amount: $970,909

DESCRIPTION:

Sacrificial anodes are highly active metals that are used for cathodic protection to prevent a less active material surface from corroding. This project will systematically install sacrificial anodes on steel transmission structures and key tower anchors identified as corroding or at a high risk for corrosion. This program, along with a specialized transmission steel towers inspection and the steel tower refurbishment will identify, quantify and address corrosion issues on steel assets throughout the province.

Summary of Related CIs +/- 2 years:
2014 CI 44970 2014 Steel Tower Refurbishment $492,271
2014 CI 44975 2014 Sacrificial Anode Installation Program $815,277
2015 CI 46356 2015 Sacrificial Anode Installation Program $2,133,377
2016 CI 48114 2016 Steel Tower Life Extension – HRM $1,485,179
2016 CI 48113 2016 Steel Tower Refurbishment $1,040,014
2017 CI TBD 2017 Sacrificial Anode Installation Program $TBD
2018 CI TBD 2018 Sacrificial Anode Installation Program $TBD

JUSTIFICATION:

Justification Criteria: Transmission Plant

Why do this project?

Based on transmission line inspections, the age of NS Power infrastructure and the corrosion rate of steel once galvanization is breached, sacrificial anodes have been recommended by the T&D Engineering group and have been proven effective in other jurisdictions to protect steel transmission structure assets and slow the rate of corrosion.

Why do this project now?

Due to the age of NS Power steel transmission structure assets, the galvanization is at or near the end of the anticipated life. The cathodic protection provided by the installation of sacrificial anode will effectively extend the life of the steel structure.

Why do this project this way?

The installation of sacrificial anodes protects the existing assets once the galvanization is ineffective, deferring costly replacement.

This project is expected to be completed by external resources.

CI Number : 48116 - 2016 Sacrificial Anode Installation Program **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		3,471	0	3,471
095		095 - Proj Supp Regular Labour AO		635	0	635
095		095-COPS Regular Labour AO		5,142	0	5,142
095		095-COPS Contracts AO		135,556	0	135,556
012	037	012 - Materials	037 - TP - Steel Towers	80,823	0	80,823
013	037	013 - COPS Contracts	037 - TP - Steel Towers	504,147	0	504,147
013	039	013 - COPS Contracts	039 - TP - O/H Cond.	164,275	0	164,275
001	085	001 - Proj Supp Regular Labour	085 Design	1,046	0	1,046
001	085	001 - Regular Labour (No AO)	085 Design	1,616	0	1,616
066	085	066 - Other Goods & Services	085 Design	66,842	0	66,842
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	7,356	0	7,356
			Total Cost:	970,909	0	970,909
			Original Cost:			

Capital Project Detailed Estimate

Location: **Transmission**
CI# / FP#: 48116
Title: 2016 Sacrificial Anode Installation Program
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Site Supervision	PD	20	$ 373	$ 7,356		
Procurement / Financial Support	Lot	1	$ 1,616	$ 1,616		
Project Support AO - Engineering Design	PD	3	$ 387	$ 1,046		
			Sub-Total	$ 10,019		
012 Materials						
Anodes & Test Stations	Ea.	535	$ 151	$ 80,823		
			Sub-Total	$ 80,823		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 668,422		
			Sub-Total	$ 668,422		
066 Other Goods & Services						
Contingency	$	1	$ 66,842	$ 66,842		
			Sub-Total	$ 66,842		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 3,471		
			Sub-Total	$ 3,471		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 5,142		
COPS Contract AO				$ 135,556		
Project Support Regular AO				$ 635		
			Sub-Total	$ 141,333		
			SUB-TOTAL (no AO, AFUDC)	$ 826,105		
			TOTAL (AO, AFUDC included)	$ 970,909		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48067

Title: 2016 Oil Containment Program

Start Date: 2016/03
In-Service Date: 2016/04
Final Cost Date: 2017/05
Function: Transmission
Forecast Amount: $470,856

DESCRIPTION:

This project includes the installation of oil containment systems for substation main power transformers. NS Power completed a survey of main power transformers without an oil containment system. The sites were also reviewed to determine their proximity to sensitive environmental sites, such as watercourses and wetlands along with the presence of pathways for contaminants to reach the receptors. From these assessments of environmental risk, a prioritized list of substation sites has been developed for retrofitting oil containment systems, thereby reducing the environmental risk.

Summary of Related CIs +/- 2 years:
2017 CI TBD 2017 Oil Containment Program $TBD
2018 CI TBD 2018 Oil Containment Program $TBD

JUSTIFICATION:

Justification Criteria: Environment

Why do this project?

NS Power has identified that there is risk of oil from substation transformers being released to a nearby sensitive environmental area at locations that currently do not have oil containment systems. Installation of oil containment systems will reduce the risk to the environment and public safety surrounding substations.

Why do this project now?

In 2013, Nova Scotia Environment released the *Contaminated Sites Regulations* which outlines new clean-up criteria for spills, increasing clean-up and assessment costs. Clean-ups and ongoing assessment costs for oil releases from substation transformers can amount to a significant cost to NS Power. These regulations can be found at the following link: https://www.novascotia.ca/just/regulations/regs/envcontsite.htm.

Proactively adding oil containment systems to the highest environmental risk sites will reduce long-term costs associated with clean-ups and will protect these sensitive areas from possible contamination.

Why do this project this way?

A total of 303 sites were evaluated for this project. Approximately 76 of these have known sensitive areas in the immediate vicinity that are at risk for possible contamination should an oil release occur. NS Power then identified the 30 sites that had the highest risk for those pathways to be created between the potential sources of oil and potential receiving waters. Installing oil containment in these highest risk sites in a prioritized approach will reduce the environmental risk of oil being released from our substation operations to nearby sensitive areas.

CI Number : 48067 - 2016 Oil Containment Program **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		6,363	0	6,363
095		095 - Proj Supp Regular Labour AO		17,512	0	17,512
095		095-COPS Regular Labour AO		9,427	0	9,427
095		095-COPS Contracts AO		26,456	0	26,456
001	007	001 - T&D Regular Labour	007 - TP - Environmental	3,696	0	3,696
012	007	012 - Materials	007 - TP - Environmental	195,677	0	195,677
013	007	013 - COPS Contracts	007 - TP - Environmental	130,451	0	130,451
001	085	001 - Proj Supp Regular Labour	085 Design	28,831	0	28,831
001	085	001 - Regular Labour (No AO)	085 Design	3,914	0	3,914
066	085	066 - Other Goods & Services	085 Design	36,845	0	36,845
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	9,791	0	9,791
			Total Cost:	468,963	0	468,963
			Original Cost:			

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48067
Title: 2016 Oil Containment Program
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	10	$ 354	$ 3,696		
T&D Labour - Site Supervision	PD	26	$ 373	$ 9,791		
Procurement / Financial Support	Lot	1	$ 3,914	$ 3,914		
Project Support AO - Engineering Design	PD	74	$ 387	$ 28,831		
			Sub-Total	$ 46,232		
012 Materials						
PVC Oil Containment Materials	Ea	7	$ 27,954	$ 195,677		
			Sub-Total	$ 195,677		
013 Contracts						
PVC Oil Containment Installation	Ea	7	$ 18,636	$ 130,451		
			Sub-Total	$ 130,451		
066 Other Goods & Services						
Contingency	%	10%	$ 368,446	$ 36,845		
			Sub-Total	$ 36,845		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 6,363		
			Sub-Total	$ 6,363		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 9,427		
COPS Contract AO				$ 26,456		
Project Support Regular AO				$ 17,512		
			Sub-Total	$ 53,395		
			SUB-TOTAL (no AO, AFUDC)	$ 409,205		
			TOTAL (AO, AFUDC included)	$ 468,963		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48063

Title: 2016/2017 Capacitor Bank Breaker Replacements

Start Date:	2016/04
In-Service Date:	2017/04
Final Cost Date:	2017/10
Function:	Transmission
Forecast Amount:	$385,850

DESCRIPTION:

This project is required for the retirement and replacement of three capacitor bank breakers. Breaker replacements will be prioritized based on age, number of operations, maintenance history and criticality to the transmission system. Capacitor Bank Breakers are utilized by system operators to control voltage on the transmission system. Engineering, design and procurement will occur throughout 2016 with replacement mostly taking place throughout 2017.

Summary of Related CIs +/- 2 years:
2015 CI 47631 U&U Capacitor Bank Breaker Replacements $411,871
2017 CI TBD 2017/2018 Capacitor Bank Breaker Replacement $TBD
2018 CI TBD 2018/2019 Capacitor Bank Breaker Replacements $TBD

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

There are currently 23 Capacitor Bank Breakers on the transmission system. These breakers are critical to the operation of the transmission system as they are utilized to control the system voltage. These breakers are operated frequently and as a result see higher duty cycles compared to line breakers. This higher duty cycle increases the probability of failure in these devices. Issues on capacitor bank breakers in the Halifax area were discovered as a result of NS Power's preventative maintenance inspection cycle on these capacitor bank breakers. This project decreases the probability of failure by replacing those most at risk.

Why do this project now?

To ensure the reliable operation of the transmission system, a Capacitor Bank Breaker replacement program is required.

In late 2014, issues on capacitor bank breakers in the Halifax area were discovered as a result of NS Power's preventative maintenance inspection cycle on these capacitor bank breakers. In these instances, there was high contact resistance and subsequent thermal imaging showed elevated temperatures on the affected poles. As these breakers are operated multiple times per day in some cases, replacing these three breakers at this time is the prudent decision to avoid failure. Failure of these devices could result in voltage issues on the transmission system.

Why do this project this way?

Due to the age of the breakers being replaced in this program, refurbishment is not an option and sourcing spare parts is becoming more challenging. As a result, replacement is the recommended option.

CI Number : 48063 - 2016/2017 Capacitor Bank Breaker Replacements **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		24,878	0	24,878
092		092-Vehicle T&D OT Labour AO		834	0	834
094		094 - Interest Capitalized		12,471	0	12,471
095		095-COPS Overtime Labour AO		1,235	0	1,235
095		095 - Proj Supp Regular Labour AO		9,950	0	9,950
095		095-COPS Regular Labour AO		36,859	0	36,859
095		095-COPS Contracts AO		5,935	0	5,935
001	003	001 - T&D Regular Labour	003 - TP - Bldg.,Struct.Grnd.	707	0	707
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	220	0	220
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	15,265	0	15,265
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	5,303	0	5,303
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	1,125	0	1,125
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	4,800	0	4,800
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	38,620	0	38,620
002	043	002 - T&D Overtime Labour	043 - TP - Substn Dev.	3,535	0	3,535
012	043	012 - Materials	043 - TP - Substn Dev.	159,700	0	159,700
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	9,200	0	9,200
001	085	001 - Proj Supp Regular Labour	085 Design	16,381	0	16,381
001	085	001 - Regular Labour (No AO)	085 Design	3,221	0	3,221
011	085	011 - Travel Expense	085 Design	111	0	111
066	085	066 - Other Goods & Services	085 Design	26,699	0	26,699
001	086	001 - T&D Regular Labour	086 Commissioning	5,303	0	5,303
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	2,798	0	2,798
011	087	011 - Travel Expense	087 Field Super.& Ops.	700	0	700
			Total Cost:	385,850	0	385,850
			Original Cost:	35,767		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48063
Title: 2016/2017 Capacitor Bank Breaker Replacements
Execution Year: 2016-2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	149	$ 354	$ 52,731		
Procurement / Financial Support	Lot	1	$ 3,221	$ 3,221		
Project Support AO - Engineering Design	PD	42	$ 387	$ 16,381		
			Sub-Total	$ 72,333		
002 OT Labour						
T&D Labour - Electrician/Technician	PD	5	$ 707	$ 3,535		
			$ -			
			Sub-Total	$ 3,535		
011 Travel Expense						
Travel	$	1	$ 811	$ 811		
			Sub-Total	$ 811		
012 Materials						
Grounding Equipment	Lot	1	$ 220	$ 220		
Control Cables	Lot	1	$ 1,125	$ 1,125		
25 kV Circuit Breaker	ea	3	$ 45,000	$ 135,000		
25 kV Surge Arrester (Station Class)	ea	9	$ 2,000	$ 18,000		
25 kV Small Component pieces	Lot	1	$ 6,700	$ 6,700		
			Sub-Total	$ 161,045		
013 Contracts						
Concrete Foundation Installation	Lot	1	$ 15,265	$ 15,265		
Installation of Control Cables	Lot	1	$ 4,800	$ 4,800		
Boom Truck Services	Lot	1	$ 3,200	$ 3,200		
Cranes Services	Lot	1	$ 6,000	$ 6,000		
			Sub-Total	$ 29,265		
066 Other Goods & Services						
Contingency	%	10%	$ 266,989	$ 26,699		
			Sub-Total	$ 26,699		
094 Interest Capitalized						
AFUDC				$ 12,471		
			Sub-Total	$ 12,471		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 24,878		
Vehicle T&D Labour Overtime AO				$ 834		
			Sub-Total	$ 25,712		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 36,859		
COPS T&D Labour Overtime AO				$ 1,235		
COPS Contract AO				$ 5,935		
Project Support Regular AO				$ 9,950		
			Sub-Total	$ 53,979		
			SUB-TOTAL (no AO, AFUDC)	$ 293,688		
			TOTAL (AO, AFUDC included)	$ 385,850		
Original Cost				$ 35,767		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48062

Title: 2016/2017 Reactor Breaker Replacements

Start Date:	2016/03
In-Service Date:	2017/02
Final Cost Date:	2018/06
Function:	Transmission
Forecast Amount:	$384,974

DESCRIPTION:

This project is required for the retirement and replacement of three shunt reactor bank breakers in 2016/2017. Breaker replacements will be prioritized based on age, number of operations, maintenance history and criticality to the transmission system. Engineering, design and procurement will occur throughout 2016 with replacement mostly taking place throughout 2017.

The reactor breakers to be replaced are 1980s vintage. The expected life of a reactor breaker is based on a combination of age, number of operations and maintenance history. Reactor breakers are operated frequently due to their requirement to maintain transmission system voltage. The breakers proposed for replacements have between 3,000 and 6,000 operations and are exhibiting signs of deterioration.

Summary of Related CIs +/- 2 years:
2014 CI 44983 Reactor Bank Breaker Replacements $385,032
2015 CI 46354 Reactor Bank Breaker Replacements $460,691
2017 CI TBD 2017/2018 Reactor Bank Breaker Replacements $TBD

JUSTIFICATION:

Justification Criteria: Transmission Plant

Sub Criteria: Equipment Replacement

Why do this project?

A shunt reactor is an inductor that is generally connected to the tertiary winding (generally a low capacity, medium voltage transformer winding that can be used for many purposes, one of which is connection of shunt reactors or capacitors to help maintain transmission system voltage during light and heavy loading conditions) of some of our 345kV Transformers. The reactor is used to control the 345kV System Voltage. The eleven shunt reactors on the transmission system are the single most frequent devices used to control the 345kV system voltage during times of low load. In 2014, NS Power saw an increase in forced reactor outages due to an increased rate of reactor bank breaker failures. The number of operations on the existing breakers has exceeded the manufacturer's recommendations. In 2015, three reactor bank breakers were replaced; this is the continuation of that program with three more replacements in 2016/2017.

Why do this project now?

An increasing failure rate has been seen over the past several years. Overall reliability of the 11 shunt reactor banks on the 345kV system is critical to the operating of the transmission system.

Why do this project this way?

The age of the installed breakers means that overhauls are not an option, as spare parts are not available. Replacement with new breakers suited for the duty is the only option.

CI Number : 48062 - 2016/2017 Reactor Breaker Replacements **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		24,878	0	24,878
092		092-Vehicle T&D OT Labour AO		834	0	834
094		094 - Interest Capitalized		11,594	0	11,594
095		095-COPS Regular Labour AO		36,859	0	36,859
095		095 - Proj Supp Regular Labour AO		9,950	0	9,950
095		095-COPS Overtime Labour AO		1,236	0	1,236
095		095-COPS Contracts AO		5,935	0	5,935
001	003	001 - T&D Regular Labour	003 - TP - Bldg.,Struct.Grnd.	707	0	707
012	003	012 - Materials	003 - TP - Bldg.,Struct.Grnd.	220	0	220
013	003	013 - COPS Contracts	003 - TP - Bldg.,Struct.Grnd.	15,265	0	15,265
001	022	001 - T&D Regular Labour	022 - TP - Elec Contr.Equip.	5,303	0	5,303
012	022	012 - Materials	022 - TP - Elec Contr.Equip.	1,125	0	1,125
013	022	013 - COPS Contracts	022 - TP - Elec Contr.Equip.	4,800	0	4,800
001	043	001 - T&D Regular Labour	043 - TP - Substn Dev.	38,620	0	38,620
002	043	002 - T&D Overtime Labour	043 - TP - Substn Dev.	3,535	0	3,535
012	043	012 - Materials	043 - TP - Substn Dev.	159,700	0	159,700
013	043	013 - COPS Contracts	043 - TP - Substn Dev.	9,200	0	9,200
001	085	001 - Proj Supp Regular Labour	085 Design	16,381	0	16,381
001	085	001 - Regular Labour (No AO)	085 Design	3,221	0	3,221
011	085	011 - Travel Expense	085 Design	111	0	111
066	085	066 - Other Goods & Services	085 Design	26,699	0	26,699
001	086	001 - T&D Regular Labour	086 Commissioning	5,303	0	5,303
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	2,798	0	2,798
011	087	011 - Travel Expense	087 Field Super.& Ops.	700	0	700
			Total Cost:	384,974	0	384,974
			Original Cost:	18,932		

Capital Project Detailed Estimate

Location: Transmission
CI# / FP#: 48062
Title: 2016/2017 Reactor Breaker Replacements
Execution Year: 2016/2017

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	141	$ 354	$ 49,933		
T&D Labour - Site Supervision	PD	8	$ 373	$ 2,798		
Procurement / Financial Support	Lot	1	$ 3,221	$ 3,221		
Project Support AO - Engineering Design	PD	42	$ 387	$ 16,381		
			Sub-Total	$ 72,333		
002 OT Labour						
T&D Labour - Electrician/Technician	PD	5	$ 707	$ 3,535		
			Sub-Total	$ 3,535		
011 Travel Expense						
Travel	$	1	$ 811	$ 811		
			Sub-Total	$ 811		
012 Materials						
Grounding Equipment	Lot	1	$ 220	$ 220		
Control Cables	Lot	1	$ 1,125	$ 1,125		
25 kV Surge Arrester (Station Class)	ea	9	$ 2,000	$ 18,000		
25 kV Circuit Breaker	ea	3	$ 45,000	$ 135,000		
25 kV Small Component pieces	Lot	1	$ 6,700	$ 6,700		
			Sub-Total	$ 161,045		
013 Contracts						
Concrete Foundation Installation	Lot	1	$ 15,265	$ 15,265		
Installation of Control Cables	Lot	1	$ 4,800	$ 4,800		
Boom Truck Services	Lot	1	$ 3,200	$ 3,200		
Cranes Services	Lot	1	$ 6,000	$ 6,000		
				$ -		
			Sub-Total	$ 29,265		
066 Other Goods & Services						
Contingency	%	10%	$ 266,989	$ 26,699		
				$ -		
			Sub-Total	$ 26,699		
094 Interest Capitalized						
AFUDC				$ 11,594		
			Sub-Total	$ 11,594		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 24,878		
Vehicle T&D Labour Overtime AO				$ 834		
			Sub-Total	$ 25,712		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 36,859		
COPS T&D Labour Overtime AO				$ 1,236		
COPS Contract AO				$ 5,935		
Project Support Regular AO				$ 9,950		
			Sub-Total	$ 53,979		
			SUB-TOTAL (no AO, AFUDC)	$ 293,688		
			TOTAL (AO, AFUDC included)	$ 384,974		
Original Cost				$ 18,932		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Distribution

Distribution

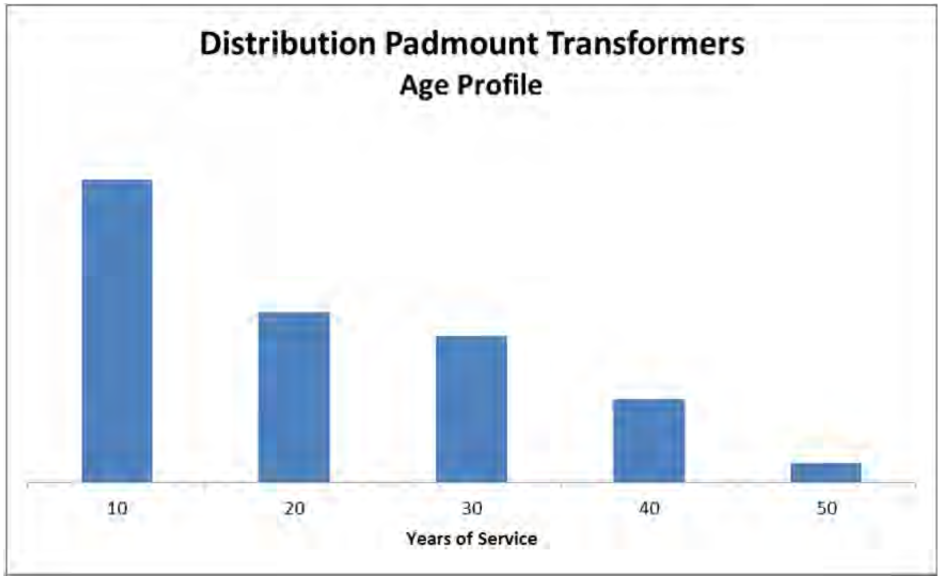
The Distribution capital investment included in this plan is based on asset management strategies to further optimize the reliability and performance of NS Power's plant. Investments in the distribution system have been identified through inspection programs, test results and analysis of opportunities to improve overall reliability and system performance. These investments can be summarized into four categories: Sustaining, Customer Driven, Compliance and Transformative.

Category	2016 ACE ($M)
Sustaining	35.8
Customer Driven	24.6
Compliance	2.7
Transformative	11.7
Total Capital Program	**$74.8**

Sustaining Capital

Sustaining capital investment targets the upgrade and replacement of key infrastructure like padmount transformers, reclosers, poles and conductor, which have reached end-of-life. The investment in these assets is based on inspections and is well-aligned with the overall quantity and age of assets in the distribution plant. The average age of distribution equipment being replaced in 2016 is 45 years old.

An example of sustaining investment on an asset is the padmount transformer replacement program. This program is developed through inspection results, in conjunction with age profiles, to determine the quantity of padmount transformers to be replaced in a given year. There are 90 padmount transformers planned for replacement in the 2016 capital program. The age profile of the padmount transformer fleet shows the progress that has been made in the last ten years to replace assets that have reached the end of their service lives. The average age of the padmount transformers currently in-service is 16 years old, with 116 transformers exceeding 40 years of service. The expected useful life for a padmount transformer is 30 years.



Customer Driven

Customer driven capital investment projects are completed in response to new customer installations, load growth and load shifting, identified through planning studies or from analysis of equipment test results. Load growth and load shifting is triggering investments in voltage conversions, upgrades to higher capacity feeders, transformers and conductor in 2016.

Compliance

Compliance capital investments are projects required in order to meet environmental and legislative regulations. An example of a compliance driven project is the 2016 PCB Phase-out for Pole Top Transformers which is required to meet federal environmental regulations surrounding the removal of PCB from electrical equipment by 2025. In addition, NS Power is required to replace all street lights with LED street lights by December 31, 2019 and 2016 capital investment reflects this.

CI Number: 47721

Title: 2016 PCB Phase-out for Pole Top Transformers

Start Date: 2015/09
In-Service Date: 2016/01
Final Cost Date: 2017/01
Function: Distribution
Forecast Amount: $4,409,579

DESCRIPTION:

This project provides for the systematic removal of the second phase of potentially Polychlorinated biphenyl (PCB) contaminated material in accordance with federal and provincial guidelines. Regulations state that all pole top equipment containing PCBs in a concentration greater than 50mg/kg must be removed from service by December 31, 2025. Based on the results of feeder inspections, NS Power estimates there are approximately 45,000 pole top transformers on the distribution system which may contain PCBs. Feeder inspectors identified potential PCB transformers based on the apparent age of the equipment, and visual inspection of bushings, connections, color, etc.

In 2016, the third phase of multiple projects, NS Power will test 10,000 pole top transformers that have been identified as potentially PCB contaminated and change out approximately 250 of these transformers. The 2016 project has an increased focused on identification of PCB containing transformers through sampling, enabling the development of a strategic replacement plan. The amount of testing as part of the 2016 program has been accelerated in order to take advantage of approximately 15% savings in the cost of testing.

Summary of Related CIs +/- 2 years:
2014 CI 45046 PCB Phase-out for Pole Top Transformers $779,620
2015 CI 46576 PCB Phase-out for Pole Top Transformers $733,503
2017 CI TBD PCB Phase-Out for Pole Top Transformer Program $TBD
2018 CI TBD PCB Phase-Out for Poly Top Transformer Program $TBD

Depreciation Class: Distribution Plant- Line Transformers

Estimated Life of the Asset: 40 years

JUSTIFICATION:

Justification Criteria: Environment

Why do this project?

The Canadian Council of Ministers of the Environment (CCME) has committed to a policy of phasing out the use of all PCBs in Canada. In support of this policy, NS Power will be focusing on eliminating all pole-top electrical transformers and related pole-top auxiliary electrical equipment containing PCBs in a concentration of 50 mg/kg or more before December 31, 2025.

Why do this project now?

The volume of potentially PCB contaminated pole top transformers in our system is estimated at approximately 45,000. Proceeding with this work over a 10 year timeframe will allow the work to be incorporated into our existing work plan and resources.

Why do this project this way?

An inventory of pole top assets will be completed to identify the location and number of potentially contaminated transformers. NS Power will engage a contractor to obtain oil samples of these units. All units that test greater than the

50mg/kg limit will be changed out. This project provides for testing and destruction of materials, as required. Based on pole top transformer disposal data from 2004 to 2013, 8.5 percent of the pole-top transformers replaced contain PCB concentration equal to or above 50 mg/kg. Based on that percentage, NS Power anticipates 3,825 transformers of the 45,000 will be replaced throughout the multiple annual projects. The 2016 project is focused on identification of PCB containing transformers through sampling, enabling the development of a strategic replacement plan, which will be executed in future year ACE Plan projects. This work will be completed by an external contractor.

CI Number : 47721-D670 - 2016 PCB Phase-out for Pole Top Transformers **Project Number** D670

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		3,696	0	3,696
095		095-COPS Contracts AO		599,807	0	599,807
095		095-COPS Regular Labour AO		5,475	0	5,475
095		095 - Proj Supp Regular Labour AO		6,611	0	6,611
012	041	012 - Materials	041 - DP - O/H Line Transf.	667,500	0	667,500
013	041	013 - COPS Contracts	041 - DP - O/H Line Transf.	2,747,725	0	2,747,725
001	085	001 - Regular Labour (No AO)	085 Design	18,525	0	18,525
001	085	001 - Proj Supp Regular Labour	085 Design	10,884	0	10,884
001	085	001 - T&D Regular Labour	085 Design	2,588	0	2,588
066	085	066 - Other Goods & Services	085 Design	341,523	0	341,523
001	087	001 - T&D Regular Labour	087 Field Super.& Ops.	5,245	0	5,245
			Total Cost:	4,409,579	0	4,409,579
			Original Cost:	1,957,826		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47721
Title: 2016 PCB Phase-out for Pole Top Tranformers
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Site Supervision	PD	14	$ 373	$ 5,245		
T&D Labour - Project Support	PD	7	$ 368	$ 2,588		
Procurment / Financial Support	Lot	1	$ 18,525	$ 18,525		
Project Support AO - Engineering Design	PD	28	$ 387	$ 10,884		
			Sub-Total	$ 37,242		
012 Materials						
Pole Top Transformers	ea	250	$ 2,670	$ 667,500		
			Sub-Total	$ 667,500		
013 Contracts						
Field Testing Costs - Oil sampling	ea	10000	$ 210	$ 2,100,000		
Lab Testing Costs	ea	10000	$ 32	$ 315,000		
Environmental Disposal Fee	ea	10000	$ 2	$ 17,500		
PLT Line Contract	Hrs	1125	$ 178	$ 200,475		
Destruction Costs	ea	250	$ 252	$ 63,113		
Traffic Control	Unit	250	$ 207	$ 51,638		
			Sub-Total	$ 2,747,725		
066 Other Goods & Services						
Contigency	%	10%	$ 3,415,225	$ 341,523		
			Sub-Total	$ 341,523		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 3,696		
				$ -		
			Sub-Total	$ 3,696		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 5,475		
COPS Contract AO				$ 599,807		
Project Support Regular AO				$ 6,611		
			Sub-Total	$ 611,894		
			SUB-TOTAL (no AO, AFUDC)	$ 3,793,990		
			TOTAL (AO, AFUDC included)	$ 4,409,579		
Original Cost				$ 1,957,826		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 48093

Title: 2016 Padmount Transformer Replacement Program

Start Date:	2016/02
In-Service Date:	2016/02
Final Cost Date:	2017/01
Function:	Distribution
Forecast Amount:	$1,911,470

DESCRIPTION:

This project will provide for costs associated with the replacement of 90 padmount transformers identified through the padmount inspection program. NS Power has 4,058 padmount transformers across its fleet which are inspected every year through the padmount inspection program. This will be an ongoing program as part of lifecycle and condition management of the in-service distribution padmount transformer inventory.

Summary of Related CIs +/- 2 years:
2015 CI 46292 2015 Padmount Replacement Program $1,536,110

Depreciation Class: Distribution Equipment, Underground Line Transformers

Estimated Useful Life: 30 years

JUSTIFICATION:

Justification Criteria: Distribution System

Why do this project?

Padmount transformer inspections have identified transformers that need to be replaced next year due to deterioration. Environmental regulations prohibit the release of mineral oil into the environment. Proactive, planned replacement of end of life padmount transformers mitigates the potential for environmental impact from oil-filled equipment, as well as prolonged, unplanned outages from transformer failures.

Why do this project now?

At or near end of life padmount transformers were identified through the padmount inspection process, and prioritized for replacement. They will be replaced in a planned manner as part of NS Power's environmental due diligence.

Why do this project this way?

Padmount transformers are typically associated with commercial customers. Planned replacement of end of life padmount transformers is conducted during an outage coordinated at the convenience of the customer. The replacement of these transformers will minimize unplanned customer outages and mitigate potential environmental impact.

CI Number : 48093 - 2016 Padmount Transformer Replacement Program **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		46,699	0	46,699
095		095 - Proj Supp Regular Labour AO		2,351	0	2,351
095		095-COPS Contracts AO		34,708	0	34,708
095		095-COPS Regular Labour AO		69,187	0	69,187
001	048	001 - T&D Regular Labour	048 - DP - U/G Line Transf.	98,980	0	98,980
012	048	012 - Materials	048 - DP - U/G Line Transf.	1,330,200	0	1,330,200
013	048	013 - COPS Contracts	048 - DP - U/G Line Transf.	171,144	0	171,144
001	085	001 - Regular Labour (No AO)	085 Design	4,198	0	4,198
001	085	001 - Proj Supp Regular Labour	085 Design	3,870	0	3,870
066	085	066 - Other Goods & Services	085 Design	150,134	0	150,134
			Total Cost:	1,911,470	0	1,911,470
			Original Cost:	909,192		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 48093
Title: 2016 Padmount Transformer Replacement Program
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	280	$ 354	$ 98,980		
Procurement / Financial Support	Lot	1	$ 4,198	$ 4,198		
Project Support AO - Engineering Design	PD	10	$ 387	$ 3,870		
			Sub-Total	$ 107,048		
012 Materials						
Padmount Transformers	ea	72	$ 13,000	$ 936,000		
Padmount Transformers	ea	18	$ 16,900	$ 304,200		
Small Components for Padmount Transformers	ea	90	$ 1,000	$ 90,000		
			Sub-Total	$ 1,330,200		
013 Contracts						
PLT Line Contract	Hrs	640	$ 178	$ 114,048		
Transformer Deliveries	Lot	1	$ 45,000	$ 45,000		
Traffic Control	Lot	1	$ 12,096	$ 12,096		
			Sub-Total	$ 171,144		
066 Other Goods & Services						
Contingency	$	1	$ 150,134	$ 150,134		
				$ -		
				$ -		
			Sub-Total	$ 150,134		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 46,699		
			Sub-Total	$ 46,699		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 69,187		
COPS Contract AO				$ 34,708		
Project Support Regular AO				$ 2,351		
			Sub-Total	$ 106,246		
			SUB-TOTAL (no AO, AFUDC)	$ 1,758,526		
			TOTAL (AO, AFUDC included)	$ 1,911,470		
Original Cost				$ 909,192		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47752

Title: 4S-333 Bentinck St. Rebuild

Start Date: 2016/04
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Distribution
Forecast Amount: $575,357

DESCRIPTION:

This project is for work identified in recommendations of the Sydney 4kV Conversion and Membertou Load Growth Planning Study (283-0212-E27), specifically, recommendation 6.1.2.1 Bentinck Street Upgrades. This includes work to reconfigure the Shipyard area supply and upgrade the remaining conductor on Bentinck Street (a continuation of work performed during the Mason Street Conversion project in 2013), which enables the removal of the remaining off-road section of feeder along the railway tracks. This section of 4S-333 is deteriorated and approaching its end of life.

Summary of Related CIs +/- 2 years:
2015 CI 45306 111S Prime Brook Substation $3,442,582
2016 CI 47776 111S Prime Brook Feeder Exits $1,565,057

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Pole Strength Compliance with Standard CAN/CSA-C22.3 No. 1-10 - Overhead Systems

Why do this project?

Primary distribution feeder 4S-333 is important to the supply of the increasing load in the Membertou area of Sydney. The targeted sections of 4S-333 are deteriorated and approaching their end of life. Reconfiguration and reconductoring a portion of Bentinck Street will allow for the removal of the inaccessible section of line that is currently running along railway tracks.

Why do this project now?

As outlined in the planning study, this section of feeder is deteriorated, approaching its end of life and requires replacement. Failures on the inaccessible section of line will result in extended outage durations.

Why do this project this way?

Rebuilding Bentinck Street and reconductoring the previously retired 4kV conductor on Townsend Street will prevent outages from deteriorated equipment and enable 4S-333 to be adjacent to the road extending from the substation to the majority of the load it supplies.

CI Number : 47752 - 4S-333 Bentinck St. Rebuild **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,185	0	3,185
095		095-COPS Contracts AO		70,061	0	70,061
013	002	013 - COPS Contracts	002 - DP - Land Rights	25,000	0	25,000
020	002	020 - Royalties, Easements, App	002 - DP - Land Rights	40,000	0	40,000
012	004	012 - Materials	004 - DP - Misc.Equipment	0	0	0
012	035	012 - Materials	035 - DP - Wood Poles	38,673	0	38,673
013	035	013 - COPS Contracts	035 - DP - Wood Poles	138,654	0	138,654
012	039	012 - Materials	039 - DP - O/H Cond.	15,214	0	15,214
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	134,776	0	134,776
012	040	012 - Materials	040 - DP - O/H Cond.Devices	1,352	0	1,352
013	040	013 - COPS Contracts	040 - DP - O/H Cond.Devices	4,288	0	4,288
012	041	012 - Materials	041 - DP - O/H Line Transf.	16,186	0	16,186
013	041	013 - COPS Contracts	041 - DP - O/H Line Transf.	22,943	0	22,943
012	046	012 - Materials	046 - DP - U/G Conductor	887	0	887
013	046	013 - COPS Contracts	046 - DP - U/G Conductor	3,731	0	3,731
013	050	013 - COPS Contracts	050 - DP - Street Lights	4,789	0	4,789
012	052	012 - Materials	052 - DP - Services	1,275	0	1,275
013	052	013 - COPS Contracts	052 - DP - Services	11,287	0	11,287
001	085	001 - Regular Labour (No AO)	085 Design	8,508	0	8,508
002	085	002 - Overtime Labour (No AO)	085 Design	0	0	0
011	085	011 - Travel Expense	085 Design	0	0	0
041	085	041 - Meals & Entertainment	085 Design	0	0	0
066	085	066 - Other Goods & Services	085 Design	34,547	0	34,547
			Total Cost:	575,357	0	575,357
			Original Cost:	82,406		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47752
Title: 4S-333 Bentinck St. Rebuild
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	$ 1	$ 8,508	$ 8,508		
			Sub-Total	$ 8,508		
012 Materials						
Poles, Anchors and Guys	Lot	$ 1	$ 38,673	$ 38,673		
Overhead Conductor	Lot	$ 1	$ 15,214	$ 15,214		
Cutouts	Lot	$ 1	$ 1,352	$ 1,352		
Overhead Transformer	Lot	$ 1	$ 16,186	$ 16,186		
Underground Conductor	Lot	$ 1	$ 887	$ 887		
Services	Lot	$ 1	$ 1,275	$ 1,275		
			Sub-Total	$ 73,588		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 272,034		
Tree Trimming	Lot	$ 1	$ 25,000	$ 25,000		
Backhoe	Lot	$ 1	$ 14,250	$ 14,250		
Flagging	Lot	$ 1	$ 34,185	$ 34,185		
			Sub-Total	$ 345,469		
020 Easements						
Easements	Lot	$ 1	$ 40,000	$ 40,000		
			Sub-Total	$ 40,000		
066 Other Goods & Services						
Contingency	%	10%	$ 345,469	$ 34,547		
			Sub-Total	$ 34,547		
094 Interest Capitalized						
AFUDC				$ 3,185		
			Sub-Total	$ 3,185		
095 Administrative Overhead						
COPS Contract AO				$ 70,061		
			Sub-Total	$ 70,061		
			SUB-TOTAL (no AO, AFUDC)	$ 502,111		
			TOTAL (AO, AFUDC included)	$ 575,357		
Original Cost				$ 82,406		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

Sydney 4kV Conversion
DISTRIBUTION PLANNING STUDY

Report number 283-0212-E27

Revision		Date	Drafted By	Reviewed by	Approved By
0	Issued for Study	16-Feb-2012	JMQ		
1	Issued for Release	16-Aug-2013	JMQ	MGS PZ	

EXECUTIVE SUMMARY

This study was initiated by the Eastern Territory, in order to determine solutions to the reduction of the islanded 4kV in Sydney and consider the anticipated near term load growth developments in the Membertou area. The scope of this study encompasses the conversion of both 533S-Mason Street and 6S-Terrace Street.

The conversion of 533S-Mason Street, from 4kV to 12kV will enable the creation of another supply into Membertou. This will enable the transfer of load from the existing Membertou feeders, to a feeder with reduced loading, as developments in the community continue.

Future studies investigating any additional transformation requirements and transmission impacts to the Sydney area due to the anticipated growth in the Membertou area will be carried out if and/or when necessary..

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1.0 SCOPE

This study was initiated by the Eastern Territory and undertaken by the Distribution Planning Department to outline the conversion of the islanded 4kV and the future retirement of the 6S-Terrace Street substation.

The conversion of 533S-Mason Street will remove the remaining 4kV in the Shipyard area of Sydney. A reconfiguration of the feeders in the area will change the supply to the Shipyard area and Kings Road. A new feeder tie will be created, in the future to meet the near term growth, in the Membertou area.

The initial 4kV load conversions from 6S-Terrace Street to 12kV supplied by 4S-Townsend Street will enable the installation of the mobile substation, 3P-MS, without the requirement to transfer additional load, under peak loading conditions. This initial 4kV load reduction at 6S-Terrace Street will also enable the removal of the existing deteriorated breakers, at the substation. These breakers will be replaced with pole mounted reclosers. The duration of conversions, in subsequent years, also considers the performance of scheduled maintenance on 6S-T1, in 2018.

Subsequent studies will be completed to examine the transmission and transformation requirements in the Sydney area.

2.0 EXISTING SYSTEMS

2.1 Distribution

The distribution system studied in this report includes the feeders supplied from 6S-Terrace Street, as well as the impacted feeders from 4S-Townsend Street and 11S-Keltic Drive.

Table 1 pvovides the transformer data for the substations that are directly impacted by the scope of this study.

Table 1 Sydney Area Distribution Transformers

Substation	Transformer Data				
	ID	MAN	kV	Rating	Age
4S-Townsend Street	T52	Federal Pioneer	69-12.47	15/20//24.6	1972
4S-Townsend Street	T53	Federal Pioneer	69-12.47	15/20//22.4	1973
6S-Terrace Street	T1	Moloney Electric	69-4.16	7.5/10	1969
11S-Keltic Drive	T1	Federal Pioneer	69-12.47	10/13.3//14.9	1972
11S-Keltic Drive	T2	Federal Pioneer	69-12.47	10/13//14.8	1972
11S-Keltic Drive	T53	Virginia Transformer	69-26.4	15/20/25	1999

2.1.1 533S-Mason Street

Currently, the 533S-Mason Street stepdown transformer is supplied by feeder 4S-333 originating from the 4S-Townsend Street substation, as seen in Figure 1. The three 333kVA, single phase stepdown transformers at 533S-Mason Street supply a portion of Argyle Street, including Alexandria, Yendys, and Warne Streets and Xavier Drive, as illustrated in Figure 1 below.

The customer profile served by this feeder, 533S-211, includes guest homes. There are no other 4kV sources in the area, to easily transfer load.

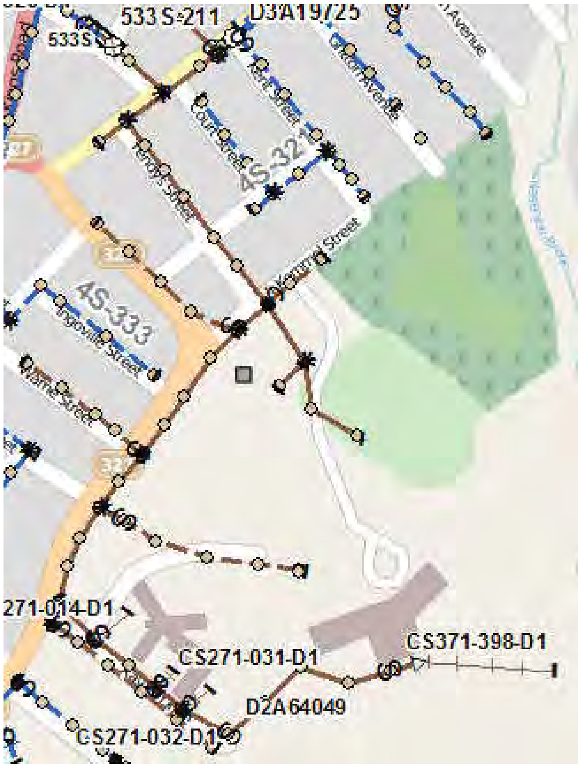

Figure 1 **533S-Mason Street extents**

2.1.2 6S-Terrace Street

The lone transformer in the 6S-Terrace Street, 6S-T1, was placed into service in 1969. This 69-4kV transformer is rated at 7.5/10MVA. The transformer annually peaks above 6MVA, with a maximum winter peak of 6.7MVA, recoded in the winter 2010 / 2011.The only suitable mobile transformer, in the NSPI fleet is 3P-MS, which is rated at 6MVA at 4kV. Given this, the mobile transformer is unable to assume the peak load on 6S-T1 without transferring a portion of customer load to 534S; the neighbouring 4kV stepdown transformer. While this response to a loss of 6S-T1 is feasible, it would extend the duration of the outage experienced by customers due to the failure of 6S-T1. The 4kV area supplied by 6S-Terrace Street can be found below, in Figure 2.

The average age of the distribution plant in the area is greater than 40 years. At the present time, there is difficulty with maintaining the substation breakers due to the age and condition of the building structure. There is also an inability to source replacement components for the breakers themselves represent a significant reliability concern. With these in mind, a replacement plan for this plant will be required in the near future..

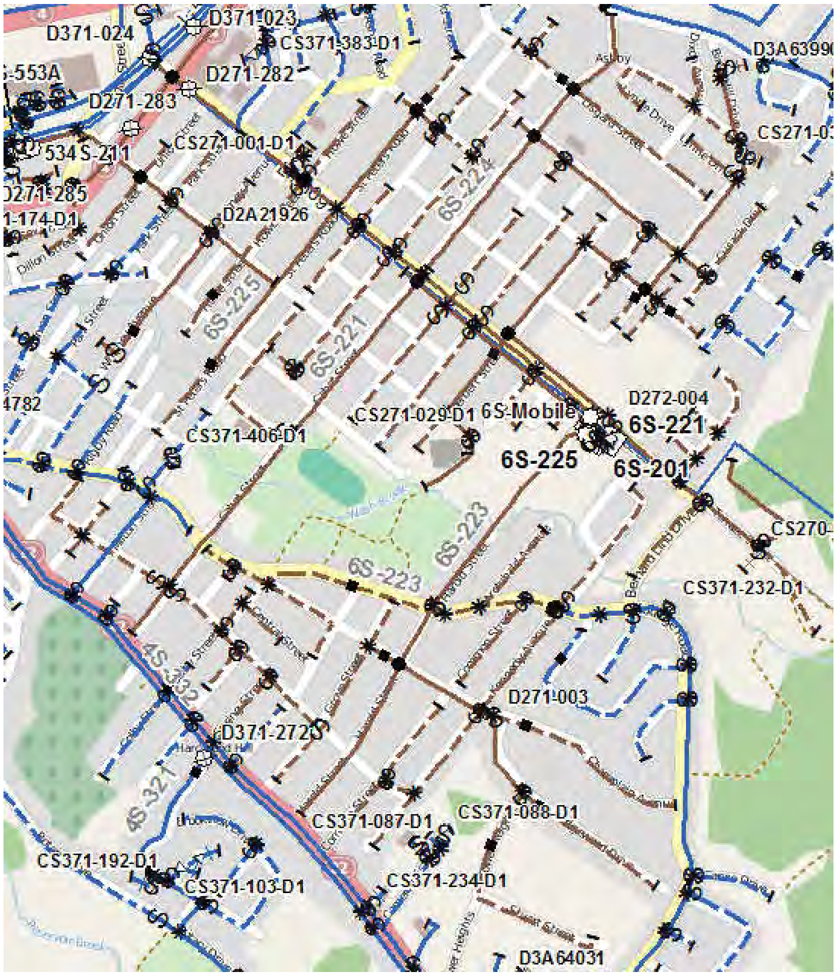

Figure 2 6S-Terrace Street extents

3.0 LOAD HISTORY AND FORECAST

The loading for those feeders being studied is largely residential, with a small number of commercial customers. As illustrated in the load history for these feeders, Appendix B, the feeders being studied have had a larger winter peak than summer. Historical load data for the feeders and transformers being studied was collected from the Distribution Load Check Database.

3.1 Load History

Customer load has been generally consistent in the Sydney area, demonstrating a slight overall growth in recent years. That being stated, the community of Membertou has seen the largest growth, in the Sydney in recent years. This load growth is anticipated to continue for the next several years, with some of the proposed developments outlined in subsequent sections of this study.

The growth rates indicated in Table 2 were determined through examination of the peak load check data over the past 15 years. The forecasted load growth was then calculated using the 90th percentile, to determine potential peak load growth in the area.

Table 2 Growth Rates; 1997 - 2012

Transformer	2012 Load in MVA	Load Growth	Notes
4S-T52	18.13	-0.84%	
4S-T53	16.99	1.31%	Current Membertou Supply
6S-T1	6.4	0.21%	
11S-T1	12.48	1.09%	
11S-T2	14.59	0.90%	
Feeder	**2012 Load in AMPS**	**Load Growth**	**Notes**
6S-221	49.17	-2.93%	
6S-223			No Load Check Data
6S-224	176.33	0.43%	
6S-225			No Load Check Data
4S-321	220.33	2.29%	Rotary Drive Supply
4S-324	261	0.32%	Ashby Supply
4S-331	214.33	3.20%	534S Stepdown transformer
4S-332	292.67	-0.57%	South George Street and Alternate Membertou Supply
4S-333	269	0.79%	533S Stepdown transformer Current Membertou Supply
4S-334	249.33	4.66%	South Esplanade Supply
11S-302	300	1.15%	Sydney River area Supply
11S-305	300	0.03%	South Alexandra Street and Alternate Membertou Supply

3.2 Load Forecast

The 90th percentile load forecasts for the 12kV feeders at 4S-Townsend Street and 11S-Keltic Drive impacted by this study; as well as the 4kV feeders at 6S-Terrace Street are presented in the following tables. The forecasted loading of the substation transformers are indicated in Table 5.

Table 3 90th Percentile Load Forecast for 12kV Feeders, in Amps

	4S-321	4S-324	4S-331	4S-332	4S-333	4S-334		11S-302	11S-305
2012 / 2013	322.90	296.84	321.92	339.22	264.86	275.90		300.64	300.98
2013 / 2014	331.61	297.80	334.88	337.36	267.07	293.93		304.39	301.07
2014 / 2015	340.31	298.75	347.84	335.50	269.28	311.95		308.15	301.17
2015 / 2016	349.02	299.71	360.81	333.64	271.49	329.98		311.90	301.27
2016 / 2017	357.72	300.67	373.77	331.79	273.69	348.01		315.65	301.37
2017 / 2018	366.42	301.63	386.74	329.93	275.90	366.04		319.40	301.46
2018 / 2019	375.13	302.59	399.70	328.07	278.11	384.07		323.16	301.56
2019 / 2020	383.83	303.55	412.67	326.21	280.32	402.10		326.91	301.66
2020 / 2021	392.54	304.51	425.63	324.35	282.53	420.12		330.66	301.76
2021 / 2022	401.24	305.47	438.60	322.49	284.74	438.15		334.41	301.85
2022 / 2023	409.95	306.43	451.56	320.63	286.95	456.18		338.17	301.95
2023 / 2024	418.65	307.38	464.53	318.77	289.15	474.21		341.92	302.05
2024 / 2025	427.35	308.34	477.49	316.92	291.36	492.24		345.67	302.15
2025 / 2026	436.06	309.30	490.46	315.06	293.57	510.27		349.43	302.24
2026 / 2027	444.76	310.26	503.42	313.20	295.78	528.29		353.18	302.34
2027 / 2028	453.47	311.22	516.38	311.34	297.99	546.32		356.93	302.44

Table 4 90th Percentile Load Forecast 6S-Terrace Street, in Amps

	6S-221	6S-223	6S-224	6S-225
2012 / 2013	286.08	180.88	327.08	358.16
2013 / 2014	286.47	171.96	328.70	361.49
2014 / 2015	286.86	163.05	330.31	364.82
2015 / 2016	287.25	154.13	331.93	368.15
2016 / 2017	287.64	145.22	333.55	371.48
2017 / 2018	288.03	136.30	335.17	374.81
2018 / 2019	288.42	127.39	336.79	378.13
2019 / 2020	288.81	118.47	338.41	381.46
2020 / 2021	289.20	109.56	340.03	384.79
2021 / 2022	289.59	100.64	341.65	388.12
2022 / 2023	289.98	91.73	343.27	391.45
2023 / 2024	290.37	82.81	344.89	394.78
2024 / 2025	290.76	73.90	346.51	398.11
2025 / 2026	291.15	64.98	348.13	401.44
2026 / 2027	291.54	56.07	349.75	404.77
2027 / 2028	291.93	47.15	351.37	408.09

Table 5 90th Percentile Load Forecast for Sydney Transformers, in MVA

	4S-T52	4S-T53	4S Total	6S-T1	11S-T1	11S-T2	11S Total
2012 / 2013	19.90	21.06	55.30	6.73	15.62	15.39	33.82
2013 / 2014	19.74	21.36	58.13	6.74	15.80	15.54	34.47
2014 / 2015	19.58	21.67	60.97	6.75	15.99	15.69	35.12
2015 / 2016	19.42	21.97	63.80	6.77	16.17	15.84	35.76
2016 / 2017	19.27	22.27	66.64	6.78	16.36	15.98	36.41
2017 / 2018	19.11	22.58	69.47	6.80	16.54	16.13	37.05
2018 / 2019	18.95	22.88	72.31	6.81	16.72	16.28	37.70
2019 / 2020	18.79	23.18	75.14	6.83	16.91	16.43	38.34
2020 / 2021	18.64	23.48	77.98	6.84	17.09	16.58	38.99
2021 / 2022	18.48	23.79	80.81	6.85	17.28	16.72	39.63
2022 / 2023	18.32	24.09	83.65	6.87	17.46	16.87	40.28
2023 / 2024	18.16	24.39	86.49	6.88	17.64	17.02	40.93
2024 / 2025	18.01	24.69	89.32	6.90	17.83	17.17	41.57
2025 / 2026	17.85	25.00	92.16	6.91	18.01	17.32	42.22
2026 / 2027	17.69	25.30	94.99	6.93	18.20	17.47	42.86
2027 / 2028	17.53	25.60	97.83	6.94	18.38	17.61	43.51

4.0 OVERLOADS AND OTHER CONSIDERATIONS

The following section identifies issues that warrant correction based on NSPI's *Capital Expenditure Justification Criteria*.

4.1 Feeder Overloads

There are several feeders whose peak loading is approaching 325A. These peak values can be seen in the feeder histories, located in Appendix B. These feeders include:

- 6S-224 consistently peaked above 300A,with a peak above 325A in 2010
- 6S-225 peaked above 300A, in 2003 and 2004

4.2 Contingency Loss of Supply

4.2.1 6S-T1

The lone transformer at 6S-Terrace Street, 6S-T1, has not exceeded its nameplate rating, in recent years, however the peak winter loading has exceeded the capacity of the mobile substation, 3P-MS. As there are no other 4kV substations, in the vicinity of 6S-Terrace Street, the 6S-T1 contingency response would require the installation of 3P-MS and transferring portions of load to 534S a local stepdown transformer, under peak loading conditions.

4.2.2 533S-Mason Street

533S-Mason Street is currently supplied from 4S-333. In the event of loss of this feeder, there is no other 4kV feeder near the stepdown transformer, to supply its load. The duration of an outage caused by stepdown transformer failure depends on the installation of an available replacement transformer, at 533S-Mason Street.

4.3 Age of Plant

The average age of poles and equipment in the Hardwood Hill area of Sydney is greater than 40 years old. Inspections have confirmed this equipment is at or is nearing full service life.

The current breakers at 6S-Terrace Street are obsolete. The breaker manufacturer is no longer in business. With this in mind, the sourcing of replacement components is near impossible. Added to this is the deteriorated condition of the breaker house. In the event of a breaker failure, the duration of an outage would be significant in length.

With this in mind, a planned replacement of these poles and equipment will enable the budgeting of phased replacement over a period of time. The planning of these replacements will also minimize disruptions to customers.

4.4 Proposed Load Growth

There are several areas of load growth in the Sydney area impacting this study. The two largest developments are detailed below.

4.4.1 Membertou Load Growth

The community of Membertou is in the midst of a large growth, through commercial and residential developments within the community. The anticipated increase in load has been considered throughout this study. Future development plans in the community include:

- Multi-surface ice rink (construction commencing summer 2013)
- New School
- New overpass across Highway 125 related to a new multi-unit Business Park,
- Expanding residential housing areas

Currently there are three supplies into the area, via Churchill Drive and Membertou Street, as seen in Figure 3 and Figure 4. The two feeders capable of supplying the area from the Kings Road side of the development, 11S-305 and 4S-333, do not have excess capacity to serve this proposed growth. The third feeder, 4S-332, has less capacity than those feeders capable supplying from the other side of the development. From the 2011/2012 winter load checks these feeders were measured at 249amps, 269amps, and 292amps respectively. Accordingly, a prolonged outage of one of these feeders could result in an extended customer outage, as the remaining feeders cannot support the peak winter load.

Figure 3 **Feeders Currently Serving Membertou from Kings Road area**

Figure 4 Feeder Currently Serving Membertou from George Street area

4.4.2 Cossitt Heights New Housing Development

A new housing development is planned for the Cossitt Heights area. This new subdivision is approximately 114 Acres and is slated to have both detached homes and multi-unit dwellings. This load will be added to one of the following feeders; 4S-324 or 4S-331. The area of this proposed development is shown below, in Figure 5.

Figure 5 Cossitt Heights Residential Development

5.0 SOLUTIONS AND EVALUATION

The 4kV load supplied by 533S-Mason Street does not have any adjacent 4kV sources. Additionally, the anticipated growth in the Membertou area will exceed the current available capacity, in the area in the near term. Solutions to these separate issues need to be determined.

The peak 4kV loading at 6S-Terrace Street consistently exceeds the rating of the mobile substation, 3P-MS. Considering the aging infrastructure at the 6S-Terrace Street substation, there exists a requirement to reduce loading, to enable the replacement of the existing breakers with pole mounted reclosers. This replacement will further extend the service life of the substation. The length of this extension will be discussed in details, in a subsequent section of this report.

5.1 533S-Mason Street

Currently, there are three feeders capable of supplying the Membertou area; 11S-305, 4S-333 and 4S-332. Two of these feeders, 11S-305 and 4S-333 supply Membertou from the Alexandra Street. 4S-332 enters from the George Street side of the community, but does not supply load in Membertou. Presently, these three feeders are heavily loaded, with 4S-332 serving as the primary supply for the Cape Breton Regional Hospital. With this in mind, reducing the load on the existing feeder supplying Membertou or the extension of another feeder into Membertou is required to meet the forthcoming load, currently in the early project stages.

Four alternatives have been outlined below; each outlines the creation of more flexibility and capacity available to supply Membertou, from the Kings Road side of the reserve. These alternatives will also address the islanded 4kV being supplied via the 533S-Mason Street stepdown transformer, in different manners.

The first of option outlined, Alternative 533S-A, would see the removal of the 533S-Mason Street stepdown transformer through the conversion of 533S-211 from 4kV to 12kV. In conjunction with converting the stepdown, the load would be supplied from a newly created 12kV double circuit routed from School Street to Mason Street. The transferring of customer load from 4S-333 to 4S-334 will enable more customer load to be added to 4S-333. Another feeder supply into Membertou would be created, via Towerview Place. This new source into Membertou would be supplied by 4S-334. New feeder ties would be created with 11S-305 and 4S-321, to increase the available switching and contingency options in the area.

The second alternative proposed, Alternative 533S-B, is similar to Alternative 533S-A in that it proposes the removal of 533S-Mason Street, by way of conversion to 12kV. This alternative would also propose the primary Membertou supply changed from 4S-333 to 4S-334. This change of supply would occur by extending 4S-334 along Kings Road and removing the 4S-333 supply to Kings Road. The removal of this deteriorated off road section of line, between Kings Road and George Street, will increase the reliability of the supply along Kings Road. Mason Street and Argyle Street would then be supplied by Bentinck Street. The conversion of 533S-Mason Street, as well as the construction of an additional Membertou supply is similar to that outlined in Alternative 533S-A.

The third alternative proposed, Alternative 533S-C, would construct a double circuit along Kings Road to Churchill Drive. The supply for Membertou would change from 4S-333 to 4S-334, as this a feeder with more available capacity. While this alternative would add contingency to the Membertou supply, it does not address the contingency concerns for 533S-Mason Street.

The fourth alternative proposed, Alternative 533S-D, would require the extension of 11S-305 and converting 533S-211 along Alexandra Street to Yendys Street. This alternative would see the conversion of the guest homes on Xavier Drive to 12kV, thereby adding contingency options, in the event of loss of supply. While this alternative would reduce some of the customer load on 4S-333, it does add additional load onto 11S-305, a feeder with little additional capacity available.

The details of the four alternative solutions are outlined in further detail below.

5.1.1 Alternative 533S- A Convert 533S-Mason Street, via Kings Road Supply

The conversion 533S-Mason Street from 4kV to 12kV would remove the islanded 4kV system in Sydney. Mason Street would then be supplied from 4S-334 by way of constructing a double circuit on the existing poles along Kings Road from School Street to Mason Street. Also to be included in this conversion is the extension of the newly converted 533S-211 to Membertou Road, to create additional feeder ties in the area. Refer to Figure 6 for an overview, of this proposed work.

Currently, three of the four padmount transformers on 533S-211 are dual voltage rated (at 4kV and 12kV) and would not require replacement as part of the voltage conversion. Due to the age of the poles and equipment, in the area, the main three phase pole line from Argyle Street to Alexandra Street will need to be rebuilt. The existing poles in this area are approaching their end of service life and do not meet the height requirements for a three phase 12kV system. The additional single phase circuit along Xavier Drive would be removed, but the poles and secondary would remain.

An alternate supply into Membertou would be created through the extension and rebuild of Alexandra Street feeders, from Xavier Drive to Harbourview Drive and an extension and rebuild of Towerview Place feeder. This new supply into Membertou will enable the transferring of load between 4S-333 and 4S-334.

The conversion of Alexandra and Argyle Streets would create the ability for future feeder ties between the existing 4S-334 and 11S-305 (Alexandra Street) and 4S-321 (George Street). These feeder ties would enable greater contingency response and flexibility in the area.

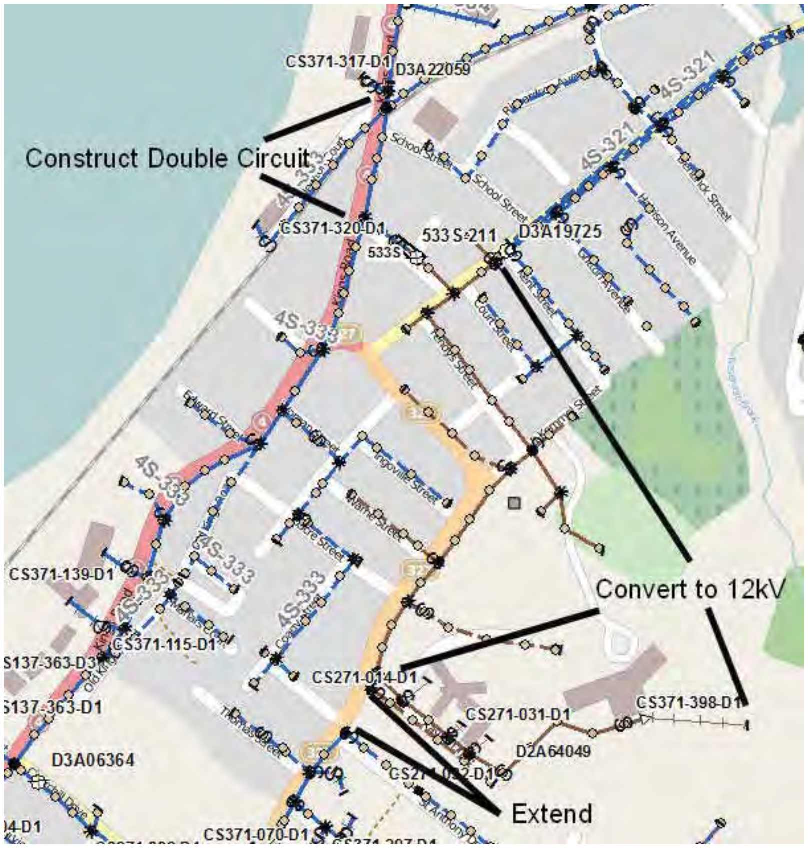

Figure 6 **Alternative 533S-A** **533S-Mason Street Conversion**

5.1.2 Alternative 533S-B Convert 533S-Mason Street, via Bentinck Street

Alternative 533S-B would see the supply on Kings Road between School Street and Churchill Drive change from 4S-333 to 4S-334. This alternative would also see the conversion to 12kV of the islanded 4kV supplied by 533S-Mason Street to 12kV. Also included in this alternative would be the creation of another supply into Membertou via Towerview Place. Refer to Figure 7 for an overview of this proposed work.

Currently, Kings Road is supplied by 4S-333 which has a large off-road section, between Townsend Street and Kings Road. This off-road section is along the existing railway tracks, limiting access and prolonging response time to faults on this section of line. This off-road section is deteriorated and approaching its end of service life. Feeder 4S-334 currently supplies a portion of Kings Road from Falmouth Street to just prior to School Street; extending 4S-334 along Kings Road would be accomplished through the reconfiguration of the distribution at the Kings Road and School Street intersection. This reconfiguration would enable the use of a lightly loaded feeder, 4S-334, to supply Kings Road and Membertou.

In addition to resupplying a portion of Kings Road, the removal of the islanded 4kV supplied by 533S-Mason Street would also be addressed. The conversion, as outlined in Alternative 533S-A would entail the conversion of the lone 4kV feeder, 533S-211, to 12kV. Supplying this new section of 12kV would be accomplished through the rebuilding of Bentinck Street and supplying Argyle Street via 4S-333.

With the newly converted section of 4S-333 along Alexandra Street, the opportunity exists to create an additional supply into Membertou, as outlined in Alternative 533S-A, through the extension and rebuilding of Alexandra Street from Xavier Drive to Castle Drive. Extending the 3 phase circuit along Towerview Place to the Millard Street intersection would bring a second lightly loaded feeder into Membertou, 4S-333.

The detailed outline of this conversion and feeder tie creation is outlined in the recommendations section of this study.

Figure 7 **Alternative 533S-B** **Reconfigure Shipyard Supply**

5.1.3 Alternative 533S-C Double circuit Kings Road to Churchill Drive

Alternative 533S-C would see the construction of a double circuit along Kings Road, from School Street to Churchill Drive. The supply for Churchill Drive would change from 4S-333 to 4S-334. This would change one of the supplies for Membertou, with a lighter loaded feeder. This would enable the ability to supply a portion of the proposed load growth for the area in the short term. This is shown below, in Figure 8.

In completing this alternative, there is no provision to remove the islanded 4kV stepdown at 533S-Mason Street. This section of islanded 4kV load would remain unaddressed.

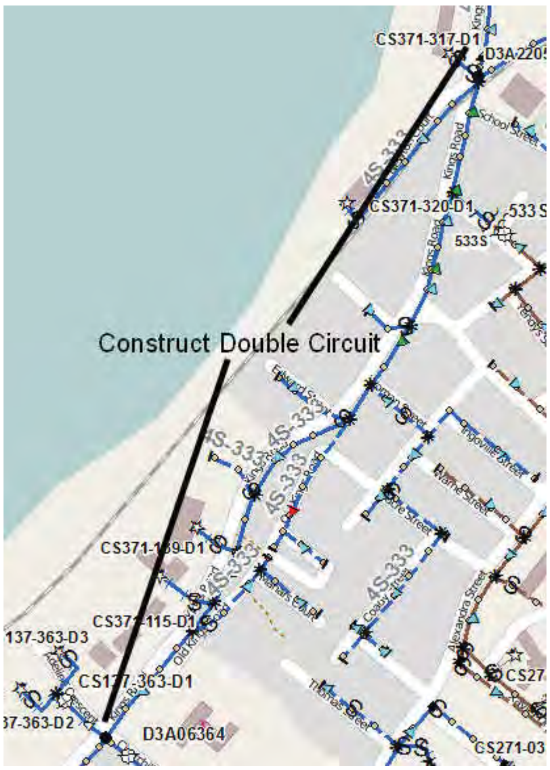

Figure 8 Alternative 533S-C Construct Double Circuit on Kings Road

5.1.4 Alternative 533S-D Reconductor and Convert Alexandra Street to 12kV

This alternative would reconductor of Alexandra Street, from Membertou Street to Mt Kemmel Street. This reconductoring would enable the 12kV conversion of Alexandra Street from Xavier to Mt Kemmel Street. This conversion will place the guest homes on Xavier Drive onto the 12kV system, enabling them to be supplied from two different substations, 4S-Terrace Street and 11S-Keltic Drive. This will require a new open point at Mt Kemmel Street. Another open point will need to be added to the other side of Membertou Street opposite to D371-351.This will allow for more options for contingency response to shorten outage durations. Refer to Figure 9, below.

This alternative will convert the customer loads of the retirement homes and other customers to the 12kV supply. This alternative will also reduce the loading on 4S-333, as the customer load currently on 533-211 would be partially converted and supplied by 11S-305. There are limited contingency options with this alternative, as 11S-305 has limited capacity available due to its current configuration.

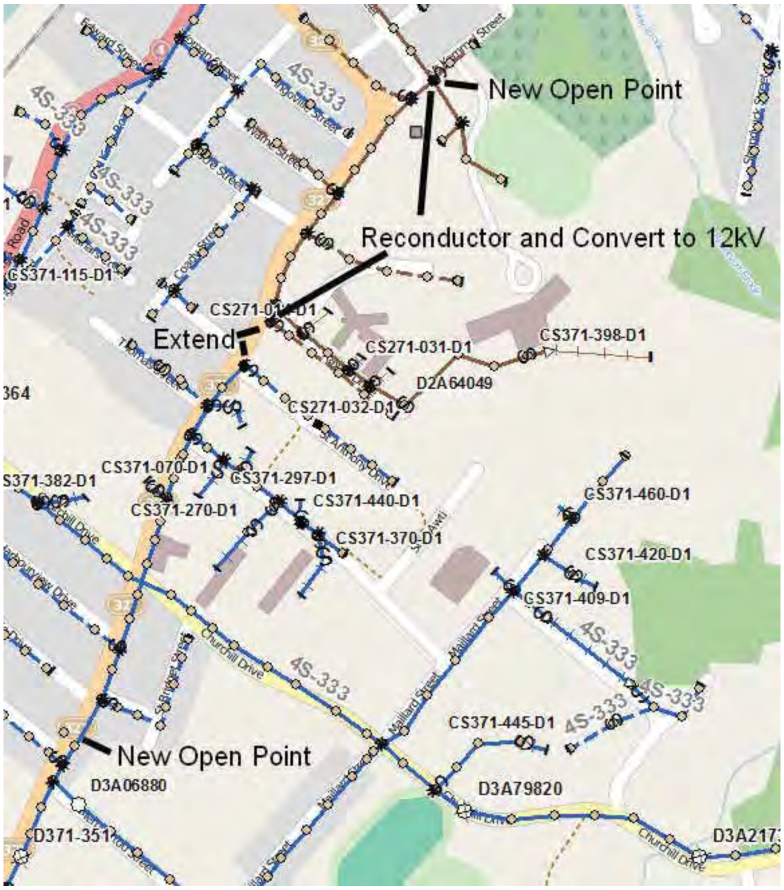

Figure 9 Alternative 533S-D Reconductor Alexandra Street

5.1.5 533S-Mason Street Recommendation

While Alternative 533S-B is not the least cost alternative, it does provide the greatest long term benefit through the creation of a new supply into Membertou. This alternative also will see the conversion of the islanded 4kV to 12kV. This conversion will increase the contingency options in the area, as well as increase the reliability along Kings Road through the relocation to roadside of the existing deteriorated off-road supply, 4S-333.

A detailed outline of the 533S-Mason Street conversions and rebuilding of 4S-333 is outlined in the recommendations section of this study.

5.2 6S-Terrace Street

The substation infrastructure at the 6S-Terrace Street substation is approaching its end of service life. In order to extend the service life of the substation, the replacement of the existing breakers with reclosers is included in each alternative outlined below. In order to facilitate the replacement of these breakers, an overall reduction of load on 6S-T1 is necessary. This eventually leads to the planned retirement of 6S-T1 upon completion of the 4kV conversion.

Additionally, the 4kV distribution plant supplied by 6S-Terrace Street is approaching its end of service life. The planned replacement and conversion of this equipment is the basis for the differing alternatives outlined below.

The first option, Alternative 6S-A, would meet the requirement to reduce the loading on 6S-T1, to enable the installation of the mobile substation without the need to transfer load. Conversions from 4 kV to 12kV would continue in the following two years, with the 6S-Terrace Street substation being retired in 2016. While this alternative would see the accelerated retirement of the 6S-Terrace Street substation, it would require a great deal of resources through the duration of the conversions. Due to the amount of load to be converted, there would be a great deal of customer interruptions, in the area.

The second option, Alternative 6S-B, would meet the requirement to reduce the loading on 6S-T1, to enable the installation of the mobile substation without the need to transfer load. Conversions from 4kV to 12kV would continue over the next four years, with the 6S-Terrace Street substation being retired in 2018. Completing the conversions before 2018 adheres to the current 8 year maintenance cycle of 6S-T1 and does not require the scheduled maintenance to be performed in 2018. The pace of conversions, while not as ambitious as Alternative 6S-A, still require a large amount of resources, to minimize customer interruptions, in the area.

The third option, Alternative 6S-C, would meet the requirement to reduce the loading on 6S-T1, to enable the installation of the mobile substation without the need to transfer load. Conversions from 4kV to 12kV would continue over the next six years, with the 6S-Terrace Street substation being retired in 2021. This alternative, unlike the previous would require the maintenance of 6S-T1 in 2018. The rate of conversions, in this alternative would not require as many resources as the previous alternatives.

5.2.1 Alternative 6S-A Convert and Retire 6S-Terrace Street by 2016

The initial 4-12kV conversions at 6S-Terrace Street are required to reduce the overall peak loading at the substation, such that the mobile substation can be installed without the need to transfer a portion of load to the 534S step down transformer, under peak loading conditions. Additionally, this load reduction would enable the installation of pole mounted reclosers to enable the removal of the existing deteriorated breakers and structure.

The pace of the remaining conversions will enable the retirement of the 6S-Terrace Street substation by 2016. The conversions would require significant resources to ensure the completion of work, while minimizing customer interruptions, in the area.

5.2.2 Alternative 6S-B Convert and Retire 6S-Terrace Street by 2018

Similarly to Alternative 6S-A, the initial 4kV to 12kV conversions at the 6S-Terrace Street are required to reduce the overall loading at the substation, to enable the installation of the mobile substation without the need to transfer a portion of load to 534S, under peak loading conditions.
The remaining 4kV to 12kV conversions would be completed over the next four years to enable the retirement of the 6S-T1 in 2018. Removing the remaining load from 6S-T1 by 2018 will not require the maintenance of the transformer, prior to retirement.

5.2.3 Alternative 6S-C Convert and Retire 6S-Terrace Street by 2021

Similarly to Alternative 6S-A, the initial 4kV to 12kV conversions at the 6S-Terrace Street are required to reduce the overall loading at the substation, to enable the installation of the mobile substation without the need to transfer a portion of load to 534S, under peak loading conditions.

The remaining conversions in this alternative would distribute the resource requirements over a six year period, with the retirement of the 6S-Terrace Street substation in 2021. This alternative will require that the scheduled maintenance be performed on 6S-T1, in 2018.

5.2.4 6S-Terrace Street Recommendation

Alternative 6S-C is the least cost option in comparison to the other alternatives, as indicated in the Economic Assessment, in Appendix C. This alternative will initially reduce the loading at 6S-Terrace Street by way of conversions to 12kV, to enable the replacement of the 4kV breakers with reclosers. These conversions will also enable the installation of the mobile substation without the need to transfer load, in the event of a failure of 6S-T1 under peak loading.

This alternative will also see the remaining conversion of 4kV load to 12kV over an additional six years. Although continuing to utilize 6S-T1 beyond 2018 requires maintenance to be carried out, this alternative is still the least cost alternative.

A detailed outline of the forthcoming conversions and substation construction is outlined in the recommendations section of this study.

6.0 RECOMMENDATIONS

In summary, the following provide the impetus for the recommendations contained herein:

- The 4kV distribution facilities at 6S-Terrace Street are nearing its end of service life and key components are obsolete, exposing customers to prolonged outages.
- The 4kV distribution facilities at 533S-Mason Street and 6S-Terrace Street are islanded 4kV that are susceptible to prolonged outages as load cannot be transferred to any adjacent feeders
- The continuing load growth in the Membertou community requires additional distribution capacity, greater than those feeders currently supplying the area.
- Schemes to rebalance loading across adjacent feeders are sufficient for the near term, but do not address the longer term needs

Accordingly, this study recommends the conversion of 533S-Mason Street, as outlined in Alternative 533S-B, section 5.1.2. This alternative provides the greatest flexibility in the area, to meet the near term anticipated load growth.

The Economic Assessment Model, refer to Appendix C, recommends the conversions of the 4kV distribution supplied by 6S-Terrace Street be converted to 12kV by 2020. Upon completion of these conversions, the 6S-Terrace Street substation will be retired.

A detailed outline of the components of each of these alternatives is outlined below, organized by capital year completion.

6.1 533S-Mason Street

Alternative B was selected as the option to proceed with, as it offers the greatest flexibility to meet the customer load growth in Membertou, through the conversion of 533S-211. This is a more costly option in comparison to the other alternatives, but it creates a new supply into Membertou, as well as creating new contingency options, with the creation of new feeder ties, between 4S-Townsend Street and 11S-Keltic Drive.

This alternative also addresses the lack of contingency options that are currently available, in the event of loss of supply to the 533S-Mason Street stepdown transformers.

6.1.1 2013 Capital Year

6.1.1.1 Shipyard Area Reconfigure

This portion of the project outlines the change of supply within the Shipyard area, of Sydney. The supply for Kings Road will be changed from 4S-333 to 4S-334.The supply for Argyle Street will also be changed from 4S-321 to 4S-333. Refer to Figure 10 below. The details of this work are as follows:

- Dead-end 4S-333 adjacent to railway tracks, at Bentinck Street and open.
- Jumper 4S-334, to the existing 4S-333, on Kings Road.
- Remove the de-energized section of 4S-333, adjacent to the railway tracks, from Kings Road to Bentinck Street.
- Rebuild Bentinck Street, from Crescent Street to Argyle Street, to 3 phases.
- Open Argyle Street at George Street.

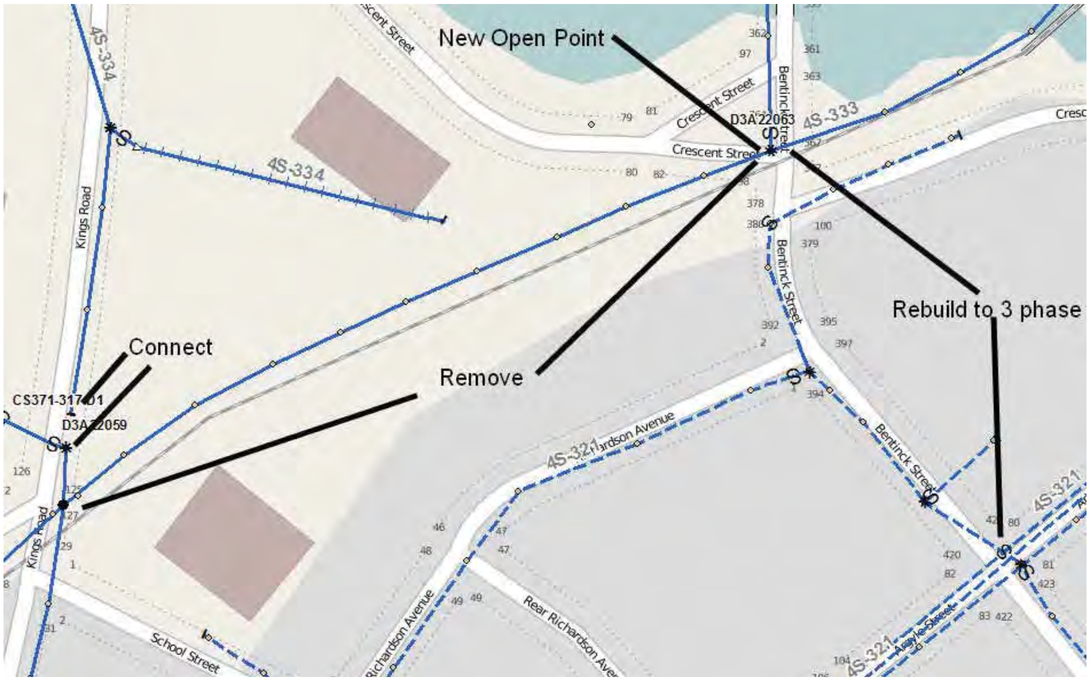

Figure 10 **2013 Reconfigure Supply to Shipyard Area**

6.1.1.2 533S- Mason Street Conversion

This portion of the project will convert 533S-Mason Street changing the supply to the area from Kings Road to Argyle Street. This portion of the project will also see the removal of the 533S-Mason Street stepdown, upon completion of the conversion to 12kV. Upon completion of this portion of the project, Alexandra Street will be supplied by 4S-333 from Yendys Street to Harbourview Drive. Refer to Figure 11 below. The details are as follows;

- Reconductor Mason Street to 336.
- Open Mason Street, at Kings Road
- Close D3A19725 on Argyle Street, at Kent Street
- Replace neutral on Argyle Street and Yendys Streets to 4/0.
- Reconductor primary and neutral on Xavier Drive to 2/0ACSR.
- Remove single phase primary on Xavier Drive.
- Convert area from 4kV to 12kV.

Figure 11 **2013 533S-Mason Street Conversion**

6.1.2 2014 Capital Year

The work, to be completed within the 2014 capital year, is a continuation of the work that is to commence in 2013. These two portions of the project will increase the reliability and contingency within the Shipyard and Membertou areas.

These projects may need to be advanced, depending on the load growth, in the Membertou area.

6.1.2.1 Bentinck Street Upgrades

This portion of the project will upgrade the remaining conductor on Bentinck Street, to enable the removal of the remaining off-road section of feeder, along the railway tracks. This feeder 4S-333, is deteriorated and approaching its end of life. Rebuilding Bentinck Street and reconductoring the previously retired 4kV conductor on Townsend Street will enable 4S-333 to be adjacent to the road, from the substation to the majority of the load it supplies. Refer to Figure 12 below. The details are as follows:

- Reconductor Bentinck Street, from Crescent Street to Townsend Street.

- Reconductor lower circuit on Townsend Street, from 4S-Townsend Street to Bentinck Street, with 336.
- Remove 4S-333, adjacent to the railway tracks, from Bentinck Street to Townsend Street, except for the first two spans from George Street towards Townsend Street.
- Install new 3 phase tap from the remaining portion of 4S-333 to the top circuit along George Street, to supply the customers at the start of Glenwood Street.

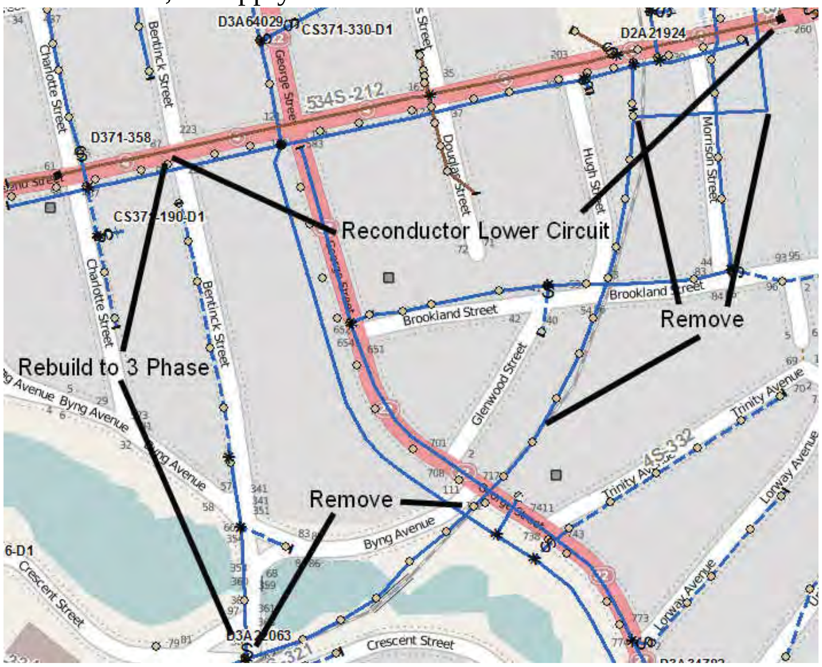

Figure 12 **2014 Bentinck Street Upgrades**

6.1.2.2 Membertou Feeder Tie

This portion of the project will see the creation of a feeder tie between the recently converted portion of Alexandra Street and the existing feeder on Alexandra Street. Also included in this portion of work is the construction of an additional feeder tie with the primary Membertou supply, on Maillard Street. Refer to Figure 13 below. The details are as follows:

- Extend newly converted 12kV (4S-333) along Alexandra Street to St. Anthony Drive, reconductoring from St Anthony Drive to the new open point with 336.
- Create new, normally closed, solid blade, sectionalizing point on Alexandra Street, at Xavier Drive.
- Create new open point on Alexandra Street, between Castle Drive and Harbourview Drive.
- Reconductor Towerview Place and extend to Maillard Street.
- Create new open point, on Maillard Street, on the north side of the intersection of Churchill Drive and Maillard Street.

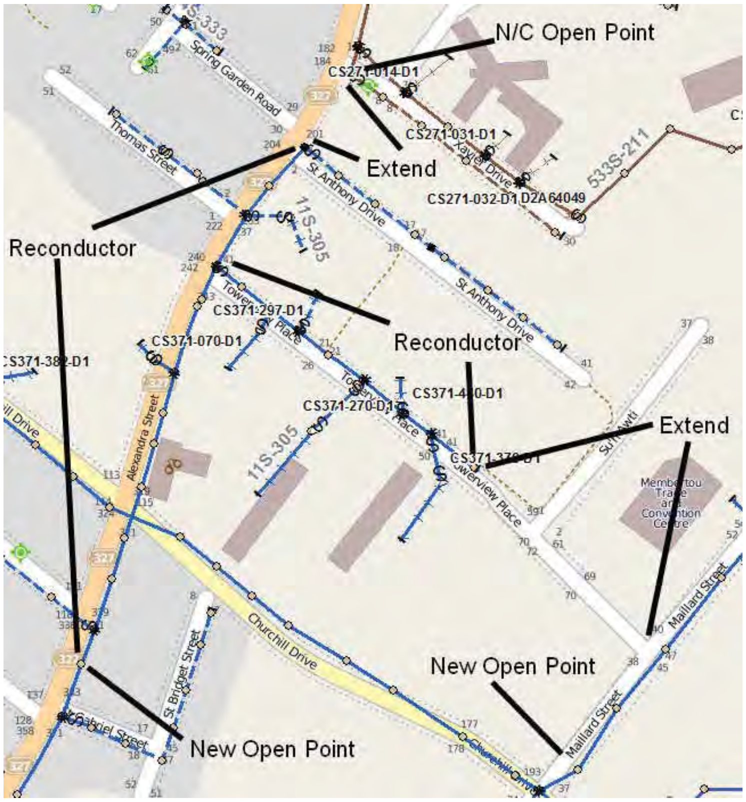

Figure 13 **2014 Membertou Feeder Tie**

6.1.2.3 New Kings Road Open Point

This portion of the project will enable the transfer of a portion of load from 4S-Townsend Street to 11S-Keltic Drive. This load transfer will reduce the overall loading on 4S-334 that will be supplying Membertou via Churchill Drive. Refer to Figure 14 below. The details are as follows:

- Install new open point on Kings Road, between Harbourview Drive and Churchill Drive.

Figure 14 **2014 Kings Road Open Point**

6.2 6S-Terrace Street

Alternative C was determined to be the most cost effective solution, to plan the retirement of the 4kV supplied by 6S-Terrace Street. This alternative will increase the flexibility in the Hardwood Hill and Ashby areas, in Sydney.

6.2.1 2013 Capital Year

The majority of the work for the 2013 capital year is required to ensure an adequate load reduction on the 4kV supplied by 6S-Terrace Street. These conversions will enable installation of the mobile substation, under peak loading conditions, without the requirement to transfer load to 534S. This 4kV load reduction will also enable the removal of the existing breakers at the 6S-Terrace Street substation and replace them with pole mounted reclosers.

6.2.1.1 Cabot Street Conversion

This portion of the project will convert Cabot Street, north of Terrace Street. This conversion, along with the Rockdale Avenue conversion, will reduce the load on 6S-T1, to enable the installation of the mobile substation, minimizing the requirement to transfer load to 534S. Refer to Figure 15 below. This will be accomplished by:

- Fill in the gap on Cabot Street and Upper Prince Street
- Create open point at Cabot and Terrace.
- Install open point on Cornwallis Street at McConnell Drive.
- Convert shaded areas, including side streets.

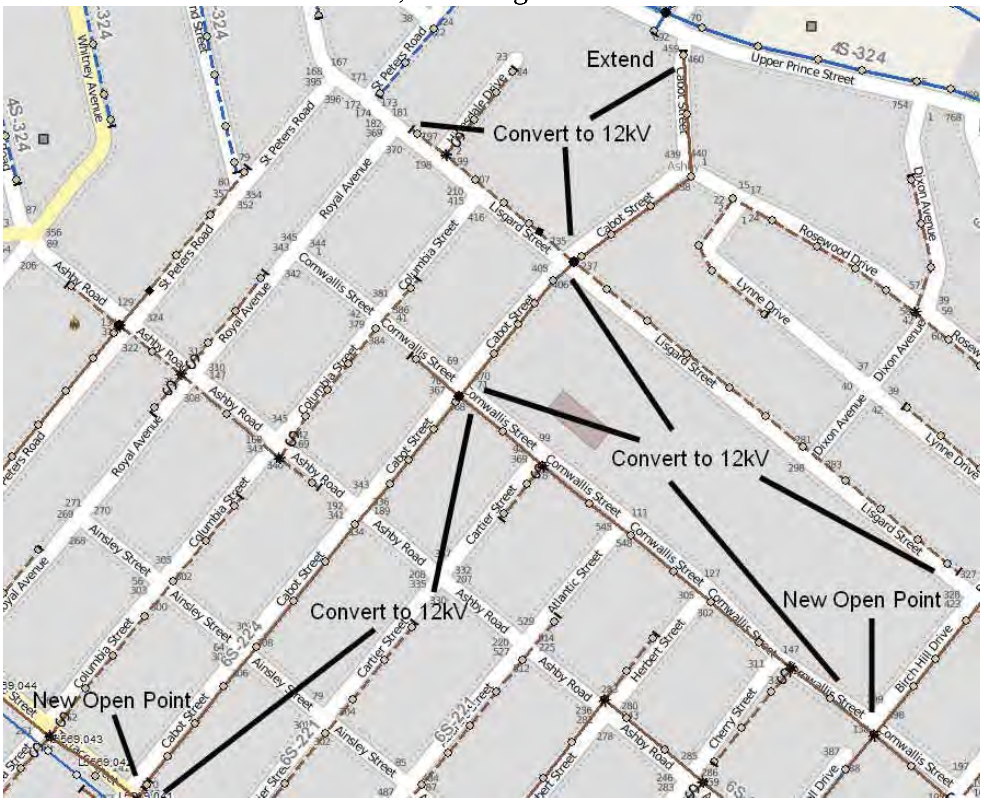

Figure 15 **2013 Cabot Street Conversion**

6.2.1.2 Rockdale Avenue Conversion

This portion of the project will convert Rockdale Avenue and Cottage Road to Harold Street. This phase of the project will further reduce the overall load on 6S-T1, reducing the need to transfer customer load to 534S, when the mobile substation is installed. Refer to Figure 16 below. This will be accomplished by:

- Close switch at Oxford Street onto George Street.
- Install cutout, on single phase along Cottage Road, at the intersection with Oxford Street.
- Open Harold and Cottage Road.
- Convert Oxford Street, to open point on Cottage Road, from 4kV to 12kV.
- Convert Rockdale Avenue, Champlain Avenue and Cottage Road, to Harold Street, including all side streets and branch lines, as indicated in Figure 16.

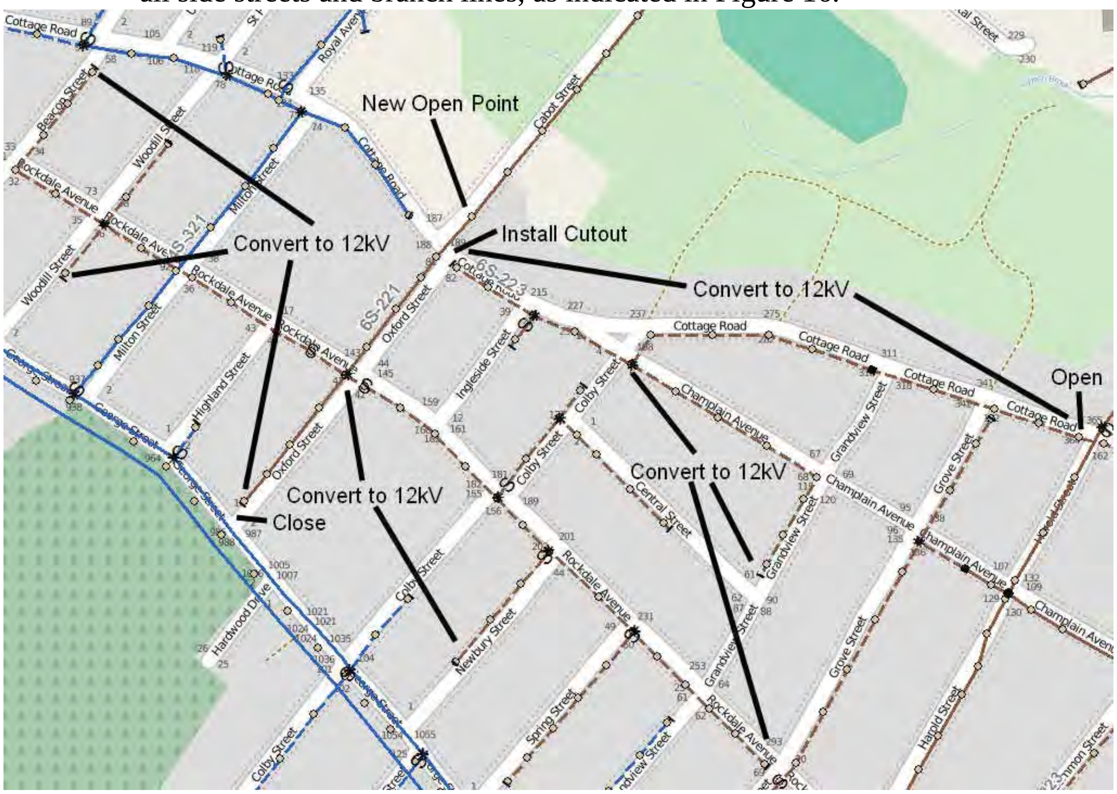

Figure 16 2013 Rockdale Conversion

6.2.1.3 6S-Terrace Street Substation Upgrades

This portion of the project will see the removal of the existing switchgear building, as well as the installation of pole mounted reclosers. This will be accomplished by:

- Installation of three dedicated power cables and buried ducts.
- The installation of three temporary pole mounted reclosers, to be supplied from new power cables.
- Removal of existing 4kV switchgear and building.

6.2.2 2015 Capital Year

6.2.2.1 Harold Street Conversion

This portion of the project will see the conversion of the Harold Street area, south of the 6S-Terrace Street substation. This will also include the conversion of the remaining sections of Champlain Avenue, Cottage Road and adjacent streets. This new conversion will be supplied via one of the 12kV feeders, on George Street. The off-road section of the existing 4kV feeder will be removed, between Harold Street and Holly Street. Holly Street will remain at 4kV. Refer to Figure 17 below. This will be accomplished through the following:

- Create new N/C open point on Harold Street at George Street.
- Rebuild Cottage Road to Bernard Lind Drive with 3phase, 336ACSR.
- Create a new open point on Cottage Road, at Bernard Lind.
- Convert east of Harold Street to 12kV, as well as Grove Street.
- Remove off-road portion of feeder between Harold Street and Holy Street.
- Extend one phase on Holly Street to Terrace Street and remove the remaining two phases.
- Remove 2 phases from Harold Street, from Cottage Road towards Holly Street.

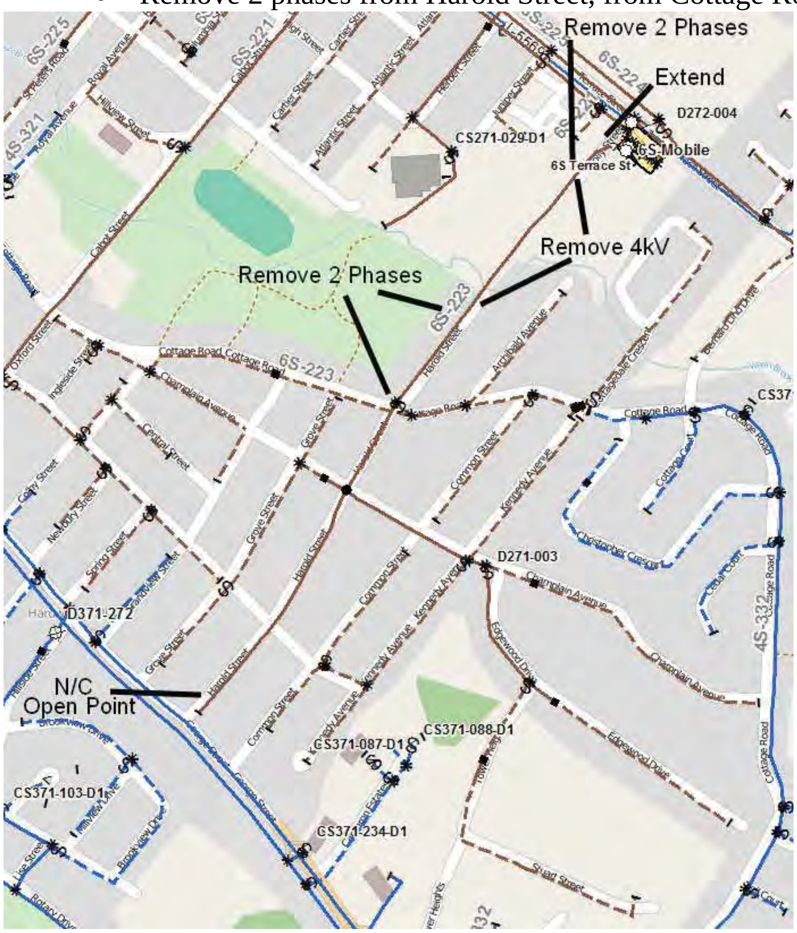

Figure 17 **2015 Harold Street Conversion**

6.2.3 2016 Capital Year

6.2.3.1 Bernard Lind Drive Rebuild

This portion of the project will convert Terrace Street, east of the 6S-Terrace Street substation. This portion of the project will also see the addition of two phases along Bernard Lind Drive, supplying the area via Cottage Road. Refer to Figure 18 below. This will be accomplished by:

- Rebuild Bernard Lind Drive with three phase 4/0 primary and 4/0 neutral, from Cottage Road to Terrace Street.
- Install a new open point east of the 6S-Terrace Street substation.
- Convert Terrace Street east of the 6S-Terrace Street substation.
- Create new Open Point at the end of Bernard Lind Drive and Cottage Road.

Figure 18 **2016 Bernard Lind Rebuild**

6.2.4 2017 Capital Year

6.2.4.1 Birch Hill Drive Conversion

This portion of the project will convert Birch Hill Drive and its side streets from 4kV to 12kV. This newly converted section will be supplied via 4S-324. Refer to Figure 19 below. The details are as follows;

- Extend 3phase on Birch Hill Drive to Upper Prince Street.
- Create new N/C open point at the intersection of Birch Hill Drive and Upper Prince Street.
- Convert Birch Hill Drive, McConnell Drive, Ashby Road and Herbert Street to Terrace Street, including side streets, from 4kV to 12kV.
- Change supply of Herbert Street, south of Terrace Street, to 6S-221. This portion of the street will be converted in a following portion of work.

Figure 19 2017 Birch Hill Drive Conversion

6.2.5 2018 Capital Year

6.2.5.1 Townsend Street Conversion

This portion of the project will convert the 4kV customer load on Terrace Street, from St. Peters Road to Townsend Street. The load will be supplied via 4S-324, until the remaining section of Terrace Street is converted. High Street, from St. Peters Road to Townsend Street will continue to be supplied via 6S-225. Refer to Figure 20 below. The details are as follows;

- Install open point on Terrace Street, between Howe Street and St. Peters Road.
- Open Howe Street, between High Street and Terrace Street.
- Install new open point on the north side of the Howe Street and High Street intersection.
- Install new tap on south Howe Street, to High Street.
- Open D271-283.
- Extend High Street to St Peters Road.
- Install new open point on Park Street, at Terrace Street.
- Convert Terrace Street, from St. Peters Road to Townsend Street, as well as the side streets indicated in Figure 20.

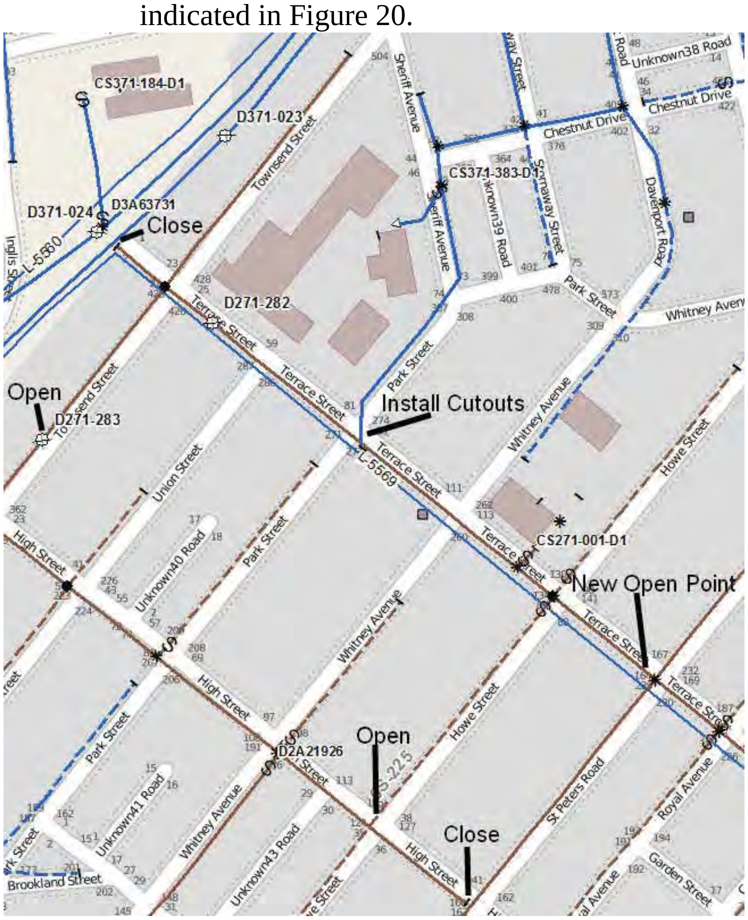

Figure 20 **2018 Townsend Street Conversion**

6.2.6 2019 Capital Year

6.2.6.1 High Street Conversion

This portion of the project will convert the High Street area, from 4kV to 12kV. The load will be supplied by 4S-324, via the open point on Townsend Street. Upon completion of this portion of work, the 534S stepdown will be removed from service, as there will be no load able to be transferred to it. Refer to Figure 21 below. The details are as follows;

- Close D271-283, on Townsend Street.
- Install new Open Point on Terrace Street, between St. Peters Road and Royal Avenue.
- Convert High Street, from Styles Lane (534S stepdown) to St. Peters Road, including all side streets.
- Convert St. Peters Road, including all side streets.
- Remove 534S stepdown.

Figure 21 **2019 High Street Conversion**

6.2.7 2020 Capital Year

6.2.7.1 Terrace Street

This portion of the project will see the conversion of the remaining 4kV, east of the 6S-Terrace Street substation. This conversion will include rebuild of a section of Terrace Street, from the substation to Cabot Street. This rebuild will reduce the feeders along Terrace Street from a maximum of three to one. Refer to Figure 22 below. The details are as follows;

- Convert Terrace Street, from the 6S-Terrace Street substation to St. Peters Road, from 4kV to 12kV, including all side streets that have not been previously converted.

- Rebuild Terrace Street, from the 6S-Terrace Street substation, to St. Peters Road with one, 3-phase 336, circuit.

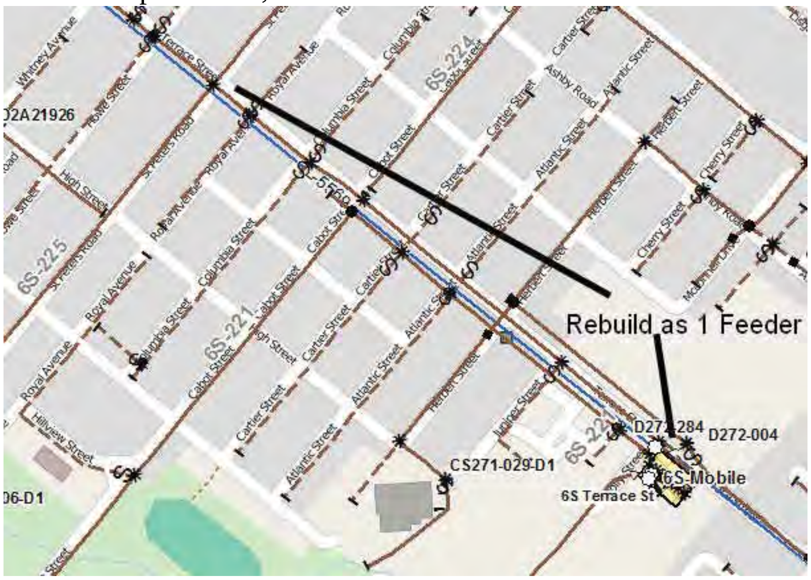

Figure 22 **2020 Terrace Street**

6.2.8 2021 Capital Year

6.2.8.1 6S-Terrace Street Retirement

This portion of the project will see the retirement of the 6S-Terrace Street substation. This will include the decommissioning of 6S-T1, as well as the removal of most substation equipment. A requirement to modify the 69kV transmission will be necessary, to facilitate the removal of the substation buswork. Refer to Figure 23 below. This will be accomplished by:

- Decommission 6S-T1.
- Reconfigure L-5564, in front of the 6S-Terrace Street substation, to bypass the substation.
- Remove buswork and all NSPI owned equipment.

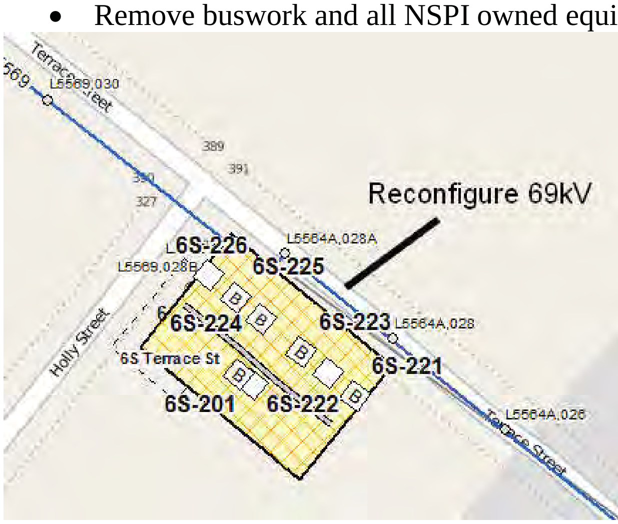

Figure 23 **2021 6S-Terrace Street Retirement**

APPENDIX A

System Operating Diagrams

[redacted]

[redacted]

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APPENDIX B

Load History and Forecast

Please refer to section 3.2 Load Forecast for the 90th Percentile Data values

Appendix B: Load History and Forecast

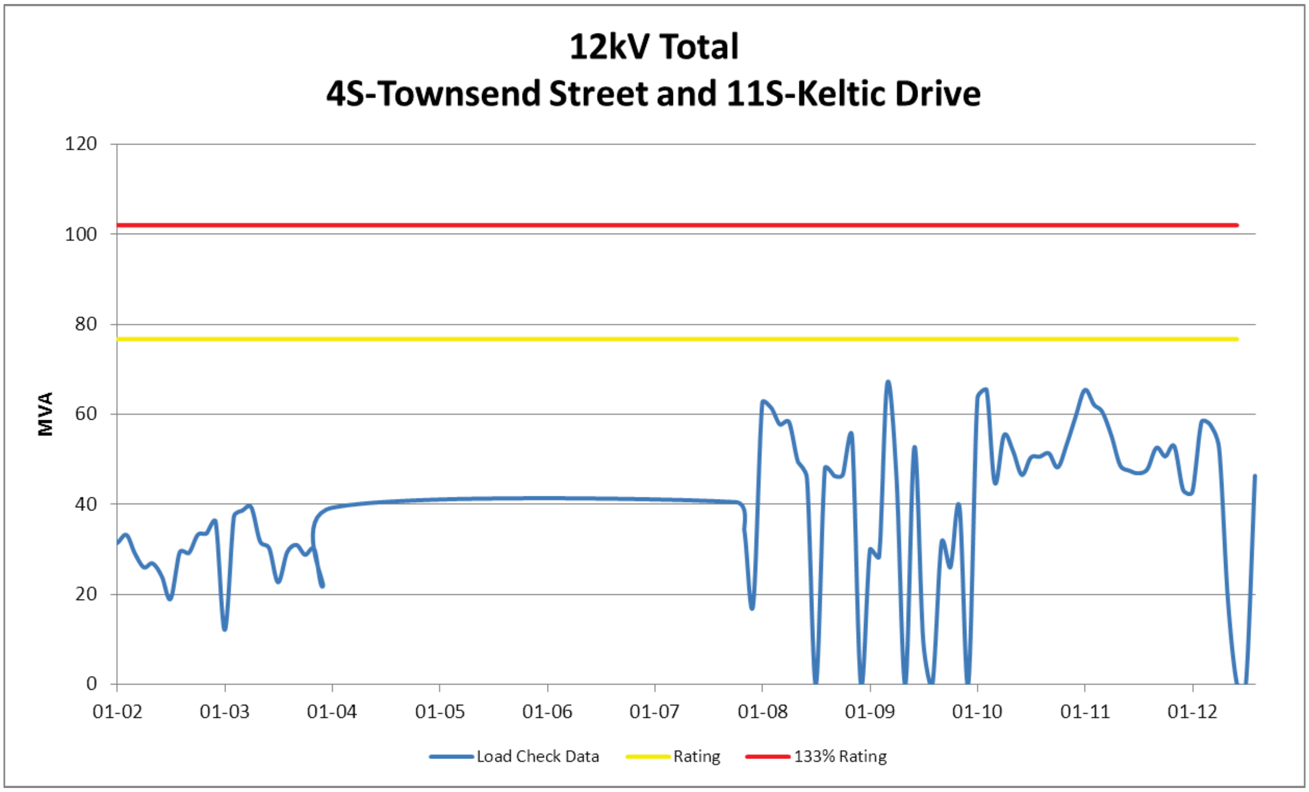


Figure 28 **4S-Townsend Street and 11S-Keltic Drive 12kV Load History**

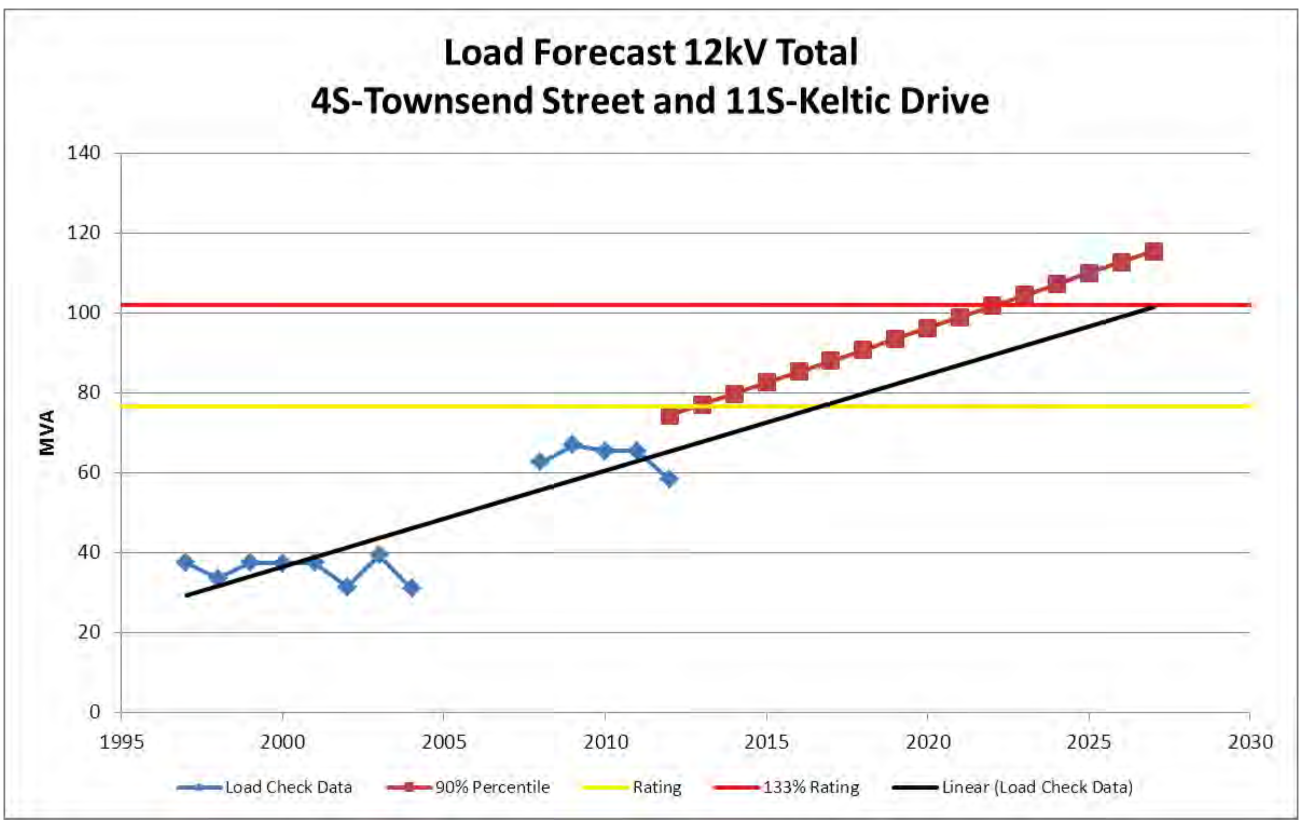


Figure 29 **4S-Townsend Street and 11S-Keltic Drive 12kV Load Forecast**

Load Growth **2.98%**

Appendix B: Load History and Forecast

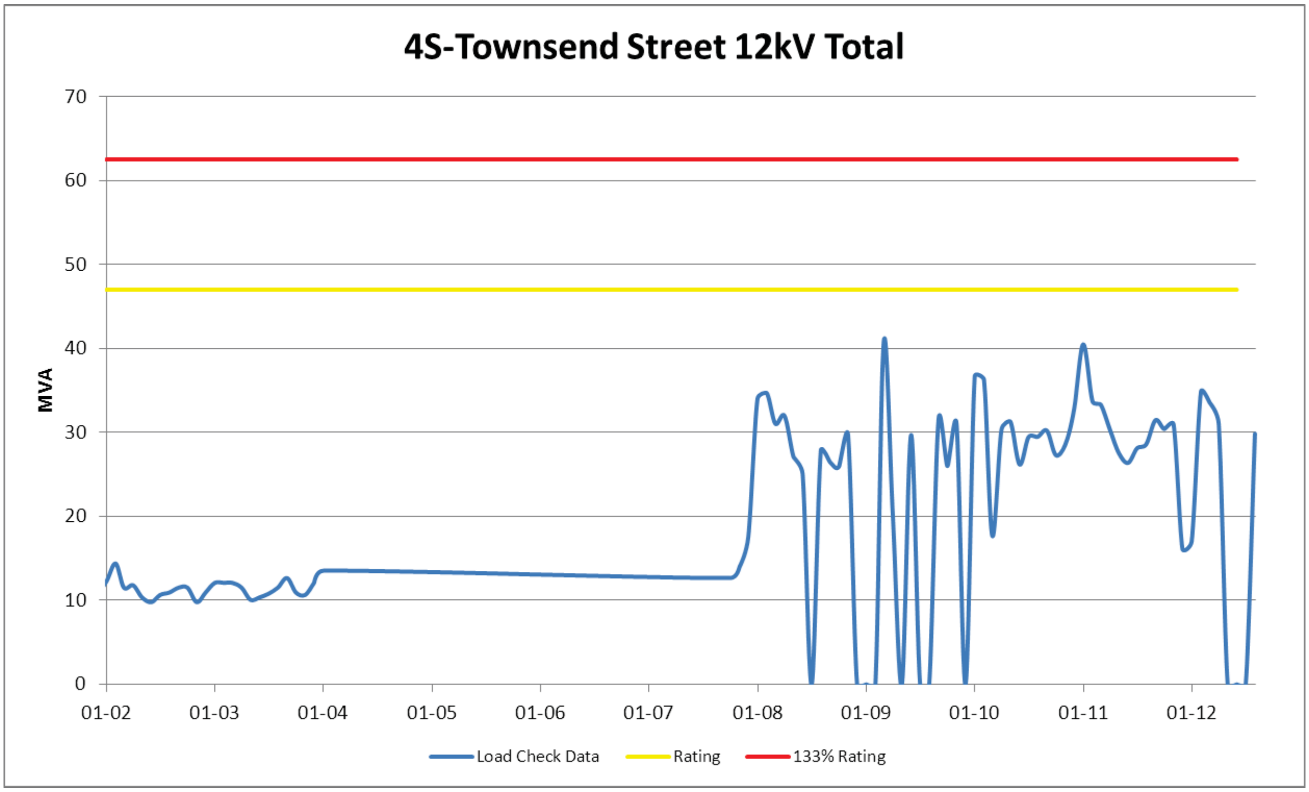


Figure 30 **4S-Townsend Street 12kV Load History**

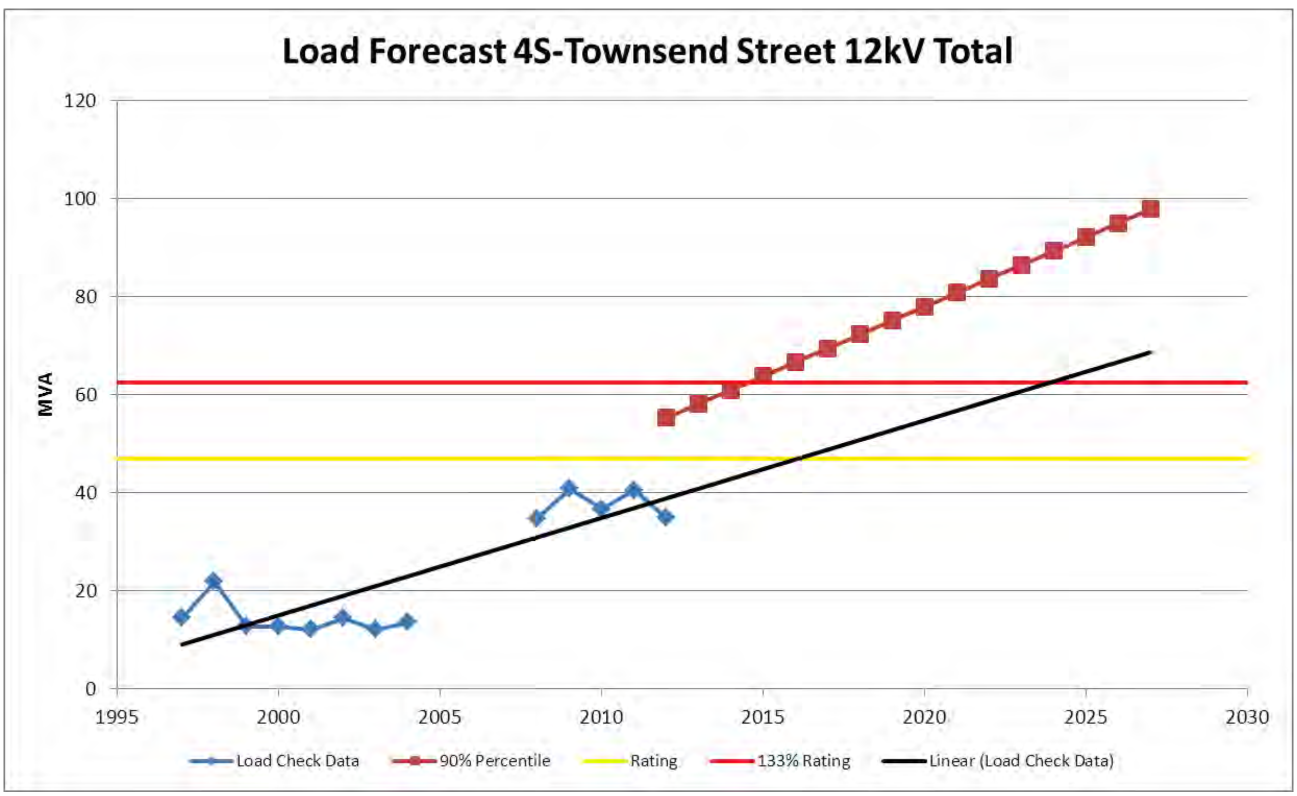


Figure 31 **4S-Townsend Street 12kV Load Forecast**

Load Growth 3.88%

Appendix B: Load History and Forecast

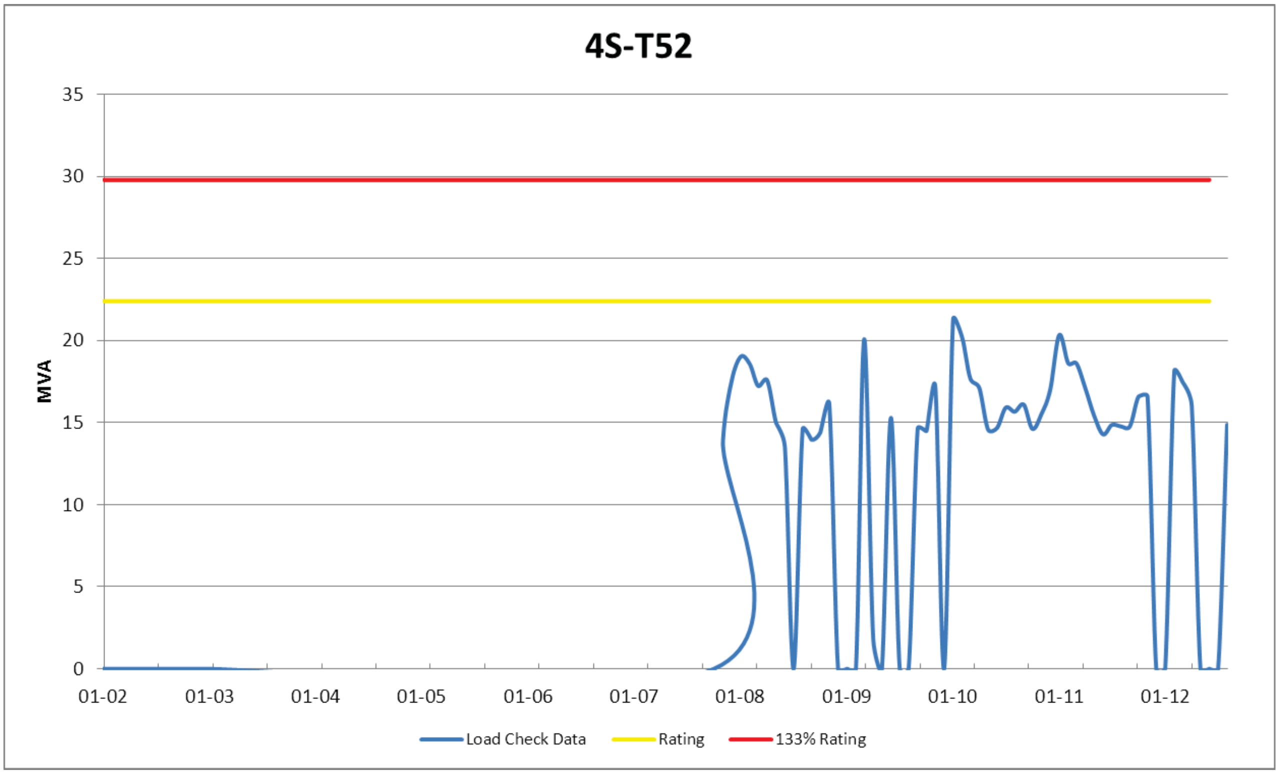


Figure 32 **4S-T52 Load History**

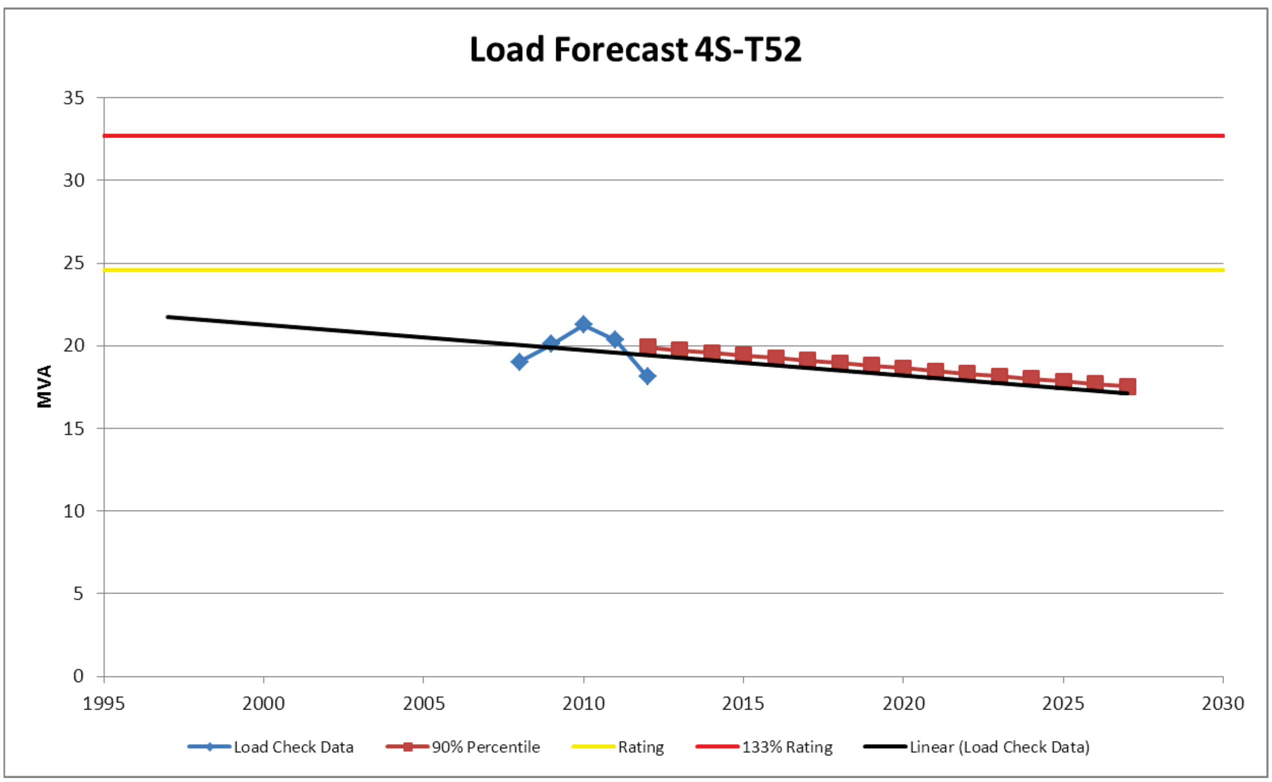


Figure 33 **4S-T52 Load Forecast**

Load Growth **-0.84%****

**** There is not enough information available to accurately determine the load forecast for this transformer.**

Appendix B: Load History and Forecast

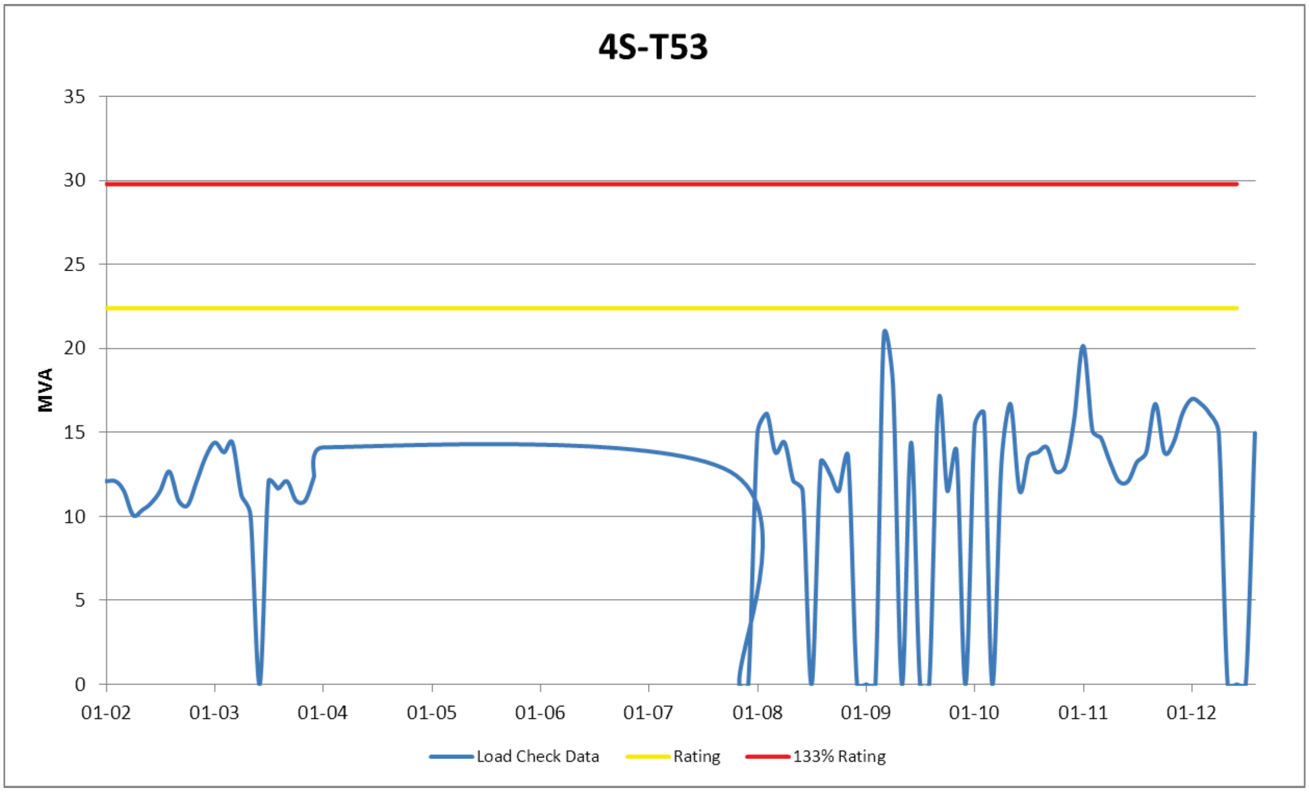


Figure 34 **4S-T53 Load History**

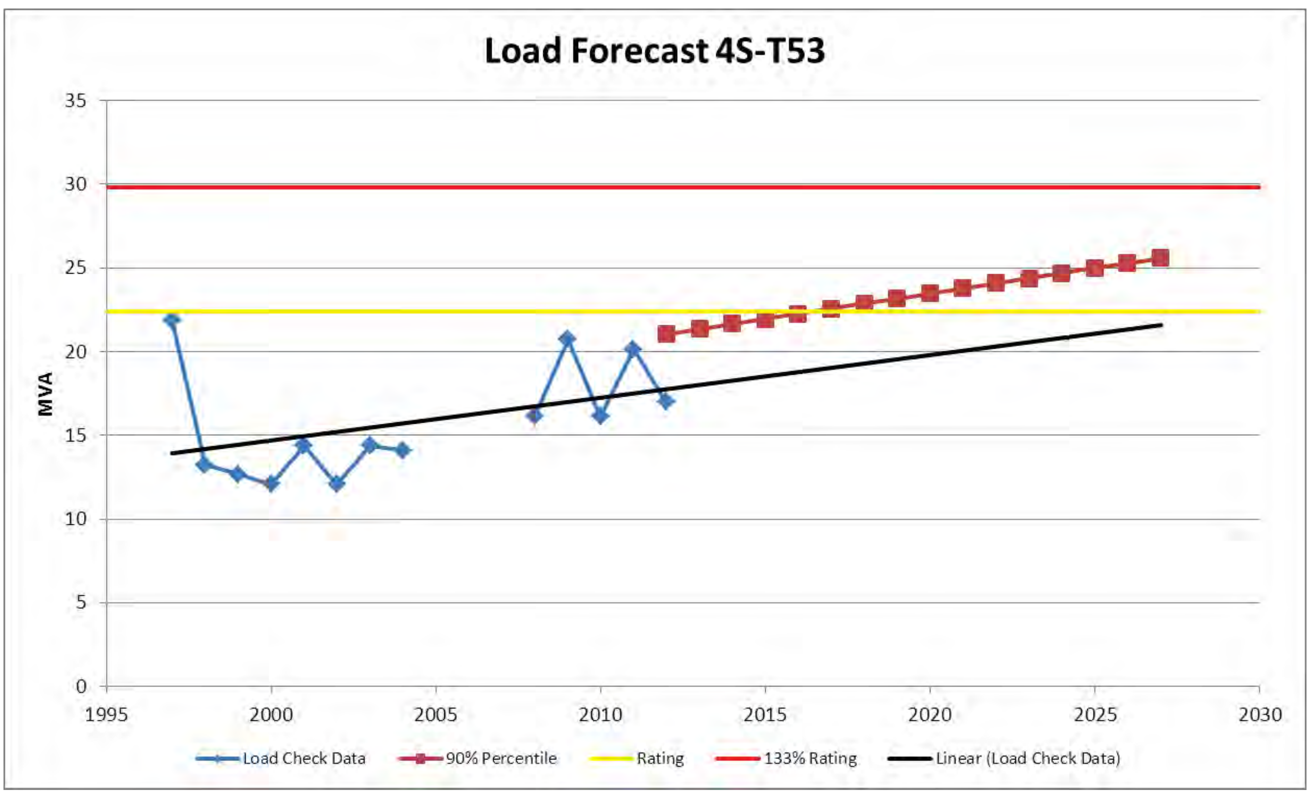


Figure 35 **4S-T53 Load Forecast**

Load Growth **1.31%**

Appendix B: Load History and Forecast

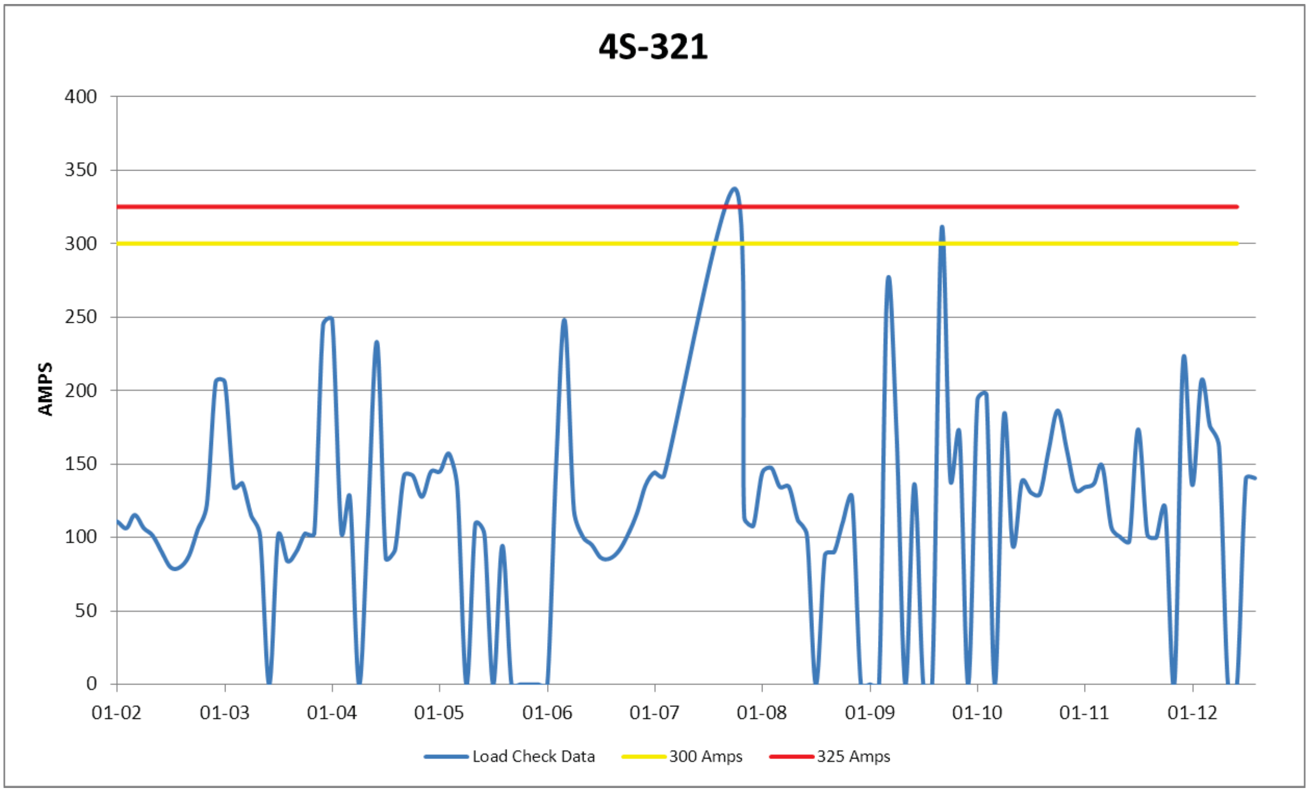


Figure 36 **4S-321 Load History**

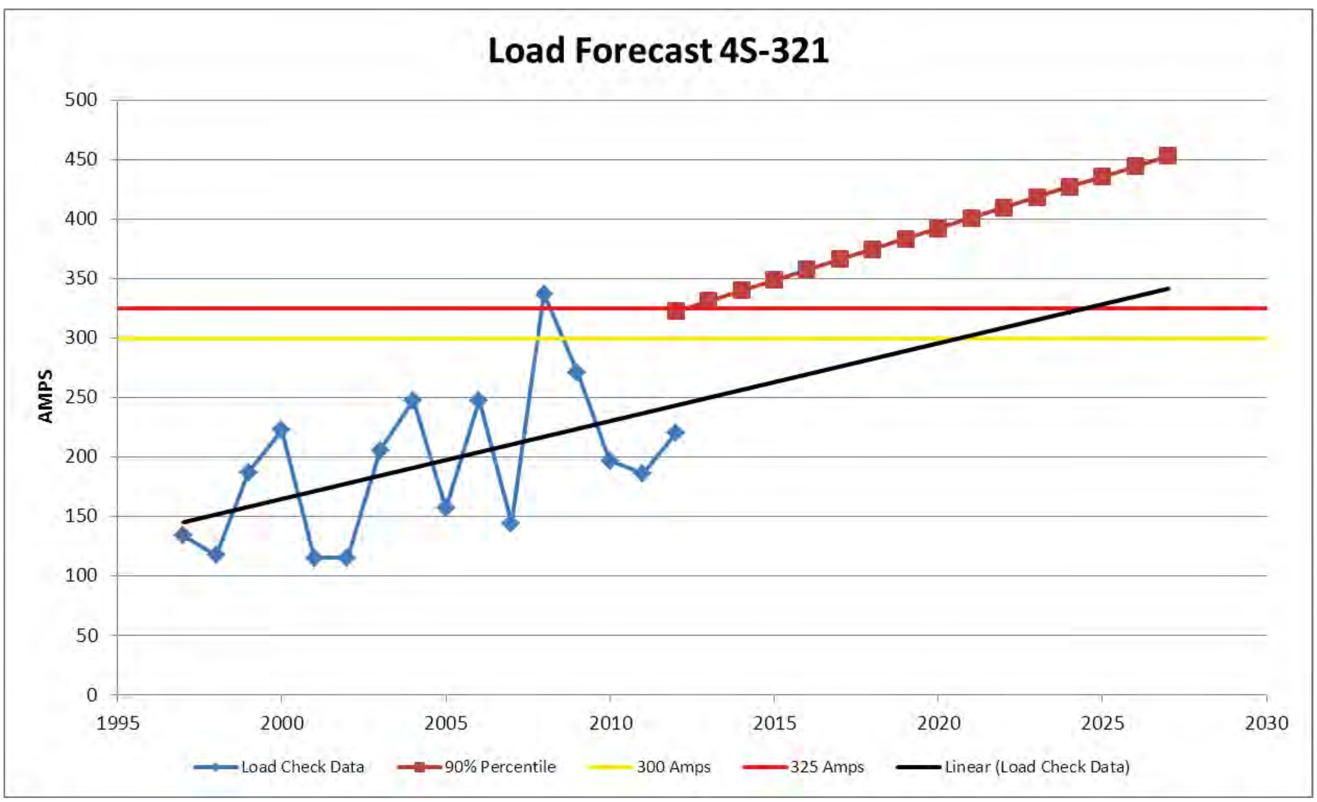


Figure 37 **4S-321 Load Forecast**

Load Growth **2.29%**

Appendix B: Load History and Forecast

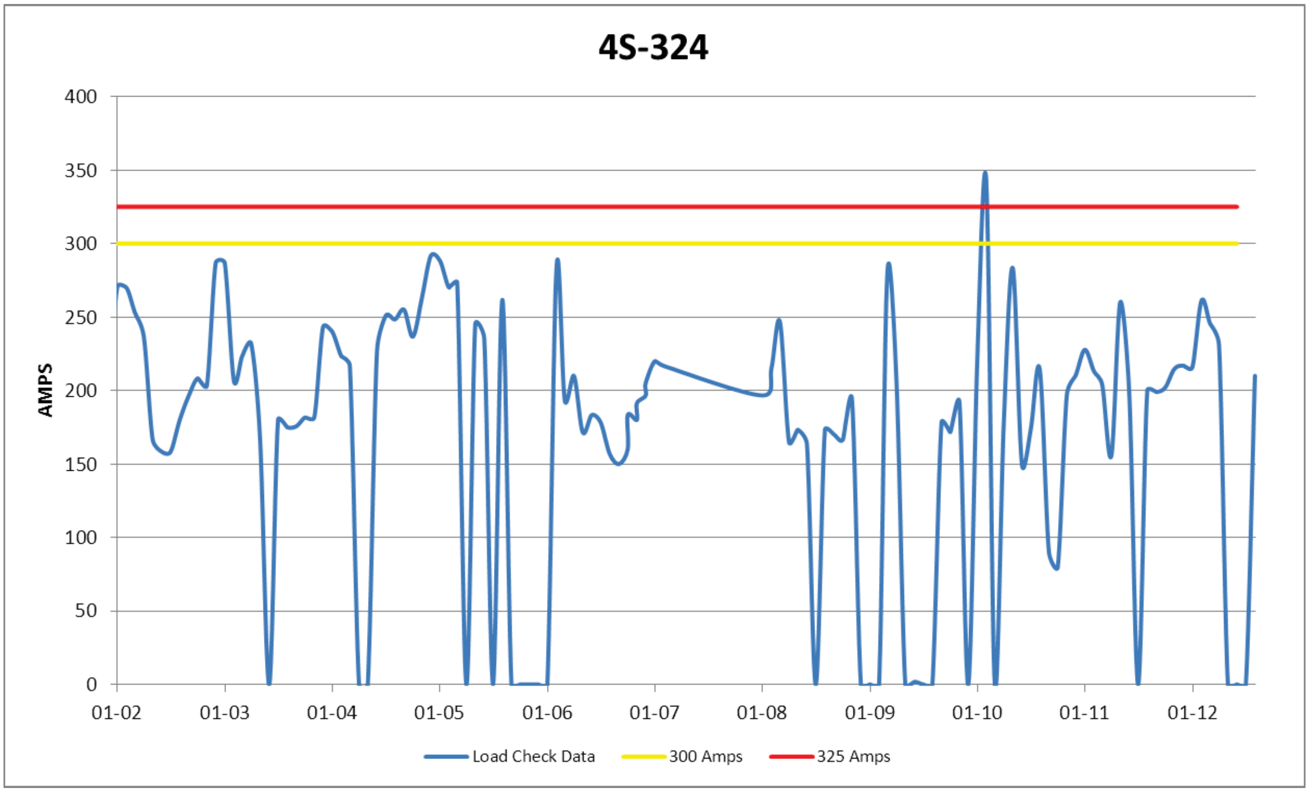


Figure 38 **4S-324 Load History**

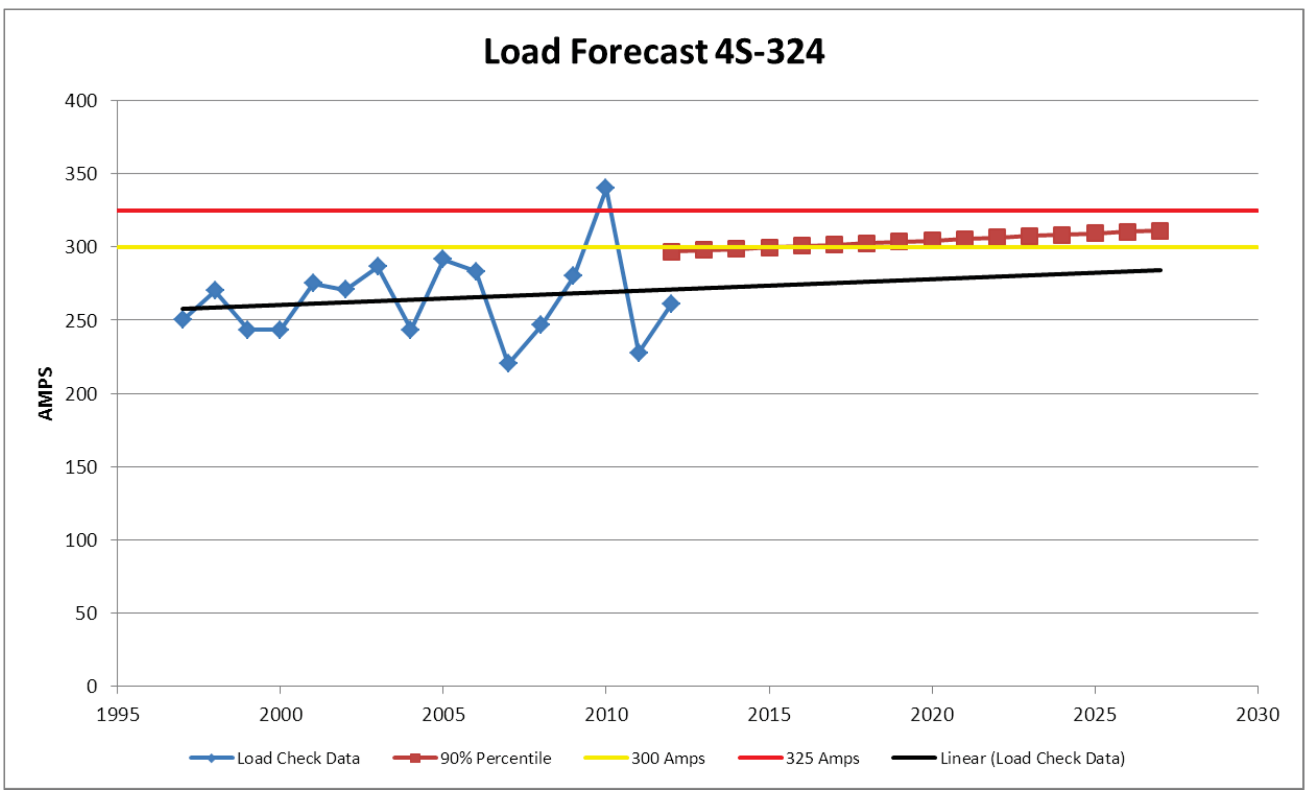


Figure 39 **4S-324 Load Forecast**

Load Growth **0.32%**

Appendix B: Load History and Forecast

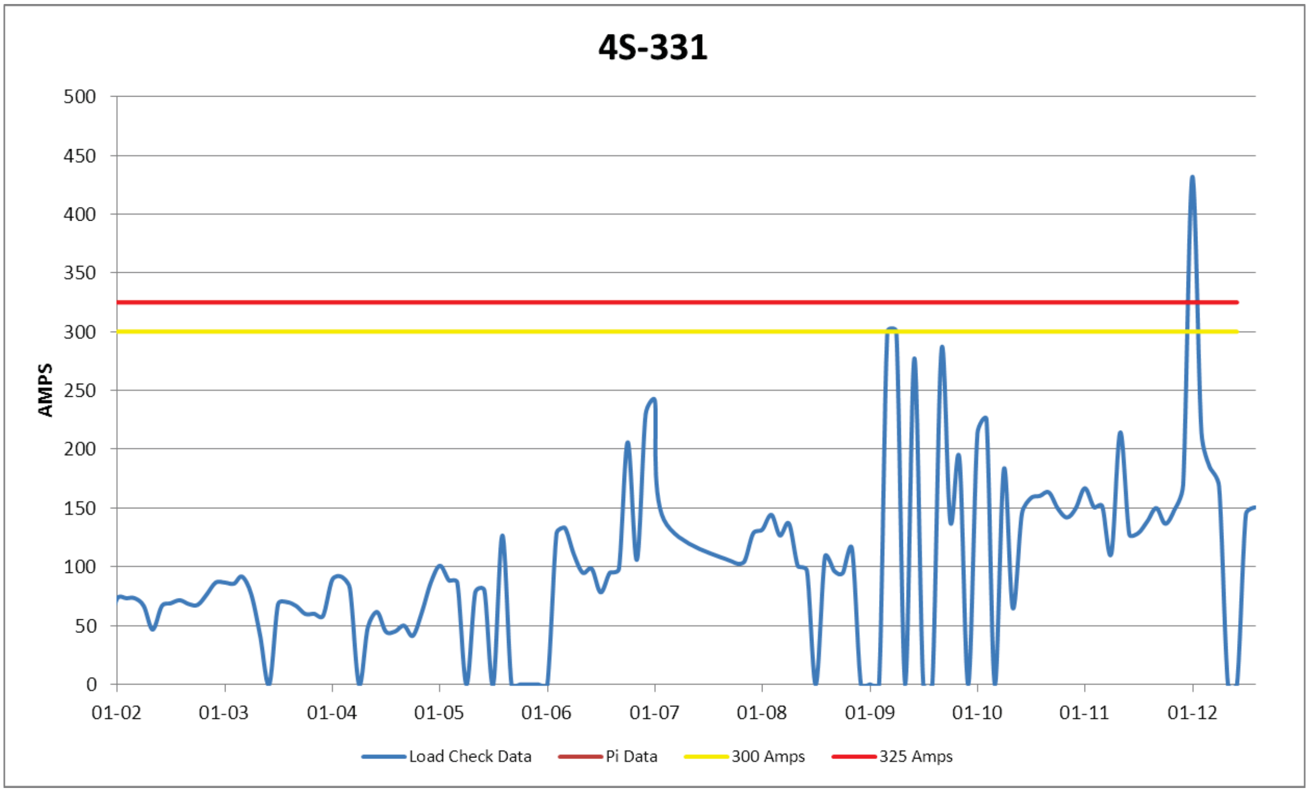


Figure 40 **4S-331 Load History**

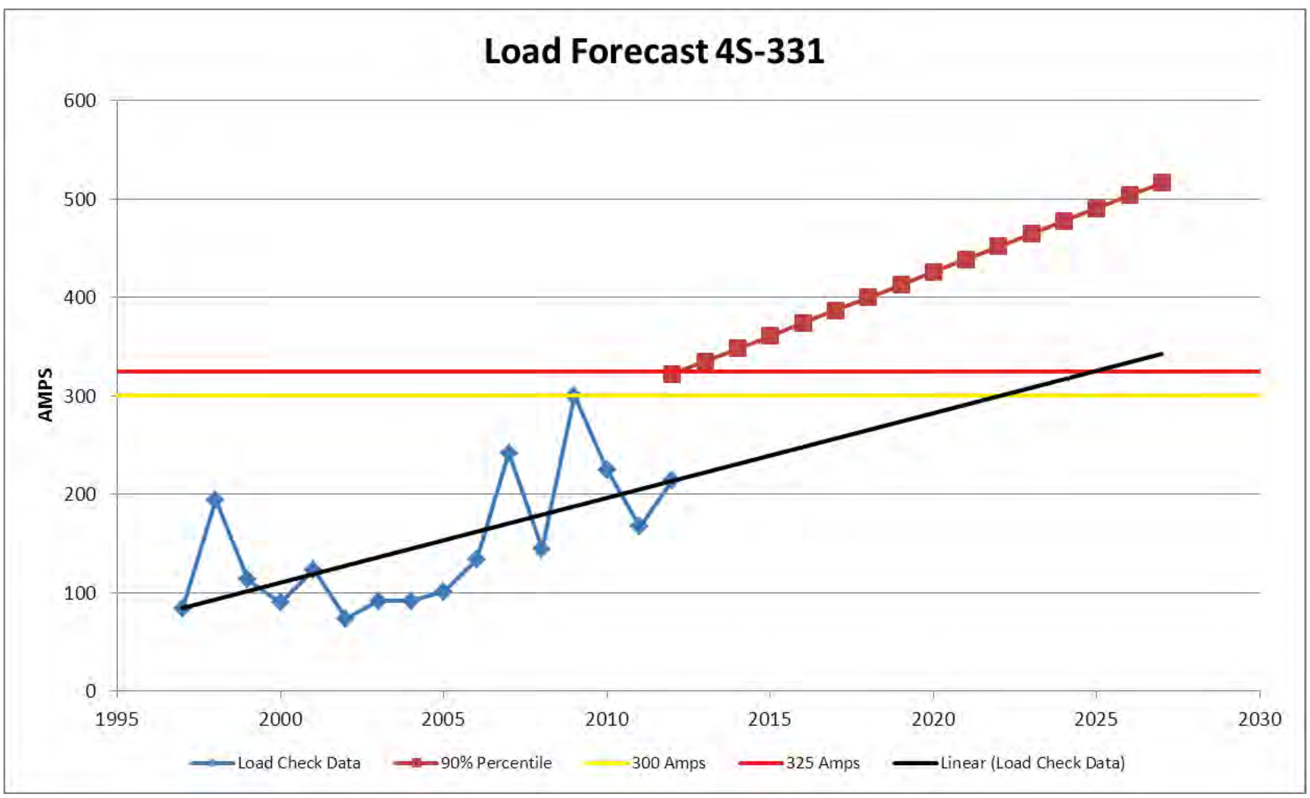


Figure 41 **4S-331 Load Forecast**

Load Growth **3.20%**

Appendix B: Load History and Forecast

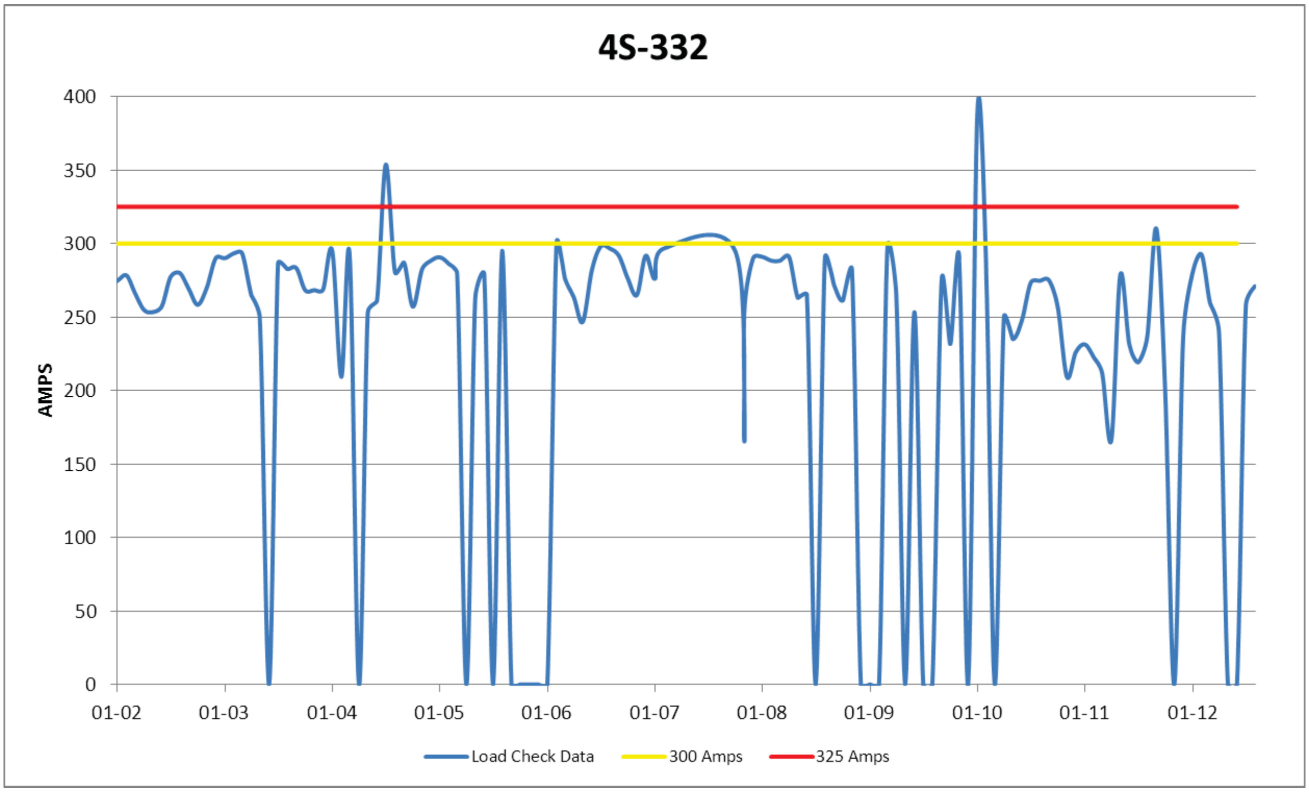


Figure 42 **4S-332 Load History**

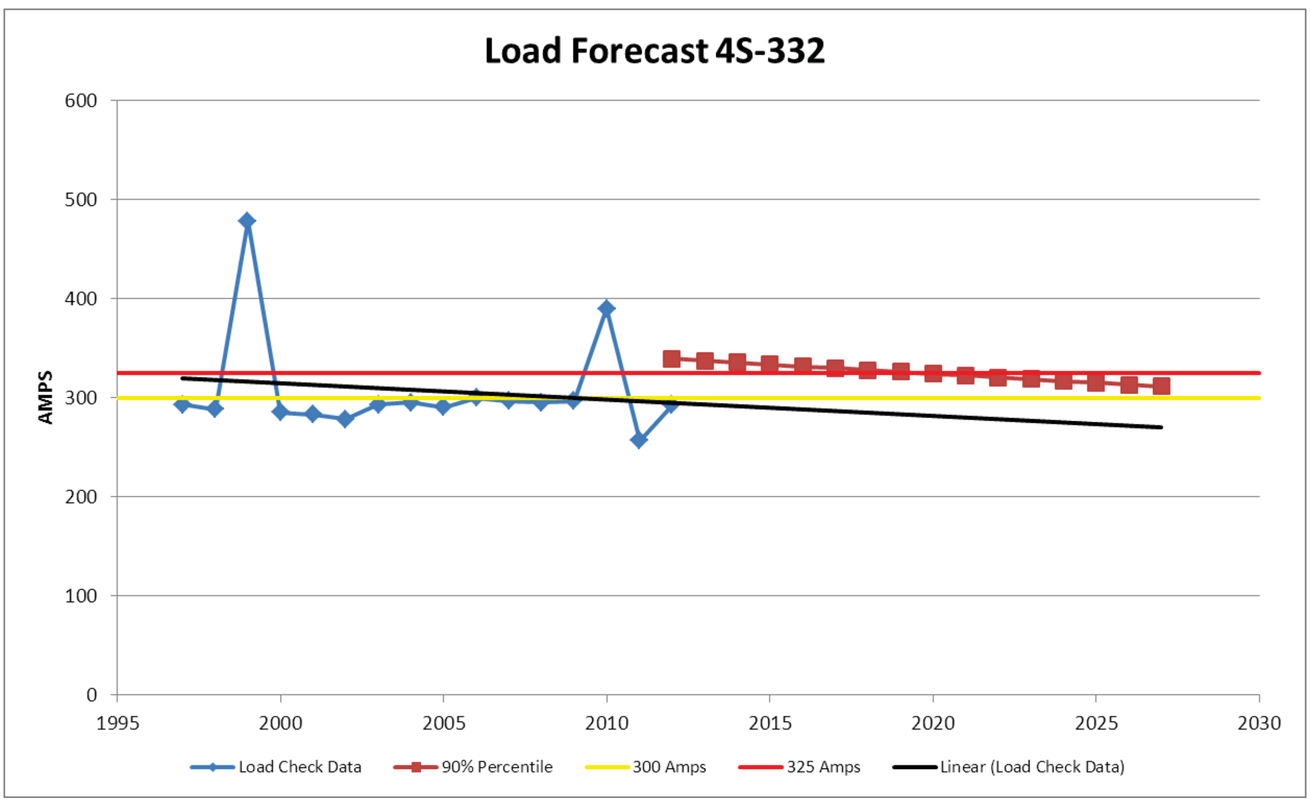


Figure 43 **4S-332 Load Forecast**

Load Growth **-0.57%**

Appendix B: Load History and Forecast

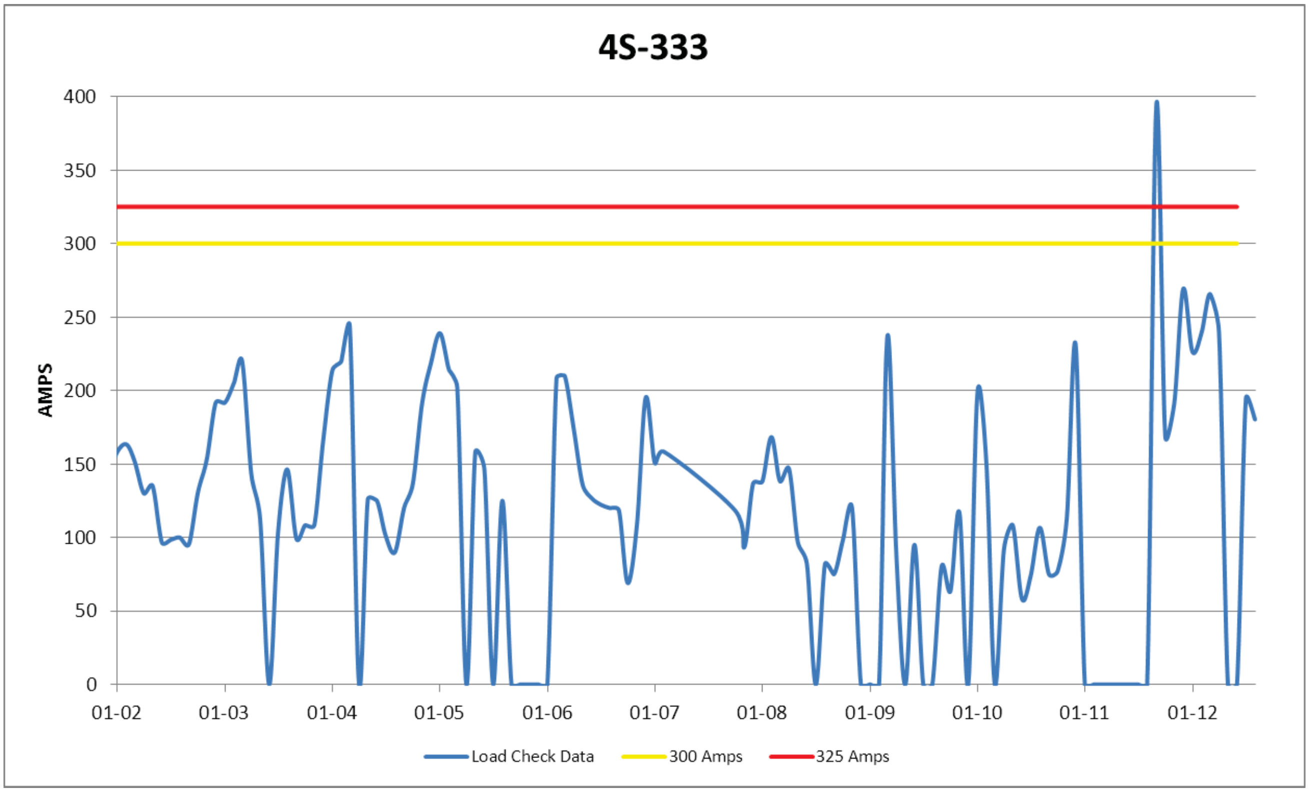


Figure 44 **4S-333 Load History**

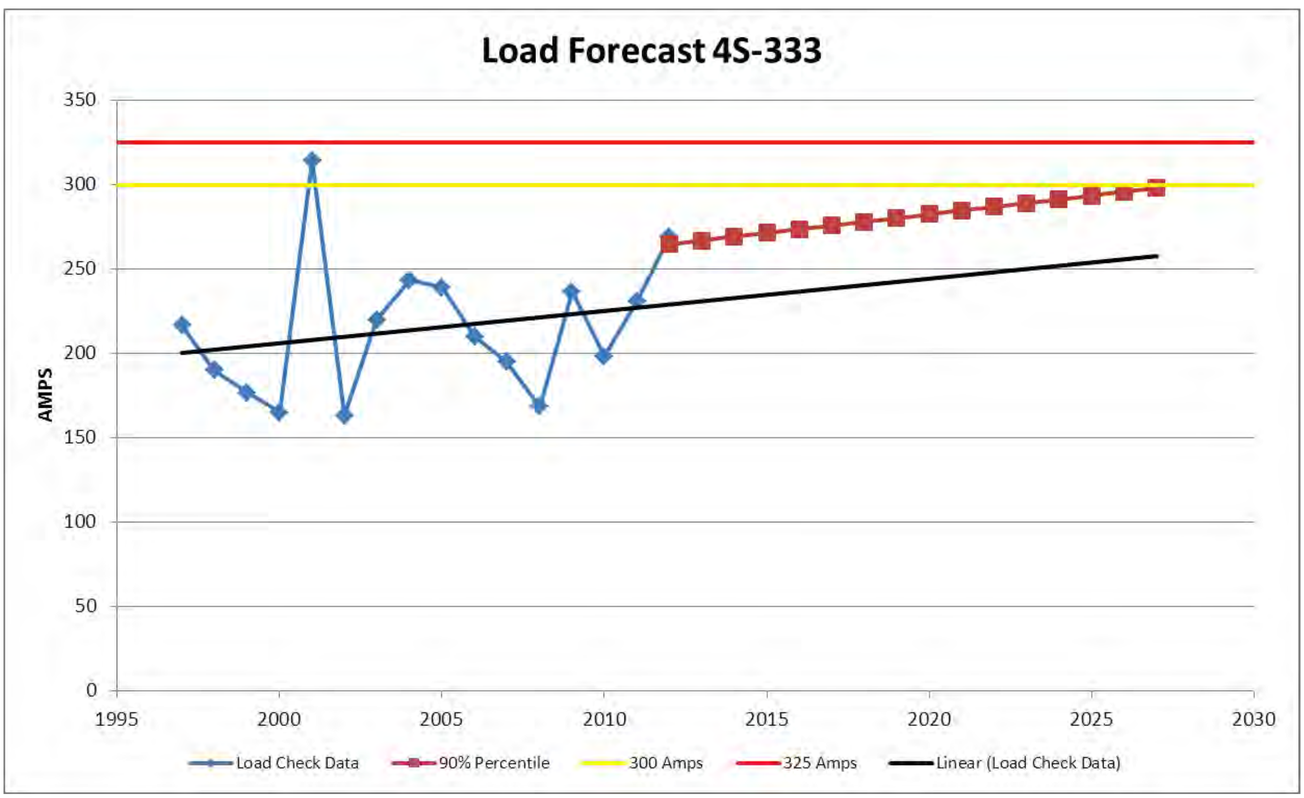


Figure 45 **4S-333 Load Forecast**

Load Growth **0.79%**

Appendix B: Load History and Forecast

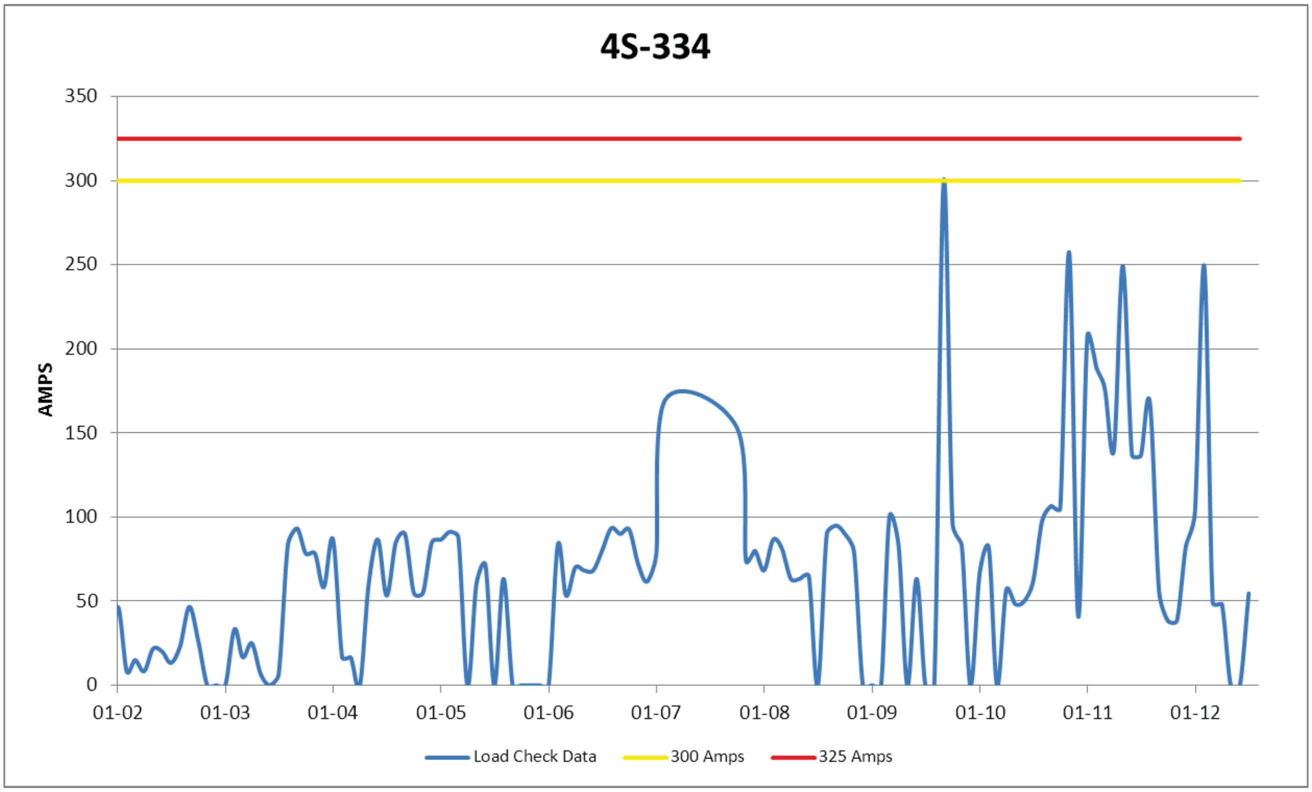


Figure 46 **4S-334 Load History**

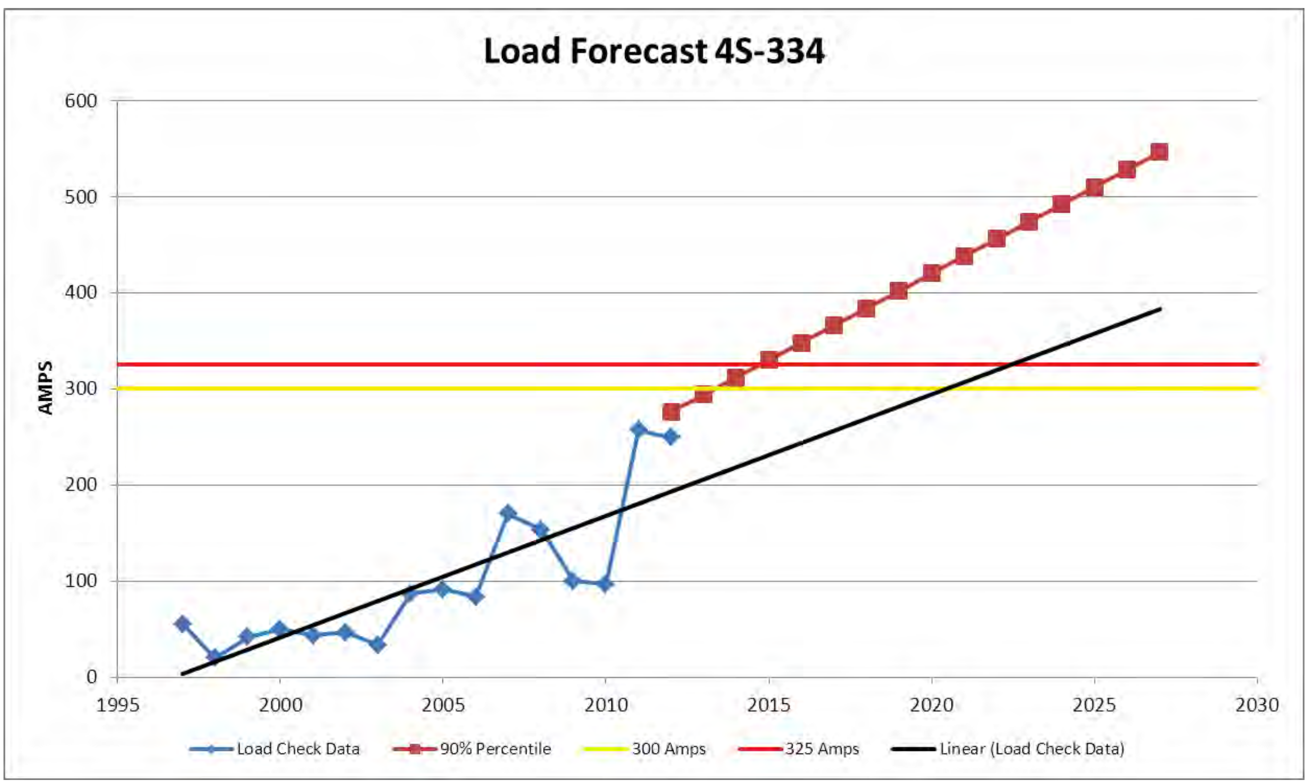


Figure 47 **4S-334 Load Forecast**

Load Growth	**4.66%**

Appendix B: Load History and Forecast

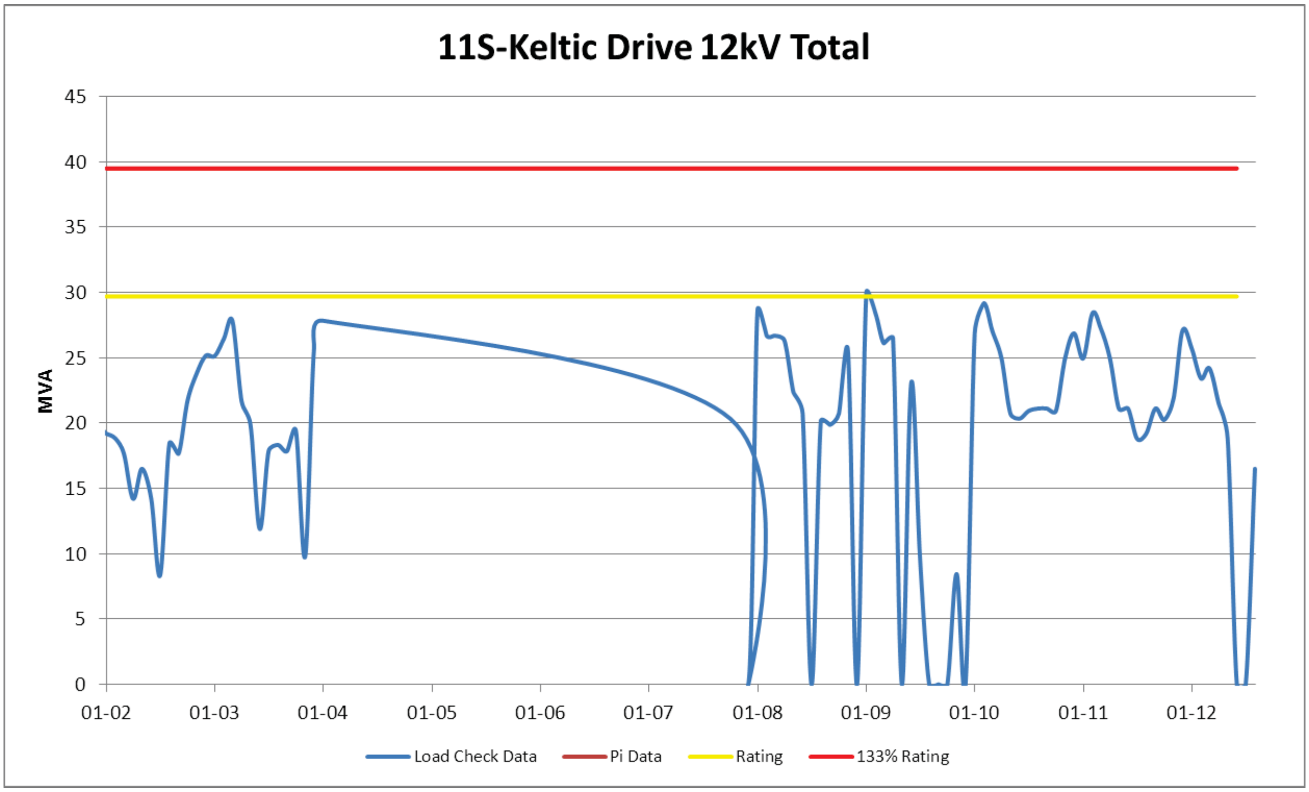


Figure 48 **11S-Keltic Drive 12kV Load History**

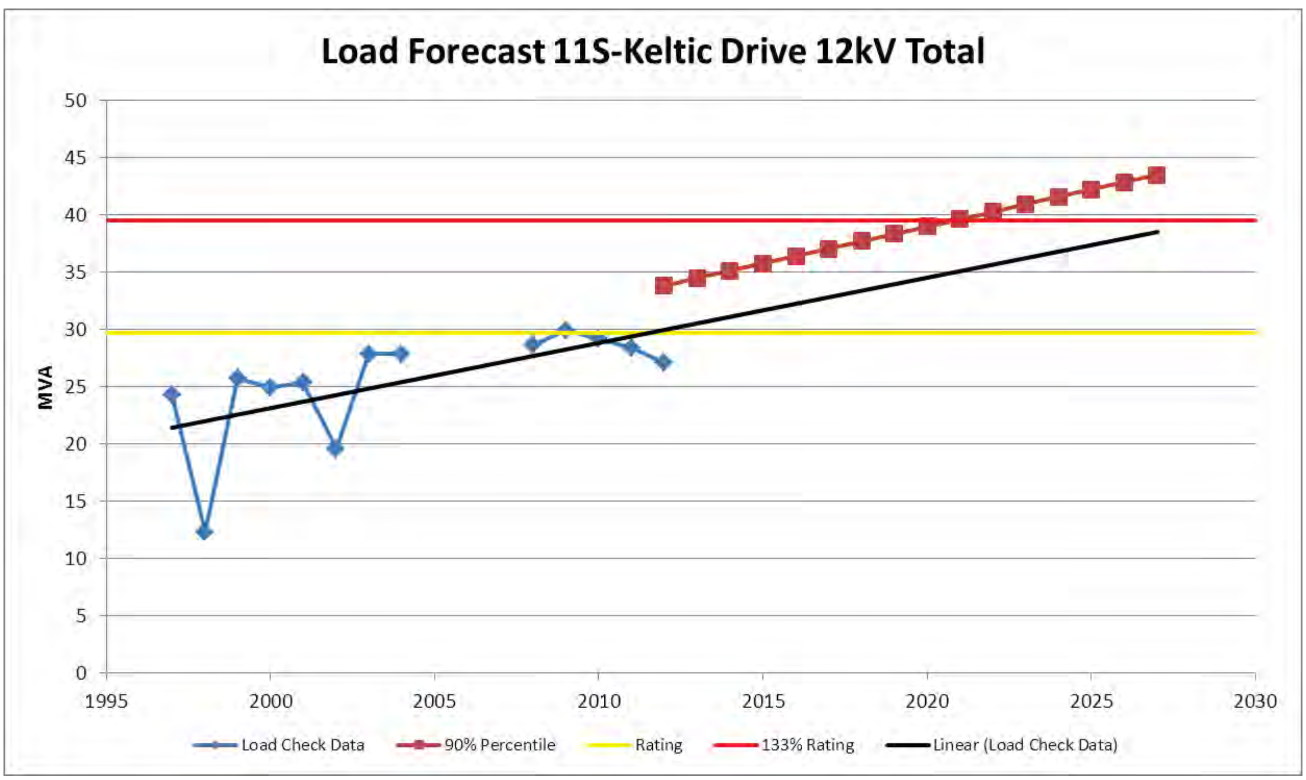


Figure 49 **11S-Keltic Drive 12kV Load Forecast**

Load Growth **1.69%**

Appendix B: Load History and Forecast

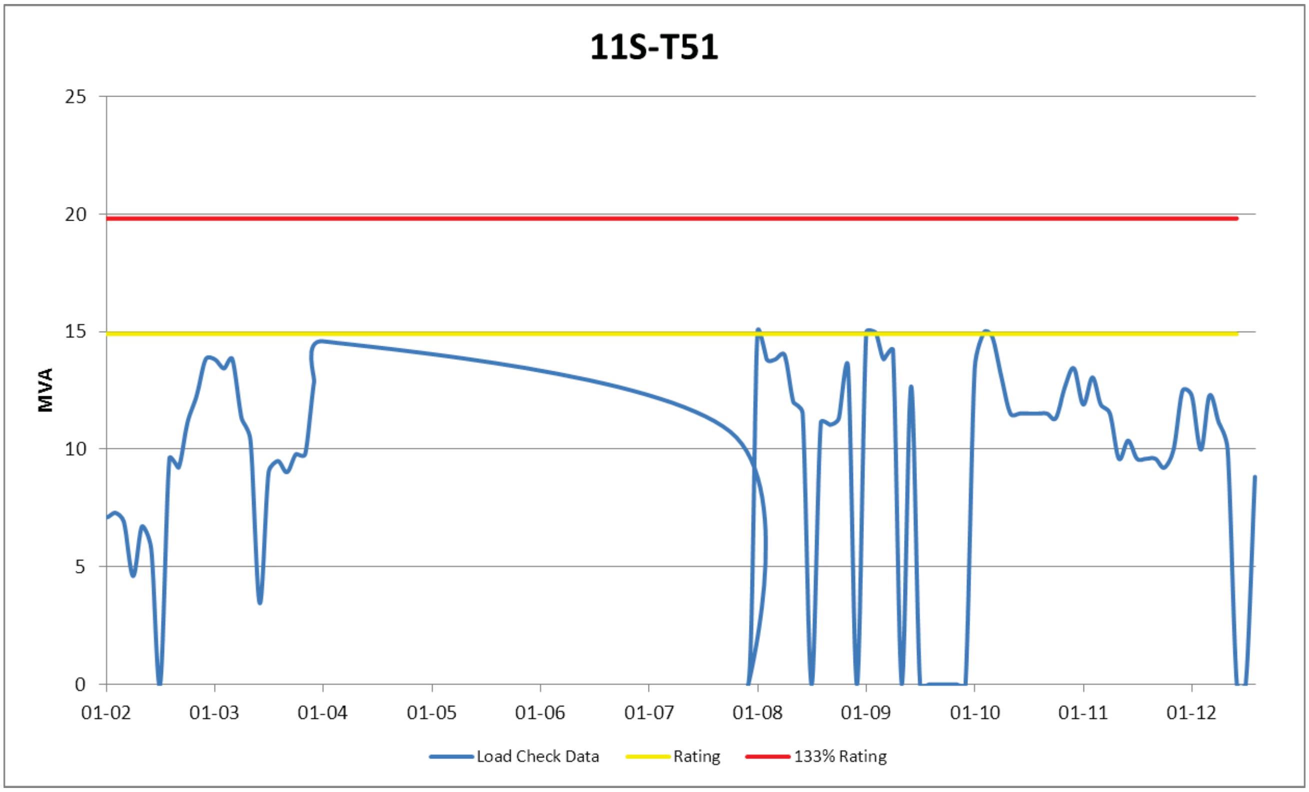


Figure 50 **11S-T51 Load History**

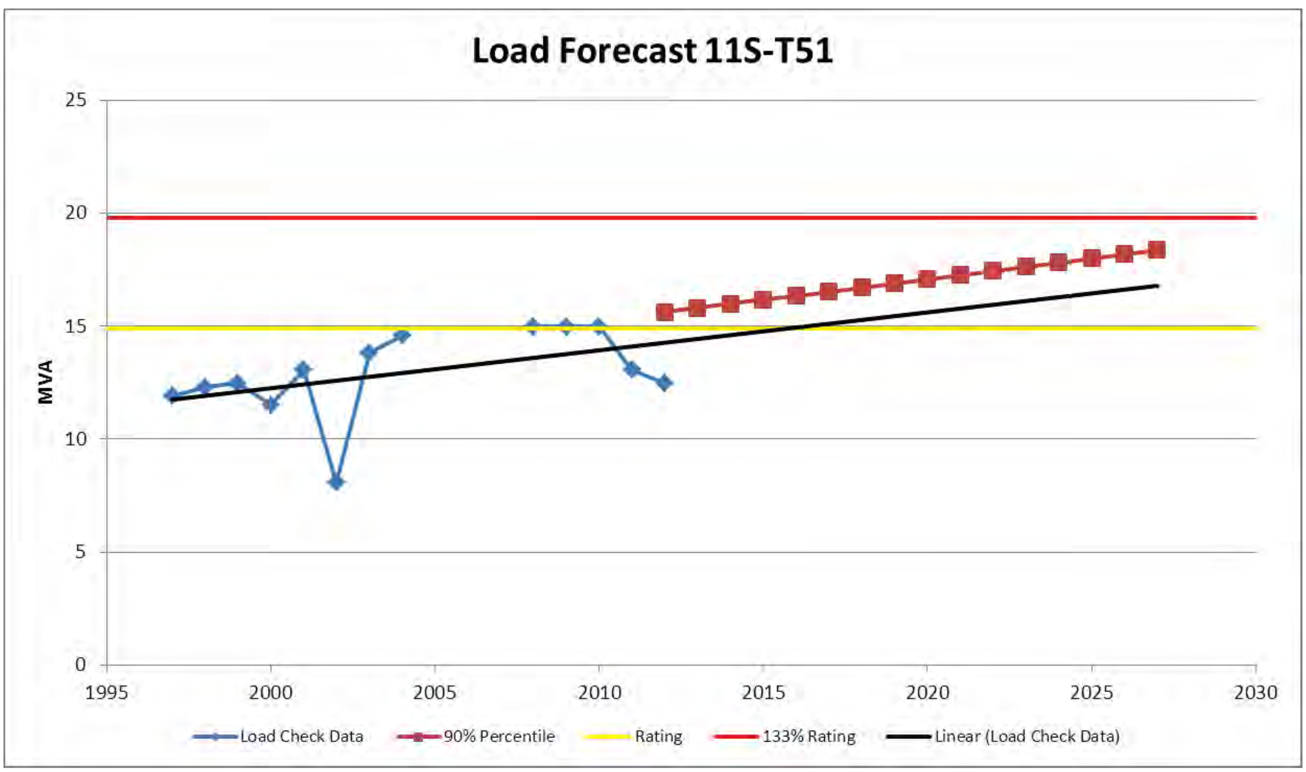


Figure 51 **11S-T51 Load History**

Load Growth **1.09%**

Appendix B: Load History and Forecast

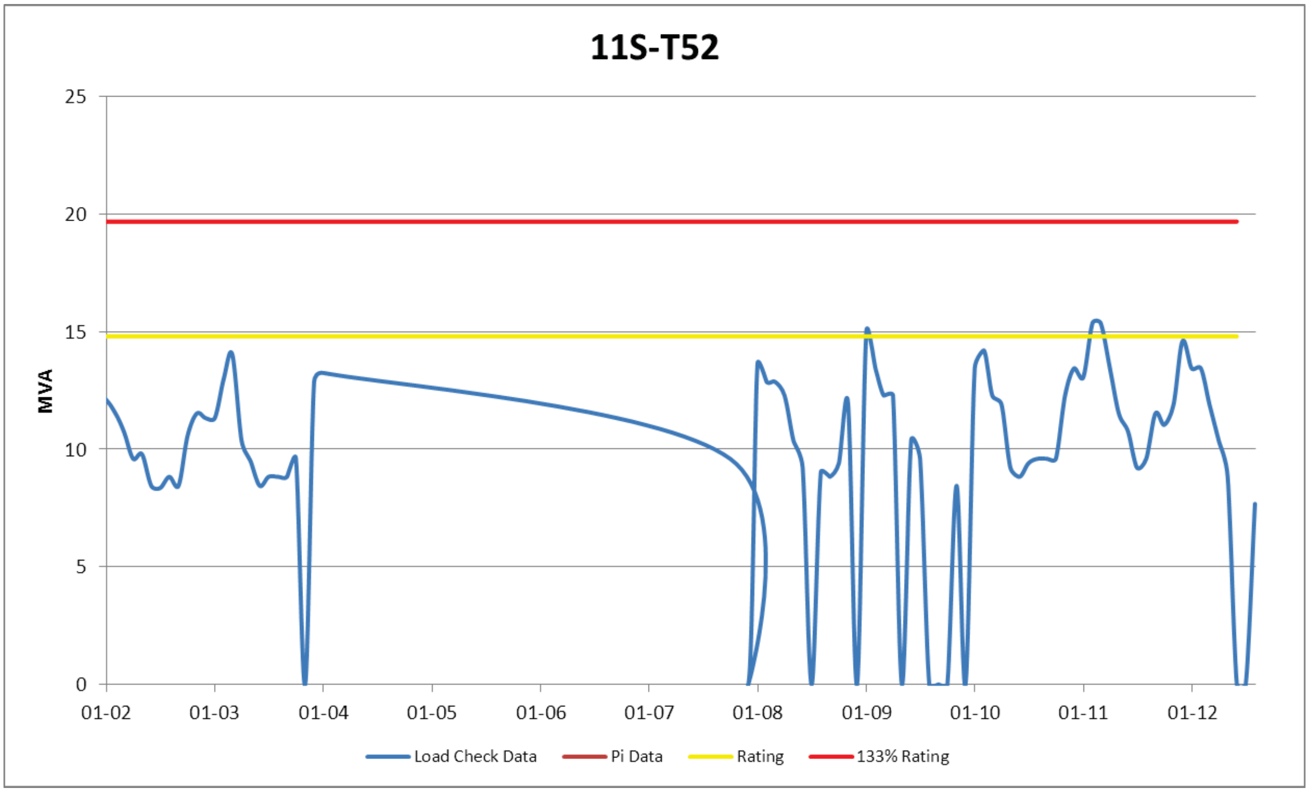


Figure 52 **11S-T52 Load History**

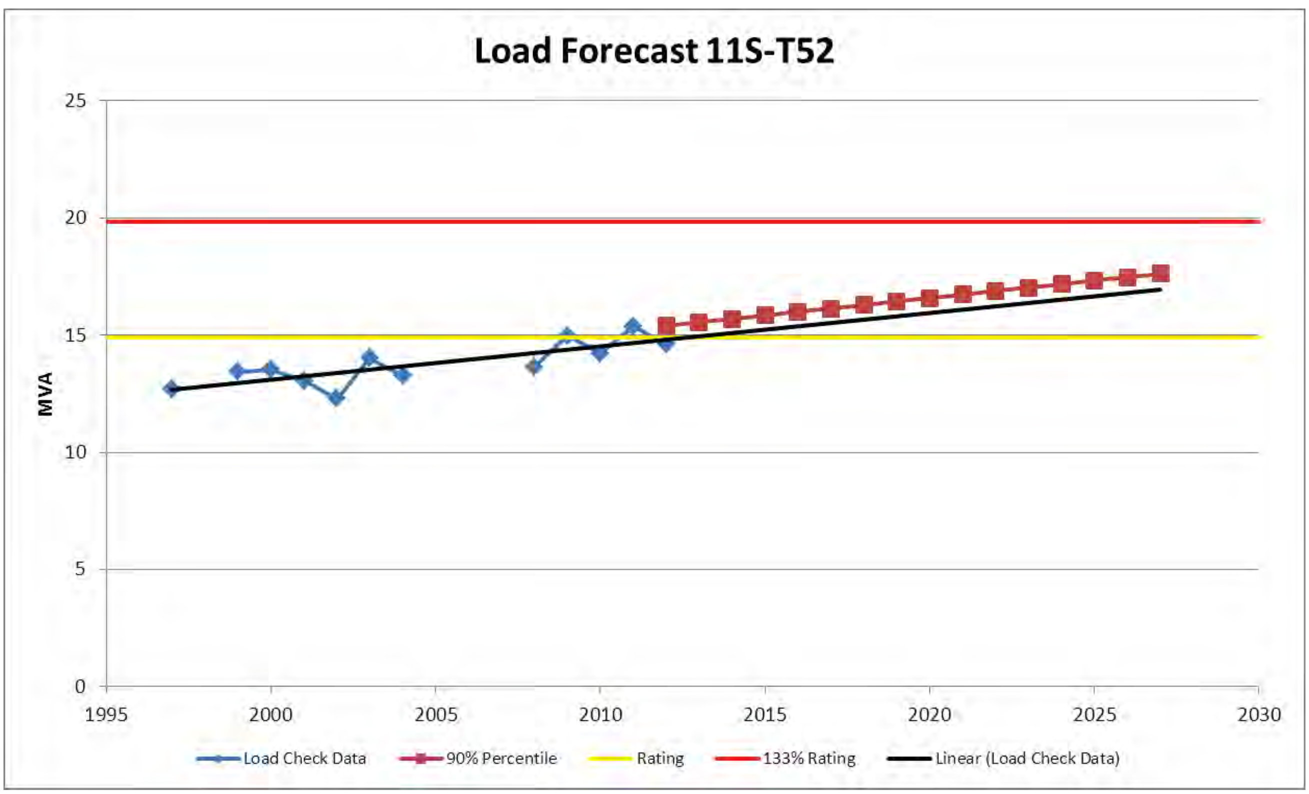


Figure 53 **11S-T52 Load Forecast**

Load Growth **0.90%**

Appendix B: Load History and Forecast

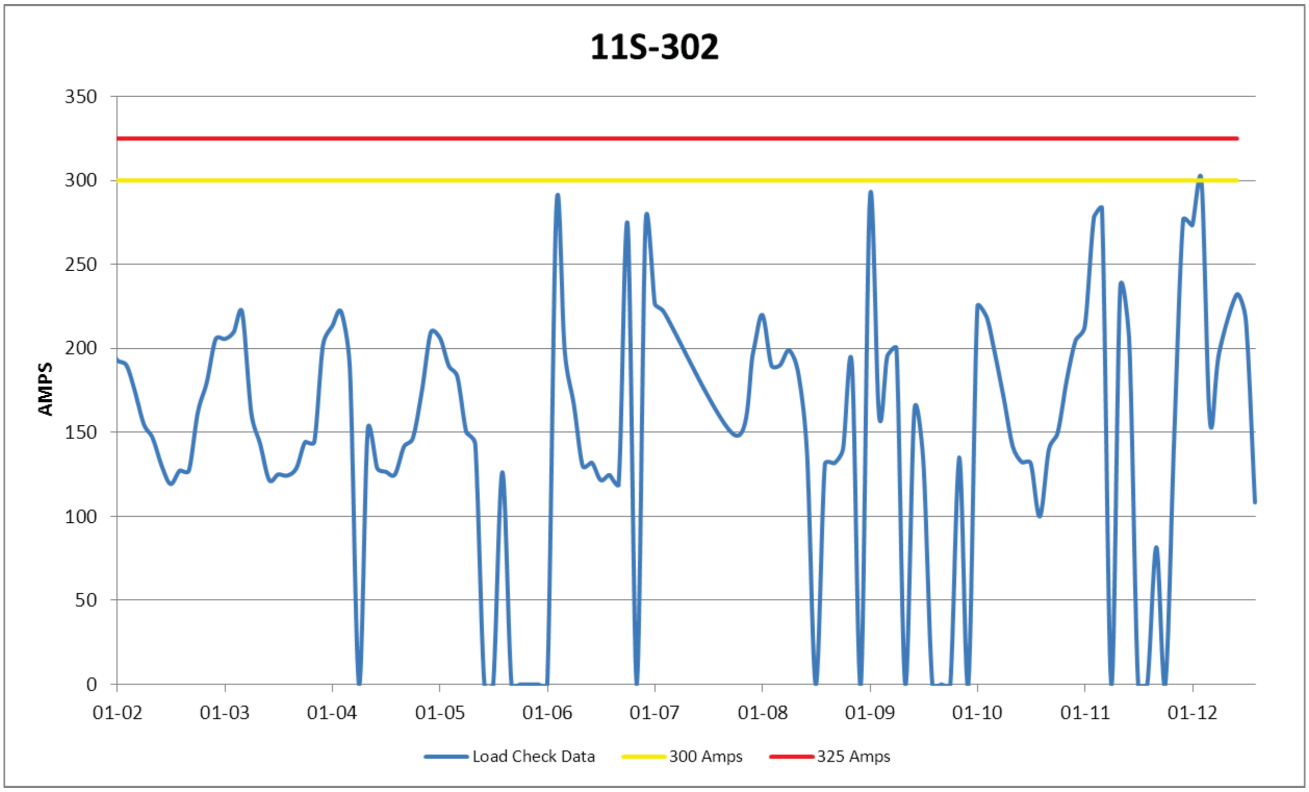


Figure 54 **11S-302 Load History**

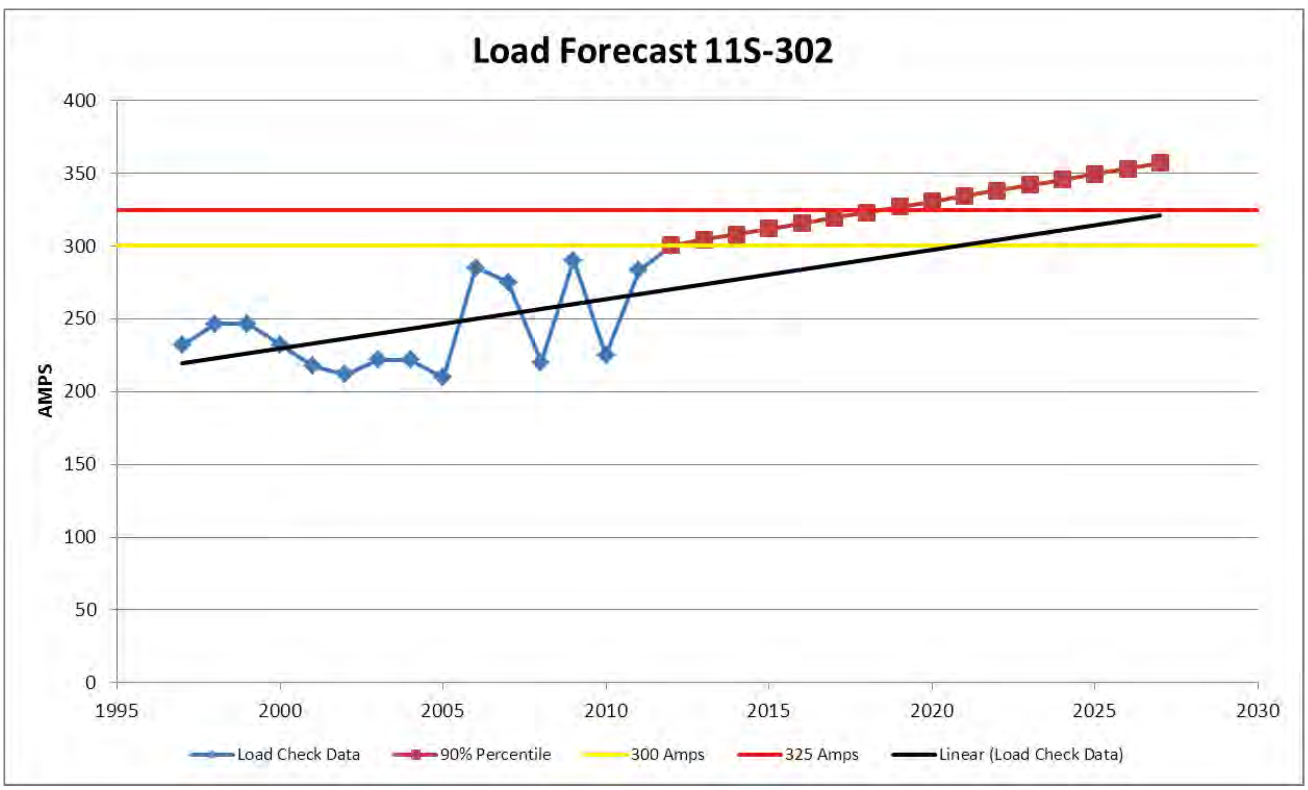


Figure 55 **11S-302 Load Forecast**

Load Growth **1.15%**

Appendix B: Load History and Forecast

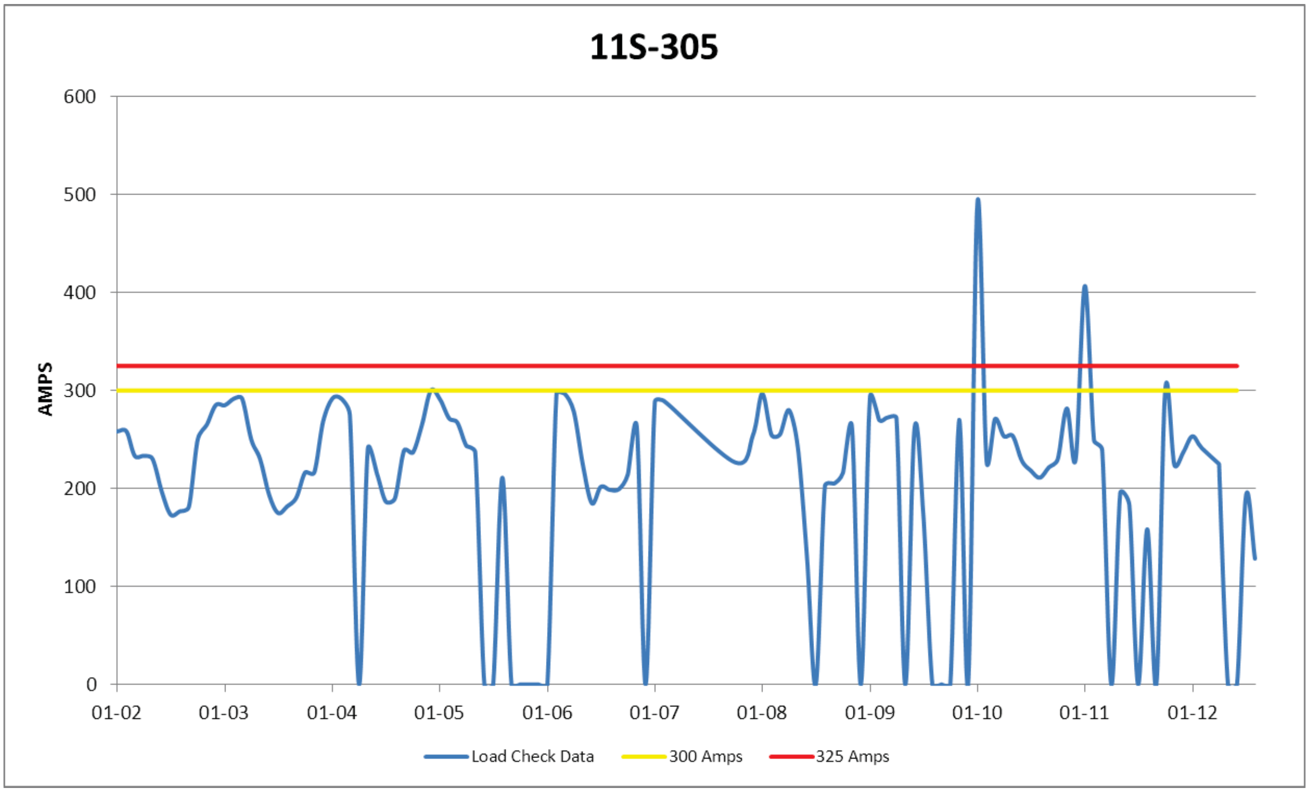


Figure 56 11S-305 Load History

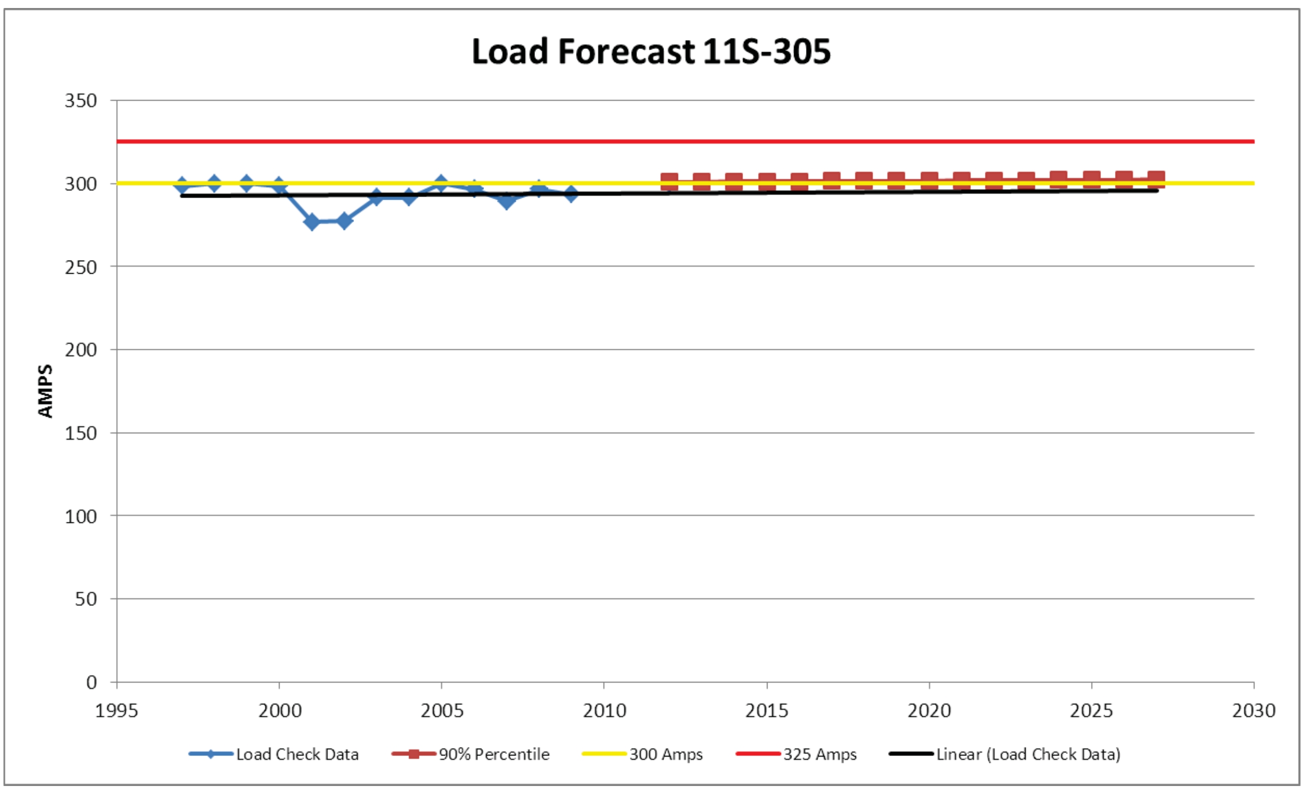


Figure 57 11S-305 Load Forecast

Load Growth 0.03%

Appendix B: Load History and Forecast

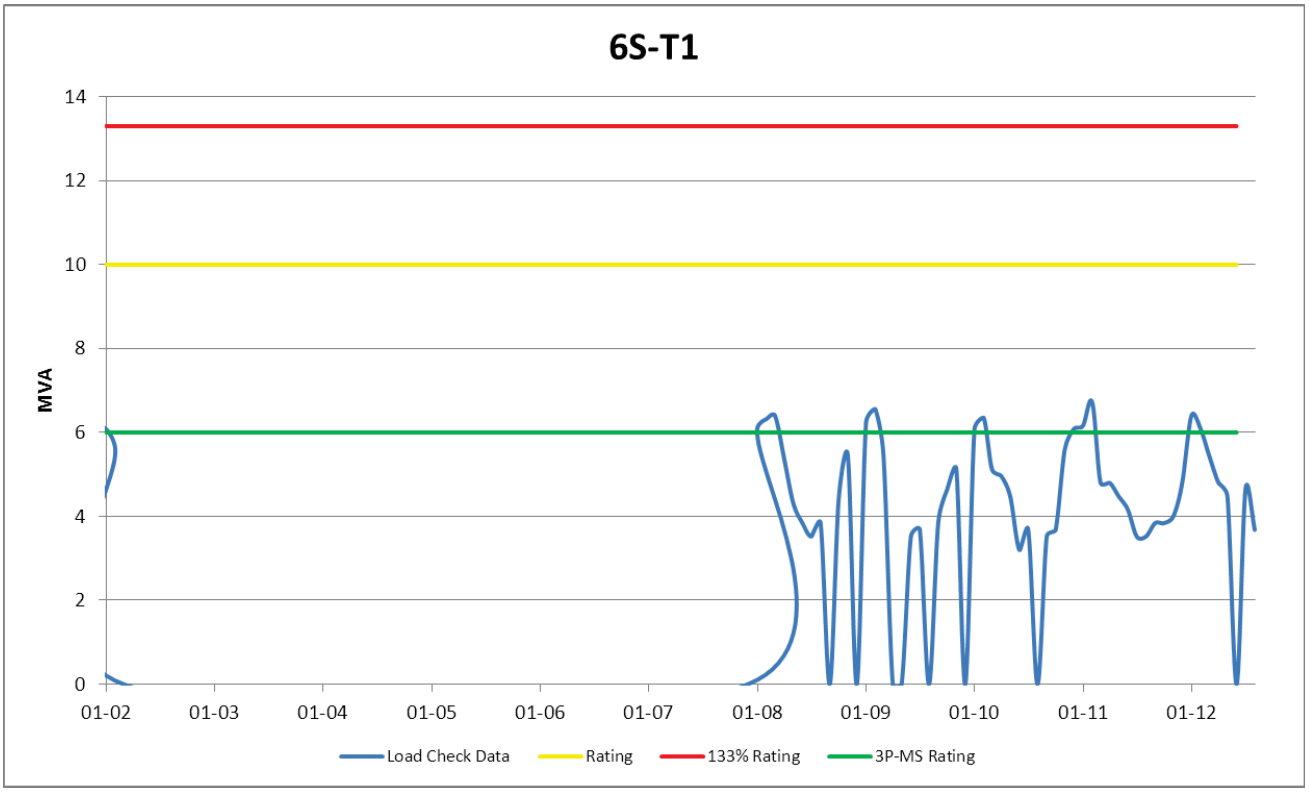


Figure 58 **6S-T1 Load History**

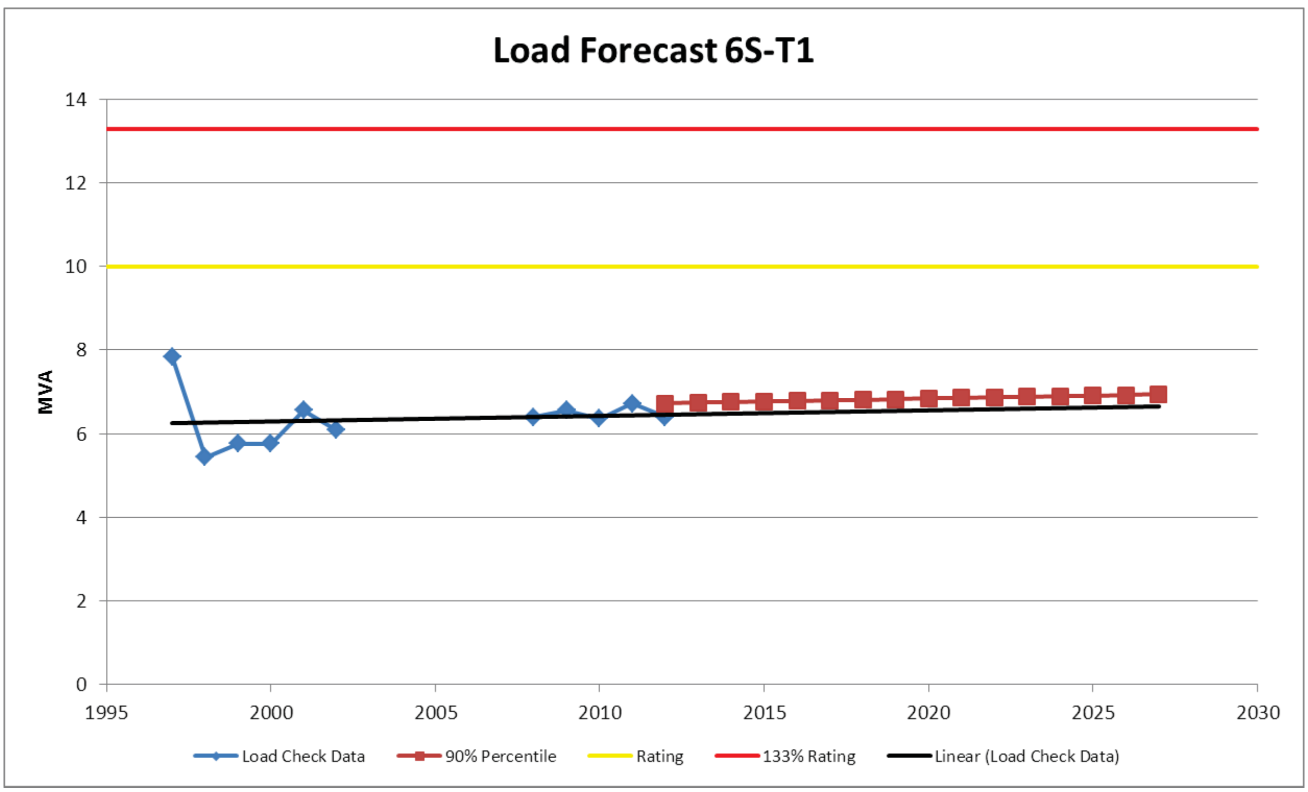


Figure 59 **6S-T1 Load Forecast**

Load Growth **0.21%**

Appendix B: Load History and Forecast

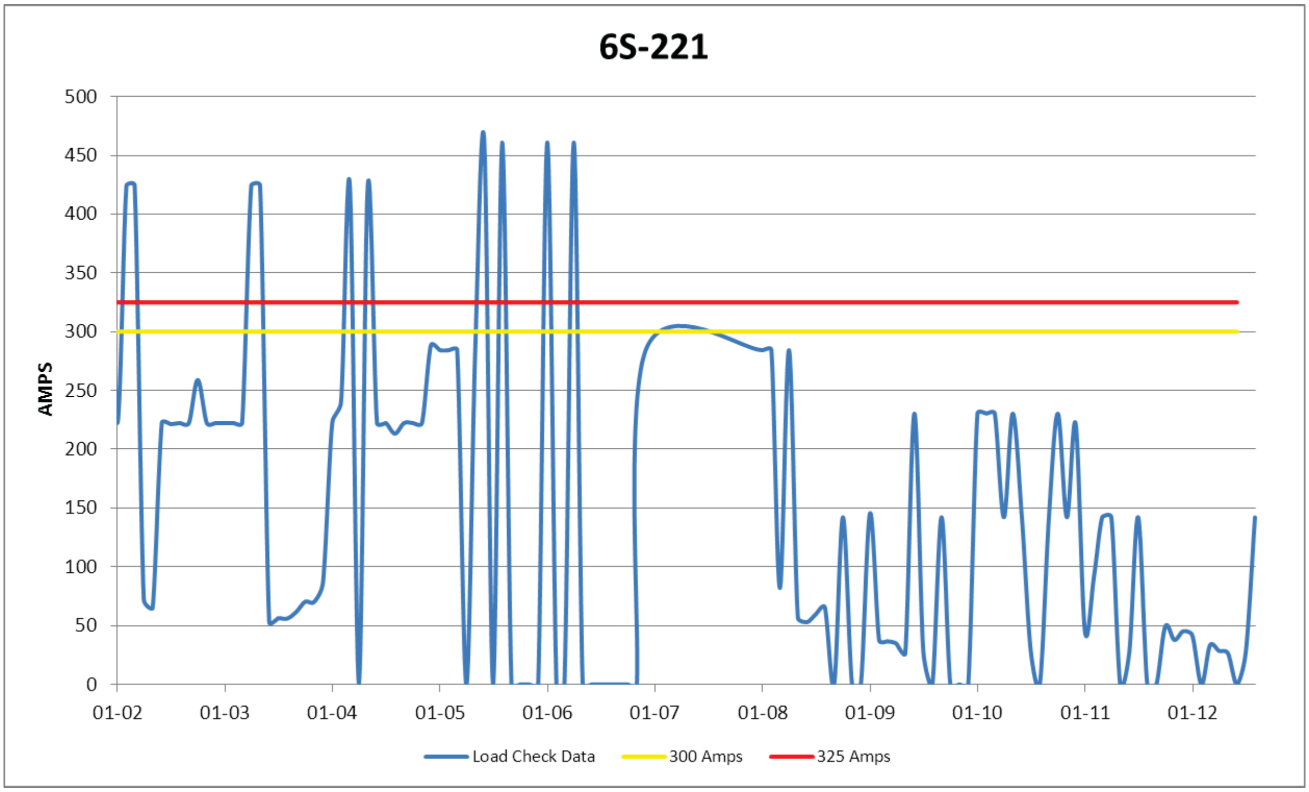


Figure 60 **6S-221 Load History**

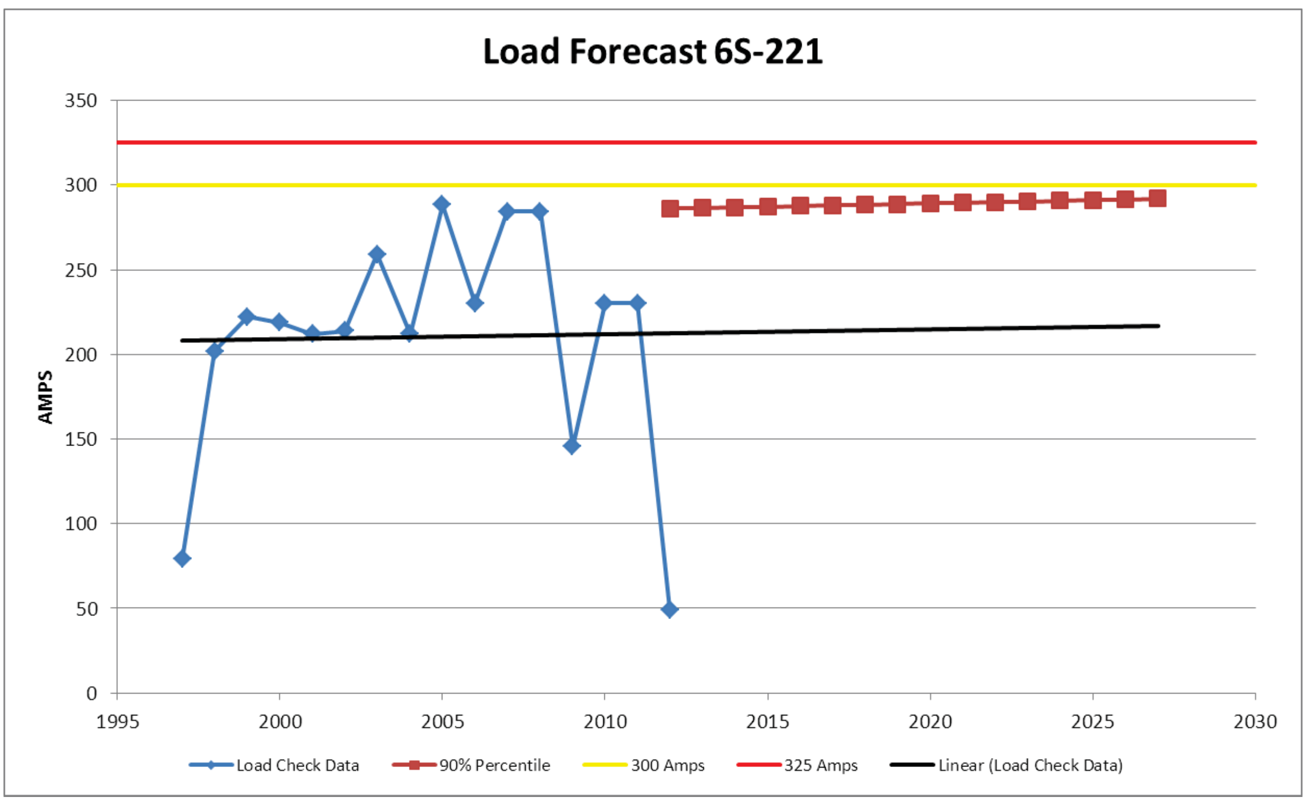


Figure 61 **6S-221 Load Forecast**

Load Growth **0.13%**

Appendix B: Load History and Forecast

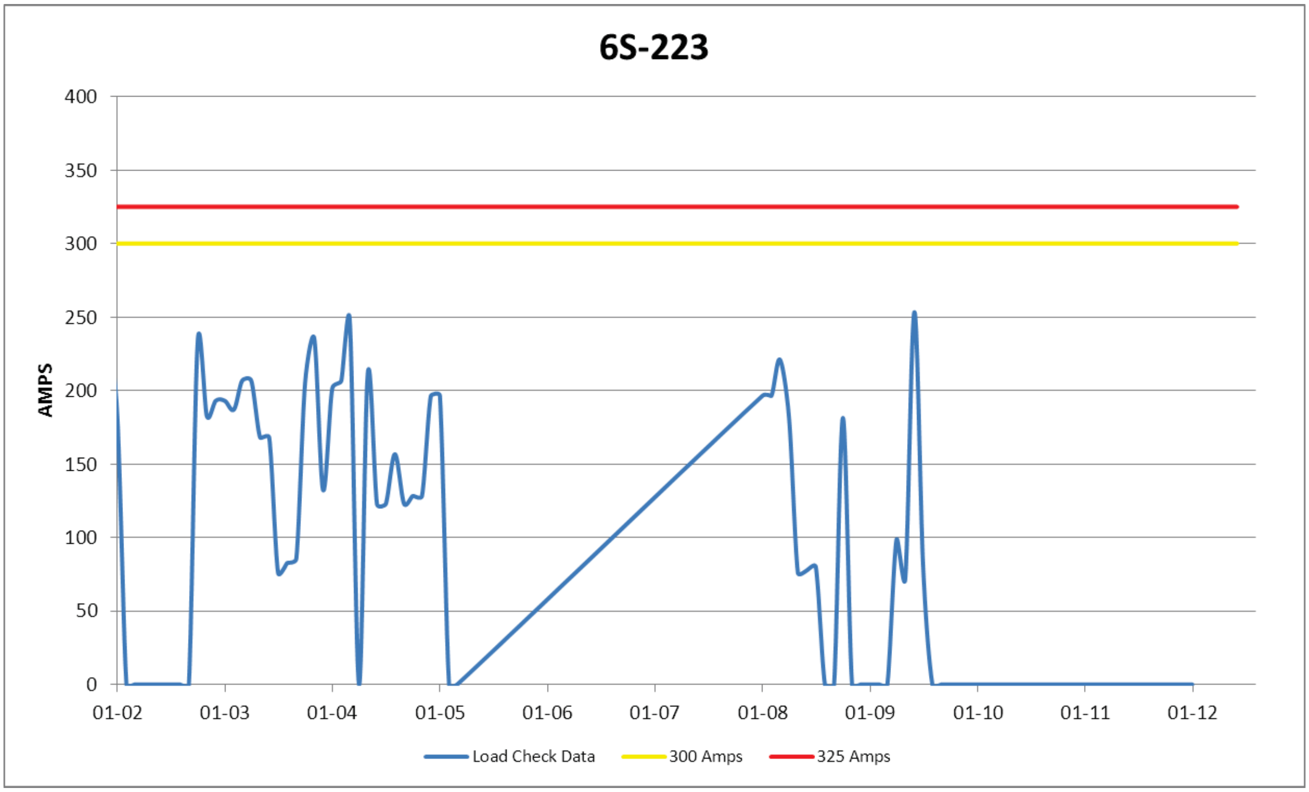


Figure 62 6S-223 Load History

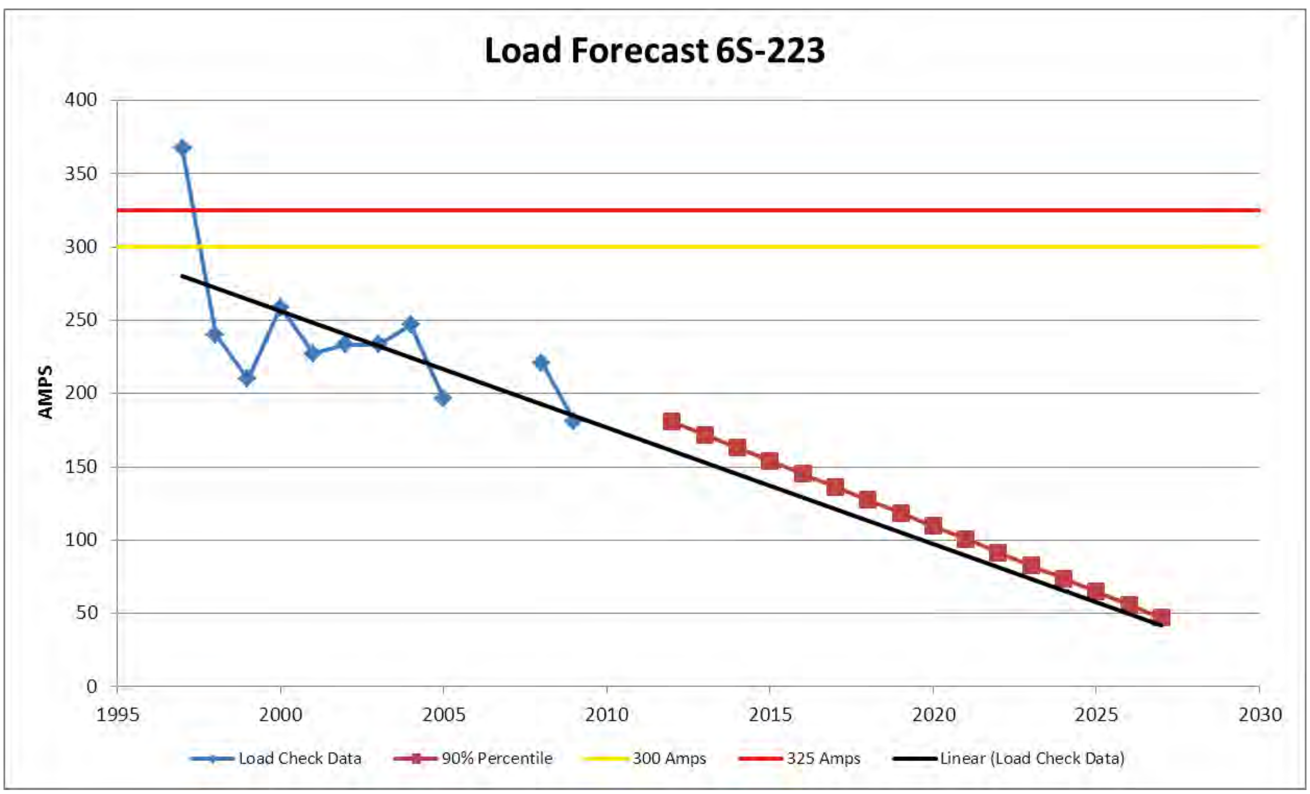


Figure 63 6S-223 Load Forecast

Load Growth -8.57%**

**** Forecast skewed due to no data available from 2006/2007 and 2010 to 2012**

Appendix B: Load History and Forecast

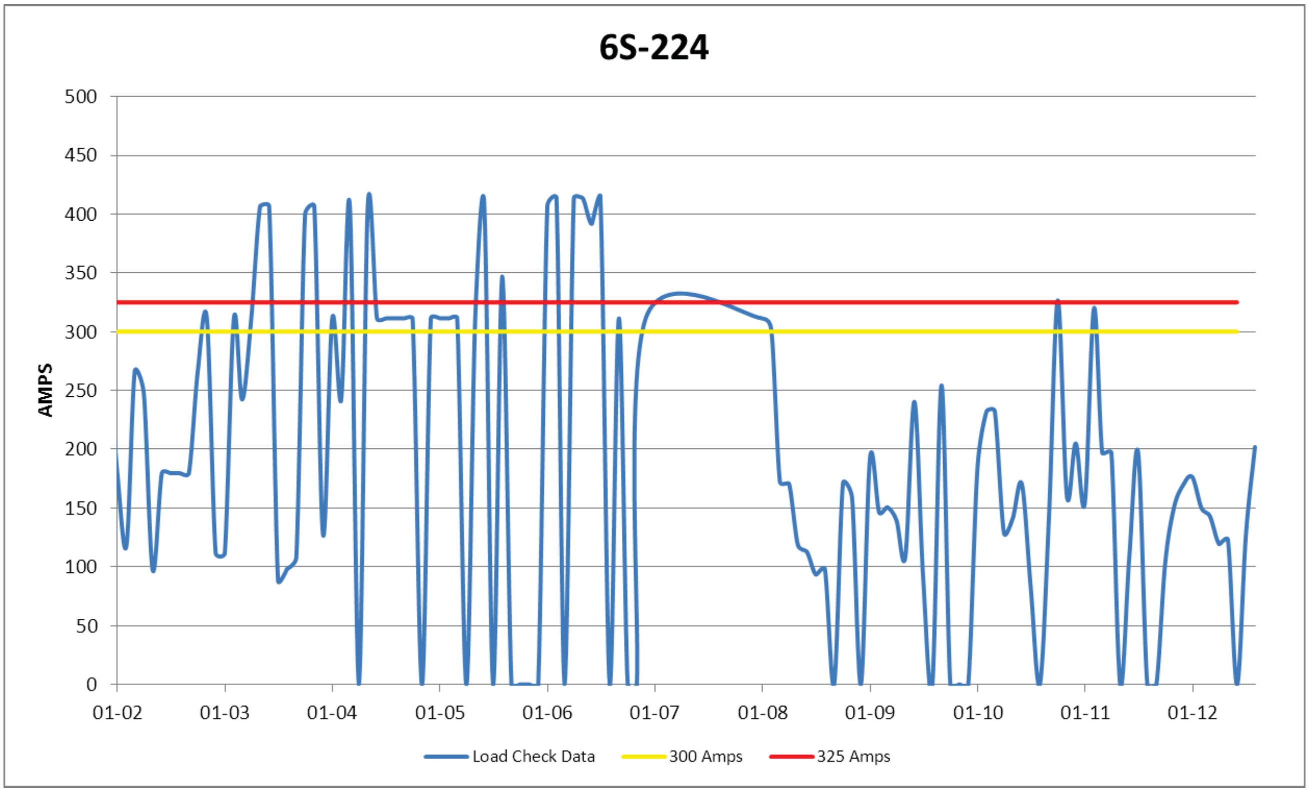


Figure 64 6S-224 Load History

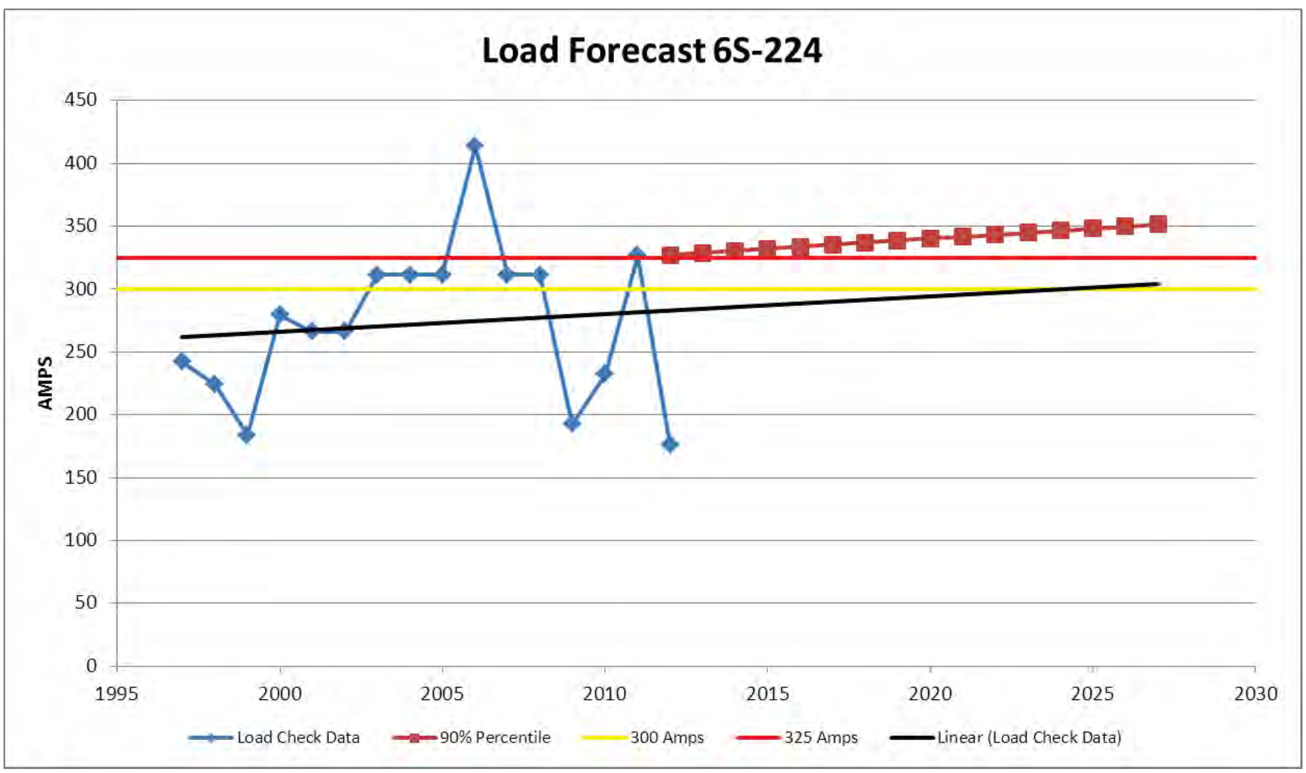


Figure 65 6S-224 Load Forecast

Load Growth 0.48%

Appendix B: Load History and Forecast

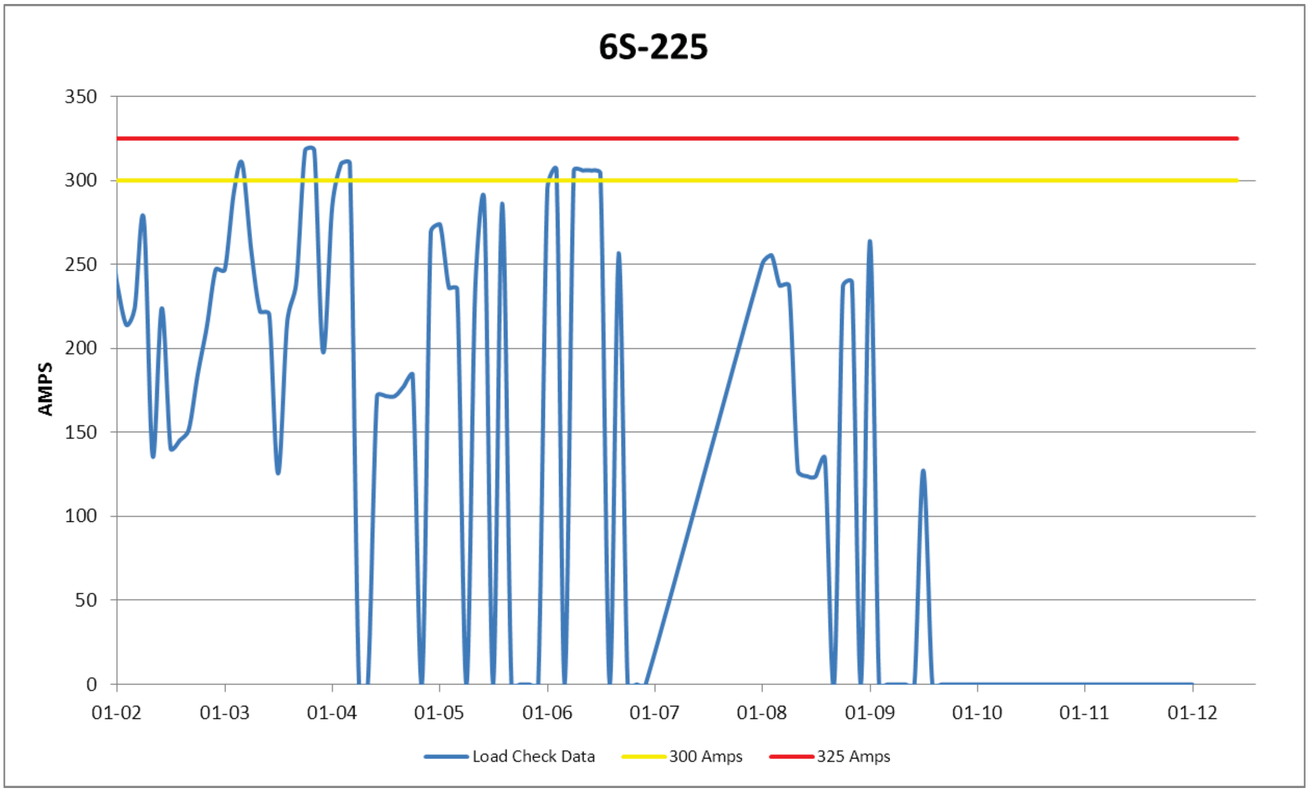


Figure 66 6S-225 Load History

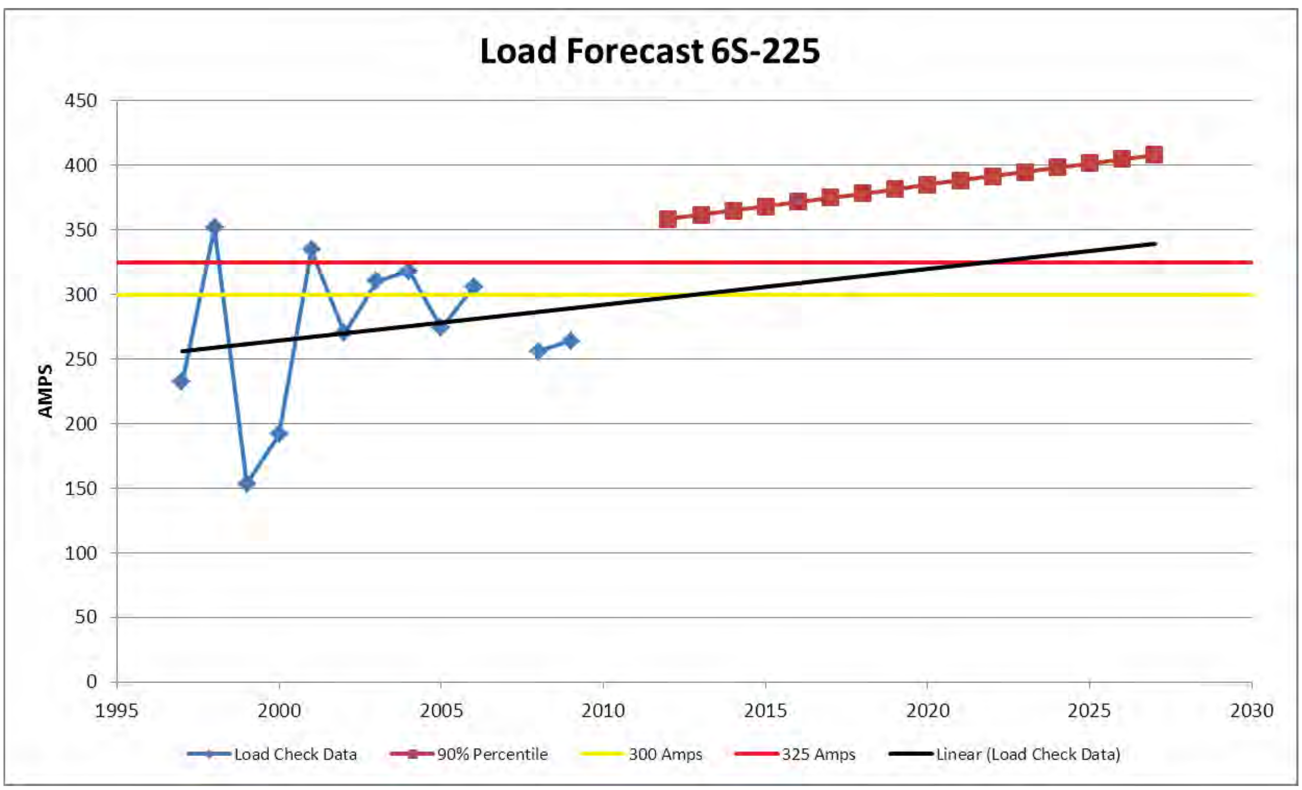


Figure 67 6S-225 Load Forecast

Load Growth 0.87%

APPENDIX C

Economic Analysis

Appendix C: Economic Analysis

Summary of Alternatives

Sydney 4kV Conversions
Summary of Alternatives

Nova Scotia POWER An Emera Company

Division :		Date :	23-Jul-13
Department :	Distribution Planning	CI Number:	
Originator :	James MacQueen	Project No. :	

	Alternative	After Tax WACC	PV of EVA / NPV	Rank	IRR	Disc Pay
A	533S-B 6S-A; Convert and Retire 6S-Terrace Street by 2016	6.48%	-2,074,838	3	-7.86%	0.0 years
B	533S-B 6S-B; Convert and Retire 6S-Terrace Street by 2018	6.48%	-2,029,860	2	-7.97%	0.0 years
C	533S-B 6S-C; Convert and Retire 6S-Terrace Streert by 2021	6.48%	-2,010,029	1	-8.28%	0.0 years
	0	NA	NA	NA	#NUM!	0.0 years

Recommendation :

This Economic Assessment recommends the following:
1. Conversion of 533S-Mason Street, from 4 to 12kV, supplied via Bentinck Street
2. Conversion of 4kV load supplied by 6S-Terrace Street to 12kV, over an 8 year period
3. Retirement of 6S-Terrace Street substation in 2021

Notes/Comments :

533S-B 6S-A; Convert and Retire 6S-Terrace Street by 2016

2013: Conversion of 533S-Mason Street stepdown
Conversion at 6S-Terrace Street to reduce overall loading for the installation of mobile substation
Replacement of 4kV breakers and related equipment at 6S-Terrace Street
2014-2015: Continued conversion of 6S-Terrace Street load to 12kV
2016: Retirement of 6S-Terrace Street substation

533S-B 6S-B; Convert and Retire 6S-Terrace Street by 2018

2013: Conversion of 533S-Mason Street stepdown
Conversion at 6S-Terrace Street to reduce overall loading for the installation of mobile substation
Replacement of 4kV breakers and related equipment at 6S-Terrace Street
2014-2017: Continued conversion of 6S-Terrace Street load to 12kV
2018: Retirement of 6S-Terrace Street substation

533S-B 6S-C; Convert and Retire 6S-Terrace Streert by 2021

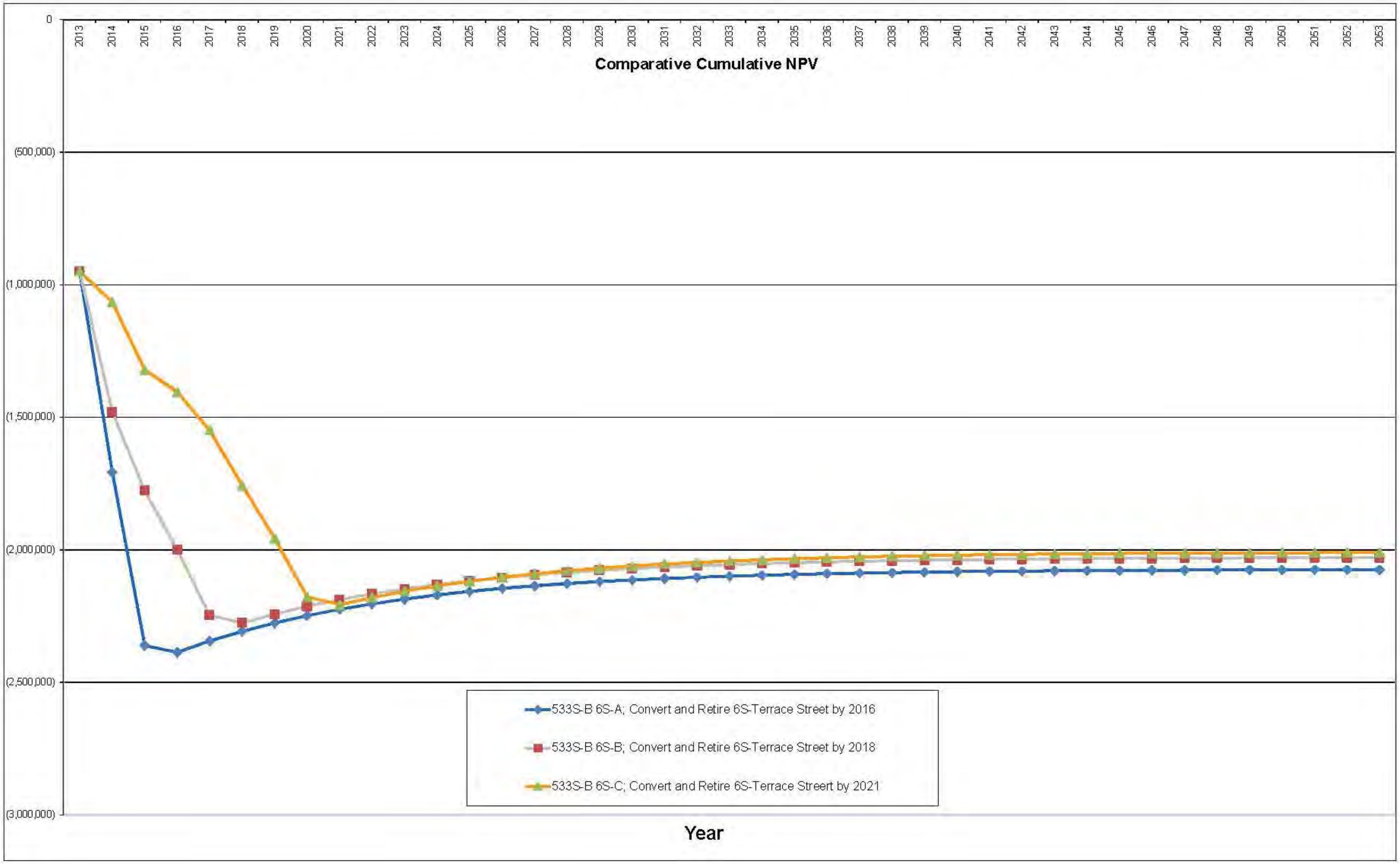
2013: Conversion of 533S-Mason Street stepdown
Conversion at 6S-Terrace Street to reduce overall loading for the installation of mobile substation
Replacement of 4kV breakers and related equipment at 6S-Terrace Street
2014-2020: Continued conversion of 6S-Terrace Street load to 12kV
2018: Maintain 6S-T1, as part of maintenance cycle
2021: Retirement of 6S-Terrace Street substation

0

2013 Sydney 4kV Conversion EAM 7/23/2013

Appendix C: Economic Analysis

NPV Comparison



Appendix C: Economic Analysis

Alternative A- 533S-A and 6S-A: Convert and Retire 6S-Terrace Street by 2016

Sydney 4kV Conversions

533S-B 6S-A; Convert and Retire 6S-Terrace Street by

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2014

Capital Invested

	Description	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.	Shipyard Reconfigure	35,042									
2.	533S-Msaon Street Conversion	274,188									
3.	Bentinck Street Reconfigure		102,510								
4.	Membertou Feeder Tie		35,228								
5.	Cabot Street Conversion	104,080									
6.	Rockdale Avenue Conversion	134,835									
7.	6S-Terrace Street Upgrade	401,500									
8.	Birch Hill Drive Conversion		211,271								
9.	Harold Street Conversion		315,355								
10.	Townsend Street Conversion		164,201								
11.	High Street Conversion			313,381							
12.	Terrace Street Conversion			358,471							
13.	Bernard Lind Conversion			132,214							
14.	6S-Terrace Street Retirement				90,203						
15.											
16.											
17.											
18.											
19.											
20.											
	Total Direct Capital Invested by Year	949,645	828,564	804,066	90,203						
	AFUDC (entered as a positive value)										
	AO (entered as a positive value)										
	Total Indirect Capital Invested by Year										
	Total Capital Invested by Year	**949,645**	**828,564**	**804,066**	**90,203**						

Alternative B- 533S-A and 6S-B: Convert and Retire 6S-Terrace Street by 2018

Sydney 4kV Conversions

533S-B 6S-B; Convert and Retire 6S-Terrace Street by

Go to: Working Capital | Capital | Expenses | Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2014

Nova Scotia POWER An Emera Company

Capital Invested

	Description	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.	Shipyard Reconfigure	35,042									
2.	533S-Mason Street Conversion	274,188									
3.	Bentinck Street Reconfigure		102,510								
4.	Membertou Feeder Tie		35,228								
5.	Caobt Street Conversion	104,080									
6.	Rockdale Avenue Conversion	134,835									
7.	6S-Terrace Street Upgrades	401,500									
8.	Birch Hill Drive Conversion			215,496							
9.	Harold Street Conversion		315,355								
10.	Townsend Street Conversion			167,485							
11.	High Street Conversion				319,649						
12.	Terrace Street Conversion					372,953					
13.	Bernard Lind Conversion		129,622								
14.	6S-Terrace Street Retirement						93,847				
15.											
16.											
17.											
18.											
19.											
20.											
	Total Direct Capital Invested by Year	949,645	582,715	382,981	319,649	372,953	93,847				
	AFUDC (entered as a positive value)										
	AO (entered as a positive value)										
	Total Indirect Capital Invested by Year										
	Total Capital Invested by Year	**949,645**	**582,715**	**382,981**	**319,649**	**372,953**	**93,847**				

Alternative C- 533S-A and 6S-C: Convert and Retire 6S-Terrace Street by 2021

Sydney 4kV Conversions

533S-B 6S-C; Convert and Retire 6S-Terrace Streert t

Go to: Working Capital
Capital
Expenses
Revenue

Add Operating Item

Project Description

Select:
In-Service Month: January
In-Service Year: 2014

Capital Invested

	Description	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.	Shipyard Reconfigure	35,042									
2.	533S-Mason Street Conversion	274,188									
3.	Bentinck Street Reconfigure		102,510								
4.	Membertou Feeder Tie		35,228								
5.	Cabot Street Conversion	104,080									
6.	Rockdale Avenue Conversion	134,835									
7.	6S-Terrace Street Upgrades	401,500									
8.	Birch Hill Drive Conversion					224,202					
9.	Harold Street Conversion			321,663							
10.	Townsend Street Conversion						177,736				
11.	High Street Conversion							339,214			
12.	Terrace Street Conversion								395,781		
13.	Bernard Lind Conversion				134,858						
14.	Maintain 6S-T1						150,000				
15.	6S-Terrace Street Retirement									99,591	
16.											
17.											
18.											
19.											
20.											
	Total Direct Capital Invested by Year	949,645	137,738	321,663	134,858	224,202	327,736	339,214	395,781	99,591	
	AFUDC (entered as a positive value)										
	AO (entered as a positive value)										
	Total Indirect Capital Invested by Year										
	Total Capital Invested by Year	**949,645**	**137,738**	**321,663**	**134,858**	**224,202**	**327,736**	**339,214**	**395,781**	**99,591**	

CI Number: 48092

Title: 2016 Substation Recloser Replacements

Start Date: 2016/02
In-Service Date: 2016/06
Final Cost Date: 2016/12
Function: Distribution
Forecast Amount: $529,270

DESCRIPTION:

This project is required for the retirement and replacement of 12 substation reclosers on the NS Power system. NS Power has an in-service inventory of over 440 substation reclosers, with an estimated useful life of 30-35 years. Oil filled reclosers have been targeted for replacement due to recent failures. The solid dielectric models with microprocessor controls that are being installed through this program have many benefits. They have an increased number of protection curves making it easier to coordinate protection on a feeder. Integrated instrument transformers provide data collection capabilities for planning studies and operations. It is also easier to integrate these into existing protection schemes due to the availability of programmable Input/Output. The substation recloser replacement program was initiated in 2010 and 192 of 440 substation reclosers have been replaced to date.

Summary of Related CIs +/- 2 years:
2014 CI 44973 2014 Substation Recloser Replacements $307,115
2015 CI 46353 2015 Substation Recloser Replacements $619,156
2017 CI TBD 2017 Substation Recloser Replacement $TBD
2018 CI TBD 2018 Substation Recloser Replacement $TBD

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Equipment Replacement

Why do this project?

In 2014/15, the average age of substation reclosers in the NS Power fleet was 33 years and failures of these reclosers occurred at the following substations within the last five years: 113H - Dartmouth East, 126H -Porters Lake, 131H - Lucasville, 129H - Kearney Lake Road, 4S - Townsend Street and 101H - Cobequid Road. Life expectancy is approximately 30-35 years as designed by the manufacturer with sufficient maintenance.

Why do this project now?

Failures of reclosers at substations have occurred. This project targets the replacement of oil filled reclosers that have reached the end of their useful life. To mitigate the risk of an in service failure, replacement is necessary.

Why do this project this way?

Spare parts are becoming increasingly hard to come by for the installed fleet of oil filled reclosers. This necessitates replacing them with a modern solid dielectric equivalent. This also serves to remove oil filled equipment from the fleet reducing environmental liability.

CI Number : 48092 - 2016 Substation Recloser Replacements **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		14,440	0	14,440
094		094 - Interest Capitalized		4,007	0	4,007
095		095-COPS Regular Labour AO		21,394	0	21,394
095		095 - Proj Supp Regular Labour AO		16,256	0	16,256
095		095-COPS Contracts AO		9,004	0	9,004
012	003	012 - Materials	003 - DP - Bldg.,Struct.Grnd.	140	0	140
013	003	013 - COPS Contracts	003 - DP - Bldg.,Struct.Grnd.	30,400	0	30,400
012	040	012 - Materials	040 - DP - O/H Cond.Devices	6,000	0	6,000
013	040	013 - COPS Contracts	040 - DP - O/H Cond.Devices	4,800	0	4,800
001	043	001 - T&D Regular Labour	043 - DP - Substn Dev.	24,111	0	24,111
012	043	012 - Materials	043 - DP - Substn Dev.	307,400	0	307,400
013	043	013 - COPS Contracts	043 - DP - Substn Dev.	9,198	0	9,198
012	045	012 - Materials	045 - DP - U/G Conduit	384	0	384
001	085	001 - Proj Supp Regular Labour	085 Design	26,764	0	26,764
001	085	001 - Regular Labour (No AO)	085 Design	6,278	0	6,278
066	085	066 - Other Goods & Services	085 Design	42,197	0	42,197
001	086	001 - T&D Regular Labour	086 Commissioning	6,496	0	6,496
			Total Cost:	529,270	0	529,270
			Original Cost:	201,740		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 48092
Title: 2016 Substation Recloser Replacements
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	87	$ 354	$ 30,605		
Procurement / Financial Support	Lot	1	$ 6,278	$ 6,278		
Project Support AO - Engineering Design	PD	69	$ 387	$ 26,764		
				$ -		
			Sub-Total	$ 63,647		
012 Materials						
Control Cables	Lot	1	$ 6,140	$ 6,140		
25 kV Recloser	ea	12	$ 25,000	$ 300,000		
25 kV Component Pieces	Lot	1	$ 7,400	$ 7,400		
Underground Conduit	Lot	1	$ 384	$ 384		
			Sub-Total	$ 313,924		
013 Contracts						
Concrete Foundations	Lot	1	$ 30,400	$ 30,400		
Installation of Control Cables	hr	48	$ 100	$ 4,800		
Boom Truck Services	Lot	1	$ 3,200	$ 3,200		
Crane Services	Lot	1	$ 6,000	$ 6,000		
			Sub-Total	$ 44,400		
066 Other Goods & Services						
Contingency	%	10%	$ 421,971	$ 42,197		
			Sub-Total	$ 42,197		
094 Interest Capitalized						
AFUDC				$ 4,007		
			Sub-Total	$ 4,007		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 14,440		
			Sub-Total	$ 14,440		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 21,394		
COPS Contract AO				$ 9,004		
Project Support Regular AO				$ 16,256		
			Sub-Total	$ 46,655		
			SUB-TOTAL (no AO, AFUDC)	$ 464,168		
			TOTAL (AO, AFUDC included)	$ 529,270		
Original Cost				$ 201,740		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47765

Title: 58C-405/11C Belle Cote Phase 2

Start Date:	2016/03
In-Service Date:	2016/05
Final Cost Date:	2016/11
Function:	Distribution
Forecast Amount:	$477,154

DESCRIPTION:

This project is Phase 2 of a two phase project to replace deteriorated poles on primary distribution feeder 58C-405 and remove the deteriorated 11C Belle Cote distribution substation. The first phase of this project, completed in 2015, re-routed a portion of primary feeder 58C-405 to roadside through a 700 metre extension of two phases and construction of a 400 metre three phase line along the East Margaree Road and installed a stepdown transformer.

Phase 2 of this project, to be completed in 2016, will convert the remaining 25 kV customers to 12 kV, remove 11C Belle Cote substation and remove the deteriorated off-road 25 kV feeder.

Summary of Related CIs +/- 2 years:
2015 CI 43203 58C-405/11C Belle Cote Phase 1 $339,419

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Deteriorated Conductor

Why do this project?

The main line of 58C-405 is located off-road which limits NS Power's access and can reduce the reliability of the line. Also, the poles are greater than 40 years old and are deteriorated to the point that climbing is not recommended, limiting NS Power’s maintenance options. This line feeds a small deteriorated 11C distribution substation at Belle Cote where the equipment, including a voltage regulator and step down transformer, is near the end of its useful life. The second phase of this project is required in order to transfer remaining customer load, fully de-energize the remaining 25kV line, allow for the removal of the 11C Belle Cote substation and complete the project.

Why do this project now?

This project should be completed now to support the reliability of the main line on primary feeder 58C-405. Phase 1 work is complete and Phase 2 is required to allow for retirement of the end of life equipment at 11C Belle Cote substation.

Why do this project this way?

Re-routing this section of primary feeder to roadside will improve the reliability in the area by reducing the response time to outages on this section of line. The completion of Phase 1 in 2015 now allows for the removal of the 11C Belle Cote substation in 2016, which has reached the end of its useful life. The completion of both phases of the project will assist in the future creation of a transfer scheme between 58C-405 and 103C-314 to improve reliability to this area.

This work will be completed by Emera Utility Services.

CI Number : 47765 - 58C-405 / 11C Belle Cote Phase 2 **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		1,760	0	1,760
095		095-COPS Contracts AO		66,652	0	66,652
020	002	020 - Royalties, Easements, App	002 - DP - Land Rights	3,000	0	3,000
012	035	012 - Materials	035 - DP - Wood Poles	7,224	0	7,224
013	035	013 - COPS Contracts	035 - DP - Wood Poles	224,773	0	224,773
012	039	012 - Materials	039 - DP - O/H Cond.	588	0	588
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	79,892	0	79,892
012	040	012 - Materials	040 - DP - O/H Cond.Devices	496	0	496
013	040	013 - COPS Contracts	040 - DP - O/H Cond.Devices	4,856	0	4,856
012	041	012 - Materials	041 - DP - O/H Line Transf.	29,278	0	29,278
013	041	013 - COPS Contracts	041 - DP - O/H Line Transf.	17,998	0	17,998
012	052	012 - Materials	052 - DP - Services	425	0	425
013	052	013 - COPS Contracts	052 - DP - Services	1,141	0	1,141
001	085	001 - Regular Labour (No AO)	085 Design	6,205	0	6,205
066	085	066 - Other Goods & Services	085 Design	32,866	0	32,866
			Total Cost:	477,154	0	477,154
			Original Cost:	895,819		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47765
Title: 58C-405 / 11C Belle Cote Phase 2
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	1	$ 6,205	$ 6,205		
			Sub-Total	$ 6,205		
012 Materials						
Poles, Anchors, and Guys	Lot	1	$ 7,224	$ 7,224		
Overhead Conductor	Lot	1	$ 588	$ 588		
Cutouts	Lot	1	$ 496	$ 496		
Transformer	Lot	1	$ 15,500	$ 15,500		
Transformer Cutouts	Lot	1	$ 13,778	$ 13,778		
Services	Lot	1	$ 425	$ 425		
			Sub-Total	$ 38,011		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 210,366		
Backhoe	Lot	1	$ 32,325	$ 32,325		
Flaggers	Lot	1	$ 40,969	$ 40,969		
Offroad Machinery	Lot	1	$ 45,000	$ 45,000		
			Sub-Total	$ 328,660		
020 Easements						
Easements	Lot	1	$ 3,000	$ 3,000		
			Sub-Total	$ 3,000		
066 Other Goods & Services						
Contingency	%	10%	$ 328,660	$ 32,866		
			Sub-Total	$ 32,866		
094 Interest Capitalized						
AFUDC				$ 1,760		
			Sub-Total	$ 1,760		
095 Administrative Overhead						
COPS Contract AO				$ 66,652		
			Sub-Total	$ 66,652		
			SUB-TOTAL (no AO, AFUDC)	$ 408,742		
			TOTAL (AO, AFUDC included)	$ 477,154		
Original Cost				$ 895,819		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47766

Title: 70V-312 Centerlea Rebuild

Start Date: 2016/07
In-Service Date: 2016/10
Final Cost Date: 2017/04
Function Class: Distribution
Forecast Amount: $456,314

DESCRIPTION:

This project is to rebuild a 3km section of primary distribution feeder 70V-312G along Highway 201 between Bridgetown and Tupperville with 336 AASC primary and 4/0 neutral. This section is no longer able to be worked on under live conditions due to deteriorated conductor and the number of splices in the line, and also has deteriorated poles. It is also part of the local load transfer scheme with feeder 12V-304.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Deteriorated Conductor

Why do this project?

This section of 70V-312G can no longer be worked on under live conditions due to deteriorated conductor and the number of splices in the line. There are currently over 110 splices in the primary and neutral conductor in the targeted section. Two planned outages within the last 12 months have also been required in order to replace deteriorated poles. This project will mitigate the need to do this on a go forward.

Why do this project now?

Delaying replacement will result in continued outages and will further limit the ability to utilize the feeder tie with 12V-304 for partial restoration during outages.

Why do this project this way?

Rebuilding like for like is standard practice for deteriorated plant. No other roadside route is available in the area that is able to feed local customers. By reconductoring with the similar conductor size, the feeder tie with 12V-304 is able to be maintained.

This work will be completed by Emera Utility Services.

Figure 1 – Highlighted section being rebuilt under this project.

CI Number : 47766 - 70V-302 Centerlea Rebuild **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,566	0	3,566
095		095-COPS Contracts AO		64,570	0	64,570
013	002	013 - COPS Contracts	002 - DP - Land Rights	20,000	0	20,000
012	035	012 - Materials	035 - DP - Wood Poles	7,602	0	7,602
013	035	013 - COPS Contracts	035 - DP - Wood Poles	70,170	0	70,170
012	039	012 - Materials	039 - DP - O/H Cond.	29,600	0	29,600
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	223,545	0	223,545
013	041	013 - COPS Contracts	041 - DP - O/H Line Transf.	4,678	0	4,678
001	085	001 - Regular Labour (No AO)	085 Design	744	0	744
066	085	066 - Other Goods & Services	085 Design	31,839	0	31,839
			Total Cost:	456,314	0	456,314
			Original Cost:	48,099		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47766
Title: 70V-312 Centerlea Rebuild
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	1	$ 744	$ 744		
			Sub-Total	$ 744		
012 Materials						
Poles	Lot	1	$ 7,602	$ 7,602		
Overhead Conductor	Lot	1	$ 29,600	$ 29,600		
			Sub-Total	$ 37,202		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 249,941		
Tree Trimming	Lot	1	$ 20,000	$ 20,000		
Backhoe	Lot	1	$ 6,750	$ 6,750		
Flagging	Lot	1	$ 41,702	$ 41,702		
			Sub-Total	$ 318,393		
066 Other Goods & Services						
Contingency	%	10%	$ 318,393	$ 31,839		
				$ -		
			Sub-Total	$ 31,839		
094 Interest Capitalized						
AFUDC				$ 3,566		
			Sub-Total	$ 3,566		
095 Administrative Overhead						
COPS Contract AO				$ 64,570		
			Sub-Total	$ 64,570.09		
			SUB-TOTAL (no AO, AFUDC)	$ 388,178		
			TOTAL (AO, AFUDC included)	$ 456,314		
Original Cost				$ 48,099		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

CI Number: 47734

Title: 1C-411 Highway 4 Reconductor

Start Date:	2016/03
In-Service Date:	2016/05
Final Cost Date:	2016/11
Function:	Distribution
Forecast Amount:	$437,410

DESCRIPTION:

This project is to reconductor approximately 3 km of deteriorated conductor on primary distribution feeder 1C-411 in Port Hawkesbury, from 54C at Sydney Road to the recloser RS4A01497 along Highway 4.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Deteriorated Conductor

Why do this project?

The 1/0 ACSR conductor along this stretch of primary distribution feeder 1C-411 is deteriorated and is unable to support additional load from the transfer scheme between this feeder and adjacent feeders, 2C-401 and 22C-401, in the event of an outage. This limits the ability for the transfer scheme to be fully effective.

Why do this project now?

This deteriorated conductor poses a reliability risk in terms of outages as a result of failure, and the inability to carry transferred load in the event of outages on the adjacent feeders in the area transfer scheme. There have been two recent instances of failed conductor on the targeted section of 1C-411 when attempting to carry transferred load.

Why do this project this way?

Reconductoring will address both the issue of outages due to deteriorated wire, as well as improve transfer capabilities in this area. There is no alternative route or feeder to provide service to this area, therefore the existing conductor must be replaced.

CI Number : 47734 - 1C-411 Highway 4 Reconductor **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

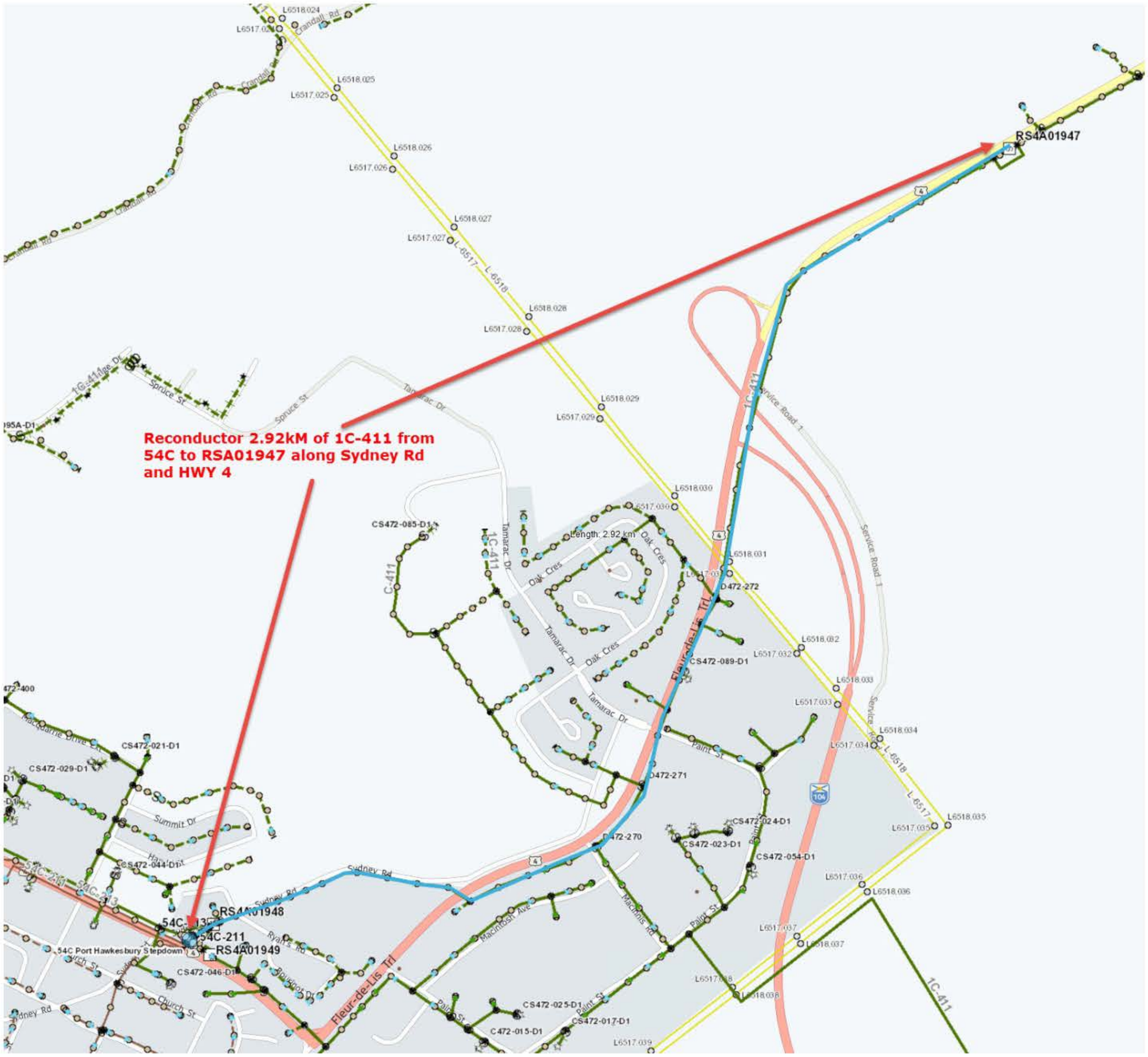
Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		3,169	0	3,169
095		095-COPS Contracts AO		59,412	0	59,412
013	002	013 - COPS Contracts	002 - DP - Land Rights	75,000	0	75,000
020	002	020 - Royalties, Easements, App	002 - DP - Land Rights	10,000	0	10,000
012	035	012 - Materials	035 - DP - Wood Poles	4,666	0	4,666
013	035	013 - COPS Contracts	035 - DP - Wood Poles	53,677	0	53,677
012	039	012 - Materials	039 - DP - O/H Cond.	27,703	0	27,703
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	152,588	0	152,588
012	040	012 - Materials	040 - DP - O/H Cond.Devices	4,651	0	4,651
013	040	013 - COPS Contracts	040 - DP - O/H Cond.Devices	11,695	0	11,695
001	085	001 - Regular Labour (No AO)	085 Design	5,553	0	5,553
066	085	066 - Other Goods & Services	085 Design	29,296	0	29,296
			Total Cost:	437,410	0	437,410
			Original Cost:	53,759		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47734
Title: 1C-411 Highway 4 Reconductor
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	1	$ 5,553	$ 5,553		
			Sub-Total	$ 5,553		
012 Materials						
Anchors and Guys	Lot	1	$ 4,666	$ 4,666		
Overhead Conductor	Lot	1	$ 27,703	$ 27,703		
Cutouts	Lot	1	$ 4,651	$ 4,651		
			Sub-Total	$ 37,019		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 191,794		
Tree Trimming	Lot	1	$ 75,000	$ 75,000		
Backhoe	Lot	1	$ 2,000	$ 2,000		
Flagging	Lot	1	$ 24,166	$ 24,166		
				$ -		
			Sub-Total	$ 292,961		
020 Easements						
Easements	Lot	1	$ 10,000	$ 10,000		
				$ -		
			Sub-Total	$ 10,000		
066 Other Goods & Services						
Contingency	%	10%	$ 292,961	$ 29,296		
				$ -		
			Sub-Total	$ 29,296		
094 Interest Capitalized						
AFUDC				$ 3,169		
			Sub-Total	$ 3,169		
095 Administrative Overhead						
COPS Contract AO				$ 59,412		
			Sub-Total	$ 59,412		
			SUB-TOTAL (no AO, AFUDC)	$ 374,829		
			TOTAL (AO, AFUDC included)	$ 437,410		
Original Cost				$ 53,759		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.


Reconductor 2.92kM of 1C-411 from 54C to RSA01947 along Sydney Rd and HWY 4
RS4A01947
RS4A01948
RS4A01949
54C-211
54C Port Hawkesbury Stepdown
Length: 2.92 km
1C-411
Fleur-de-Lis Trl
Sydney Rd
Tamarac Dr
Oak Cres
Summit Dr
Service Road 1

CI Number: 47732

Title: 131H-424/137H-412 Hammonds Plains Feeder Tie

Start Date:	2016/03
In-Service Date:	2016/06
Final Cost Date:	2016/12
Function:	Distribution
Forecast Amount:	$337,133

DESCRIPTION:

This project encompasses the line extension of primary distribution feeder 137H-412 along the right of way between Gatehouse Run and Lucasville Rd. The peak loading on distribution feeder 131H-424 in 2014 was 326A, 381A and 413A on phase A, B and C respectively, with an average of 373A. Load imbalance on this feeder is causing the equipment protection to malfunction. Furthermore, anticipated future load growth will further exacerbate the imbalance unless these changes are implemented.

The three-phase line extension will take-off from feeder 137H-412 on Gatehouse Run and pick up feeder 131H-424 on Lucasville Rd.

A section of this feeder will run off-road, however it will be within a large transmission corridor with easy access from roadside on both ends of the nine span run. In addition, the established Right Of Way is wide enough to allow for this new distribution line extension without the need for vegetation widening, or ongoing maintenance beyond the current veg management practice.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Distribution System

Why do this project?

This project will address the overload on feeder 131H-424 by transferring customer load on Lucasville Rd from 131H-424 to 137H-412. The average load on 131H-424 was 373A, which is in excess of the overhead distribution standard of 325A.

Why do this project now?

The loading on distribution feeder 131H-424 exceeds the 325A criteria. Doing the project now will reduce the loading on 131H-424 and improve the reliability in the area by creating a feeder tie between 131H-424 and 137H-412. In addition, the feeder is experiencing load imbalance which can be resolved by transferring load to the adjacent feeder.

Why do this project this way?

Two alternatives were compared for this project, the first alternative entails building new three-phase line along the transmission right of way between Gatehouse Run and Lucasville Rd. This option has several advantages including no traffic control requirements, no easements requirements and the new line can be built under dead-line conditions. The second alternative entails upgrading feeder 137H-413 along Hammonds Plains Rd to a double circuit line between Gatehouse Run and Lucasville Rd. Building a double circuit line along Hammonds Plains Rd will require significant traffic control, prolonged planned customer outages and easements may be required. It is estimated that second alternative is $249,000 more expensive than the first. Therefore, the first option is the most economical.

This work will be completed by Emera Utility Services.

CI Number : 47732 - 131H-424/137H-412 Hammonds Plains Feeder Tie **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		2,295	0	2,295
095		095-COPS Contracts AO		44,970	0	44,970
013	002	013 - COPS Contracts	002 - DP - Land Rights	20,000	0	20,000
012	035	012 - Materials	035 - DP - Wood Poles	26,273	0	26,273
013	035	013 - COPS Contracts	035 - DP - Wood Poles	159,756	0	159,756
012	038	012 - Materials	038 - DP - Insulators	689	0	689
013	038	013 - COPS Contracts	038 - DP - Insulators	16,840	0	16,840
012	039	012 - Materials	039 - DP - O/H Cond.	18,087	0	18,087
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	25,148	0	25,148
001	085	001 - Regular Labour (No AO)	085 Design	901	0	901
066	085	066 - Other Goods & Services	085 Design	22,174	0	22,174
			Total Cost:	337,133	0	337,133
			Original Cost:			

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47732
Title: 131H-424/137H-412 Hammonds Plains Feeder Tie
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	1	$ 901	$ 901		
			Sub-Total	$ 901		
012 Materials						
Poles	Lot	1	$ 26,273	$ 26,273		
Overhead Conductor	Lot	1	$ 18,087	$ 18,087		
Insulators	Lot	1	$ 689	$ 689		
			Sub-Total	$ 45,050		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 64,708		
Tree Trimming	Lot	1	$ 20,000	$ 20,000		
Flagging	Lot	1	$ 12,746	$ 12,746		
Backhoe	Lot	1	$ 15,750	$ 15,750		
Off-road Machinery	Lot	1	$ 108,540	$ 108,540		
			Sub-Total	$ 221,743		
066 Other Goods & Services						
Contingency	%	10%	$ 221,743	$ 22,174		
			Sub-Total	$ 22,174		
094 Interest Capitalized						
AFUDC				$ 2,295		
			Sub-Total	$ 2,295		
095 Administrative Overhead						
COPS Contract AO				$ 44,970		
			Sub-Total	$ 44,970		
			SUB-TOTAL (no AO, AFUDC)	$ 289,869		
			TOTAL (AO, AFUDC included)	$ 337,133		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

131H-424/137H-412-Hammonds Plains-Feeder Tie-Diagram

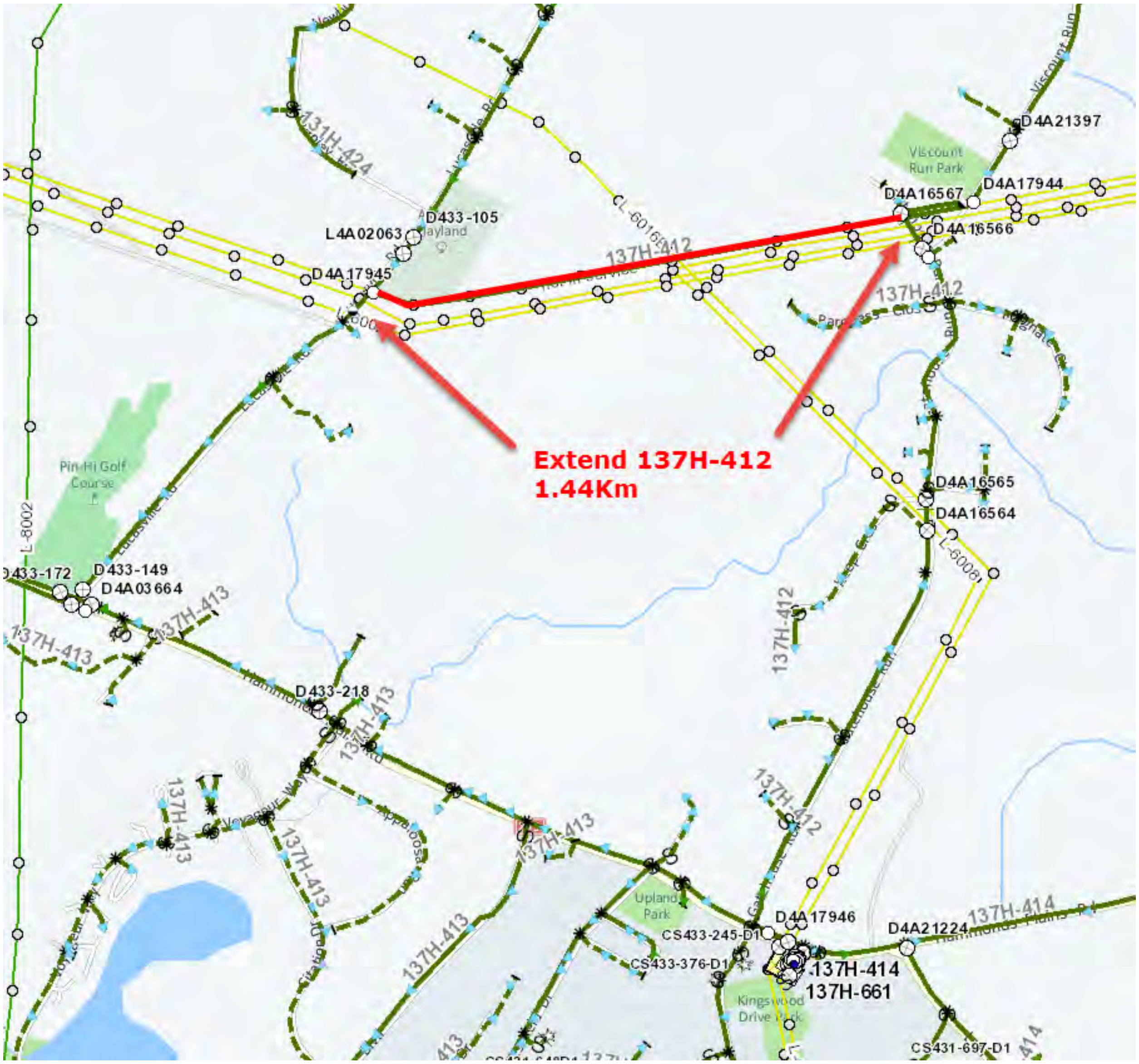


Figure 1 Extend 137H-412 along the transmission right-of-way between Gatehouse Run and Lucasville Rd (D4A16567 and D4A17945).

CI Number: 47754

Title: 63V-313 Ward Rd Reconductor

Start Date: 2016/03
In-Service Date: 2016/09
Final Cost Date: 2017/03
Function: Distribution
Forecast Amount: $308,994

DESCRIPTION:

The 2.2 km section of conductor on primary distribution feeder 63V-313G along Ward Rd from Palmer Rd to Highway 201 near Kingston is approximately 35 years old and is deteriorated. Failures on this section have started to occur and have been attributed to deteriorated conductor and insulators. This project is to reconductor and reinsulate along this section of line with 2/0 AASC primary and neutral.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Deteriorated Conductor

Why do this project?

The age and condition of the conductor, which currently has approximately 33 splices, and insulators are causing outages along this section of line. Reconductoring and reinsulating this section reduces the reliability risk from the deteriorated plant.

Why do this project now?

Outages are occurring due to the level of deterioration, and the line can no longer be worked on under live conditions due to a history of the conductor breaking on this section of line and being repaired with splices. There is no option to supply customers though switching during any unplanned outages along this section increasing the duration of any outage. Reconductoring and reinsulating will allow for operation of this line in a reliable manner.

Why do this project this way?

Reconductoring and reinsulating like for like is the standard practice for deteriorated plant. The present routing is the only option available to feed the existing customers along this section of Ward Rd. Retaining the existing distribution roadside right of way allows for the continued use of the existing structures without significant changes or replacements.

This work will be completed by Emera Utility Services.

CI Number : 47754 - 63V-313 Ward Rd Reconductor **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
094		094 - Interest Capitalized		5,005	0	5,005
095		095-COPS Contracts AO		41,144	0	41,144
013	002	013 - COPS Contracts	002 - DP - Land Rights	34,000	0	34,000
020	002	020 - Royalties, Easements, App	002 - DP - Land Rights	12,000	0	12,000
012	035	012 - Materials	035 - DP - Wood Poles	4,633	0	4,633
013	035	013 - COPS Contracts	035 - DP - Wood Poles	42,966	0	42,966
012	038	012 - Materials	038 - DP - Insulators	47	0	47
013	038	013 - COPS Contracts	038 - DP - Insulators	936	0	936
012	039	012 - Materials	039 - DP - O/H Cond.	11,472	0	11,472
013	039	013 - COPS Contracts	039 - DP - O/H Cond.	109,966	0	109,966
012	040	012 - Materials	040 - DP - O/H Cond.Devices	224	0	224
013	040	013 - COPS Contracts	040 - DP - O/H Cond.Devices	1,114	0	1,114
012	041	012 - Materials	041 - DP - O/H Line Transf.	7,063	0	7,063
013	041	013 - COPS Contracts	041 - DP - O/H Line Transf.	7,128	0	7,128
013	050	013 - COPS Contracts	050 - DP - Street Lights	267	0	267
012	052	012 - Materials	052 - DP - Services	41	0	41
013	052	013 - COPS Contracts	052 - DP - Services	6,504	0	6,504
001	085	001 - Regular Labour (No AO)	085 Design	4,195	0	4,195
066	085	066 - Other Goods & Services	085 Design	20,288	0	20,288
			Total Cost:	308,994	0	308,994
			Original Cost:	45,138		

Capital Project Detailed Estimate

Location: Distribution
CI# / FP#: 47754
Title: 63V-313 Ward Rd Reconductor
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
Procurement / Financial Support	Lot	1	$ 4,195	$ 4,195		
			Sub-Total	$ 4,195		
012 Materials						
Poles	EA	6	$ 772	$ 4,633		
Insulator	Lot	1	$ 47	$ 47		
Overhead Conductor	Meter	8533	$ 1	$ 11,472		
Reclosers and Cutouts	EA	3	$ 75	$ 224		
Overhead Transformer	EA	4	$ 505	$ 2,018		
Cutouts	EA	10	$ 505	$ 5,045		
Services	Lot	1	$ 41	$ 41		
			Sub-Total	$ 23,481		
013 Contracts						
Contract Line Work	Hrs	[redacted]		$ 168,881		
Tree Trimming	Lot	1	$ 34,000	$ 34,000		
			Sub-Total	$ 202,881		
020 Easements						
Easements	Lot	1	$ 12,000	$ 12,000		
			Sub-Total	$ 12,000		
066 Other Goods & Services						
Contingency	%	10%	$ 202,881	$ 20,288		
			Sub-Total	$ 20,288		
094 Interest Capitalized						
AFUDC				$ 5,005		
			Sub-Total	$ 5,005		
095 Administrative Overhead						
COPS Contract AO				$ 41,144		
				$ -		
			Sub-Total	$ 41,144		
			SUB-TOTAL (no AO, AFUDC)	$ 262,844		
			TOTAL (AO, AFUDC included)	$ 308,994		
Original Cost				$ 45,138		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

General Plant

CI Number: 48072

Title: 2016 ADMS Switch Order Management

Start Date:	2016/03
In-Service Date:	2016/07
Final Cost Date:	2017/01
Function:	General Plant
Forecast Amount:	$305,467

DESCRIPTION:

The NS Power Advanced Distribution Management System (ADMS) is the distribution operator control interface which has features that if enabled would allow more effective distribution switching. Distribution Switching Orders are detailed step-by-step operations to energize/de-energized the distribution network and are used to support planned work, to manage outage events, and to ensure the safety of the field workforce. The current process for managing switching procedures involves the handing of Excel spreadsheets through a chain of command until it is approved and executed in the field. This project would design, test, and implement the Switch Order Management functionality within the NS Power ADMS environment.

Summary of Related CIs +/- 2 years:
No other projects in 2014, 2015, 2016, 2017 or 2018.

JUSTIFICATION:

Justification Criteria: Work Support Facilities

Why do this project?

The current process for managing switching procedures involves the handing of Excel spreadsheets through a chain of command until it is approved and executed in the field. This project would design, test, and implement the Switch Order Management functionality within the NS Power ADMS environment. The ADMS system provides the ability to create, complete, and manage distribution switching with the ADMS application. Using ADMS for switching management provides advanced functions, better controls, enhanced safety and the timely update of system status to the Control Centre.

Why do this project now?

The ADMS has been installed as the NS Power Outage Management System since April 2015. There are advanced features in ADMS that can add value to NS Power operations beyond just outage management. Executing this project in 2016 allows NS Power to realize the benefits of the functionality available in ADMS. NS Power field crews are being provided the ability to manage ADMS outage incidents on field units (tablets) and the next extension of this capability is for the crews to receive switching instructions on the tablet. Electronic issue and delivery of switching procedures helps maintain work schedules and provides for timely device operations reporting back to ADMS. The use of ADMS also enhances safety in the field and improves efficiencies as compared to current state, which can be adversely affected by the manual nature of switching procedure changes and reviews, approvals, and fax delivery to field resources.

Why do this project this way?

The project will be done leveraging existing infrastructure and ADMS features with effort from NS Power resources as well as ADMS vendor support. Leveraging existing ADMS features allows NS Power to maximizing the value of assets already in place. The use of vendor support is critical to ensure the design and implementation of Switch Order management is aligned with vendor recommendations and takes advantage of vendor expertise and experience.

CI Number : 48072 - 2016 ADMS Switch Order Management **Project Number**

Parent CI Number : -

Cost Centre : 800 - 800-Services - Admin. **Budget Version** 2016 ACE Plan

Capital Item Accounts

Acct	Actv	Account	Activity	Forecast Amount	Amount	Variance
092		092-Vehicle T&D Reg. Labour AO		15,844	0	15,844
094		094 - Interest Capitalized		2,317	0	2,317
095		095 - Proj Supp Regular Labour AO		46,515	0	46,515
095		095-COPS Regular Labour AO		23,474	0	23,474
001	064	001 - T&D Regular Labour	064 - GP - Sup. Control and DA	33,583	0	33,583
035	072	035 - Comp.Hrdwr & Op.Sftwr	072 - GP - Computer Equipment	8,000	0	8,000
028	078	028 - Consulting	078 - GP - Comp. Appl. Software	50,000	0	50,000
034	078	034 - Appl. Software	078 - GP - Comp. Appl. Software	25,000	0	25,000
001	085	001 - Regular Labour (No AO)	085 Design	500	0	500
001	085	001 - Proj Supp Regular Labour	085 Design	76,580	0	76,580
011	085	011 - Travel Expense	085 Design	3,000	0	3,000
041	085	041 - Meals & Entertainment	085 Design	900	0	900
066	085	066 - Other Goods & Services	085 Design	19,756	0	19,756
			Total Cost:	305,469	0	305,469
			Original Cost:			

Capital Project Detailed Estimate

Location: **Distribution**
CI# / FP#: 48072
Title: 2016 ADMS Switch Order Management
Execution Year: 2016

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
001 Regular Labour						
T&D Labour - Electrician/Technician	PD	95	$ 354	$ 33,583		
Procurement / Financial Support	Lot	1	$ 500	$ 500		
Project Support AO - Engineering Design	PD	190	$ 387	$ 73,530		
Project Support - IT	PD	10	$ 305	$ 3,050		
			Sub-Total	$ 110,663		
011 Travel Expense						
ADMS Training for support resources	Lot	1	$ 3,000	$ 3,000		
			Sub-Total	$ 3,000		
028 Consulting						
Schneider ADMS vendor support	Lot	1	$ 50,000	$ 50,000		
			Sub-Total	$ 50,000		
034 Software						
ADMS enhancements from Schneider	Lot	1	$ 25,000	$ 25,000		
			Sub-Total	$ 25,000		
035 Computer Hardware						
Tablets for testing/validating ADMS field functionality	Lot	1	$ 8,000	$ 8,000		
			Sub-Total	$ 8,000		
041 Meals & Entertainment						
Project team activities	Lot	1	$ 400	$ 400		
Training meals	Lot	1	$ 500	$ 500		
			Sub-Total	$ 900		
066 Other Goods & Services						
Contingency	%	10	$ 197,563	$ 19,756		
			Sub-Total	$ 19,756		
094 Interest Capitalized						
AFUDC				$ 2,317		
			Sub-Total	$ 2,317		
092 Vehicle Overhead						
Vehicle T&D Labour Regular AO				$ 15,844		
			Sub-Total	$ 15,844		
095 Administrative Overhead						
COPS T&D Labour Regular AO				$ 23,474		
Project Support Regular AO				$ 46,515		
			Sub-Total	$ 69,989		
			SUB-TOTAL (no AO, AFUDC)	$ 217,319		
			TOTAL (AO, AFUDC included)	$ 305,469		
Original Cost				$ -		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.