newfoundland labrador
hydro
a nalcor energy company

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February 22, 2016

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

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

Dear Ms. Blundon:

Re: **A Revised Application by Newfoundland and Labrador Hydro (Hydro) pursuant to Subsection 41(3) of the Act for the approval of the procurement of 12 MW of diesel generation at Holyrood**

Please find enclosed the original and 12 copies of the above-noted Application, plus supporting affidavit, project proposal, and draft order.

Under this Application, Hydro is proposing to purchase six of the eight 2 MW mobile diesel generators that it is presently leasing for black start purposes at the Holyrood Thermal generation Station site pursuant to Order No. P.U. 38(2013). As part of this acquisition, Hydro is also proposing that it be permitted to defer and amortize over a period of five years a portion of its lease payments which can be applied towards the purchase price.

Please note that Hydro previously filed an application for the acquisition of these diesel units on November 22, 2015. Due to changes in circumstances leading to changes in the justification of this project, Hydro believes it to be appropriate to refile this application and to provide a new supporting report that provides new information justifying the project. Therefore, while Hydro had requested that the Board hold the previous application in abeyance, it now requests that the previous application be deemed to be withdrawn and that the Board receive and consider the enclosed application in its place.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Geoffrey P. Young
Senior Legal Counsel
GPY/bs

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Sheryl Nisenbaum – Praxair Canada Inc.
Thomas Johnson – Consumer Advocate
Thomas J. O'Reilly, Q.C. – Cox & Palmer

IN THE MATTER OF the *Electrical Power Control Act*, R.S.N.L. 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, R.S.N.L. 1990, Chapter P-47 (the *Act*), and regulations thereunder;

AND IN THE MATTER OF a revised Application by Newfoundland and Labrador Hydro (Hydro) pursuant to Subsection 41(3) of the *Act*, for approval of the procurement of 12 MW of diesel generation at Holyrood.

TO: The Board of Commissioners of Public Utilities (the Board)

THE APPLICATION OF NEWFOUNDLAND AND LABRADOR HYDRO (Hydro) STATES THAT:

1. Hydro is a corporation continued and existing under the *Hydro Corporation Act, 2007*, is a public utility within the meaning of the Act and is subject to the provisions of the *Electrical Power Control Act, 1994*.

2. On November 29, 2013 the Board issued Order No. P.U. 38(2013) approving, inter alia, the lease of 16 MW of diesel generation comprising eight two MW mobile diesel generators for the purpose of providing black start capability at the site of the Holyrood Thermal Generating Station. The Order approved the deferral of the lease costs but did not provide a determination with regard to the recovery of these lease costs. The Board investigated this issue further in the Prudence component of Hydro's recent General Rate Application but has not yet ruled on that matter.

3. Hydro has leased and operated these units since January 2014 and now has an opportunity to make a cost-effective purchase of some of these units. Hydro is proposing to purchase six of the eight 2 MW Caterpillar XQ 2000 mobile diesel generators and associated equipment (transformers and cables) located at the Holyrood Thermal Generating Station for an estimated additional capital cost of $5.0 million.

4. As the diesels are already installed and working at Holyrood, this project consists primarily of an asset purchase only.

5. On March 4, 2015 Hydro experienced a voltage collapse event on the Avalon Peninsula. Following the event of March 4, 2015, Hydro completed an analysis to consider system conditions on the Avalon Peninsula. The results of the analysis indicate that the Holyrood diesel generators are required to supply a P90 peak loading condition in the event of a single worst-case contingency. A P90 forecast, the criteria that Hydro is using currently, is one in which the actual peak demand is expected to be below the forecast number 90% of the time and above 10% of the time.

6. Since August of 2015, Hydro has been experiencing extremely low inflows in its reservoirs. Hydro needs to replace this hydraulic energy by using its thermal generating resources but it has become apparent that Hydro cannot generate sufficient thermal energy for this purpose by running just its Holyrood Thermal Generating Station. Therefore, since early January of 2016, Hydro has been running these diesel units, along with all of its sources of standby generation, to provide energy to the Island Interconnected system.

7. In addition to providing peaking capacity and voltage support for the Avalon Peninsula, and energy for the Interconnected island Grid, the diesel units will also provide operating cost savings through fuel savings, as Hydro's standby generation (combustion turbines (CT) and diesels) will be able to be dispatched more efficiently. These savings are estimated to result in a Cumulative Present Worth savings of $254,000.

8. There will also be capital savings by avoiding the need to construct a secondary black start connection to the new Holyrood CT. In addition, due to a low purchase price opportunity, at the end of their deployment at the Holyrood site these units may be either sold by Hydro at an attractive price or may be retained to meet other generation

needs of Hydro, as may be applied for and approved by the Board at the time of that decision.

9. The diesels were manufactured in 2010 and have less than 1000 cumulative operating hours. The agreement with the supplier of the diesel units provides that 80% of the lease payments can be applied against the purchase price of the units. While all lease payments made to date with respect to the units proposed to be purchased would qualify under this provision to reduce the end-of-lease purchase price accordingly, in this Application Hydro is seeking the deferral and recovery of 80% of the lease payments for six of the eight diesel units made from July of 2015 to April 2016, in the amount of $1.3 million.

10. The forecast cost savings was included in the evaluation of this proposal. There is a Cumulative Present Worth preference of $542,000 to Hydro and its customers, if this purchase proposal is approved and carried out.

11. The Applicant submits that the proposed capital expenditure is economic and will assist Hydro in ensuring that its generation system can continue to provide service which is reasonable safe and adequate and just and reasonable as required by Section 37 of the *Act*.

12. Therefore, Hydro makes Application that the Board make an Order approving, pursuant to Subsection 41(3) of the *Act,* the capital expenditure for the purchase of 12 MW of diesel generation comprised of six diesel units each of a capacity of two MW, the same which are already installed at Holyrood, for a total amount of $6.3 million, as set out in this Application and in the attached project description and justification document, as follows:

(a) the deferral and amortization of $1.3 million over a period of five years with unamortized balances to be included in rate base, and

(b) the incremental purchase and associated costs of $5.0 million

DATED at St. John's, in the Province of Newfoundland and Labrador, this 22nd day of February, 2016.

Geoffrey P. Young
Counsel for the Applicant
Newfoundland and Labrador Hydro
500 Columbus Drive P.O. Box 12400
St. John's, NL A1B 4K7
Telephone: (709) 737-1277
Facsimile: (709) 737-1782

IN THE MATTER OF the *Electrical Power Control Act,* R.S.N.L. 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, R.S.N.L. 1990, Chapter P-47 (the *Act*), and regulations thereunder;

AND IN THE MATTER OF a revised Application by Newfoundland and Labrador Hydro (Hydro) pursuant to Subsection 41(3) of the *Act*, for approval of the procurement of 12 MW of diesel generation at Holyrood.

AFFIDAVIT

I, Paul W. Humphries, of the City of St. John's, in the Province of Newfoundland and Labrador, Professional Engineer, **MAKE OATH AND SAY AS FOLLOWS**:

1. I am employed by Newfoundland and Labrador Hydro, the Applicant herein, in the capacity of Vice-President, System Planning, and as such I have knowledge of the matters and things to which I have herein deposed, and make this Affidavit in support of the Application.

2. I have read the contents of the Application and they are correct and true to the best of my knowledge, information and belief.

SWORN at St. John's in the)
Province of Newfoundland and)
Labrador,)
this 22nd day of February 2016,)
before me:)

Barrister – Newfoundland and Labrador

Paul W. Humphries

IN THE MATTER OF the *Electrical Power Control Act,* R.S.N.L. 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, R.S.N.L. 1990, Chapter P-47 (the *Act*), and regulations thereunder;

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this 22nd day of February 2016,)
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Barrister – Newfoundland and Labrador

Paul W. Humphries

A REPORT TO
THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

REGISTERED PROFESSIONAL ENGINEER PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS ROBERT P. COLLETT R. Collett SIGNATURE 2016-FEB-19 DATE NEWFOUNDLAND & LABRADOR	Electrical
	Mechanical
	Civil
	Protection & Control
	Transmission & Distribution
	Telecontrol
	System Planning

Purchase 12 MW of Diesel Generation (Revised)

Holyrood

February 19, 2016

newfoundland labrador hydro
a nalcor energy company

Table of Contents

1 Overview: Requirement for Diesel Generation

Newfoundland and Labrador Hydro (Hydro) has a mandate for the reliable supply of electricity to its customers. To that end, Hydro is enhancing its capabilities to plan and manage for system matters that may affect reliability[1]. Hydro has updated its generation planning criteria and also expanded reviews of capability and reserves that now include a dedicated assessment of system conditions on the Avalon Peninsula.

As part of these reviews and in light of recent events in the supply of electricity on the system, Hydro has considered the following items in its provision of reliable electricity supply:

1. There is a risk of a shortfall of capacity for customers on the Avalon Peninsula due to customers forecasted needs on the Avalon;
2. There has been an increase in availability concerns regarding Hydro's thermal generating units increasing the risk of a capacity shortfall; and
3. There is currently a material reduction in water available to Hydro for hydraulic generation.

In its assessment, Hydro has determined that purchasing the existing diesel generation at Holyrood is both required and justified to provide least-cost, reliable service to customers. Hydro proposes proposes that the six 2 MW Caterpillar XQ 2000 mobile diesel generators and associated equipment located at the Holyrood Thermal Generating Station are an integral component of its reliable electricity supply and should be purchased and be maintained in the generation fleet for, at least, the medium term.

[1] Consistent with the recommendations of Liberty Consulting in the *Review of the March 4, 2015 Voltage Collapse*, page 7: "Liberty continues to believe that Hydro should be significantly enhancing its capabilities to plan and manage reliability contingencies."

2 Winter 2016-17 Avalon Peninsula Capacity Shortfall

2.1 New Generation Planning Criteria Requirements

Hydro issued its most recent Generation Adequacy Report in September of 2015[2]. The analysis introduced new generation planning criteria that generation capacity must be sufficient to maintain a reserve of at least 240 MW based on a P90[3] peak load forecast for the Island Interconnected System. The report considered the system adequacy until interconnections with Labrador and Nova Scotia.

2.2 Growing Avalon Load

Considering both the Island and the Avalon, customer energy requirements have been steadily increasing since 2010, as shown in Figure 1. The Avalon Peninsula peak demand requirement has increased by 17% over the past 5 years.

[2] A Report to the Board of Commissioners of Public Utilities on Generation Adequacy – Newfoundland and Labrador Hydro (Generation Adequacy Report), September 2015. http://www.pub.nl.ca/applications/IslandInterconnectedSystem/files/reports/NLHGenerationAdequacyReport-September2015-09-17.pdf

[3] A P90 forecast is one in which the actual peak demand is expected to be below the forecast number 90% of the time and above 10% of the time. A P50 forecast is one in which the actual peak demand is expected to be below the forecast number 50% of the time and above 50% of the time, i.e. the average forecast.

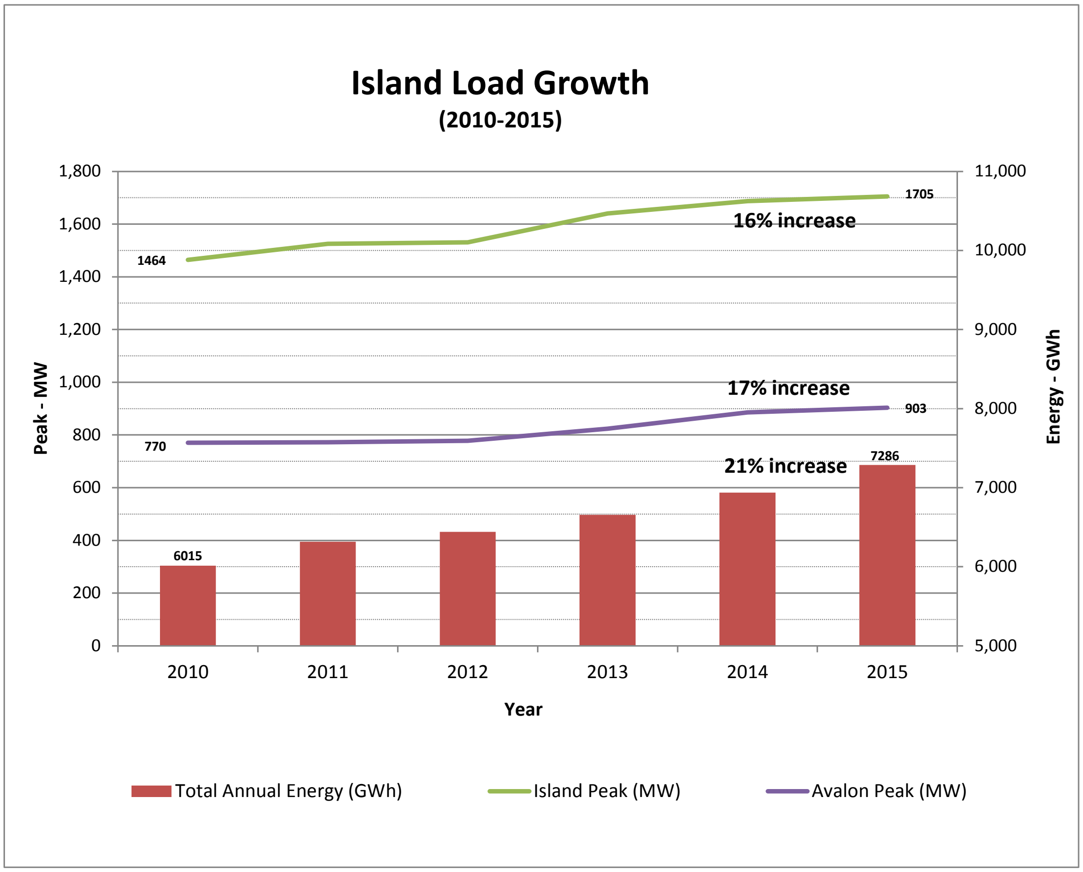


Figure 1 – Load Growth

In Table 1, P50 and P90 peak load forecasts for Island and Avalon Systems for the winters of 2015-16 and 2016-17 are provided. It is noted that the projected rate of load growth is significantly reduced from what has been experienced in recent years. For the Avalon Peninsula, load growth of 0.4% is anticipated from the winter of 2015-16 to the winter of 2016-17. This compares to an average annual load increase of 3.4% during the period ranging from 2010 to 2015.

Although load growth has slowed, the current load has meant increased utilization of our generation fleet.

Table 1 – Peak Load Forecast
Island Interconnected System (IIS) and Avalon Peninsula[4]

Winter	P50 Peak		P90 Peak	
	IIS (MW)	Avalon Peninsula (MW)	IIS (MW)	Avalon Peninsula (MW)
2015-16	1737	936	1794	968
2016-17	1741	940	1798	972

2.3 Reliability Assessments of the Avalon Peninsula

As illustrated in Figure 2, customers on the Avalon Peninsula is supported by the following sources of supply:

- Thermal generation from Holyrood Units;
- Thermal generation from the Holyrood Combustion Turbine;
- Thermal generation from the Hardwoods Gas Turbine;
- Hydraulic Generation from Newfoundland Power Units;
- Diesel Generation at Vale Terminal Station;
- Wind Generation[5]; and
- 230 kV transmission lines TL203 and TL237 at Western Avalon Terminal Station.

With only two 230 kV transmission lines interconnecting the Avalon Peninsula to the rest of the Interconnected Island System, the delivery of hydroelectric capacity from the western portion of the system is constrained. Reserve levels on the Avalon Peninsula are therefore more restricted than those of the Island System and must be calculated separately.

[4] As per Customer Winter Peak Demand Forecast, Island Interconnected System, November 2015. Base case load flows were developed to determine peak load values for the Avalon Peninsula in each case.
[5] Wind generation is not considered to be online in this analysis as it cannot be counted on for firm supply.

Following the events of March 4, 2015, Hydro expanded its operational reviews of capability and reserves to include a dedicated assessment of system conditions on the Avalon Peninsula. System reliability assessments of both the Island Interconnected System and the Avalon Peninsula are now performed daily, based on current load forecasts for the next seven days. The assessments allow for advance coordination of primary generation, standby generation, and sources of reactive support, such as capacitor banks. The daily assessment includes forecasts of the Avalon capability, the impact on the capability of the system in the event of the largest single contingency, and the Avalon reserves for the upcoming seven days. These operational practices are consistent with the recommendations of Liberty Consulting in their report on the events of March 4, 2015.[6]

[6] Liberty Consulting Review of the March 4, 2015 Voltage Collapse, Page 7 reads "Liberty continues to believe that Hydro should be significantly enhancing its capabilities to plan and manage reliability contingencies."

Figure 2 – Provincial Transmission Grid

2.4 Diesels: Required Capacity to Meet P90 Peak

As a part of the Avalon operational reliability assessment, load flow analyses were performed to assess the adequacy of supply to the Avalon Peninsula. Load flow analyses are performed as part of Hydro's Transmission Planning. These analysis involve simulations of the transmission system using representative models to ensure compliance with System Planning Criteria. These criteria are specified as follows:

1. With a transmission element (line, transformer, generator, shunt or series compensation device) is out of service, power flow in all other elements of the power system should be at or below normal rating;
2. Transformer additions at all major terminal stations (i.e. two or more transformers per voltage class) are planned on the basis of being able to withstand the loss of the largest unit;
3. For normal operations all voltages be maintained between 95% and 105%; and
4. For contingency or emergency situations all voltages be maintained between 90% and 110%.

Load flow models were developed in accordance with forecasted peak load values provided in Section 2.2 and were used to assess the impact of the Holyrood diesel generators in the context of P50 and P90 forecasts. The results of the analysis indicate that the Holyrood diesel generators are required to supply a P90 peak loading condition in the event of a single worst-case contingency.

The analyses included an assessment of the worst case contingency, which involves the loss of transmission line TL202 or TL206 between Bay d’Espoir Terminal Station and Sunnyside Terminal Station. Further detail relating to this load flow analysis is provided in Appendix A.

The results of the analysis show an outage to TL202 results in an overload to TL206 under P90 peak loading conditions when the Holyrood diesel generators are not in service. This overload condition is eliminated when the Holyrood diesel generators are brought online. This is summarized in Table 2.

Table 2 – TL206 Loading With TL202 Out of Service for 2016-17 P90 Peak Loading Condition

	Loading (A)	% Loading
Transmission Line Rating[7]	927.5	100%
Loading with Holyrood Diesel Generation	920.8	99.3%
Loading without Holyrood Diesel Generation	947.1	102.1%

On the basis of this analysis, the Holyrood diesel generators are required to ensure the adequacy of supply for a P90 peak loading condition on the Avalon Peninsula in the event of a single worst-case contingency involving the loss of transmission line TL202 or TL206.

2.5 Ongoing Generation Adequacy Review

In the analysis described above, the Holyrood diesel units are required to ensure adequacy of supply on the Avalon Peninsula in a load flow analysis where all generating units are assumed to be available at full capacity[8] and the diesels are indeed required to meet the P90 forecast. Hydro is currently performing an in depth review of Holyrood and its future capability. If the outcome of this review indicates a reduction in capacity of any units go-forward, the need for the diesels to meet the peak is even further supported despite their relatively small contribution. They form an important part of the generation mix in meeting customer requirements.

[7] Hydro transmission line conductor ratings are calculated using IEEE Std 738 "IEEE Standard for Calculating the Current-Temperature of Bare Overhead Conductors". For winter operation, conductor ratings are calculated for an ambient air temperature of 0^0C.
[8] Holyrood unit ratings for load flow analysis are summarized as follows: Unit 1: 170 MW, Unit 2: 170 MW, Unit 3: 150 MW. The Hardwoods Gas Turbine is rated for 50 MW.

3 Additional Benefits of Diesels in Hydro's Standby Fleet

3.1 Increased Reliability

Since spring 2015, Hydro amended its operational practice regarding the dispatch of standby generation. The new approach to operating practice is consistent with the findings of Liberty Consulting in their report on the events of March 4, 2015.

Specifically, Hydro is using increased standby generation in 2016 compared to the 2015 Test Year. Hydro operates its standby generation in the following situations:

1. In advance of single largest contingencies on the Avalon[9];
2. To meet spinning reserves requirements on the Avalon and Island Interconnected system[9]; and
3. In response to generating unit and transmission line outages.

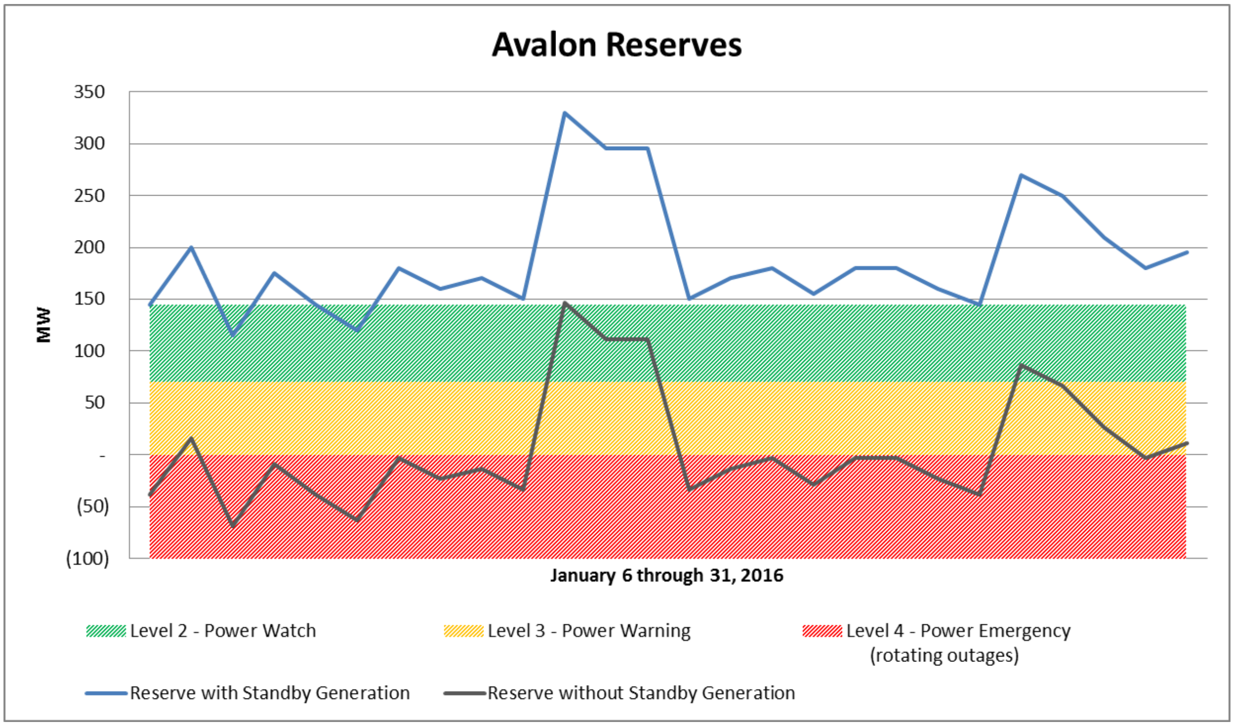
3.2 Increased Avalon and Energy Reserves

As discussed above, generating units are placed online to ensure that adequate system capacity is available. In January and February of 2016, Holyrood Units 1 and 2 were forced out of service for urgent boiler tube replacements. During this same timeframe, the Hardwoods Gas Turbine experienced operational issues, including a requirement for an engine replacement. These operational issues have increased Hydro's requirement to run standby units to ensure energy and reliability for customers. There has been a substantial increase in the requirement for standby generation to ensure reliable service for customers on the Avalon. Specifically, the operation of the diesel units was required on 20 occasions during this period to ensure adequate reserve levels.

[9] NLH 2013 GRA Final Submission, page reads "Included in these forecast fuel costs for 2015 is the cost of operating the new Holyrood CT. In contrast to forecast production levels included in the 2015 Test Year, Hydro has been running the Holyrood CT at minimum output levels during peak periods of the day to provide enhanced system reliability. This operational practice began in 2015 in response to enhanced reliability assessments following the March 4, 2015 outage event, and has resulted in increased fuel consumption at the Holyrood CT relative to the 2015 Test Year forecast."

Figure 3 illustrates the overall benefit that Avalon Standby Generation provides towards reliable supply on the Avalon Peninsula during January, 2016.

Figure 3 – Avalon Reserves, January 6-31, 2016



As shown in Figure 3**,** if Hydro had not operated Hydro's Avalon Standby Generation, the Avalon Peninsula would have been in a Level 4 Power Emergency for the majority of January 2016 when there were boiler tube issues at Holyrood and Hydro would have worked with Newfoundland Power to institute rolling customer outages on the Avalon Peninsula.

Appendix B provides a summary of the operation of the Holyrood diesel generators during the period December 24, 2015 to January 31, 2016.

3.3 2016 Standby Generation Operation in Response Low Hydrology

On February 5, 2016, Hydro submitted to the Board of Commissioners of Public Utilities (the Board) an Application for a 2016 Standby Fuel Deferral Account for Fuel Consumed in Combustion Turbines and Diesel Generators. The letter accompanying this application states:

> Since July of 2015, precipitation and inflows in hydro-electric reservoirs on the Island have been very low. In addition, the current snow pack is well below normal. Meanwhile, Hydro continues to see strong load growth and has been experiencing outages and deratings of its Holyrood Thermal Generating Station ("Holyrood TGS"). Based on these circumstances, if action is not taken, there is a very real risk that the reservoirs will remain far below normal, putting Hydro's ability to provide sufficient energy generation to its customers in jeopardy.
>
> The requirement to consume diesel fuel for these purposes is caused primarily by the low hydrology, not just in Hydro's reservoirs but also in the reservoirs not owned by Hydro, including the Exploits resources. In addition, Newfoundland Power and Corner Brook Pulp and Paper Limited have informed Hydro that their inflows have been, and are expected to be, lower than usual. Due to these circumstances and the need to provide reliable service to its customers, Hydro will be running combustion turbines and diesel generators at much higher levels in 2016 than in previous years.

The diesel generators at Holyrood form an important part of Hydro’s standby fleet. In addition to reserve support, they are required to be run in response to the 2016 low Hydrology scenario.

3.4 Economic Dispatch of Diesels

Economic benefits associated with the purchase of the diesel generating units including those resulting from the deferral of the dispatch of the Holyrood Combustion Turbine, from lease savings and, if a sale occurs, from proceeds of the sale of the units. An analysis was completed which indicates that there is a potential fuel savings for the Island Interconnected System if the black start diesels are part of dispatch order for Avalon reliability prior to the start-up of the Holyrood CT. This would mean fewer starts for the CT and less run time, as the diesels could be started before the CT. Using the diesels in this capacity could mean a fuel savings of $0.73 million in 2016 ($0.33 million from June to December) and $1.06 million in 2017. As summarized in Appendix C, analysis indicates that the purchase of the units is preferred and would provide a projected Cumulative Present Worth (CPW) savings of $254,000.

3.5 Holyrood Generating Station Proven Black Start Solution

The Holyrood Thermal Generating Station is required to have black start capability in the event of a loss of grid power. In the original plan for the diesels, they were to provide a black start solution until the new Holyrood CT was fully commissioned after which it would provide black start, through two connections, a primary and secondary. The secondary connection is the same path used by the diesels to black start Holyrood, and therefore, the diesels would have to be disconnected to test this path. Keeping the diesels in place, there would be no requirement to construct the secondary connection to the CT, resulting in the saving of the cost of that connection of approximately $480,000 included in the Holyrood CT project. With this proposal, the diesels will remain connected and continue to provide a tested and proven black start solution for the plant.

This is further discussed in Appendix D.

4 Project Description

As the diesels are already installed and working at Holyrood, this project consists of an asset purchase only.

The proposal consists of the purchase of six 2 MW Caterpillar XQ2000 diesel generators and associated equipment (transformers and cables). They are installed at the Holyrood Thermal Generating Station. The generators generate at 480 V which is then stepped up to 4,160 V by six 2.5 MVA padmount transformers. The generators are connected to the plant through an overhead distribution line operating at 4,160 V. The power is brought into the plant using high voltage cables to breaker SSB-2. The generators provide an on-site black start solution to the plant and while they are capable of producing 12 MW, only 10 MW is available to the Island Interconnected System due to limitations of the existing plant connection. All the generators were manufactured in 2010 and installed in Holyrood in January 2014, but have low operating hours (less than 1000 cumulative for all units).

In 2020, after the interconnections to Labrador and Nova Scotia are complete and proven, and the diesels are no longer required for black start, peaking and back-up, Hydro will evaluate the potential for continued se of the generators and apply to the Board based on the outcome of the evaluation. For the Board's reference, the current market for used XQ 2000 mobile diesel units indicates that $525,000 USD is a reasonable estimate of the resale price for these diesels in 2020. Further discussion of this is in Appendix E.

4.1 Purchase of Six Units Versus Eight Units

There are currently eight 2 MW diesels being leased at Holyrood. The decision has been made to end the leases on two diesels. When the fleet of diesels was initially installed, analysis showed that eight diesels would be required to do successful black start. Subsequent testing, as documented in Appendix D, has confirmed that the black start can be completed with only five diesel units operating. As a result, six diesels (five plus an additional unit for redundancy and therefore reliability) are adequate to provide reliable black start.

With the current connection at Holyrood, only 10 MW can be supplied to the Island Interconnected System. It would require approximately $3 million of modifications at Holyrood to enable any extra supply to the system beyond the existing 10 MW capability. If the full 16 MW were utilized the additional benefit in fuel savings would only be in the order of $0.8 million over the period compared to the $3 million required investment. Therefore, keeping all eight units was not considered an economically viable decision and is not recommended by Hydro.

Additional detail is provided in Appendix F.

4.2 Operating Experience

Each of the diesel units have been run monthly since commissioning. Operation during the period December 24, 2015 to January 31, 2016 is summarized in Appendix B, where details on operations of the units on 20 occasions is provided. During the 2014-15 winter season, they were operated on four occasions to provide power to the Island Interconnected System.

4.3 Reliability Performance

Since commissioning, there have been no occasions when more than one unit was not available when required.

4.4 Legislative or Regulatory Requirements

Hydro is in consultation with the Department of Environment and Conservation (DOEC) on the environmental approvals for future proposed use of the diesels. The regulatory approvals for the black start diesels require further clarification from the DOEC. As such, a formal submission to DOEC will be required for a determination of environmental assessment requirements. Currently, it has been confirmed that an environmental registration and associated air emissions modelling must be carried out. This cost will be approximately $60,000 and take approximately five months. A potential outcome of the air emissions modelling would be the requirement for the installation of stacks for each of the six units, at a total estimated cost of $160,000 to $200,000.

4.5 Lease Payments

While 80% of all lease payments made to date with respect to the units proposed to be purchased would qualify under this provision to reduce the end-of-lease purchase price, Hydro is seeking the deferral and recovery of 80% of the lease payments for six of the eight diesel units made since July of 2015 to April 2016. These would be applied as a reduction to the purchase price under the agreement with the supplier in the amount of $1.3 million.

4.5 Budget Estimate

Hydro is seeking approval of $6.3 million as follows:

(i) the deferral and recovery over a period of five years of $1.3 million, which represents 80% of the lease payments for the six units made by Hydro from July 2015 to the proposed purchase in April 2016, which will be applied as a reduction to the purchase price under the agreement with the supplier, and

(ii) the incremental purchase and associated costs of $5.0 million comprised of (a) a one-time payment and costs to carry out the Environmental Registration for a total of $4.5 million, plus (b) a contingency of $0.5 in the event there is a change in the exchange rate between time of application and approval or if Hydro does indeed have to proceed with costs for an Environmental Assessments and its outcomes.

4.7 Project Schedule

The six diesels would be purchased on or about April 1, 2016.

5 Conclusion

Purchase and operation of the diesels form a key component of Hydro's reliable operation of the electrical system and in particular, the Avalon Peninsula. This addition is required as it has been determined that there is a shortfall of capacity for the winter of 2016-17 in the P90 case.

This requirement for the diesels in meeting the Avalon peak is coupled with the increasing importance of standby generation due to concerns associated with the reliability and availability of Hydro's thermal generating units and with pressure on reservoir levels. The diesels also are a proven black start solution and at times, they can also be dispatched more economically than other standby generation.

The load flows Figure 1 and Figure 2 represent the Avalon Peninsula for the P90 peak load case for the winter of 2016/17 with and without the Holyrood diesel generators, respectively. The plots illustrate system bus voltages, real power flows (provided above the line) and reactive power flows (provided below the line). System elements are coloured to represent operating voltages as per Hydro convention:

- 230 kV Elements – Red
- 138 kV Elements – Green
- 66 kV Elements – Blue

It is noted that no violations to System Planning Criteria (including transmission line overloading conditions or under voltage conditions) were found for contingencies involving the loss of a generating unit, including units at Holyrood, under P50 or P90 peak loading conditions.

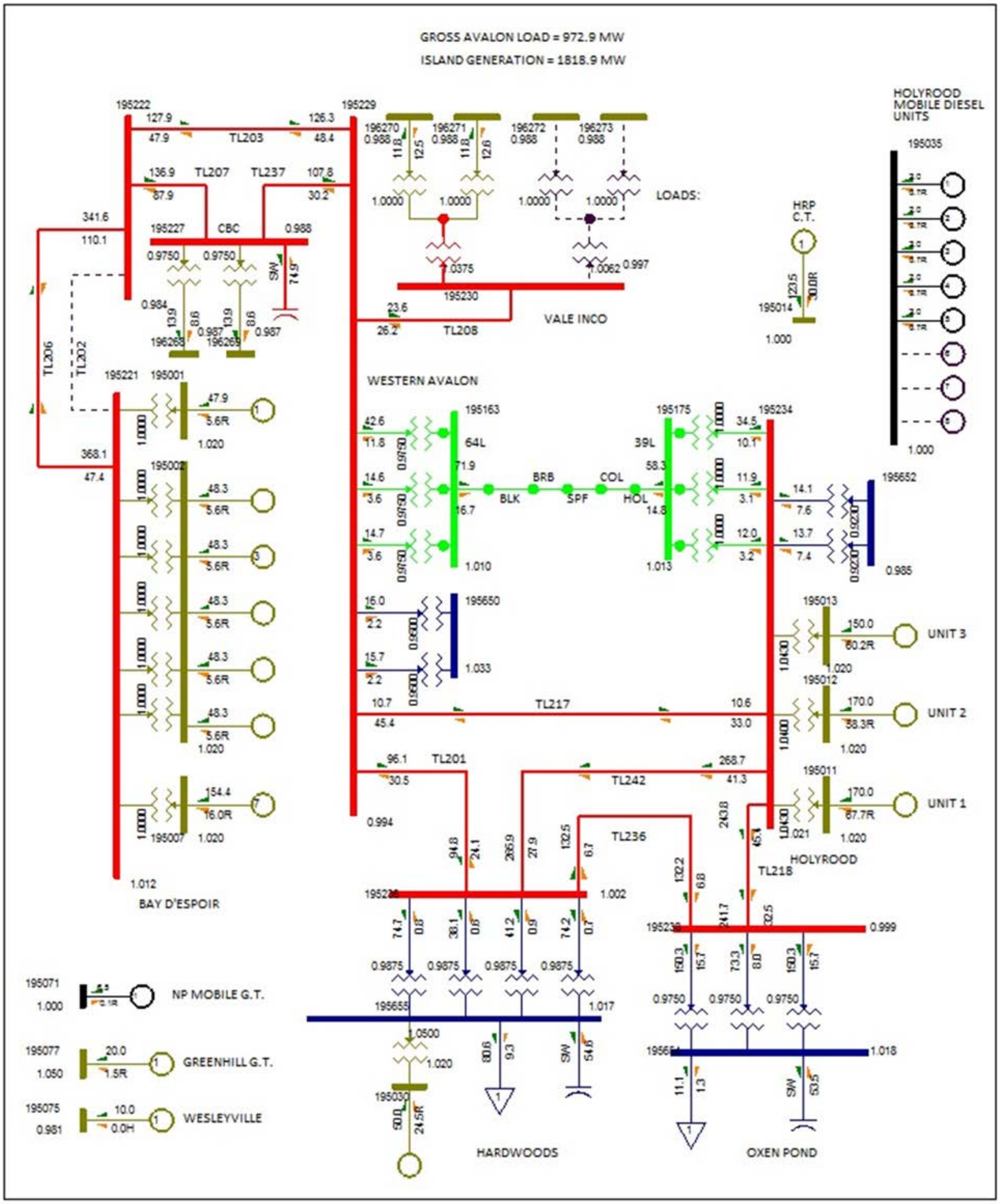


Figure 1 – Avalon Peninsula Load Flow Plot – 2016-17 P90 Peak Load Case
Holyrood Diesel Generation In Service

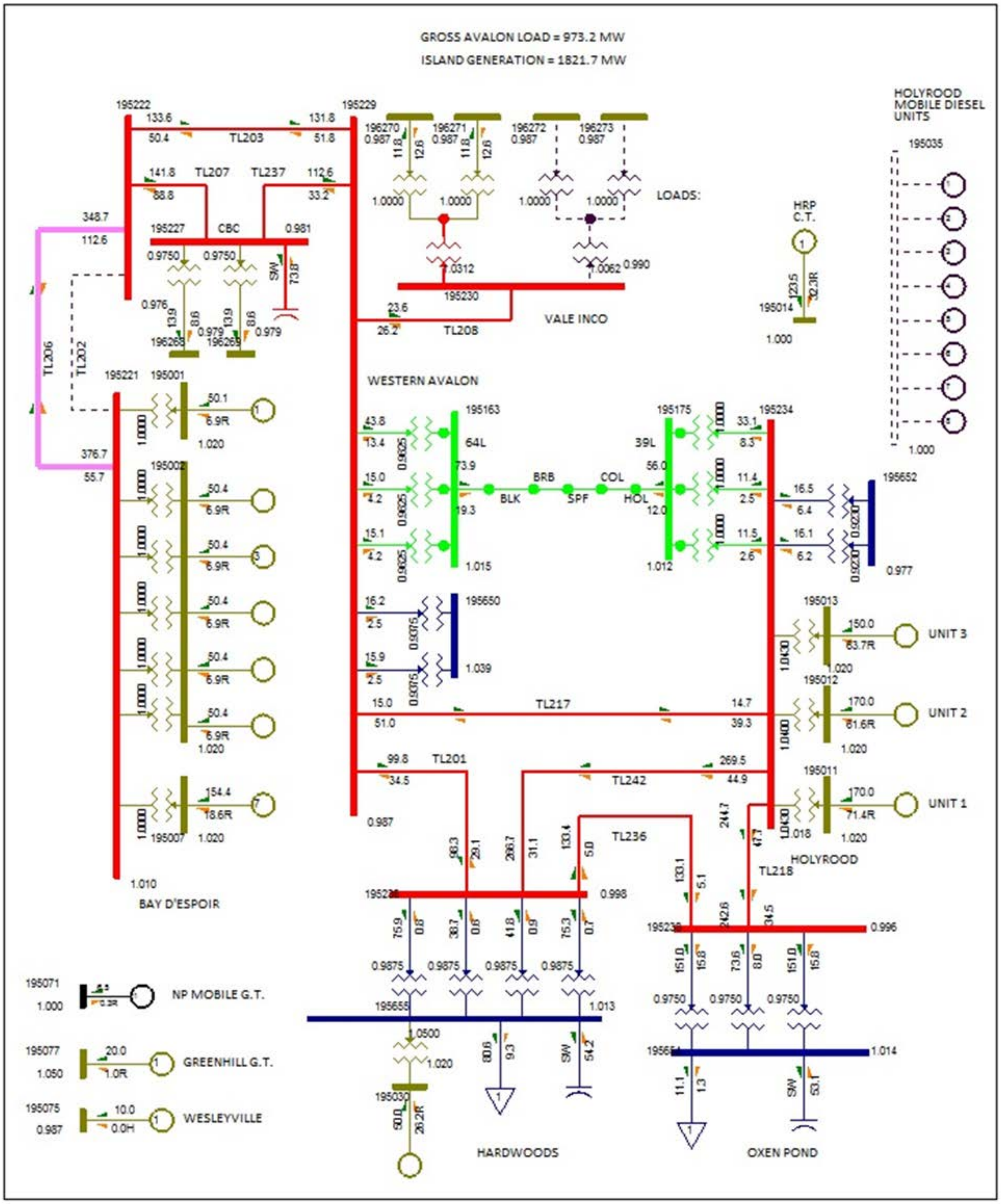


Figure 2 – Avalon Peninsula Load Flow Plot – 2016-17 P90 Peak Load Case
Holyrood Diesel Generation Not In Service

The table below a summary of the operation of the Holyrood diesel generators during the period December 24, 2015 to January 31, 2016. As noted, the operation of the diesel units was required on multiple occasions to ensure adequate reserve levels

Dispatch of Holyrood Diesel Generators, December 2015 to January 2016

Date, Time	Justification
Dec 24, 16:00 to 17:50	To maintain Avalon reserve
Dec 29, 15:15 to 18:25	To maintain Avalon reserve
Dec 31, 07:30 to 10:10 and 18:30 to 20:15	To maintain Avalon reserve
Jan 02, 16:00 to 18:17	To maintain Avalon reserve
Jan 06, 06:11-10:35 and 16:25 to 20:15	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 07, 06:25-10:15	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 08, 06:50-10:33 and 14:21 to 21:15	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 09, 12:05-19:06	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 10, 10:08 to 17:55	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 11, 07:30 to 13:25 and 15:37 to 18:40	To maintain Avalon reserve, RD Unit 2 Offline
Jan 12, 17:12 to 19:00	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 13, 12:05 to 19:40	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 14, 16:09 to 18:12	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 18, 15:40 to 17:50	To maintain Avalon reserve
Jan 22, 06:51 to 10:35	To maintain Avalon reserve, HRD Unit 2 Offline
Jan 26, 06:00 to 10:15	To maintain Avalon reserve, HRD Unit 2 Offline

As discussed in Section 3.1, Hydro currently operates its standby generation to avoid customer outage on the Avalon Peninsula in the event of transmission line or generation contingencies. When the resultant impact of a contingency is expected to be less than 50 MW, Hydro operates the Hardwoods Gas Turbine at a minimum loading of 10 MW to be ready to respond to contingencies of up to 50 MW. In the event that the resultant impact of the contingency is expected to be greater than 50 MW Hydro currently operates the Holyrood CT at a minimum output of 40 MW to be able to respond quickly and prevent customer outage in the event of a contingency. While the Holyrood CT can operate below 40 MW, there would be concerns with running the emissions control equipment below that level and with meeting all aspects of the CT's Certificate of Approval.

An analysis was completed which indicates that there is a potential fuel savings for the IIS if the black start diesels are part of dispatch order for Avalon reliability prior to the start-up of the Holyrood CT. This would mean fewer starts for the CT and less run time, as the diesels could be started before the CT. Using the diesels in this capacity could mean a fuel savings of $0.73 million in 2016 ($0.33 million from June to December) and $1.06 million in 2017. Completion of the third line to the Avalon and completion of the interconnection to Labrador would reduce these annual savings considerably in 2018.

The evaluation of this proposal was carried out on the basis of forecast costs and savings. All costs and savings were analyzed for present worth (PW) to April 1, 2016. Operating and maintenance costs were included. Fuel costs were not included as it is assumed that energy generated by the diesels would be generated by existing standby units at a similar cost, if the diesels were not available. The $311,000 of fuel savings included in the economic analysis for 2016 is for the period from June to December.

It should also be noted that the purchase of the diesel units will allow for lease savings. Hydro is currently paying $30,000 * six diesels = $180,000 per month to lease these six diesels.

Purchasing the diesels on April 1, 2016 means a savings of $180,000 * 2 months = $360,000 from April 1 to May 31, when it is expected the diesels would be returned after the CT black start test, if they were not to be purchased.

As noted in Table 1, there is a Cumulative Present Worth[1] (CPW) preference of $254,000, indicating that this is a least-cost alternative for customers and a more efficient means to provide reliable service.[2]

Table 1 – CPW Analysis

Purchase Diesels April 01, 2016 - Sell June 2020

Discount Rate 7.5% CPW Date: Apr 01, 2016

	Diesel Purchase (,000s)	PW	Inter-connection Savings	PW	Fuel Savings	PW	Lease Savings	PW	EA Reg Cost	PW	O&M Cost	PW	**Total PW**	Diesel Resale Price	PW	**CPW**
2016	$ 4,453	$ 4,453	($480)	($469)	($328)	($316)	($360)	($356)	$60	$60	$56	$54	**$3,426**			
2017					($1,060)	($968)					$76	$70	**($898)**			
2018											$78	$67	**$67**			
2019											$80	$64	**$64**			
2020											$34	$26	**$26**	($4,068)	($2,938)	
													$2,684		($2,938)	**($254)**

[1] For Hydro, the term "least-cost" refers to the lowest Cumulative Present Worth (CPW) of all capital and operating costs associated with a particular incremental supply source (or portfolio of resources) over its useful economic life, versus competing alternatives or portfolios. CPW concerns itself only with the expenditure side of the financial equation. The lower the CPW, the lower the revenue requirement for the utility and hence, the lower the electricity rates will be.

[2] Hydro did not include the contingency of $0.5 million in the CPW analysis. If it is spent, the CPW remains positive, indicating a least-cost alternative for customers.

With this proposal, the diesels will continue to provide a black start solution for the Holyrood Thermal Plant, a function for which they have been tested and proven to provide. In the original plan for the diesels, they were to provide a temporary black start solution until the new Holyrood CT was fully commissioned after which it would provide black start. In its current configuration, the Holyrood CT can provide black start through its primary connection to the Holyrood switchyard. As the power system events of January 2013 involved equipment unavailability at the Holyrood switchyard, Hydro planned to have a secondary connection from the CT into the Holyrood Plant to mitigate potential problems in the switchyard. This connection would have utilized the same connection path used by the black start diesels and the diesels need to be removed from service before the secondary connection could be completed.

The commissioning plan for the Holyrood CT included a test to confirm that the CT could reliably black start the Holyrood facility. The black start testing was to be staged with the first stage being to test black start through the primary switchyard connection. With the first stage successfully completed it would then be possible to remove the diesels, complete the secondary connection and test that path, thus assuring a proven black start source was available.

The first phase of the black start testing of the Holyrood CT has yet to be completed. The maintenance schedules at both the Holyrood plant and for major transmission system elements on the Avalon Peninsula made it difficult to find a period of time in 2015 when this test could be completed without causing undue risk to customers. The test was scheduled originally at the time of the restart of Holyrood Unit 3 following its annual maintenance in late August and when that could not be securely scheduled, it was rescheduled around the restart of Holyrood Unit 2 in late September. On both occasions, the test had to be cancelled due to concerns with reliability of supply to customers during the test. With winter approaching and the ongoing work required to assure generation equipment outages were completed to meet winter availability requirements, it will not be possible to complete the black start testing of the Holyrood CT until spring/early summer of 2016. As a result, it is necessary to keep the diesels in place through the winter to ensure certainty around on-site black start capability.

With approval of this proposal, the diesels will be purchased and remain connected to provide black start for the Holyrood Plant. Also if the diesels remain, there will be no requirement to construct the secondary connection to the CT, resulting in the saving of the cost of that connection of approximately $480,000 included in the Holyrood CT project.

When the diesels were initially installed it was thought that eight diesels would be required to do a successful black start. Subsequent testing, as documented in Appendix F, has confirmed that the black start can be completed with only five diesel units operating. As a result, six diesels, five plus an additional unit for reliability are adequate to provide reliable black start.

In 2020, after the interconnections to Labrador and Nova Scotia are complete, and the diesels are no longer required for black start, peaking and back-up, Hydro will apply to the Board to either sell or keep the diesels, as appropriate at the time.

A check of the current market for used XQ 2000 mobile diesel units indicates that $525,000 USD is a reasonable estimate of the resale price for these diesels in 2020. (The price for used diesel units is based on US dollars). As well, a resale price of $40,000 USD was assumed for each of the 2.5 MVA transformers. $565,000 USD * 1.20 US/CAN exchange rate[1] (FX) = $678,000 CAN * 6 units = $4,068,000 CAN resale price in 2020. It is noted that the original lease price for each unit and transformer was based on a price of $1,132,000 USD ($1,200,000 CAN at an FX of 1.06).

Alternatively, the diesel generators may be utilized in a number of roles across Hydro's system. These roles include use as emergency generation on distribution systems, generation support at interconnected diesel plants, and mobile power for distribution capital projects. Maintaining these six units beyond the 2020 time frame is not part of this proposal, but Hydro would apply to the Board for action in that year, either justified retention, or sale of the units.

[1] Nalcor Energy Corporate Planning Assumptions – November 2015

R. Collett	2015-Nov-20
Approved for Release	Date

REGISTERED PROFESSIONAL ENGINEER
JOHN P. FLYNN
SIGNATURE
Nov. 19/15
DATE
NEWFOUNDLAND & LABRADOR

JUSTIFICATION FOR REDUCTION FROM EIGHT TO SIX – 1825KW DIESEL GENSETS FOR HOLYROOD BLACK START

Newfoundland and Labrador Hydro

newfoundland labrador hydro
a nalcor energy company

Table of Contents

1.0 INTRODUCTION

In November of 2013 analysis was provided that recommended the need of eight – 1825kW diesel generators at the Holyrood Thermal Generating Station for the sole purpose of being able to start a 3000Hp, 4160V Boiler Feed Pump motor. Analysis at the time indicated that seven units were required for starting a 2500Hp motor on Unit 3, while eight units would be required for starting a 3000Hp motor on Units 1 and 2, based on minimum bus voltage protection.

This analysis was requested as a result of the January 11, 2013 outage and subsequent installation of Newfoundland Power (NP) back-up generation at Holyrood Plant to supply emergency generation to the Avalon as well as potential on site Black Start capability of the Holyrood Plant. The installation of NP's 7.5MVA gas turbine and 3.06 MVA diesel units proved to be insufficient to start a Unit 2 boiler feed pump during testing in the spring of 2013.

Information used at the time of the analysis was based on technical specification sheets provided by Caterpillar of the 1825 kV diesels and Unit 1 Boiler Feed Pump West, 3000 Hp Westinghouse unit.

Subsequent to the installation of the 8 diesel units, testing was carried out that proved that only five diesel units were required to start a 3000 Hp Boiler Feed Pump on Unit 1 and Unit 2. This prompted Operations to request a review of the original technical justification in order to assist in reducing the need from 8 to 6 units, 5 used for starting with one spare for backup.

The following report outlines the review carried out and subsequent recommendation based on new and updated information. The study involved the dynamic analysis of motoring starting using Version 33 of PSS®E software from Siemens PTI.

2.0 MODEL DETAILS

For this study, Hydro's existing electrical system, including Holyrood's 4160V distribution network, is used as the basis for analysis. A detailed model of a 3000HP Boiler Feed Pump has been added along with its accompanying cable from the 4160V Unit Board. As well, a modest plant load of 1 MW has been assumed prior to starting of a boiler feed pump during a black start condition. For this revised study, changes have been made to the original models because of new information, operational testing and an error in the previous model. The following two sections identify the major modeling parameter changes to the Caterpillar Diesel Genset and Boiler Feed Pump.

2.1 Original 1825kW Caterpillar Diesel Model

This model simulates leased 1825kW, 480V Caterpillar diesel engine generator sets with individual 480/4160V step up transformers being connected to a common bus. A 100m overhead 3 phase distribution line then connects the diesels to Holyrood's 4160V plant Station Service Bus SB12. As noted in the introduction, actual testing of the diesels, most recently tested in October 2015, confirmed that only five diesel gensets were required to start a Boiler Feed Pump on Units 1 and 2 (3000 Hp units). As a result of this knowledge, simulations were made using the original model, but starting of the 3000 Hp was not successful. A review of the original model was undertaken and changes were made as a result. Section 2.1 outlines the original model while section 2.2 outlines the newest model used to successfully simulate the starting of the 3000 Hp motor with 5 diesel units.

Appendix A outlines the 480V diesel engine genset's data sheets as well as the PSS®E dynamics model data sheets used for the November 2013 analysis, which included the following:

- **GENROU** (Round Rotor Generator Model), data as per Caterpillar's data sheets in Appendix A.
- **IEEET2** (IEEE Type 2 Excitation System), this model was copied from the existing

Greenhill Gas Turbine data with exception VRmax = 6.0 instead of 2.5 and Vmin = -1.0 instead of 0.

- **GAST** (Gas Turbine-Governor Model), this model was copied from the existing Greenhill Gas Turbine data with exception Vmax = 1.0 instead of 0.8, T1 = 0.1 instead of 0.4 and T2 = 0.025 instead of 0.1.

2.2 Updated 1825kW Caterpillar Diesel Model

A review of the diesel engine data sheets indicated that the inertia constant (H) calculated, 0.424, was based on the torsional data of the unit and does not represent the actual inertia of the machine. The actual H values for these machines are actually 0.86, as provided by Caterpillar in November 2015. As a result the H constant has been changed from 0.424 to 0.86 in the GENROU.

Also modified was the assumption of use of IEEET2 for the excitation and GAST for the governor, which are those used to represent the Greenhill Gas Turbine (owned by Newfoundland Power). In its place, a simplified exciter and diesel governor model with standard parameters are used, as presented in the “American Transmission Company – Generation Interconnection System Impact Study Report” authored in June 2003 for a 10MW Diesel Generation Facility using 8 – 1.25MW diesel units. The models used and parameters are as listed in Tables 1 and 2 below:

Table 1
Simplified Exciter Model – SEXS

Description	Value
TA / TB	0.3
TB (sec)	10
K	100
TE	0.1
Emin (pu on EFD base)	0
Emax (pu on EFD base)	6.0

Table 2
Woodward Diesel Governor Model – DEGOV

Description	Value
T1 (sec)	0.01
T2 (sec)	0.02
T3 (sec)	0.2
K	24
T4 (sec)	0.25
T5 (sec)	0.04
T6 (sec)	0.009
TD	0.0125
Tmax	1
Tmin	0

The response and step tests of the exciter and governor using these dynamic data / models showed acceptable results of damping and stable operation.

2.3 Original 3000 Hp Boiler Feed Pump Model

Unit 2 Boiler Feed Pump East is a Westinghouse, 3000 Hp, induction motor with full load current rating of 350A. Appendix B outlines the technical data associated with this motor, including a locked rotor current of 581% of rated full load. PSS®E's Induction Motor Dynamics (IMD) program estimates the motor equivalent circuit data based on full load and locked rotor current, starting and pull up torque. Results of these parameters are then used in PSS®E's Induction Motor Load Model CIM5BL to dynamically simulate a motor starting analysis. Appendix C outlines the parameters used in the PSS®E model CIM5BL for the 3000 Hp Induction Motor for the November 2013 motor starting analysis.

2.4 Updated 3000 Hp Boiler Feed Pump Model

Actual Boiler Feed Pump motor starting currents were obtained from the Holyrood Plant via two SEL protection relays monitoring Units 1 and 2 BFPW. Actual starting currents are shown in Figure 1 for both motors. Unit 1 BFPW has a peak starting current of approximately 1640A or 4.7pu with the nominal current equal to 350A. Unit 2 is an ABB 3000HP motor with a peak starting current of approximately 1820A or 5.04pu with nominal current equal to 361A.

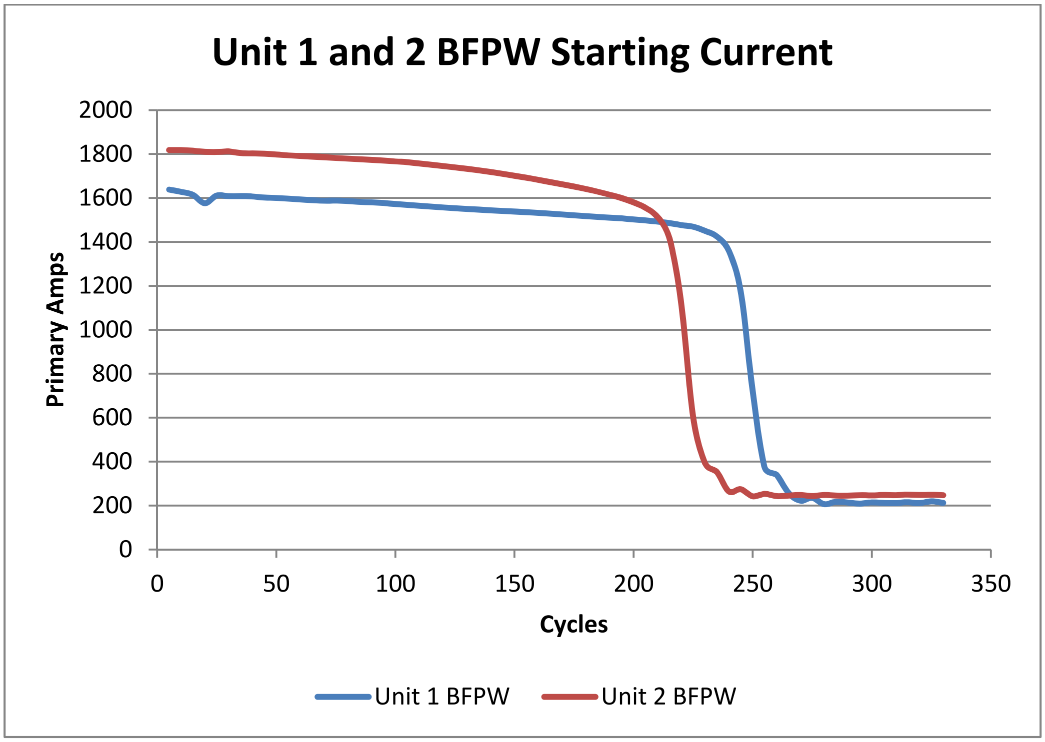


Figure 1
Actual Motor Starting Currents for Units 1 and 2 BFPW

The original simulation used values that provided a peak current of 5.81pu starting current at nominal voltage. IMD was used to predict the motor equivalent circuit based on a new peak of 5.04pu instead of 5.81. Another modification made to the Induction Motor Load Model is the H (inertia) constant. The original H constant used was 0.58, based on full load inertia (Wk^2)of 70 $lb.ft^2$ and motor inertia (Wk^2)of 423 $lb.ft^2$. After consultation with Holyrood Plant, full load is never applied to the boiler feed pump, in fact discharge valves are closed and recirculation to the deaerator is used during start-up. For the purpose of this study, it is assumed that 10% of full load is used during start-up. This reduces the combined H constant from 0.58 to 0.49, thus reducing the starting current requirements. Based on these changes, a modified Induction Motor Load CIM5BL is presented in Table 3 below, which provided a simulated starting current of 5.03pu.

Table 3
Induction Motor Load Model – CIM5BL

Description	Value
RA	0.022
XA	0.14
XM	3.82
R1	0.047
X1	0.034
R2	0.0054
X2	0.0430
E1	1.0
S(E1)	0.17
E2	1.2
S(E2)	0.52
MBase	2.598
PMult	1
H (inertia)	0.49
V1 (pu)	0
T1 (cycles)	0.1667
TB (cycles)	0.0833
D (load damping factor)	2.52
Tnom, Load Torque at 1 pu speed	0.8836

3.0 MINIMUM BUS VOLTAGE REQUIREMENT

Under-voltage protection relays settings for the 4160V bus at Holyrood is currently set at 81% of nominal for a minimum of 1.5 seconds in order to prevent low voltage motor operation which can cause thermal damage. This value of 81% has been chosen as the minimum value the 4160V bus may reach during a black start boiler feed pump motor start. For any alternative considered in the black start analysis, it is a technical requirement that a motor start shall not cause voltage dip below 81% of the 4160 bus voltage at the plant for greater than 1.5 seconds.

4.0 MOTOR STARTING ANALYSIS

The simplified Holyrood system model of a black start condition forms the basis of the motor starting analysis. It is assumed an initial plant load of 1 MW is being fed by the alternative generation sources (black start diesels) under technical evaluation. Voltages prior to motor starting are considered to be at 105% of nominal to give the greatest opportunity for motor start-up and prevention of voltage dip below 81%.

Section 4.1 outlines the results of the dynamic motor starting simulation for starting of a 3000 Hp Boiler Feed Pump with five diesel gensets.

4.1 Isolated Black Start – Five 1825kW Diesels

For this alternative, all units at Holyrood Plant are off line with an approximate total plant load of 1MW, which is being supplied via five (5) 1825kW Caterpillar diesel generators. Figures 2 and 3 show the 4160V bus voltage profile and motor current during a 3000HP motor start. As can be seen from Figure 2, motor starting will cause a very substantive drop in voltage on the 4.16kV bus to approximately 0.78 pu and will take approximately 2.0 seconds before it recovers beyond 0.90pu. Voltage is below 0.81pu for less than 0.5 seconds, thus the under voltage relay protection is not expected to operate.

While this simulation predicts that there should be no issues in starting a boiler feed pump and Holyrood Plant has successfully started 3000Hp motors with five diesels, actual voltage and current readings of the boiler feed pump have not been recorded. For a higher degree of simulation and modeling accuracy, it would be advisable to monitor these values if another black start test were to occur in the future.

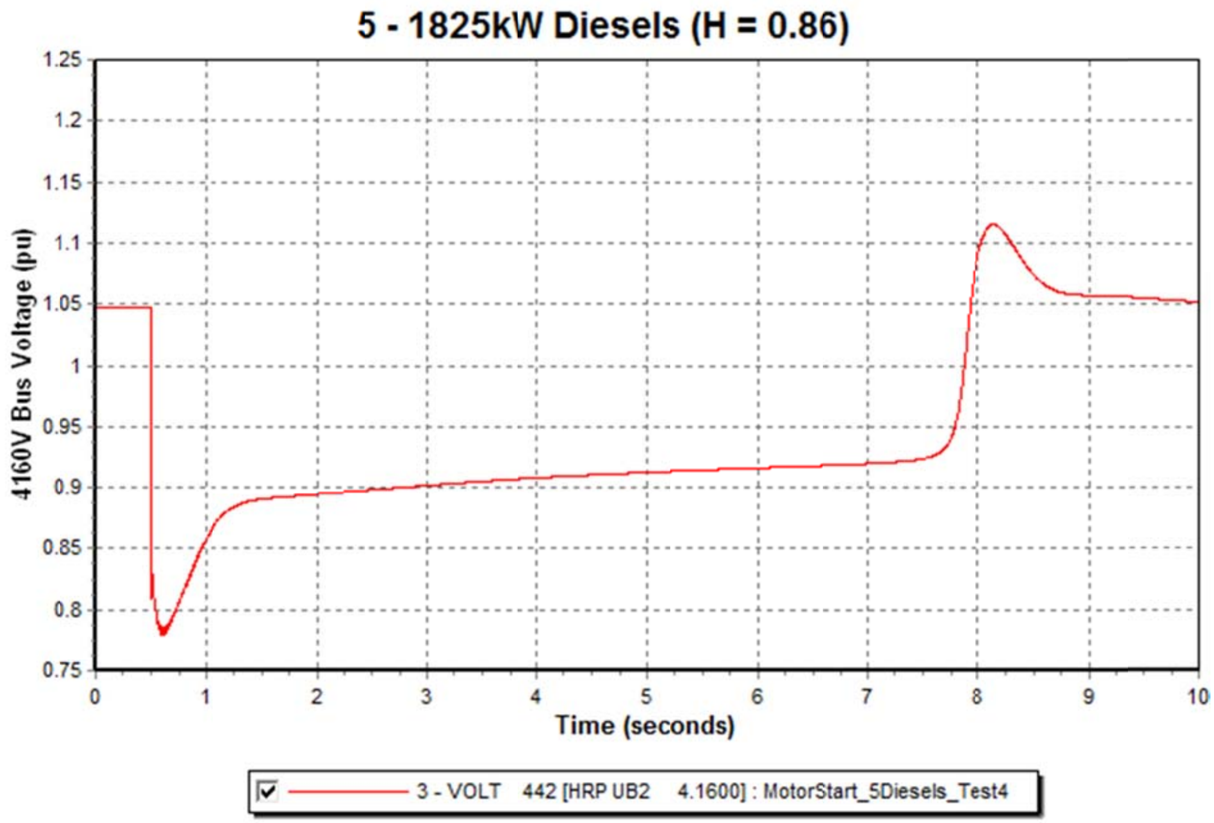


Figure 2 (Motor Starting – 4.16kV Bus Voltage)

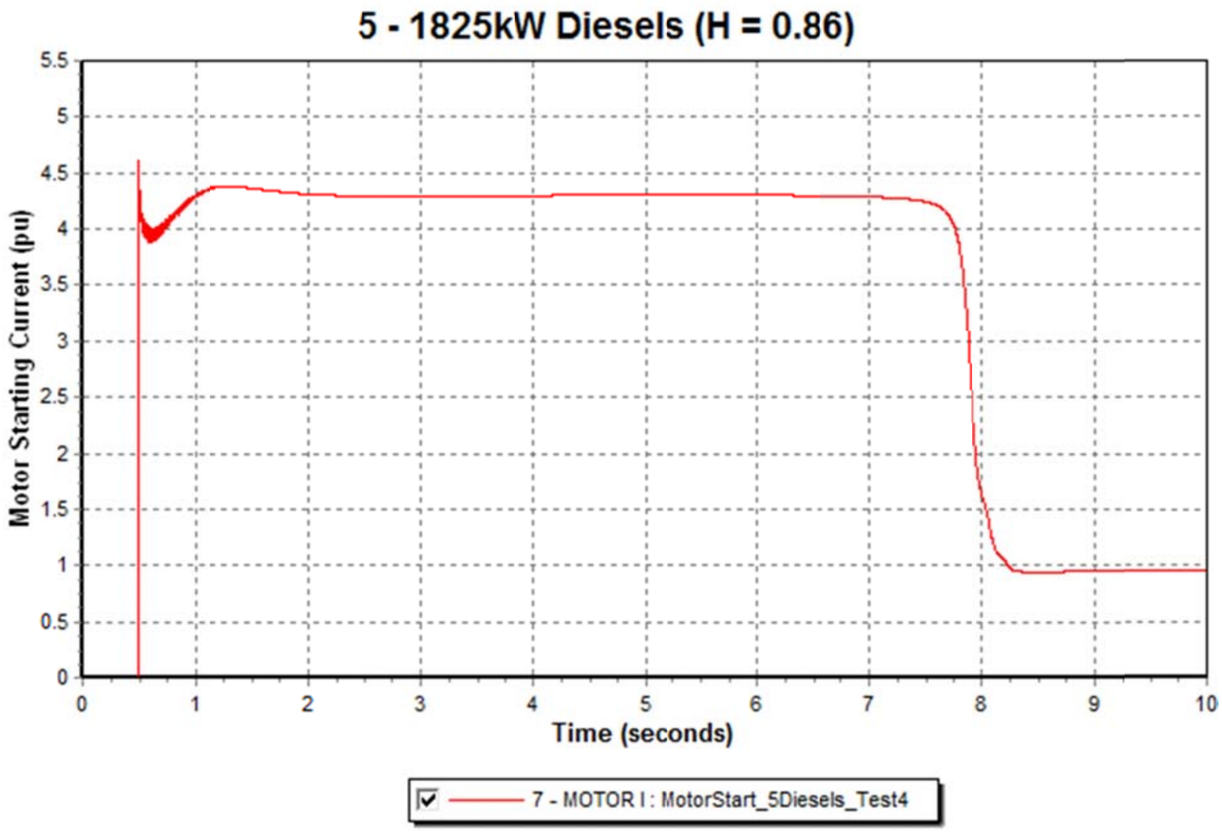


Figure 3 - Motor Starting Current

5.0 CONCLUSION

Revised simulations, based on model modifications and assumptions listed in the body of this report, indicate that the starting of a 3000 Hp using only five 1825kW diesel is highly probable. Actual black start testing in 2014 and 2015 proved that to be the case in which a 3000 Hp was start using only five 1825kW diesels. This report concludes that a reduction of the number of black start diesels from eight to six is warranted based on actual and simulated events. The sixth unit would provide a level of redundancy should one unit not start or be unavailable due to maintenance.

APPENDIX A

1825 KW CATERPILLAR DIESEL ENGINE GENSETS DATA SHEETS

and PSSE DYNAMICS DATA SHEETS

GENERATOR DATA

NOVEMBER 05, 2013

For Help Desk Phone Numbers Click here

Selected Model

Engine: 3516	**Generator Frame:** 825	**Genset Rating (kW):** 1825.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3123144	**Genset Rating (kVA):** 2281.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2743.6
Duty: PRIME	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 39094 /39315 /40129 /13885

Spec Information

Generator Specification

Frame: 825 **Type:** SR4B	**No. of Bearings:** 1
Winding Type: FORM WOUND	**Flywheel:** 21.0
Connection: SERIES STAR	**Housing:** 00
Phases: 3	**No. of Leads:** 6
Poles: 4	**Wires per Lead:** 8
Sync Speed: 1800	**Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	456.3	93.3
0.5	912.5	95.9
0.75	1368.8	96.5
1.0	1825.0	96.7
1.1	2007.5	96.7

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1347 ✓	0.0136
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1228	0.0124
TRANSIENT - SATURATED X'_d	0.2178	0.0220
SYNCHRONOUS - DIRECT AXIS X_d	2.9981	0.3028
SYNCHRONOUS - QUADRATURE AXIS X_q	1.4723	0.1487
NEGATIVE SEQUENCE X_2	0.1287	0.0130
ZERO SEQUENCE X_0	0.0079	0.0008

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	6.6330
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.4643
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0074
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0064
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.0057
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0050
EXCITER TIME CONSTANT T_e	0.2225
ARMATURE SHORT CIRCUIT T_a	0.0438

Short Circuit Ratio: 0.43 | Stator Resistance = 0.0015 Ohms | Field Resistance = 1.003 Ohms

Voltage Regulation

Voltage level adustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	3.0%
Telephone influence factor: less than	50

Generator Excitation

	No Load	Full Load, (rated) pf Series	Parallel
Excitation voltage:	7.94 Volts	34.14 Volts	Volts
Excitation current	2.09 Amps	7.39 Amps	Amps

Selected Model

Engine: 3516	**Generator Frame:** 825	**Genset Rating (kW):** 1825.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3123144	**Genset Rating (kVA):** 2281.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2743.6
Duty: PRIME	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 39094 /39315 /40129 /13885

Generator Mechanical Information

Center of Gravity

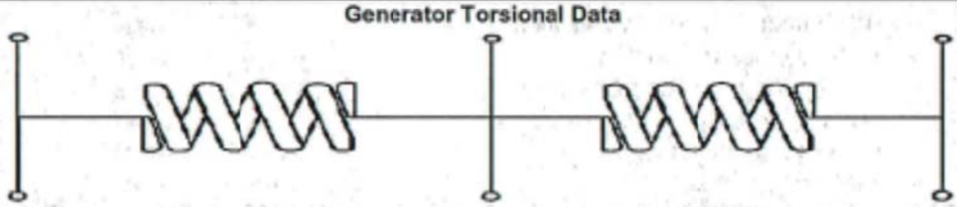
Dimension X	-906.8 mm	-35.7 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 4330 kg 9,546 LB * Rotor WT = 1541 kg 3,397 LB * Stator WT = 2789 kg 6,149 LB

Rotor Balance = 0.0508 mm deflection PTP
Overspeed Capacity = 150% of synchronous speed

Generator Torsional Data



J1 – Coupling and Fan **J2 – Rotor** **J3 – Exciter End**

TOTAL J = J1 + J2 + J3

K1 = Shaft Stiffness between J1 + J2 (Diameter 1)
K2 = Shaft Stiffness between J2 + J3 (Diameter 2)

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
23.1 LB IN. s^2	265.5 MLB IN./rad	6.2 IN.	456.1 LB IN. s^2	57.5 MLB IN./rad	3.8 IN.	2.3 LB IN. s^2
2.608 N m s^2	30.0 MN m/rad	157.5 mm	51.534 N m s^2	6.5 MN m/rad	96.5 mm	0.257 N m s^2

Total J
481.5 LB IN. s^2
54.399 N m s^2

Selected Model

Engine: 3516	**Generator Frame:** 825	**Genset Rating (kW):** 1825.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3123144	**Genset Rating (kVA):** 2281.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2743.6
Duty: PRIME	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 39094 /39315 /40129 /13885

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 °C)**	
Heat Dissipated: 62.3 kW		**Stator Rise:**	105.0 °C
Air Flow:	168.0 m^3/min	**Rotor Rise:**	105.0 °C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 °C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	1893.0 kVA
F BR -105/40	2281.0 kVA
H BR - 125/40	2500.0 kVA
F PR - 130/40	2500.0 kVA

Selected Model

Engine: 3516	**Generator Frame:** 825	**Genset Rating (kW):** 1825.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3123144	**Genset Rating (kVA):** 2281.0	**Phase Voltage:** 277
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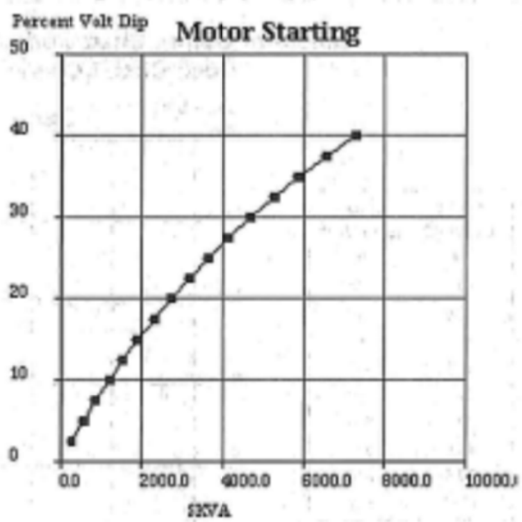
			Version: 39094 /39315 /40129 /13885

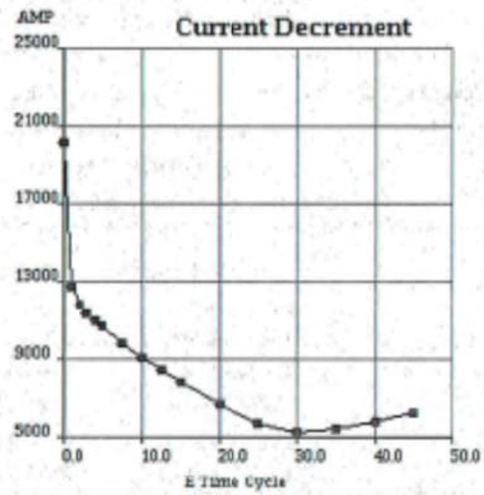
Starting Capability & Current Decrement
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
280	2.5
574	5.0
884	7.5
1,212	10.0
1,558	12.5
1,925	15.0
2,314	17.5
2,727	20.0
3,167	22.5
3,636	25.0
4,137	27.5
4,675	30.0
5,252	32.5
5,873	35.0
6,545	37.5
7,272	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	20,213
1.0	12,753
2.0	11,824
3.0	11,407
4.0	11,039
5.0	10,687
7.5	9,862
10.0	9,107
12.5	8,417
15.0	7,786
20.0	6,683
25.0	5,760
30.0	5,247
35.0	5,485
40.0	5,852
45.0	6,230



Instantaneous 3 Phase Fault Current: 20213 Amps **Instantaneous Line - Line Fault Current:** 17909 Amps
Instantaneous Line - Neutral Fault Current: 30076 Amps

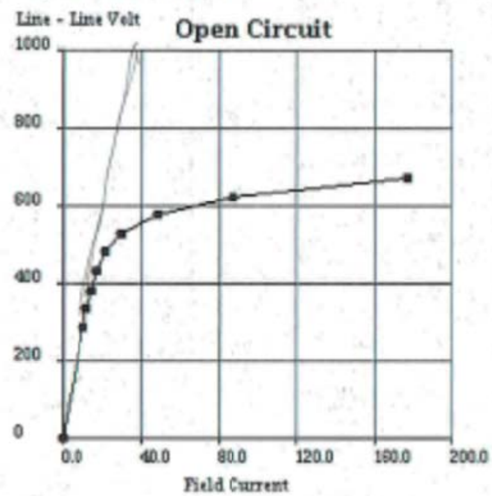
Selected Model

Engine: 3516 **Generator Frame:** 825 **Genset Rating (kW):** 1825.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3123144 **Genset Rating (kVA):** 2281.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 2743.6
Duty: PRIME **Connection:** SERIES STAR **Application:** EPG **Status:** Current
Version: 39094 /39315 /40129 /13885

Generator Output Characteristic Curves

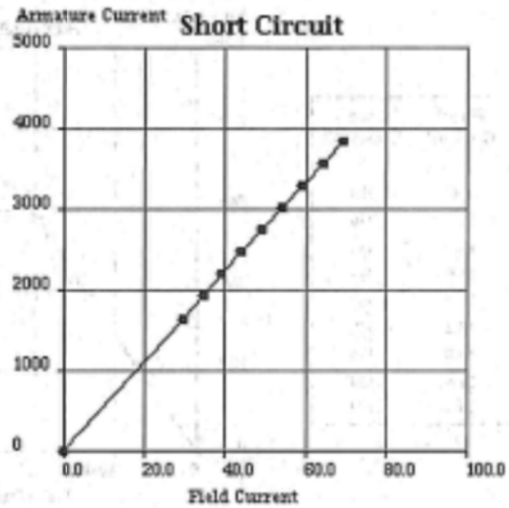
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
10.1	288
12.0	336
14.2	384
17.1	432
21.7	480
30.2	528
48.0	576
87.5	624
177.7	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
29.5	1,646
34.4	1,921
39.3	2,195
44.3	2,470
49.2	2,744
54.1	3,018
59.0	3,293
63.9	3,567
68.9	3,841



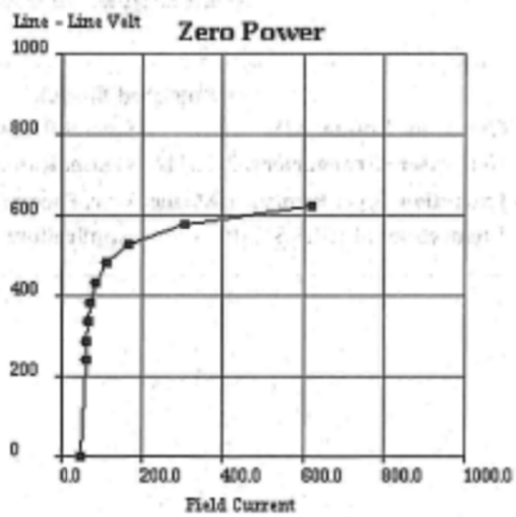
Selected Model

Engine: 3516 **Generator Frame:** 825 **Genset Rating (kW):** 1825.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3123144 **Genset Rating (kVA):** 2281.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 2743.6
Duty: PRIME **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 39094 /39315 /40129 /13885

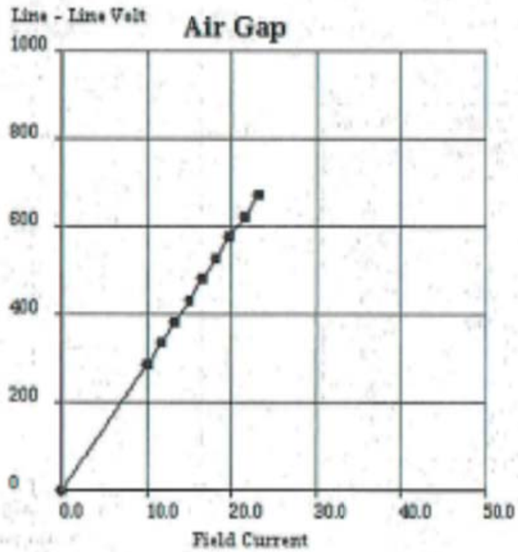
Generator Output Characteristic Curves
Zero Power Factor Curve

Field Current	Line - Line Volt
49.2	0
61.6	240
64.1	288
67.7	336
73.8	384
85.8	432
111.7	480
170.1	528
304.8	576
618.2	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
9.9	288
11.6	336
13.2	384
14.9	432
16.5	480
18.2	528
19.8	576
21.5	624
23.1	672



Selected Model

Engine: 3516 **Generator Frame:** 825 **Genset Rating (kW):** 1825.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3123144 **Genset Rating (kVA):** 2281.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 2743.6
Duty: PRIME **Connection:** SERIES STAR **Application:** EPG **Status:** Current
Version: 39094 /39315 /40129 /13885

Reactive Capability Curve

Click to view Chart

Selected Model

Engine: 3516 **Generator Frame:** 825 **Genset Rating (kW):** 1825.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3123144 **Genset Rating (kVA):** 2281.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 2743.6
Duty: PRIME **Connection:** SERIES STAR **Application:** EPG **Status:** Current
Version: 39094 /39315 /40129 /13885

SIEMENS

Generator Model Data Sheets
GENROU

PSS®E 33.3
PSS®E Model Library

1825 kW DIESEL, 480V

1.19 GENROU

Round Rotor Generator Model (Quadratic Saturation)

This model is located at system bus #501-509 IBUS,

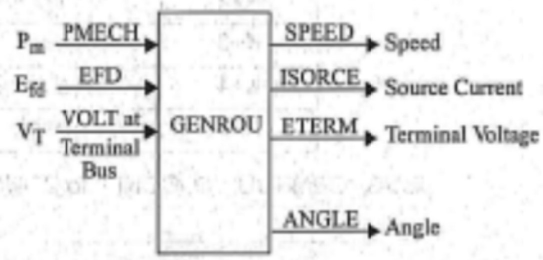
Machine identifier #1 ID,

This model uses CONs starting with #____ J,

and STATEs starting with #____ K.

The machine MVA is 2.280 for each of ____ units = 2.280 MBASE.

ZSORCE for this machine is ____ + j 0.1347 on the above MBASE



CONs	#	Value	Description
J		6.633	T'_{do} (>0) (sec)
J+1		0.05	T''_{do} (>0) (sec)
J+2		1.00	T'_{qo} (>0) (sec)
J+3		0.05	T''_{qo} (>0) (sec)
J+4		0.424	H, Inertia
J+5		0	D, Speed damping
J+6		2.40	X_d
J+7		1.4723	X_q
J+8		0.2178	X'_d
J+9		0.43	X'_q ASSUMED
J+10		0.1347	$X''_d = X''_q$
J+11		0.1	X_l ASSUMED
J+12		0.32	S(1.0)
J+13		1.42	S(1.2)

Note: X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_l, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

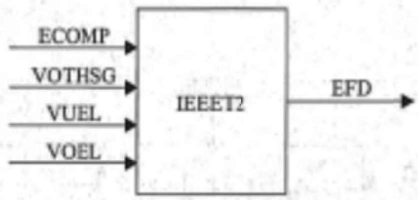
DATA AS PER CATERPILLAR ENGINE 3516, 2281 kVA, 480V

1825 kW DIESEL, 480V

6.40 IEEET2

IEEE Type 2 Excitation System

This model is located at system bus #501-509 IBUS,
Machine identifier #1 ID,
This model uses CONs starting with #____ J,
and STATEs starting with #____ K,
and VAR #____ L.



CONs	#	Value	Description
J		0.035	T_R (sec)
J+1		400	K_A
J+2		0.22	T_A (sec)
J+3		6.00	V_{RMAX} or zero
J+4		-1.00	V_{RMIN}
J+5		0	K_E
J+6		0.8	T_E (>0) (sec)
J+7		0.088	K_F
J+8		0.38	T_{F1} (>0) (sec)
J+9		1.00	T_{F2} (>0) (sec)
J+10		1.82	E_1
J+11		0.50	$S_E(E_1)$
J+12		2.43	E_2
J+13		0.86	$S_E(E_2)$

STATEs	#	Description
K		Sensed V_T
K+1		Regulator output, V_R
K+2		Exciter output, EFD
K+3		First feedback integrator
K+4		Second feedback integrator

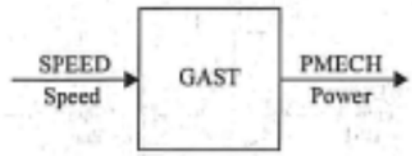
VAR	#	Description
L		K_E

1825 kW DIESEL, 480 V

7.5 GAST

Gas Turbine-Governor

This model is located at system bus #501-509 IBUS,
Machine identifier #_____ ID,
This model uses CONs starting with #_____ J,
and STATEs starting with #_____ K,
and VAR #_____ L.



CONs	#	Value	Description
J		0.07	R (speed droop)
J+1		0.10	T_1 (>0) (sec)
J+2		0.025	T_2 (>0) (sec)
J+3		3.00	T_3 (>0) (sec)
J+4		1.00	Ambient temperature load limit, AT
J+5		2.00	K_T
J+6		1.00	V_{MAX}
J+7		0	V_{MIN}
J+8		0	D_{turb}

STATEs	#	Description
K		Fuel valve
K+1		Fuel flow
K+2		Exhaust temperature

VAR	#	Description
L		Load reference

Vmax, Vmin, D_{turb} and R are in pu on generator MVA base.

IBUS, 'GAST', ID, CON(J) to CON(J+8) /

APPENDIX B

3000 HP INDUCTION MOTOR DATA

TECO-WESTINGHOUSE MOTOR COMPANY
ROUND ROCK, TEXAS U.S.A.

CUSTOMER NEW FOUNDLAND & LABRADOR HYDR   DATE - FEB 19, 2013
CUSTOMER ORDER NO. 1022269
APPLICATION ELECTRIC UTILITY PUMP
S.O. 8052AA

DATA FOR WORLD SERIES, HORIZONTAL, BRACKET TYPE INDUCTION MOTOR

1. RATING

HP	3000	HERTZ	60.0	INSUL CLASS	F
RPM FL	3580	SERVICE FACTOR	1.15	KVA CODE	E
VOLTS	4160	RISE C (1.00 SF)	80	DUTY	CONTINUOUS
AMPS FL	350	METHOD	RES	NUMBER OF POLES	2
PHASES	3	AMBIENT C	40		

2. MECHANICAL

FRAME	5011	BRG TYPE	SLEEVE	END PLAY INCH	0.50
ENCL TYPE	WP2	LUBE TYPE	FLOOD	MOTOR WK2	423
		ROTATION(FROM NDE)	CCW	LOAD WK2	70

3. STARTING PERFORMANCE - NOMINAL, VALUES WITH (*) ARE GUARANTEED

		100% VOLTS	90% VOLTS
AMPS (LR)		2032	1789
AMPS (LR)	%	581	511
POWER FACTOR	%	15.2	14.8
START TORQUE	%	78	60
ACCELERATION SEC		2.0	2.9
SAFE LOCK SEC	FROM HOT	9.2	11.8
SAFE LOCK SEC	FROM COLD	10.7	13.7

PULLOUT TORQUE AT 100% VOLTS = 248 %

4. EFFICIENCY - NOMINAL

LOAD	%	115	100	75	50
EFFICIENCY	%	96.67	96.86	97.03	96.82

5. POWER FACTOR - NOMINAL

LOAD	%	115	100	75	50
POWER FACTOR	%	91.2	91.6	91.3	88.6

6. POWER FACTOR CORRECTION

MAX KVAR = 327   MAX FL P.F. = 95.8 %

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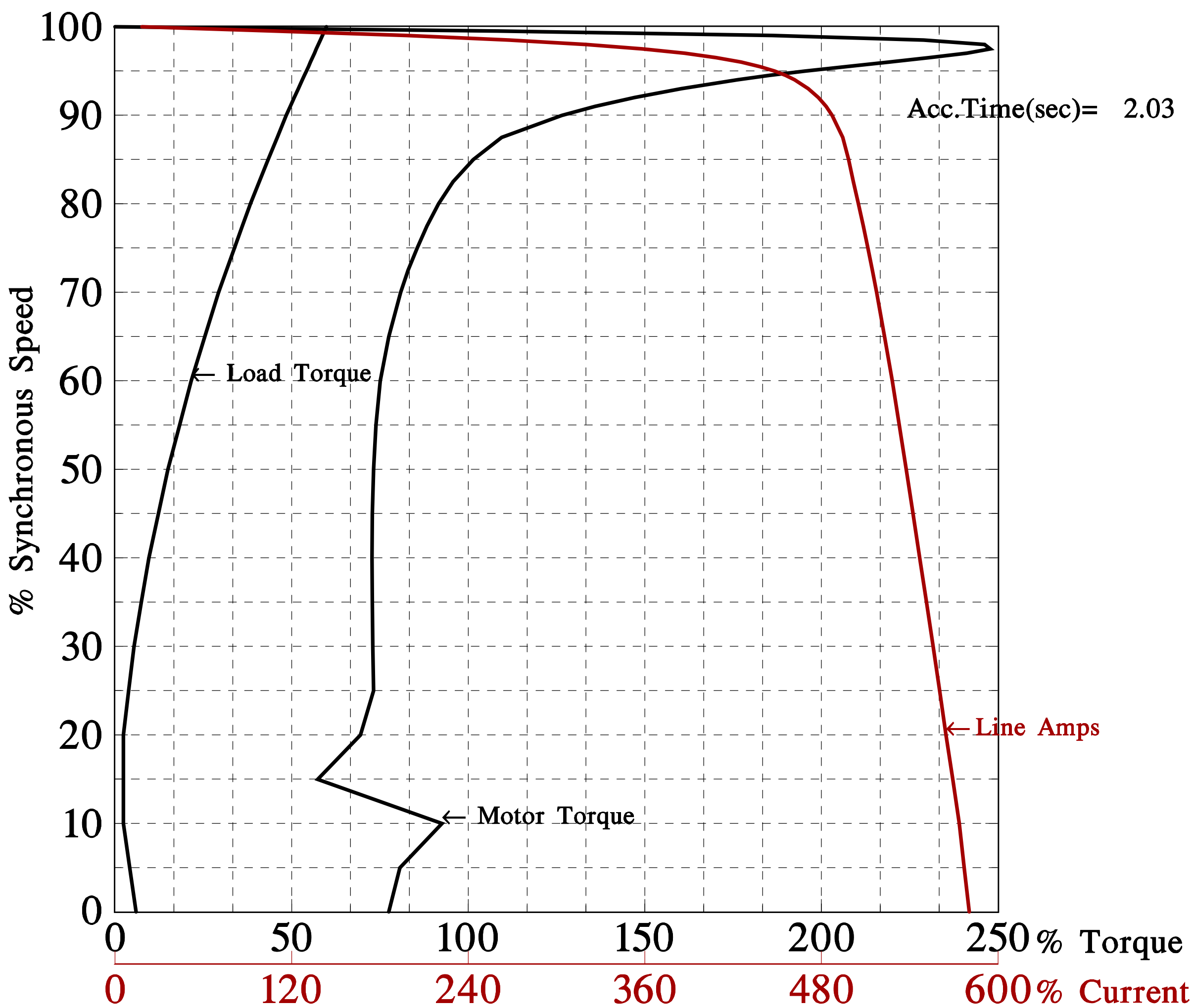
Induction Motor Starting Characteristics
Calculated at 100% Line Voltage

Design.ID	8052AA	Customer	NEW FOUNDLAND & LABRADOR
Engineer	T.NGUYEN	Application	ELECTRIC UTILITY PUMP

Poles	2	Volts	4160	Rpm(fl)	3580	Load Curve	ASSUMED
Hp	3000	Fl Amps	350	Rpm(syn)	3600	Lock Amps(%)	581
Pf	0.92	Frame	5011	Load Wk^2	70	Fl Torque(lb-ft)	4400
Phase	3	Hertz	60.0	Motor Wk^2	423	Lock Torque(%)	78



TECO-Westinghouse Motor Company Round Rock, Texas

Signature ______________________ Curve No.

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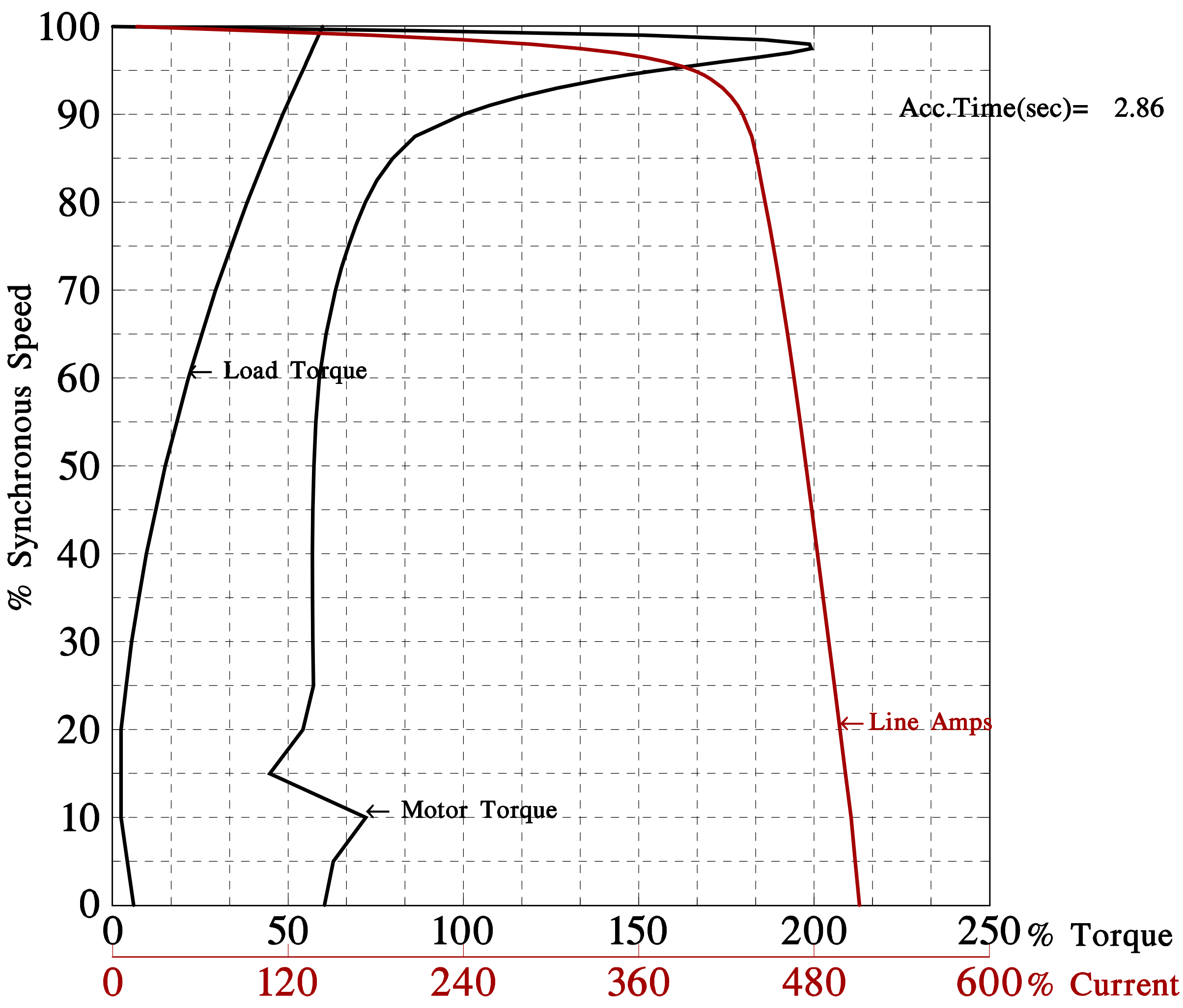
Induction Motor Starting Characteristics
Calculated at 90% Line Voltage

Design.ID	8052AA	Customer	NEW FOUNDLAND & LABRADOR
Engineer	T.NGUYEN	Application	ELECTRIC UTILITY PUMP

Poles	2	Volts	4160	Rpm(fl)	3580	Load Curve	ASSUMED
Hp	3000	Fl Amps	350	Rpm(syn)	3600	Lock Amps(%)	511
Pf	0.92	Frame	5011	Load Wk^2	70	Fl Torque(lb-ft)	4400
Phase	3	Hertz	60.0	Motor Wk^2	423	Lock Torque(%)	60



TECO-Westinghouse Motor Company — Round Rock, Texas

Signature ______________________ Curve No.

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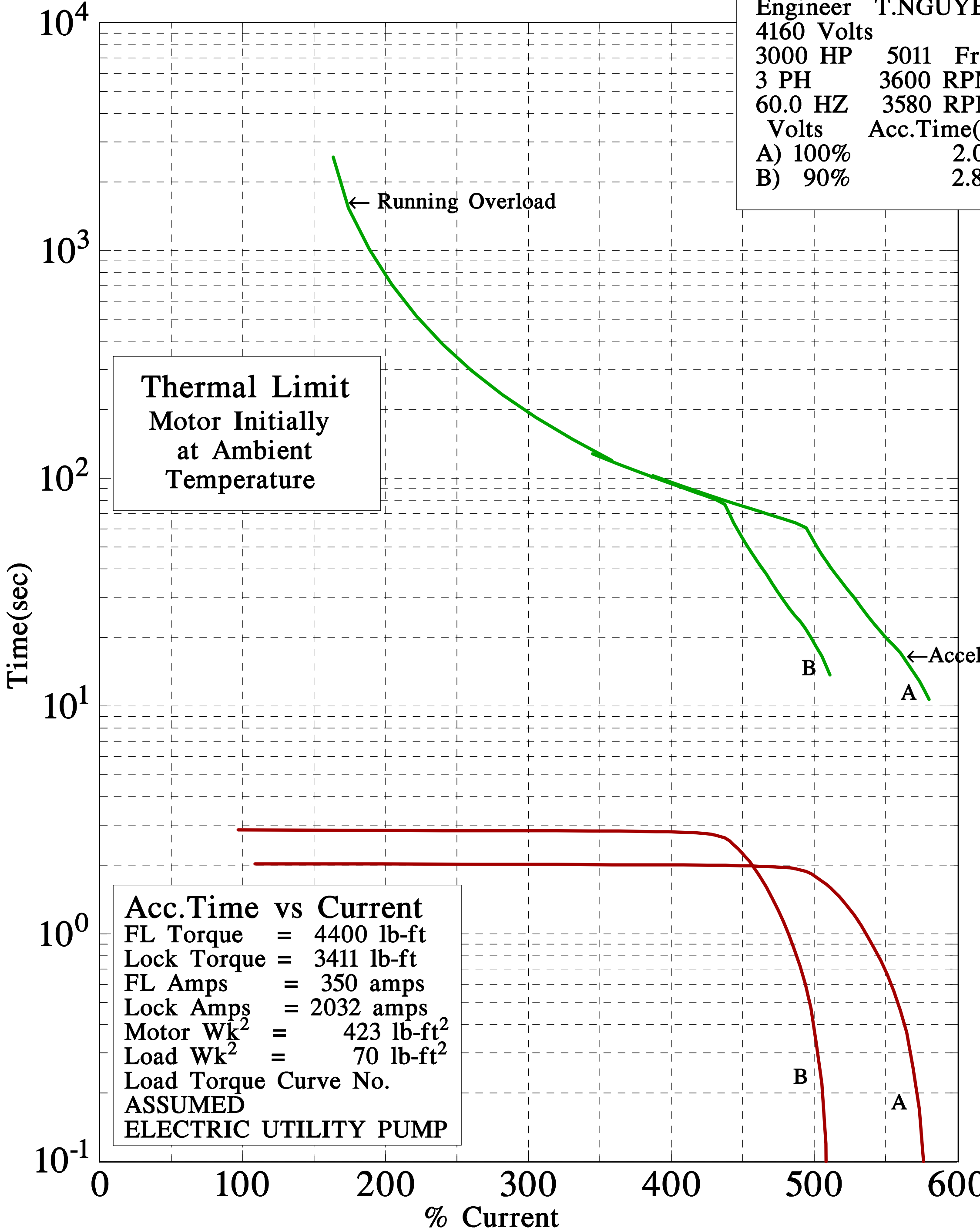
Time vs Current and Thermal Limit Curves

Customer- NEW FOUNDLAND & LABRADOR

Design.ID 8052AA
Engineer T.NGUYEN
4160 Volts
3000 HP 5011 Frame
3 PH 3600 RPM(Syn)
60.0 HZ 3580 RPM(FL)

Volts	Acc.Time(sec)
A) 100%	2.03
B) 90%	2.86

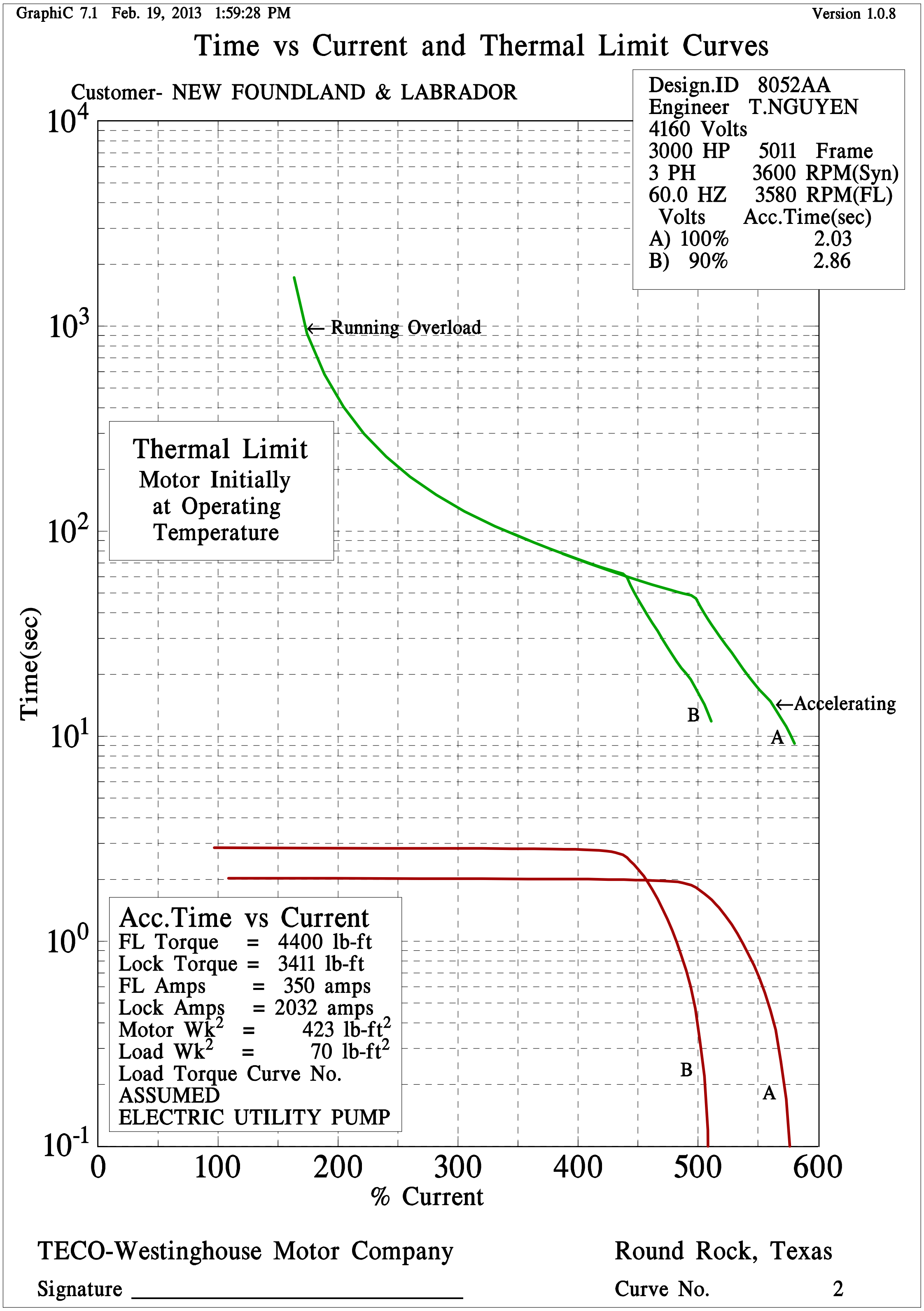


Thermal Limit
Motor Initially at Ambient Temperature

Acc.Time vs Current
FL Torque = 4400 lb-ft
Lock Torque = 3411 lb-ft
FL Amps = 350 amps
Lock Amps = 2032 amps
Motor Wk^2 = 423 lb-ft^2
Load Wk^2 = 70 lb-ft^2
Load Torque Curve No.
ASSUMED
ELECTRIC UTILITY PUMP

TECO-Westinghouse Motor Company Round Rock, Texas

Signature ______________________ Curve No. 1


GraphiC 7.1 Feb. 19, 2013 1:59:28 PM
Version 1.0.8
Time vs Current and Thermal Limit Curves
Customer- NEW FOUNDLAND & LABRADOR
Design.ID 8052AA
Engineer T.NGUYEN
4160 Volts
3000 HP 5011 Frame
3 PH 3600 RPM(Syn)
60.0 HZ 3580 RPM(FL)
Volts Acc.Time(sec)
A) 100% 2.03
B) 90% 2.86
← Running Overload
Thermal Limit
Motor Initially
at Operating
Temperature
←Accelerating
A
B
Acc.Time vs Current
FL Torque = 4400 lb-ft
Lock Torque = 3411 lb-ft
FL Amps = 350 amps
Lock Amps = 2032 amps
Motor Wk² = 423 lb-ft²
Load Wk² = 70 lb-ft²
Load Torque Curve No.
ASSUMED
ELECTRIC UTILITY PUMP
Time(sec)
% Current
0
100
200
300
400
500
600
TECO-Westinghouse Motor Company
Round Rock, Texas
Signature
Curve No. 2

APPENDIX C

NOVEMBER 2013 PSS®E DATA FOR 3000 HP INDUCTION MOTOR DATA

9.2 CIM5BL, CIM5OW, CIM5ZN, CIM5AR, CIM5AL

Induction Motor Load Model

This model uses CONs starting with #_____ J,
and STATEs starting with #_____ K,
and VARs starting with #_____ L,
and ICON #_____ M,
and Reserved ICONs starting with #_____ N.

CONs	Value	Description
J	0.022	R_A
J+1	0.113	X_A
J+2	3.92	$X_m > 0$
J+3	0.047	$R_1 > 0$
J+4	0.034	$X_1 > 0$
J+5	0.00585	R_2 (0 for single cage)[1]
J+6	0.0430	X_2 (0 for single cage)
J+7	1.0	$E_1 \geq 0$
J+8	0.17	$S(E_1)$
J+9	1.2	E_2
J+10	0.52	$S(E_2)$
J+11	2.515	MBASE[2]
J+12	1	PMULT
J+13	0.58	H (inertia, per unit motor base)
J+14	0	V_I (pu)[3]
J+15	0.1667	T_I (cycles)[4]
J+16	0.0833	T_B (cycles)
J+17	1.0	D (load damping factor)
J+18	0.756	T_{nom}, Load torque at 1 pu speed (used for motor starting only) (≥ 0)

1 To model single cage motor: set $R_2 = X_2 = 0$.
2 When MBASE = 0, motor MVA base = PMULT x MW load. When MBASE > 0, motor MVA base = MBASE.
3 V_I is the per unit voltage level below which the relay to trip the motor will begin timing. To disable relay, set $V_I = 0$.
4 T_I is the time in cycles for which the voltage must remain below the threshold for the relay to trip. T_B is the breaker delay time cycles.

STATEs	Value	Description
K		E'_q
K+1		E'_d
K+2		E''_q
K+3		E''_d
K+4		Δ speed (pu)
K+5		Angle deviation

VARs	Value	Description
L		Admittance of initial condition Mvar difference
L+1		Motor Q
L+2		T_{elec} (pu motor base)
L+3		$\Delta\omega$
L+4		T (pu on motor base)[1, 2]
L+5		I_Q
L+6		I_D
L+7		Motor current (pu motor base)
L+8		Relay trip time
L+9		Breaker trip time
L+10		MVA rating

1 Load torque, $T_L = T(1 + D\omega)^D$
2 For motor starting, $T=T_{nom}$ is specified by the user in CON (J+18). For motor online studies, T=To is calculated in the code during initialization and stored in VAR (L+4).

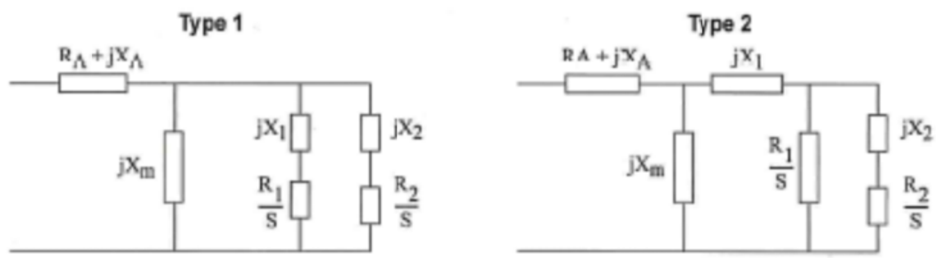
ICON	Value	Description
M	2	IT, motor type (1 or 2)

Reserved ICONs	Value	Description
N		Relay action code
N+1		Relay trip flag
N+2		Breaker action code
N+3		Breaker trip flag

I, 'CIM5xx', LID, ICON(M), CON(J) to CON(J+18) /

LID is an explicit load identifier or may be * for application to loads of any ID associated with the subsystem type.

Model suffix xx	I Description
BL	Bus number
OW	Owner number
ZN	Zone number
AR	Area number
AL	0



Impedances on Motor MVA Base

RATING : 3000 Hp @ assumed pf = 0.89

$$\frac{3000 \times 746}{0.89} = 2.515 \text{ MVA}$$

H: MOTOR $wk^2 = 423$
LOAD $wk^2 = 70$ (Assumed)
493

$$H = \frac{0.231 \times 10^{-6} (RPM)^2 \times wk^2}{KVA \text{ mach}}$$

$$H = \frac{0.231 \times 10^{-6} (3580)^2 \times 493}{2515}$$

H = 0.58

(DRAFT ORDER)
NEWFOUNDLAND AND LABRADOR
BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

AN ORDER OF THE BOARD

NO. P.U. __ (2016)

IN THE MATTER OF the *Electrical Power Control Act*, RSNL 1994, Chapter E-5.1 (the "*EPCA*") and the *Public Utilities Act*, RSNL 1990, Chapter P-47 (the "*Act*") as amended, and their subordinate regulations;

AND

AND IN THE MATTER OF an revised Application by Newfoundland and Labrador Hydro (Hydro) pursuant to Subsection 41(3) of the *Act*, for approval of the procurement of 12 MW of diesel generation at Holyrood.

WHEREAS the Applicant is a corporation continued and existing under the *Hydro Corporation Act, 2007,* is a public utility within the meaning of the Act and is subject to the provisions of the *Electrical Power Control Act*, 1994; and

WHEREAS Section 41(3) of the Act requires that a public utility not proceed with the construction, purchase or lease of improvements or additions to its property where:

a) the cost of construction or purchase is in excess of $50,000; or
b) the cost of the lease is in excess of $5,000 in a year of the lease,

without prior approval of the Board; and

WHEREAS in Order No. P.U. 33(2015) the Board approved Hydro's 2016 Capital Budget in the amount of $183,082,800; and

WHEREAS on November 20, 2015 Hydro applied to the Board for approval of a capital expenditure of $5,000,000 for the purchase of 12 MW of diesel generation, comprised of six diesel units each of a capacity of two MW, which diesel units were already installed and leased by Hydro at the site of the Holyrood Thermal Generating Station; and

WHEREAS Hydro withdrew that November 20, 2015 application and refiled an application on February 22, 2016 for the approval of a supplementary capital project being (i) the purchase of six diesel units, each of a capacity of two MW, which diesel units were already installed and leased by Hydro at the site of the Holyrood Thermal Generating Station, through a capital expenditure of $5,000,000, and (ii) the deferral of 80% of the lease costs payments made for these diesel units since July 2015, which lease payments are to be added to the $5,000,000 and applied against the purchase price for the purchase of 12 MW of diesel generation (for a total sought to be approved of $6,300,000) (the "Application"); and

WHEREAS Hydro states that the acquisition of the 12 MW of diesel generation will provide additional generation support for the Avalon Peninsula and the Island Interconnected System, energy to the Island Interconnected System, operating cost savings through reduced fuel costs through economic dispatch of power and energy, and a black start solution for the Holyrood Thermal Plant; and

WHEREAS the Application was copied to: Newfoundland Power Inc.; the Consumer Advocate, Mr. Thomas Johnson; Corner Brook Pulp and Paper Limited, NARL Refining Limited Partnership and Teck Resources Limited; Vale Newfoundland and Labrador Limited; and Praxair Canada Inc.; and

WHEREAS the Board is satisfied that the 2016 supplemental capital expenditure for approval to purchase 12 MW of diesel generation for continued deployment at the Holyrood Thermal Generating Station, and the deferral of lease payments to be applied against the purchase cost, is necessary and reasonable to allow Hydro to provide service and facilities which are reasonably safe and adequate and just and reasonable.

IT IS THEREFORE ORDERED THAT:

1. The proposed capital purchase of 12 MW of diesel generating capacity presently installed at the Holyrood Thermal Generating Station site for $6,300,000 comprised of a one-time payment and associated capital costs of $5,000,000, plus lease payments applied against the purchase price of $1,300,000 to be deferred and amortized over a period of five years with the unamortized balances to be included in rate base, is approved.

2. Hydro shall pay all expenses of the Board arising from this Application.

DATED at St. John's, Newfoundland and Labrador, this day of , 2015.

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