MARITIME ELECTRIC
A FORTIS COMPANY

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The Island Regulatory
and Appeals Commission

October 2, 2015

Mr. Mark Lanigan
Director, Technical & Regulatory Services
Island Regulatory and Appeals Commission
PO Box 577
501 – 134 Kent Street
Charlottetown PE C1A 7L1

Dear Mr. Lanigan:

2016 Capital Budget Filing Docket UE20724
Response to Interrogatories

Please find attached the Company's response to your Interrogatories with respect to the 2016 Capital Budget.

Yours truly,

MARITIME ELECTRIC

S. D. Loggie
Vice President, Finance & Chief Financial Officer

SDL42
Enclosure

1. **Commission Staff**

   What data exists to support the need for substation development in New Glasgow? What alternatives exist as opposed to substation development? What data exists regarding the Crossroads substation and load growth?

Response:

What data exists to support the need for substation development in New Glasgow?

The proposed New Glasgow substation is intended to off-load two existing substations (Hunter River and Rattenbury) that service north western Queens County.

Attached is an internal study that is updated annually to determine substation loading levels. Over the years, as load grew, Maritime Electric engaged several measures to ensure satisfactory service levels were being met.

What alternatives exist as opposed to substation development?

As noted above, the decision to pursue a new substation occurs after all other measures have been deployed.

- The installation of additional voltage regulators and capacitors on distribution lines;
- The rebuilding of distribution lines with larger capacity conductors;
- Establish new substation feeder(s) if geography warrants;
- The installation of larger capacity substation transformer(s) and voltage regulators; and
- The construction of distribution line extensions from other substations to reduce loading.

The success of these measures result in loading changes within neighboring substations as customers are, at times, refed from different distribution feeders or substations.

The growing area load is the primary driver for the proposed new substation for the New Glasgow area.

The Company investigated the expansion of the Rattenbury and Hunter River substations but determined that modifications would be difficult and that the existing locations are far from the load center (see Maritime Electric response to the PEI Energy Corporation's Interrogatory #17 for the 2016 Capital Budget).

What data exists regarding the Crossroads substation and load growth?

In addition to the internal study attached and the data contained in the Interrogatory response #17, the following table lists the number of customers fed from the Crossroads substation.

Number of Customer Fed from the Crossroads Substation	
2003	4,632
2004	4,783
2005	4,992
2006	5,093
2007	5,198
2008	5,366
2009	5,577
2010	5,613
2011	5,580
2012	5,897
2013	6,039
2014	6,108

Maritime Electric

Power Transformer Loading Study

May 2014

2015 Update By: Ian Colwell

Review of Power Transformer Loading

1. Introduction

The loading of the power transformers at Maritime Electric's distribution substations has been reviewed to identify units which are already overloaded, or will become overloaded between 2015 and 2020. This review provides recommendations for the purchase of new transformers and/or relocation of existing transformers to limit the potential for overloading.

<u>Background</u>

The rated kVA output of a transformer is the load it can deliver continuously at rated secondary voltage without exceeding a given temperature rise, measured under prescribed test conditions. The actual test temperature rise may, in a practical case, be somewhat below the established limit because of design and manufacturing tolerances.

The output that a transformer can deliver in service without undue deterioration of the insulation may be more or less than its rated output, depending upon the following design characteristics and operating conditions, as they exist at a particular time[1]:

(1) Ambient temperature.
(2) Top-oil rise over ambient temperature.
(3) Hottest-spot rise over top-oil temperature (hottest-spot copper gradient).
(4) Transformer thermal time constant.
(5) Ratio of load loss to no-load loss.

The following sections describe two easy ways to apply adjustments based on the above considerations.

<u>Loading Based on Ambient Temperature</u>

Air-cooled, oil-immersed transformers built to meet established standards will operate continuously with normal life expectancy at rated kVA and secondary voltage, provided the ambient air temperature averages no more than 30°C throughout a 24-hour period with maximum air temperature never exceeding 40°C.

When the ambient air average temperature is different from 30°C, a modification of the transformer loading may be made according to the following table:

Type of Cooling	Air above 30°C Average	Air below 30°C Average
Self-Cooled	-1.5%	+1.0%
Forced-Air-Cooled	-1.0%*	+0.75%*

*Based on forced-cooled rating

[1] American Standards for Transformers, Regulators, and Reactors, American Standards Association, ASA C57, 1948.

Loading Based on Capacity Factor

Transformer capacity factor (operating kVA divided by rated kVA) averaged throughout a 24-hour period may be well below 100 percent. When this is true some compensating increase in maximum transformer loading may be made. The percentage increase in maximum loading as a function of capacity factor, based on a normal transformer life expectancy, is given in the following table:

Type of Cooling	**Percent Increase Above Rated kVA for Each Percent By Which Capacity Factor Is Below 100**	**Maximum Percent Increase, Regardless of Capacity Factor**
Self-Cooled	0.5	25
Forced-Air-Cooled	0.4	20

*Here, percent capacity factor is equal to $\frac{\text{operating kVA}}{\text{Rated kVA}}$ x 100, averaged throughout a 24-hour period

The above tables are from Page 113 and 114 of the fourth edition of the Westinghouse Electrical Transmission and Distribution Reference Book. In the more than 40 years since the fourth edition was issued, better analytical tools have become available which enable engineers to design transformers within narrower tolerances.

Most of Maritime Electric's power transformers were manufactured more than 20 years ago, therefore the percent increase values in the above tables have been used to calculate Maritime Electric's power transformer loading.

To combine the percent increase due to the load factor below 100% and the percent increase due to the average ambient temperature below 30°C, the total increase is the percent increase due to load factor below 100% plus a half of the percent increase due to average ambient temperature below 30°C. For example, during the winter the maximum average ambient temperature is +8°C, the load factor is 70%, the total increase is:

(100 - 70) x 0.5% + ½ x (30 - 8) x 1% = 26%

2. Method

For the purposes of this study, the peak load from June to September was considered the summer peak. The peak load of the other 8 months was considered winter peak. Generally, winter peaks occur in either December or January. The summer growths used to predict future load were calculated using the summer loading data from summer 2011 through to summer 2014. This provided three values of load growth which were then averaged to predict the future growth. Similarly, the winter growths were calculated using winter 2012 data through to winter 2015 data.

The mean winter temperatures were determined by taking the average of the daily winter ambient temperature that occurs 5% of the time during winter months for 3 years, while the mean summer temperatures were determined by taking the average of daily summer ambient temperature that occurs 95% of the time during summer months for 3 years. Temperatures were gathered from Environment Canada. See Appendix B for temperature data. These temperatures were used to determine the increase of capacity of transformer due to average ambient temperatures above and below 30 °C. The load factor is determined by dividing the kilowatt-hour per day by 24 hours, then dividing this number by total kilowatts determined from meter information in each substation. The load factor is used to determine the increased capacity of a transformer due to load factor below 100%. The total increase in capacity is the percent increase due to load factor below 100% plus a half of a percent increase due to average ambient temperature below 30 deg C. The average growth is determined by averaging the yearly growths by the number of years. Due to the rapid load growth in recent years only growth data from 2012 onward was averaged for this study. Please see assumptions for further details. The average growth is used to verify when the power transformer will be overloaded due to the load growth of the substation. The ONAF (Oil-filled, forced air cooling) rating is used in this study to determine whether the transformer is overloaded or not. In most cases the transformer can be overloaded safely by 10% of ONAF rating; however it is not good practice to rely on this for normal operation and should only be done in emergency or cold load pickup circumstances. The attached spreadsheet in the Appendix shows percent loading based on ONAN, ONAF, and overload capacity. The overload schedule (Appendix B) lists the transformers and dates of when the loading is expected to be above 90%.

3. Conclusions

The power transformers that will be overloaded or very close to being overloaded (% load of ONAF rating >90%) in the next 4-5 years are listed below, as well as the transformers that are under loaded. This is based on **ONAF** rating.

Table 3 – Loading Study Summary

	2014				2015				2016			
	Winter		Summer		Winter		Summer		Winter		Summer	
Transformer	**Peak**	**Growth**	**Peak**	**Growth**	**Peak**	**Growth**	**Peak**	**Growth**	**Peak**	**Growth**	**Peak**	**Growth**
Albany (West)	92.4%	5.9%	56.7%	-2.0%	62.7%	-32.2%	57.8%	1.9%	66.2%	5.6%	58.9%	1.9%
Albany (Aug Cove)	43.9%	-0.3%	41.5%	7.2%	71.0%	61.6%	41.9%	1.0%	74.2%	4.5%	42.4%	1.0%
Alberton (Tignish Circuit)	67.2%	10.8%	55.7%	7.5%	70.4%	4.8%	55.6%	-0.1%	75.6%	7.4%	55.6%	-0.1%
Alberton (Alberton Circuit)	54.6%	0.0%	36.3%	6.3%	58.2%	6.6%	37.3%	2.7%	64.5%	10.8%	38.3%	2.7%
Charlottetown 13.8kV	59.9%	2.5%	85.5%	42.7%	63.9%	6.6%	99.4%	16.3%	67.7%	6.0%	115.6%	16.3%
Crossroads	89.1%	4.7%	56.7%	7.6%	88.4%	-0.8%	59.1%	4.3%	96.0%	8.6%	61.6%	4.3%
Dingwells Mills	71.4%	7.6%	63.8%	11.1%	71.5%	0.1%	69.8%	9.3%	75.5%	5.7%	76.3%	9.3%
Dover	71.6%	12.5%	52.0%	0.4%	61.3%	-14.3%	53.1%	2.2%	63.7%	3.9%	54.3%	2.2%
Georgetown	51.9%	11.4%	40.9%	0.0%	48.4%	-6.8%	41.9%	2.4%	49.0%	1.3%	42.9%	2.4%
Hunter River	104.9%	12.8%	78.1%	13.9%	97.4%	-7.1%	81.9%	4.9%	107.6%	10.5%	85.9%	4.9%
Kensington (NA)	103.4%	13.4%	71.6%	9.0%	50.1%	-51.5%	77.6%	8.4%	55.9%	11.5%	84.1%	8.4%
Kensington (IT)	0.0%	0.0%	0.0%	0.0%	77.0%	0.0%	0.0%	0.0%	85.9%	0.0%	0.0%	0.0%
O'Leary	90.8%	4.0%	57.2%	0.6%	90.1%	-0.7%	56.3%	-1.7%	95.8%	6.3%	55.3%	-1.7%
Rattenbury	67.2%	-5.1%	79.0%	-6.2%	67.2%	0.0%	84.1%	6.4%	75.9%	12.9%	89.4%	6.4%
Scotchfort (WSP)	73.3%	5.1%	82.3%	32.6%	79.8%	8.8%	85.2%	3.5%	86.0%	7.8%	88.2%	3.5%
Souris Industrial Park	33.0%	-0.4%	31.0%	-4.7%	33.9%	2.7%	30.9%	-0.3%	34.5%	1.9%	30.8%	-0.3%
Souris (Town & East Point)	79.4%	6.5%	65.8%	11.8%	82.5%	4.0%	69.1%	5.0%	87.8%	6.4%	72.6%	5.0%
St. Eleanors	64.8%	6.8%	48.2%	6.0%	63.2%	-2.5%	49.4%	2.3%	68.5%	8.5%	50.5%	2.3%
Victoria Cross 12.5kV	57.7%	-3.8%	45.2%	-4.7%	58.5%	1.5%	47.3%	4.7%	60.8%	3.9%	49.6%	4.7%
Victoria Cross 25kV	60.9%	8.3%	44.6%	5.9%	57.2%	-6.0%	44.6%	0.0%	60.3%	5.4%	44.6%	0.0%
Wellington	80.9%	-4.3%	57.2%	-1.7%	81.8%	1.0%	58.9%	3.0%	89.5%	9.4%	60.7%	3.0%
West Royalty 13.8kV	80.7%	-6.4%	75.6%	0.2%	84.2%	4.3%	80.6%	6.6%	87.0%	3.4%	85.9%	6.6%
West Royalty 25 kV	75.7%	5.6%	52.9%	1.0%	77.6%	2.5%	57.3%	8.3%	83.1%	7.1%	62.0%	8.3%
Average	**68.5%**	**4.2%**	**55.6%**	**6.3%**	**69.4%**	**-0.8%**	**58.2%**	**4.0%**	**74.4%**	**6.5%**	**61.1%**	**4.0%**

Table 3 – Loading Study Summary

2017				2018				2019				2020			
Winter		Summer		Winter		Summer		Winter		Summer		Winter		Summer	
Peak	Growth	Peak	Growth	Peak	Growth	Peak	Growth	Peak	Growth	Peak	Growth	Peak	Growth	Peak	Growth
69.9%	5.6%	60.0%	1.9%	73.9%	5.6%	61.1%	1.9%	78.1%	5.6%	62.3%	1.9%	82.5%	5.6%	63.4%	1.9%
77.5%	4.5%	42.8%	1.0%	81.0%	4.5%	43.2%	1.0%	84.7%	4.5%	43.6%	1.0%	88.5%	4.5%	44.1%	1.0%
81.2%	7.4%	55.5%	-0.1%	87.2%	7.4%	55.4%	-0.1%	93.6%	7.4%	55.4%	-0.1%	100.5%	7.4%	55.3%	-0.1%
71.4%	10.8%	39.3%	2.7%	79.1%	10.8%	40.4%	2.7%	87.6%	10.8%	41.5%	2.7%	97.0%	10.8%	42.6%	2.7%
71.7%	6.0%	134.4%	16.3%	76.0%	6.0%	156.3%	16.3%	80.5%	6.0%	181.8%	16.3%	85.4%	6.0%	211.4%	16.3%
104.2%	8.6%	64.2%	4.3%	113.1%	8.6%	67.0%	4.3%	122.8%	8.6%	69.8%	4.3%	133.4%	8.6%	72.8%	4.3%
79.8%	5.7%	83.4%	9.3%	84.3%	5.7%	91.2%	9.3%	89.1%	5.7%	99.7%	9.3%	94.2%	5.7%	109.0%	9.3%
66.2%	3.9%	55.5%	2.2%	68.8%	3.9%	56.7%	2.2%	71.6%	3.9%	58.0%	2.2%	74.4%	3.9%	59.3%	2.2%
49.6%	1.3%	44.0%	2.4%	50.2%	1.3%	45.0%	2.4%	50.9%	1.3%	46.1%	2.4%	51.5%	1.3%	47.3%	2.4%
118.9%	10.5%	90.1%	4.9%	131.4%	10.5%	94.5%	4.9%	145.1%	10.5%	99.1%	4.9%	160.4%	10.5%	103.9%	4.9%
62.3%	11.5%	91.1%	8.4%	69.5%	11.5%	98.7%	8.4%	77.5%	11.5%	107.0%	8.4%	86.4%	11.5%	115.9%	8.4%
95.8%	0.0%	0.0%	0.0%	106.8%	0.0%	0.0%	0.0%	119.1%	0.0%	0.0%	0.0%	132.8%	0.0%	0.0%	0.0%
101.8%	6.3%	56.3%	1.7%	108.1%	6.3%	55.3%	-1.7%	114.9%	6.3%	54.4%	-1.7%	122.1%	6.3%	53.5%	-1.7%
85.7%	12.9%	95.1%	6.4%	96.8%	12.9%	101.2%	6.4%	109.3%	12.9%	107.6%	6.4%	123.4%	12.9%	114.4%	6.4%
92.6%	7.8%	91.3%	3.5%	99.8%	7.8%	94.5%	3.5%	107.6%	7.8%	97.9%	3.5%	115.9%	7.8%	101.3%	3.5%
35.2%	1.9%	30.8%	0.0%	35.9%	1.9%	30.7%	-0.3%	36.6%	1.9%	30.6%	-0.3%	37.3%	1.9%	30.5%	-0.3%
93.4%	6.4%	76.2%	5.0%	99.3%	6.4%	80.0%	5.0%	105.6%	6.4%	84.0%	5.0%	112.4%	6.4%	88.2%	5.0%
74.3%	8.5%	51.7%	2.3%	80.7%	8.5%	52.9%	2.3%	87.5%	8.5%	54.2%	2.3%	95.0%	8.5%	55.4%	2.3%
63.2%	3.9%	51.9%	4.7%	65.7%	3.9%	54.4%	4.7%	68.3%	3.9%	56.9%	4.7%	71.0%	3.9%	59.6%	4.7%
63.6%	5.4%	44.6%	0.0%	67.1%	5.4%	44.6%	0.0%	70.7%	5.4%	44.6%	0.0%	74.6%	5.4%	44.6%	0.0%
98.0%	9.4%	62.5%	3.0%	107.2%	9.4%	64.4%	3.0%	117.3%	9.4%	66.3%	3.0%	128.4%	9.4%	68.3%	3.0%
90.0%	3.4%	91.5%	6.6%	93.0%	3.4%	97.6%	6.6%	96.1%	3.4%	104.0%	6.6%	99.3%	3.4%	110.8%	6.6%
89.0%	7.1%	67.2%	8.3%	95.3%	7.1%	72.7%	8.3%	102.1%	7.1%	78.7%	8.3%	109.3%	7.1%	85.2%	8.3%
79.8%	**6.5%**	**64.3%**	**4.1%**	**85.7%**	**6.5%**	**67.7%**	**4.0%**	**92.0%**	**6.5%**	**71.5%**	**4.0%**	**98.9%**	**6.5%**	**75.5%**	**4.0%**

4. Recommendations

Based on the conclusions listed above, the following suggestions are proposed as a possible overload prevention strategy.

2015

1. **Charlottetown Airport Substation**
   The rationale behind building this substation is to be able to offload the two 20 MVA, 69/25 kV transformers in West Royalty since the load measured in January was 31.05 MVA or 77.6% of the ONAF rating. If one transformer fails then the second transformer and mobile ONAF rating will be exceeded. The new Charlottetown Airport substation will supply most of the existing Milton Brackley load plus all future load growth from Bio Vectra and the airport. The existing West Royalty transformers will supply the load in the West Royalty Industrial Park, Bio Commons and Bonshaw feeder.

2. **West St. Peters Substation**
   Due to the delay in environmental approval, West St. Peters Substation will be built this year and will accommodate one 10 MVA, 138/12.5 kV transformer to supply the Morell feeder and the processing facility that is going to expand capacity with the third Individually quick frozen production line in 2016. The rest of the Scotchfort load will be supplied by Scotchfort substation until 2019 when the T4 line from Lorne Valley will be decommissioned as well as the substation. In the winter of 2017 the load on the 219A voltage regulators on St. Peters Road will exceed their capacity of 4.7 MVA. A 328 A voltage regulator is the largest size of voltage regulator that can be place on a specially designed platform supported by the poles. Upgrading the existing 219 A regulators to 328 A regulators will allow up to 7 MVA of loading on the feeder which will provide time to postpone building East Royalty substation.

3. **UPEI substation**
   This new substation is to be brought online in 2015. Once the substation is operational it will reduce the load on the West Royalty Charlottetown Plant 13.8 kV systems.

4. **Other Activity**
   Perform environmental studies and purchase land for a New Glasgow substation. Budget for a 10 MVA transformer for the New Glasgow substation.

2016

1. **Build New Glasgow Substation**
   The rationale behind building New Glasgow substation is to offload both the Hunter River and Rattenbury transformers. The Rattenbury 5/6.67 MVA transformer will reach 95% or 6.344 MVA in the summer of 2017.

The Hunter River (7.5/10 MVA) transformer PEAK IN 2015 WAS 9.74 MVA. In the winter of 2016 Hunter River (7.5/10 MVA) transformer will be overloaded 8% (10.763 MVA). The max winter overloading capacity is 12.32 MVA. The capacity of the 437 A voltage regulator set is 9.450 MVA which means with the predicted load of 10.763 MVA the voltage regulator will be overloaded by 1.313 MVA above nominal rating. The 437A regulator is designed to support 489 A maximum or 10.6 MVA for 12.5 kV. In 2015, the Hunter River ABC Voltage Regulators reached 449A, 472A, 429A, respectively. The overloading trend will continue downstream of voltage regulators and reclosers. A cold load pick up has not been included in this number, which can be 120%. We experienced a cold load pickup in 2014 and if this happens in 2016 then the transformer max winter overloading capacity (12.32 MVA) will be exceeded by 596 kVA.

2. **Other Activity**
Perform environmental studies and purchase land for a Cherry Valley substation. Budget for a 10 MVA transformer for the Cherry Valley substation.

2017

1. **New Cherry Valley Substation**
Crossroads substation has two 7.5/10 MVA transformers, a combined ONAF rating of 20 MW. In 2015, the load reached 17.7 MVA. In the winter of 2016 Crossroads transformers will be loaded 96% of the ONAF rating. A new Cherry Valley substation will take 5 MW load from Crossroads initially. In the winter of 2017, Crossroads predicted load will be 20.841 MVA which will exceed the ONAF rating by 4%. In the winter of 2018, Crossroads predicted load will be 22.628 MVA which is approaching the max winter overloading of 24.54 MVA. This number does not include cold load pick up.

2. **Other Activity**
    - Reconfigure the feeders in Kensington to balance the load on the 10 and 6.67 MVA transformers.

    - Perform environmental studies and purchase land for a Western PEI substation. Budget for a 10 MVA transformer for the Western PEI substation.

2018

1. **New Mount Pleasant substation**
O'Leary substation transformer is 7.5/10 MVA capacity and the 2015 peak was 9 MVA. In the winter of 2017 O'Leary transformer will have predicted load of 10.176 MVA. The transformer overloading capacity is 11.84 MVA and will be exceeded (12,213 MVA) in 2020. Wellington substation transformer is 7.5/10 MVA and the 2015 peak was 8 MVA and is expected to be overloaded by 7% in the winter of 2018. Total predicted load in that

substation will be 10.72 MVA out of 12 MVA overloading capacity. In 2019 Wellington load will be 11.73 MVA out of 12 MVA overloading capacity. In order to offload O'Leary and Wellington a new substation will be constructed in between Wellington and O'Leary. The new substation will have a 10 MVA transformer.

2. **Other Activity**
   Perform environmental studies and purchase land for the East Royalty substation. Budget for a 10 MVA transformer for both the East Royalty and West St. Peters Substation.

2019

1. **New East Royalty substation**
   - The rationale behind building East Royalty substation is to offload West Royalty transformers, # 2 Rural voltage regulators and supply some load from Scotchfort substation i.e. Mount Stewart feeder. In 2019 the T-4 line will be de-commissioned as well as Scotchfort substation.
   - East Royalty substation will supply all loads downstream of the voltage regulator at St. Peters Rd. and Mount Stewart feeder load. This will offload West St. Peters substation that will provide supply to Morell area load.
   - In the winter of 2017 the load on the 219A voltage regulators on St. Peters Rd. will exceed capacity of 4.7 MVA. The 328 A voltage regulator is the largest size of voltage regulators that can be place on a specially designed platform supported by the platform and additional stub poles. The construction of the East Royalty substation can be postponed by upgrading the regulators to 328A capacity; this will allow 7 MVA of load to be placed on these voltage regulators, under the assumption that Scotchfort substation and T-4 line from Lorne Valley to Scotchfort will not be decommissioned until 2019.

2. **Other Activity**
   - Install second 10 MVA transformer for WSP and pickup all Scotchfort load.
   - Decommission the Scotchfort substation and move the 10 MVA transformer to Souris to replace the 6 MVA unit feeding the town.
   - Shift some load from Dingwells Mills to West St. Peters Substation to avoid overloading the Dingwells Mills transformer.
   - Perform environmental studies and purchase land for a Tignish substation. Budget for a 10 MVA transformer for both the Tignish and Kensington substation.

2020

1. **New Tignish substation**
   The Profits Corner 328A voltage regulators reached 365 A in 2015. A bank of 328 A voltage regulators should be dedicated to Tignish at Profits Corner in 2015. In 2020 Alberton Tignish circuit will reach 101% of its ONAF capacity. In the long term, a Tignish Substation may be possible if MECL tapped T23. A breaker at the Tignish Substation may be an option.
2. **Other Activity**
   Replace the existing 6.67 MVA transformer in Kensington with a new 10 MVA unit.

The information and proposals provided in this study are based on load growth and assumptions determined in winter 2015. Load growth is somewhat unpredictable and should be monitored annually during peak loads to locate areas of rapid growth. It is recommended that overload prevention strategies be reviewed each year along with the loading study as needed.

Appendix A: Definitions

The following **definitions** are used in this study:

1. **Rated MVA output of a transformer** - The load which it can deliver continuously at rated secondary voltage without exceeding a given temperature rise measured under prescribed test conditions.
2. **Transformer capacity factor** - The operating kVA divided by rated kVA averaged throughout a 24-hour period.
3. **Average of maximum daily ambient temperatures for summer and winter months** - The average of maximum daily ambient temperatures for the month involved averaged over several years. The ambient temperature for any month can be approximated from reports prepared by Environment Canada.
4. **Overload capacity** - The percent increase due to load factor below 100% plus a half percent increase due to average ambient temperature below 30°C.
5. **Kilowatt-hours** are the measure of the total quantity of energy consumed.
6. **Power factor** - The ratio of the actual power to the apparent power. Assumption is 90% for the Maritime Electric system.
7. **Load factor** - The ratio of the average load over a designated period of time to

Appendix B: Loading Study Results

The following pages summarize the transformer loading study performed in 2015 using data up to February 2015. If a more detailed inspection of the study is needed it can be found at the following link:

2015 Power Transformer Study (3 Years Growth) - Baseline.xlsm

Overload Schedule

Substation	Average Load Growth (Summer)	Average Load Growth (Winter)	% Load	Based on Lower Rated Capacity (ONAN Rating)		% Load	Based on Higher Rated Capacity (ONAF Rating)		% Load	Based on Overloaded Capacity	
Albany (West)	1.9%	5.6%	93%	2017	Winter	82%	2020	Winter	70%	2020	Winter
Albany (Augustine Cove)	1.0%	4.5%	95%	2015	Winter	88%	2020	Winter	74%	2020	Winter
Alberton (Tignish Circuit)	-0.1%	7.4%	90%	2014	Winter	94%	2019	Winter	84%	2020	Winter
Alberton (Alberton Circuit)	2.7%	10.8%	95%	2017	Winter	97%	2020	Winter	83%	2020	Winter
Charlottetown 13.8kV	16.3%	6.0%	114%	2014	Summer	99%	2015	Summer	100%	2016	Summer
Crossroads	4.3%	8.6%	119%	2014	Winter	96%	2016	Winter	92%	2018	Winter
Dingwells Mills	9.3%	5.7%	95%	2014	Winter	91%	2018	Summer	92%	2020	Summer
Dover	2.2%	3.9%	95%	2014	Winter	74%	2020	Winter	58%	2020	Winter
Georgetown	2.4%	1.3%	69%	2020	Winter	52%	2020	Winter	43%	2020	Winter
Hunter River	4.9%	10.5%	104%	2006	Winter	105%	2014	Winter	97%	2017	Winter
Kensington (NA)	5.2%	11.5%	101%	2004	Winter	103%	2014	Winter	96%	2019	Winter
Kensington (IT)	0.0%	11.5%	103%	2015	Winter	96%	2017	Winter	90%	2018	Winter
O'Leary	-1.7%	6.3%	101%	2011	Winter	91%	2014	Winter	91%	2018	Winter
Rattenbury	6.4%	12.9%	104%	2012	Summer	95%	2017	Summer	92%	2019	Summer
Scotchfort	3.5%	7.8%	93%	2013	Winter	93%	2017	Winter	92%	2019	Winter
Souris Industrial Park	-0.3%	1.9%	56%	2020	Winter	37%	2020	Winter	31%	2020	Winter
Souris (Town and East Point)	5.0%	6.4%	102%	2005	Winter	93%	2017	Winter	95%	2020	Winter
St. Eleanors	2.3%	8.5%	91%	2016	Winter	95%	2020	Winter	79%	2020	Winter
Victoria Cross 12.5kV	4.7%	3.9%	91%	2019	Winter	71%	2020	Winter	60%	2020	Winter
Victoria Cross 25kV	0.0%	5.4%	94%	2019	Winter	75%	2020	Winter	61%	2020	Winter
Wellington	3.0%	9.4%	113%	2013	Winter	98%	2017	Winter	98%	2019	Winter
West Royalty 13.8 kV	6.6%	3.4%	108%	1998	Winter	92%	2017	Summer	90%	2019	Winter
West Royalty 25 kV	8.3%	7.1%	105%	2012	Summer	95%	2018	Winter	91%	2020	Winter

2. <u>Commission Staff</u>

Please provide a detailed update on Y104 transmission project. Has the route changed? Is it on budget for the overall project? (Explain underground on Y104 here.)

<u>Response</u>:

The Y-104 project is progressing well. By the end of 2015, the Company will complete the planned 42.5 km of the total 82.5 kilometers from West Royalty Substation to Green Meadows Road. The West St. Peter's Substation is expected to be fed from Y-104 by the end of the year. The 20 km section identified for construction in 2015 has been completed below the budgeted $3,200,000 by approximately $900,000. This is primarily due to the realignment of 8 kilometers along government roadway right-of-way that was originally planned to be cross-country thus reducing the expenditures for easement acquisitions, vegetation clearing and environmental assessments. In accordance with the recent directive from the Commission, Maritime Electric plans to continue with construction and tree cutting over the balance of 2015 using the total 2015 budget amount of $3,200,000 to extend Y104 an additional 7 km beyond the 20 km that was identified to be carried out in 2016. If the remaining construction to be carried out over the next two years does not experience any unforeseen circumstances, the gains made this year will reduce the overall project budget by approximately $900,000.

3. Commission Staff

Who performs the pole for pole replacements? Company staff or outside contractors? The budget is $400,000 for 350 individual poles, is $1,142.85 per pole replacement reasonable? Please provide a breakdown of budget components of a pole replacement? Also, please provide budget breakdown of porcelain cutout replacement.

Response:

There are approximately 120,000 wood poles of various species and treatment in service on the transmission and distribution system. Prior to 1986, the typical wood pole installed was untreated eastern cedar. After 1986, eastern cedar wood poles were replaced with Pentachlorophenol (Penta) treated pine poles and Chromate Copper Arsenate (CCA) treated poles which are now predominantly installed in the system. There are approximately 19,485 eastern cedar poles remaining in the system which are 40 years or older, and are approaching the end of their useful life. Eastern cedar poles represent the majority of the Company's pole failures. The pole for pole replacement is used predominantly to proactively replace these poles. This work is done by both Maritime Electric line crews and also by line contractor crews. Below is the breakdown of the pole replacement average budgeted costs:

Average labour cost to install pole. Includes survey, supervision, line crew, digger, frame, hotline and transportation and flagging	$ 515.00
Materials (based on cost of 45' pole and hardware)	$ 625.00
Total Average Installed Cost	$ 1,140.00

Below is the breakdown of the porcelain cutout replacement costs:

Labour to install cutout. Includes line crew (hotline and transportation and flagging	$ 285.00
Material (cutout)	$ 105.00
Total Average Installed Cost	$ 390.00

4. <u>Commission Staff</u>

The monies budgeted for Charlottetown thermal plant are provisional in nature. As this plant is anticipated to be retired in the near future, costs for provisional budget items should not be incurred unless absolutely necessary for safety and reasonably prudent for energy delivery needs in near term period. Can you clarify Company's position on expenditures at Charlottetown thermal plant.

Response:

Any monies budgeted at the Charlottetown Thermal Generating Station (CTGS) that are provisional in nature are either for safety and/or reliability purposes. The amounts budgeted for provisional items have been or will be reduced given that in 2019 the Company plans to begin a long term staged layup of the boilers, turbines and generators at the facility.

- Parts Storage Improvements — Reduces to $0 in starting 2018
- Door & Window Replacements — Reduced to $0 in 2018 and 2020
- Misc. Pipeline Replacements — Reduced by 50%
- Emergency Lighting — Reduced to $0 starting in 2019
- Lighting Improvements — Reduced to $0 starting in 2019
- Safety Equipment — Reduced to $0 starting in 2018
- Misc. Electrical Tools — Reduced by 50% (i.e., $0 every 2nd year)
- Large Motor Refurbishment — Reduced to $0 starting in 2018
- Boiler Insulation Replacements — Reduced by 40% for 2017 then $0 starting in 2018
- Turbine Insulation Replacements — Reduced by 40% for 2017 then $0 starting in 2018
- Misc. Turbine Improvements — Reduced by 40% for 2017 then $0 starting in 2018

Again, monies will only be spent if safety and/or reliability are in jeopardy.

5. Commission Staff

Please provide a list of projects anticipated in 4.3 b. miscellaneous turbine projects – combustion turbine improvements - $153,000.

Response:

The $153,000 is for CT3. The $153,000 is broken down as follows:

- $92,000 for Combustion Turbine Improvements

  With the increased reliance on CT3 with the shift from a stand-by generator to a peaking generator, this provisional amount is anticipated. The results of the annual inspections of the unit will determine the actual requirement.

- $61,000 for Miscellaneous Parts

  Again, with the shift from a stand-by generator to a peaking generator, this category is for miscellaneous parts needed during the year and to slowly increase the amount of spare stock items.

6. Commission Staff

What is the anticipated rate impact of capital expenditures planned in this application? 2 versions with existing rates and with proposed depreciation rates.

Response:

Under the Company's accounting policy for the depreciation of captial assets, one half year of depreciation is recorded in the year of addition. Each subsequent year will have a full year of deprecation until the asset is retired.

As shown in the schedule below, based upon an estimated annual revenue requirement of $195 million, the rate impact is approximately 0.23% in 2016 (half year of depreciation) or 0.45% on an annual basis using the existing depreciation rates. Using the proposed depreciation rates, the impact is approximately 0.24% in 2016 (half year of depreciation) or 0.48% on an annual basis.

Asset Class	2016 Additions	Allocation of GEC/IDC	Total 2016 Additions	Existing Depreciation Rate	2016 Depreciation Existing Rate	Proposed Depreciation Rate	2016 Depreciation Proposed Rate
Production Plant							
Charlottetown Thermal Generating Station	381,000	8,700	389,700	2.50	4,900	4.53	8,800
Borden Generating Station	154,000	3,500	157,500	2.50	2,000	4.81	3,800
Combustion Turbine #3	680,000	15,500	695,500	2.50	8,700	2.28	7,900
Transmission Plant	10,400,000	237,700	10,637,700	2.30	122,300	2.27	120,700
Distribution Plant	17,538,000	400,900	17,938,900	3.00	269,100	3.32	297,800
General Plant	1,214,000	27,700	1,241,700	6.73	41,800	5.96	37,000
	30,367,000	694,000	31,061,000		448,800		476,000
Contributions	(400,000)	-	(400,000)	2.90	(5,800)	2.95	(5,900)
	29,967,000	694,000	30,661,000		443,000		470,100
Estimated Revenue Requirement					195,000,000		195,000,000
Estimated Rate Impact 2016					0.23%		0.24%
Estimated Rate Impact - Full Year Depreciation					0.45%		0.48%