REPORT

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System Impact Assessment Report

Long Term Viability Project

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID 2010-416

Applicant: NOVA CHEMICALS (CANADA) LTD.

Market Facilitation Department

August 25 2010

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System Impact Assessment Report

This system impact assessment report is prepared for NOVA CHEMICALS (CANADA) LTD. for load enhancement at their Moore Site facility.

Acknowledgement

The IESO wishes to acknowledge the assistance of Hydro One in completing this assessment.

Disclaimers

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO should issue a notice of approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Approval of the proposed connection is based on information provided to the IESO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IESO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by the transmitter(s) at the request of the IESO. Furthermore, the connection approval is subject to further consideration due to changes to this information, or to additional information that may become available after the approval has been granted. Approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IESO-controlled grid. However, connection approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. This report has been prepared solely for use by the connection applicant and the IESO in accordance with Chapter 4, section 6 of the Market Rules. The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. In the event that the IESO provides a draft of this report to the connection applicant, you must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to you. Although the IESO will use its best efforts to advise you of any such changes, it is the responsibility of the connection applicant to ensure that it is using the most recent version of this report.

HYDRO ONE

Special Notes and Limitations of Study Results

The results reported in this study are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of a new generation or load connection proposal.

The thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed connection on facilities owned by other load and generation (including OPG) customers.

In this study, short circuit adequacy is assessed only for Hydro One breakers and does not include other Hydro One facilities. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One breakers and identifying upgrades required to incorporate the proposed connection. These results should not be used in the design and engineering of new facilities for the proposed connection. The necessary data will be provided by Hydro One and discussed with the connection proponent upon request.

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed connection have been identified to the extent permitted by a preliminary assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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LONG TERM VIABILITY PROJECT
IESO SYSTEM IMPACT ASSESSMENT

SIA Findings

NOVA CHEMICALS (CANADA) LTD. (Moore Site) (NOVA Chemicals) is a load facility directly connected to the IESO-controlled grid and is geographically located in southwest Ontario. It is connected to the 230 kV circuits L25V and L27V originating from Lambton TS. This load facility taps into the 230 kV circuits at a location approximately 9.3 km from Lambton TS. The length of the tap lines is approximately 0.3 km.

NOVA Chemicals has proposed to replace an 11,000 horsepower synchronous motor with a 24,800 horse power motor and add three 800 horsepower induction motors. Presently the peak load of this facility is 24 MW which will increase to 37.8 MW after the replacement of the synchronous motor and the addition of three induction motors.

The 24,800 horsepower synchronous motor will be connected to the 15 kV bus and the 800 horsepower induction motors will be connected to the 4.16 kV bus.

Summary

This assessment examined the impact to the IESO-controlled grid of the increase in load at NOVA CHEMICALS (CANADA) LTD. at their Moore site location.

The analysis concluded that:

1. There is no significant impact on the IESO-controlled grid due to load enhancement at NOVA CHEMICALS (CANADA) LTD.
2. Thermal analysis showed that under peak load conditions, for various single and double contingencies, thermal loading of the lines remained within the Long Term Emergency and Short Term Emergency ratings of the lines. Commissioning of the new load at NOVA CHEMICALS (CANADA) LTD. will have no negative impact on the system thermal performance.
3. Voltage analysis results indicate that commissioning of the new load will not impact the system voltages; in the event of a contingency, and pre-ULTC and post-ULTC voltage changes will be less than 10%.
4. The largest motor starting at NOVA Chemicals, with all elements in service and with one element out of service, does not have any negative impact on system voltages.

IESO's Requirements for Connection

1. NOVA CHEMICALS (CANADA) LTD. as a wholesale customer connected to the IESO-controlled grid shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined meter point.
2. With additional load in service, the peak load at NOVA CHEMICALS (CANADA) LTD. is expected to be more than 25 MW. This requires that as a wholesale customer NOVA CHEMICALS (CANADA) LTD. shall participate in under frequency load shedding and ensure that the under frequency load shedding (UFLS) targets specified by the IESO in Market Manual 7: System operations (Part 7.4 IESO Controlled Grid Operating Polices) in conjunction with Market Rules Chapter 5 (Section 10.4.6) are met.
3. As specified in Appendix 4.17 of the Market Rules, NOVA CHEMICALS (CANADA) LTD. is required to install all the equipment needed to provide telemetry data to the IESO on a continuous basis.
4. NOVA CHEMICALS (CANADA) LTD. must complete the IESO Facility Registration/Market Entry process in a timely manner before IESO final approval for connection is granted.

Notification of Conditional Approval

From the information provided, our review concludes that the proposed load enhancement at NOVA CHEMICALS (CANADA) LTD. will not result in a material adverse effect on the reliability of the IESO-controlled grid. It is recommended that a Notification of Conditional Approval be issued for the Long Term Viability Project (NOVA CHEMICALS (CANADA) LTD. load enhancement project), subject to the requirements listed in this report being implemented.

1. Project Description

NOVA Chemicals has proposed to replace an 11,000 horsepower synchronous motor for the compressor with a 24,800 horsepower (20,732 kVA) synchronous motor and to add three new induction motors of 800 horsepower each at their Moore site location.

The existing load at this facility is 24 MW. With the removal of the 11,000 horsepower synchronous motor, and the addition of a new 24,800 horsepower synchronous motor, three 800 horsepower induction motors and 0.5 MW miscellaneous load, the total load at the facility will be 36.8 MW.

The new 24,800 horsepower synchronous motor will be fed from the 13.8 kV bus. It will be started using the direct on line method. This synchronous motor will also used for providing the reactive power compensation to the load facility. The three 800 horsepower induction motors will be fed from the 4.16 kV bus.

The permanent in-service date for the new load is 31 August 2010.

– End of Section –

2. General Requirements

2.1. Power factor requirement

Appendix 4.3 Market Rules Chapter 4 requires that wholesale customers connected to IESO-controlled grid shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined meter point.

2.2. IESO Monitoring and Telemetry Data

In accordance with the telemetry requirements for connected wholesale customers (see Appendix 4.17 of the Market Rules) the applicant must install equipment at this project with specific performance standards (Appendix 4.22 of Market Rules) to provide telemetry data to the IESO. The data is to consist of certain equipment status and operating quantities which will be identified during the IESO Market Entry Process.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must also complete end to end testing of all necessary telemetry points with the IESO to ensure that standards are met and that sign conventions are understood. All found anomalies must be corrected before IESO final approval to connect any phase of the project is granted.

2.3. Facility Registration/Market Entry Requirements

The connection applicant must complete the IESO Facility Registration/Market Entry process in a timely manner before IESO final approval for connection is granted. Models and data, including any controls that would be operational, must be provided to the IESO. This information should be submitted at least seven months before energization to the IESO-controlled grid, to allow the IESO to incorporate this project into IESO work systems and to perform any additional reliability studies.

As part of the IESO Facility Registration/Market Entry process, the applicant must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this project's participation in the IESO-administered markets or connection to the IESO-controlled grid.

The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the project will need to be done by the IESO.

– End of Section –

3. Review of Connection Proposal

3.1. Proposed Connection Arrangement

NOVA Chemicals has proposed to replace an 11,000 horsepower synchronous motor for the compressor with a 24,800 horsepower synchronous motor and to add three new induction motors of 800 horsepower each at their Moore site location.

The load facility taps into the 230kV circuits L25V and L27V originating from Lambton TS at a location approximately 9.3 km from Lambton TS. The length of the tap lines is approximately 0.3km.

The switchyard at NOVA Chemicals consists of two 230/13.27- 13.8 kV, 25/33.3/41.6/46.7 MVA (ONAN/ONAF/ONAF/ONAF) power transformers connected to the 230 kV circuits through motorized disconnect switches. These step-down transformers have on load tap changers on the medium voltage side.

The new 24,800 horsepower synchronous motor will be fed from the 13.8 kV bus. It will be started using the direct on line method. This synchronous motor will also used for providing the reactive power compensation to the load facility. The three 800 horsepower induction motors will be fed from the 4.16 kV bus.

Figure 1 shows the simplified diagram for the load facility.

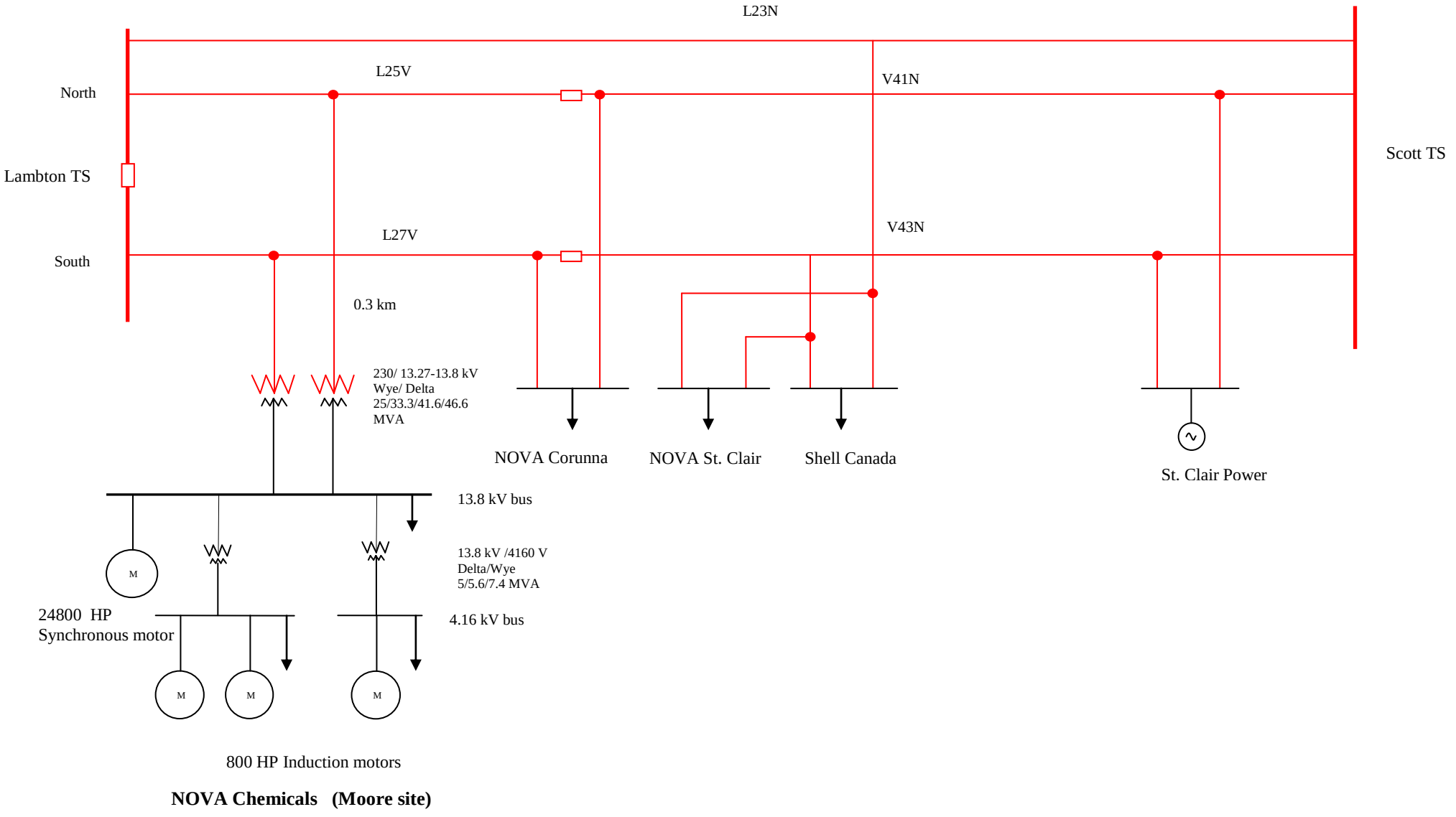

Figure 1: Simplified diagram for the load facility

3.2. Existing System

Nova Chemicals is located in south west Ontario and is connected to the 230 kV L25V and L27V circuits. L25V and L27V originate from the 230 kV Lambton TS bus. These circuits connect to the 230 kV Scott TS through inline breakers located at Nova SS. From Nova SS to 230 kV Scott TS 230 kV these circuits are designated as V41N and V43N, respectively. Three other loads, namely NOVA Corunna, NOVA St. Clair and Shell Canada are also connected to the 230 kV Lambton - Scott circuits.

Presently Lambton GS has four 510 MW coal fired generators. Greenfield CGS with a connected capacity of 1,153 MW, also feeds power into the 230 kV Lambton TS bus. In addition, the intertie circuits L51D and L4D, equipped with phase angle regulators, also feed into the 230 kV Lambton TS bus.

On the Lambton-Scott corridor, St. Clair Power GS is connected to the 230 kV circuits V41N and V43N with a plant capacity of 616 MW.

Due to high short circuit levels in the area, the 230 kV buses at Lambton, Greenfield and St. Clair are operated split, unless conditions for closing the bus tie breakers are met.

The Lambton units 1 and 2 are planned for deregistration beginning the fall of 2010. For this reason the units are assumed to be out of service for the purpose of this study.

– End of Section –

4. Load Data Verification

4.1. Synchronous motor data

Specifications of the new synchronous motor proposed to be installed are given in the table below.

Synchronous motor data	
Horsepower	24800
Rated KVA	20732
Rated Voltage	13.8 kV
Power factor	0.92 lead
Amperes	867 A
Stator resistance	0.062 Ohm
Field resistance	0.79 Ohm
Direct axis synchronous reactance(Xd)	1.2
Direct axis transient reactance(Xd')	0.34
Direct axis sub-transient reactance(Xd")	0.24

Table 1: Synchronous motor data

4.2. Induction motor data

Specifications of the three new induction motors proposed to be installed are as given in the table below.

Induction motor data	
Horsepower	800
Rated KVA	550
Rated Voltage	4.16 kV
Power factor (at full load)	0.902 lag
Amperes (full load)	100.8 A

Table 2: Induction motor data

– End of Section –

5. System Impact Studies

This connection assessment was carried out to identify the effect of the proposed facility on thermal loading of transmission circuits and on the voltage levels on the buses in the vicinity of the load facility, as well as the impact on the system voltages of starting the largest motor in the plant, with the rest of the load already in service.

5.1. Assumptions and Background

This connection assessment has been completed assuming:

- peak load conditions in Ontario. With all elements in service, for simulating peak load conditions in Ontario, load in the base case was scaled to 25556 MW corresponding to summer 2011 load forecast.
- maximum possible generation injecting into the Lambton TS 230 kV bus, in order to stress the base case, without violating the Short Term Emergency ratings of the circuits (in post-contingency). Table 3 below shows the status of generators in the area as simulated in the base case.
- the Lambton, Greenfield and St. Clair 230 kV buses are operated split, due to short circuit concerns.

No. of machines in service											
Lambton GS				Greenfield GS				St. Clair GS			
G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4
Out of service		In service		In service				In service			Out of service

Table 3: Status of generators

System conditions

The phase angle regulators on the 230 kV intertie circuits L51D and L4D were set to control the active power flow close to 0 MW.

Table 4 shows the flows on the interfaces in the Lambton – Scott – Longwood area.

Interface	London Lambton Interface	Sarnia London Interface	London Import Interface
MW	2059	1598	1430

Table 4: Flows on interfaces – Peak load conditions

The loads on the Lambton-Scott circuits were simulated to have a power factor of 0.9 lagging. Voltages were simulated to match with historical voltages in the area.

Table 5 shows the general historical voltage levels on the major buses near the project site.

Bus	Voltage
230 kV Lambton TS	244
230 kV Scott TS	241
230 kV Chatham TS	244
230 kV Longwood TS	246
500 kV Longwood TS	543

Table 5: Voltages in Lambton-Scott Area

5.2. Reactive Power Compensation

Market Rules requires that a wholesale customer shall maintain a power factor with in 0.9 lagging to 0.9 leading at defined metering point. NOVA Chemicals has confirmed that the new synchronous motor will be used for compensating the reactive power at the load facility.

Preliminary calculations show that reactive power capability of the new synchronous motor will be sufficient for providing compensation to maintain the power factor within 0.9 lagging and 0.9 leading at defined metering point. NOVA Chemical shall ensure that power factor remains within the prescribed range when new synchronous motor is not in service.

5.3. Thermal Analysis

The *Ontario Resource and Transmission Assessment Criteria* requires that all line and equipment loads be within their continuous ratings with all elements in service, and within their long-term emergency ratings with any element out of service. Lines and equipment may be loaded up to their short-term emergency ratings immediately following the contingencies provided re-dispatch, switching actions, or other control actions are available and are sufficient to reduce the loading on the equipment to their long-term emergency ratings.

The thermal analysis study examined the effect the proposed load enhancement at NOVA Chemicals (Moore site) would have on the thermal loadings of the 230 kV transmission circuits connecting the Lambton and Scott 230 kV buses. Simulation results shows that the 230 kV circuits L25V and L27V, to which NOVA Chemicals load is tapped, carried more load for recognized single and double contingencies. However, the loading on the circuits remained within the Long Term Emergency ratings of the conductors for single contingencies and within their Short Term Emergency ratings for recognized double contingencies.

Conductor ratings were calculated under summer conditions using ambient temperature of 35° C and wind speed of 4 km per hour.

Continuous ampacity ratings were calculated at lowest of the sag temperature or 93° C operating temperature. The Long Term Emergency ratings were calculated at lowest of the sag temperature or 127° C operating temperature. Short Term Emergency ratings were calculated at the sag temperature with a pre - load equal to the continuous rating of the conductor.

The ratings, maximum operating temperature and lengths of the circuits are summarized in the following table.

Circuit	From Bus	To Bus	L (km)	Ratings		
				Continuous	LTE	STE
				A	A	A
L23N	Lambton	Scott	20	1350	1800	2170
L25V	Lambton	Nova SS	11.8	1350	1800	2170
V41N	Nova SS	Scott	8.8	1350	1800	2170
L27V	Lambton	Nova SS	11.8	1350	1800	2170
V43N	Nova SS	Scott	8.8	1350	1800	2170
L24L	Lambton	Longwood	76	1060	1400	1620
L26L	Lambton	Longwood	76	1060	1330	1510
L28C	Lambton	Chatham	59	1060	1330	1510
L29C	Lambton	Chatham	59	1060	1400	1620

Table 6: Thermal ratings and lengths of circuits

Single Contingencies

Three single contingencies, loss of L23N, loss of L25V and loss L27V, were simulated to determine the impact of the proposed load increase on the loading of remaining lines in the event of loss of one circuit. Results of these contingencies are shown in Table 7. Loadings shown in the table are the highest loadings on any section of the circuit. Complete results are provided in Appendix A at the end of this report.

Simulations of single contingencies show that, with the loss of any circuit the loadings on the remaining circuits would be within the Long Term Emergency ratings of those circuits, hence there is no significant impact on the loading of lines with the proposed additional load in service.

Double Contingencies

With the loss of two lines (sharing common towers) simultaneously, loading on the remaining lines should remain within the Short Term Emergency ratings of the circuits. Following are the recognized double contingencies in the Lambton area.

1. Simultaneous loss of 230 kV circuits L23N and L25V
2. Simultaneous loss of 230 kV circuits L24L and L26L
3. Simultaneous loss of 230 kV circuits L25V and L28C
4. Simultaneous loss of 230 kV circuits L28C and L29C
5. Loss of 230 kV circuit L29C and L25L29 breaker failure at Lambton bus (trips L25V also)

All double contingencies, except loss of 230 kV circuits L23N+L25V, require arming of the Lambton G/R to prevent thermal overloading post contingency.

Simulations of these double contingencies, with appropriate amounts of generation rejection, show that the post-contingency loadings remain below the STE ratings of the remaining circuits.

Table 8 shows the summary of results for double contingencies.

Single contingencies																	
Circuit	From	To	Conductor Rating		Pre contingency			Loss of L23N			Loss of L25V			Loss of L27V			
						% loading		Amps	% loading		Amps	% loading		Amps	% loading		
			Cont	LTE	Amps	Cont	LTE		Cont	LTE		Cont	LTE		Cont	LTE	
L23N	Lambton	Scott	1350	1800	333.53	24.71%	18.53%	0	0.00%	0.00%	497.7	36.87%	27.65%	654.87	48.51%	36.38%	
L25V	Lambton	Nova SS	1350	1800	239.31	17.73%	13.30%	476.44	35.29%	26.47%	0	0.00%	0.00%	593.06	43.93%	32.95%	
V41N	Nova SS	Scott	1350	1800	892.24	66.09%	49.57%	1131.48	83.81%	62.86%	711.37	52.69%	39.52%	1175.17	87.05%	65.29%	
L27V	Lambton	Nova SS	1350	1800	1191.53	88.26%	66.20%	1241.64	91.97%	68.98%	1230.32	91.13%	68.35%	0	0.00%	0.00%	
V43N	Nova SS	Scott	1350	1800	1346.01	99.70%	74.78%	1361.28	100.84%	75.63%	1350.14	100.01%	75.01%	290.97	21.55%	16.17%	
L24L	Lambton	Longwood	1060	1400	549.49	51.84%	39.25%	584.62	55.15%	41.76%	572.98	54.05%	40.93%	295.51	27.88%	21.11%	
L26L	Lambton	Longwood	1060	1330	761.09	71.80%	57.22%	744.96	70.28%	56.01%	749.11	70.67%	56.32%	1273.99	120.19%	95.79%	
L28C	Lambton	Chatham	1060	1330	691.53	65.24%	51.99%	666.14	62.84%	50.09%	673.28	63.52%	50.62%	1302.66	122.89%	97.94%	
L29C	Lambton	Chatham	1060	1400	418.51	39.48%	29.89%	332.17	31.34%	23.73%	444.39	41.92%	31.74%	153.4	14.47%	10.96%	

Table 7: Thermal loading for Single contingencies

Double contingencies																		
Circuit	**L23N + L25V**			**L24L+L26L**			**L24L+L29C**			**L25V +L28C**			**L28C+L29C**			**L29C + Breaker failure**		
	Amps	**Cont**	**STE**	**Amps**	**Cont**	**STE**	**Amps**	**Cont**	**STE**	**Amps**	**Cont**	**STE**	**Amps**	**Cont**	**STE**	**Amps**	**Cont**	**STE**
		% loading			**% loading**			**% loading**			**% loading**			**% loading**			**% loading**	
L23N	0	0.00%	0.00%	482.83	35.77%	22.25%	795.43	58.92%	36.66%	579.09	42.90%	26.69%	485.25	35.94%	22.36%	768.54	56.93%	35.42%
L25V	0	0.00%	0.00%	380.94	28.22%	17.55%	695.7	51.53%	32.06%	519.99	38.52%	23.96%	384.57	28.49%	17.72%	0	0.00%	0.00%
V41N	718.7	53.24%	33.12%	1051.39	77.88%	48.45%	1351.45	100.11%	62.28%	1095.68	81.16%	50.49%	1047.49	77.59%	48.27%	711.87	52.73%	32.81%
L27V	1491.94	110.51%	68.75%	1220.97	90.44%	56.27%	578.46	42.85%	26.66%	0	0.00%	0.00%	924.07	68.45%	42.58%	1074.26	79.57%	49.51%
V43N	1570.94	116.37%	72.39%	1389.85	102.95%	64.05%	755.4	55.96%	34.81%	286.55	21.23%	13.21%	1097.57	81.30%	50.58%	1199.46	88.85%	55.27%
L24L	780.74	73.65%	48.19%	0	0.00%	0.00%	0	0.00%	0.00%	192.63	18.17%	11.89%	635.69	59.97%	39.24%	721.19	68.04%	44.52%
L26L	653.71	61.67%	43.29%	0	0.00%	0.00%	799.2	75.40%	52.93%	1120.73	105.73%	74.22%	735.83	69.42%	48.73%	775.21	73.13%	51.34%
L28C	522.84	49.32%	34.63%	902.83	85.17%	59.79%	831.82	78.47%	55.09%	0	0.00%	0.00%	0	0.00%	0.00%	824.52	77.78%	54.60%
L29C	685.92	64.71%	42.34%	660.16	62.28%	40.75%	0	0.00%	0.00%	293.76	27.71%	18.13%	0	0.00%	0.00%	0	0.00%	0.00%

Table 8: Thermal loading for Double contingencies

5.4. Voltage Analysis

The assessment of voltage performance in the Lambton area was done in accordance with the IESO's *Ontario Resource and Transmission Assessment Criteria.* The criteria states that with all facilities in service pre-contingency, 115 kV and 230 kV system voltage declines following a contingency shall be limited to 10% both before and after transformer tap changer action.

The voltage decline studies were performed with the enhanced load at NOVA Chemicals load facility connected to the 230 kV circuits L25V and L27V. The study was done for peak load conditions and a constant MVA load model was used in pre-contingency and post-contingency.

The study results summarized in the Tables 9 to 11 indicate that changes in both, pre-ULTC and post-ULTC voltages, are within the IESO's criteria of 10%. All double contingencies, except simultaneous loss of L23N+L25V, were simulated with generation rejection at Lambton GS and Greenfield GS in various combinations.

Single Contingencies														
Monitored Bus	Base kV	Pre cont	L23N contingency				L25V contingency				L27V contingency			
			Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
			kV	% change	kV	% change	L25V	% change	kV	% change	kV	% change	kV	% change
LAMBTON_P1K1220.00	220	243.14	243.85	0.29%	243.84	0.29%	243.93	0.32%	243.92	0.32%	242.25	-0.37%	242.36	-0.32%
LAMBTON_P2K2220.00	220	243.6	243.35	-0.10%	243.35	-0.10%	243.37	-0.09%	243.37	-0.09%	243.55	-0.02%	244.13	0.22%
N_MOORE_L25V220.00	220	241.59	241.54	-0.02%	241.54	-0.02%	-	-	-	-	240.31	-0.53%	240.33	-0.52%
N_MOORE_L27V220.00	220	241.59	240.95	-0.26%	240.94	-0.27%	240.98	-0.25%	240.97	-0.26%	-	-	-	-
N_CORUNN_L27220.00	220	241.13	240.38	-0.31%	240.37	-0.32%	240.49	-0.27%	240.48	-0.27%	-	-	-	-
N_CORUNN_V41220.00	220	241.19	240.94	-0.10%	240.94	-0.10%	239.25	-0.80%	239.24	-0.81%	239.88	-0.54%	239.89	-0.54%
SHELL_SARL23220.00	220	240.67	-	-	-	-	240.34	-0.14%	240.33	-0.14%	239.47	-0.50%	239.44	-0.51%
SHELL_SARV43220.00	220	240.69	239.8	-0.37%	239.79	-0.37%	240.04	-0.27%	240.03	-0.27%	238.74	-0.81%	238.66	-0.84%
DUP_ST_CLR23220.00	220	240.68	-	-	-	-	240.35	-0.14%	240.35	-0.14%	239.49	-0.49%	239.46	-0.51%
DUP_ST_CLR43220.00	220	240.71	239.83	-0.37%	239.82	-0.37%	240.05	-0.27%	240.04	-0.28%	238.76	-0.81%	238.68	-0.84%
ST_CLR_ECV41220.00	220	240.5	239.84	-0.27%	239.83	-0.28%	239.35	-0.48%	239.34	-0.48%	239.31	-0.49%	239.26	-0.52%
ST_CLR_ECJ43220.00	220	240.43	239.53	-0.37%	239.53	-0.37%	239.75	-0.28%	239.73	-0.29%	238.83	-0.67%	238.75	-0.70%
SCOTT_TS 220.00	220	239.84	238.86	-0.41%	238.85	-0.41%	239.08	-0.32%	239.07	-0.32%	238.6	-0.52%	238.52	-0.55%
SCOTT_TS_KP 118.05	118.05	120.7	120.17	-0.44%	120.17	-0.44%	120.29	-0.34%	120.29	-0.34%	120.03	-0.56%	120	-0.58%

Table 9: Voltage analysis results for Single contingencies

Double Contingencies														
Monitored Bus	**Base kV**	**Pre cont**	**L23N+L25V contingency**				**L24L+L26L contingency**				**L24L+L29C contingency**			
			Pre ULTC		**Post ULTC**		**Pre ULTC**		**Post ULTC**		**Pre ULTC**		**Post ULTC**	
			kV	**% change**	**kV**	**% change**	**kV**	**% change**	**kV**	**% change**	**kV**	**% change**	**kV**	**% change**
LAMBTON_P1K1220.00	220	243.14	245.78	1.09%	245.9	1.14%	242.28	-0.35%	242.42	-0.30%	242.08	-0.44%	242.16	-0.40%
LAMBTON_P2K2220.00	220	243.6	242.83	-0.32%	242.79	-0.33%	242.22	-0.57%	242.35	-0.51%	242.67	-0.38%	242.76	-0.34%
N_MOORE_L25V220.00	220	241.59	-	-	222.09	-8.07%	240.62	-0.40%	240.8	-0.33%	240.55	-0.43%	240.7	-0.37%
N_MOORE_L27V220.00	220	241.59	239.52	-0.86%	239.46	-0.88%	240.33	-0.52%	240.5	-0.45%	240.84	-0.31%	240.93	-0.27%
N_CORUNN_L27220.00	220	241.13	238.8	-0.97%	238.73	-1.00%	239.9	-0.51%	240.08	-0.44%	240.38	-0.31%	240.48	-0.27%
N_CORUNN_V41220.00	220	241.19	237.14	-1.68%	237.04	-1.72%	240.2	-0.41%	240.39	-0.33%	240.18	-0.42%	240.35	-0.35%
SHELL_SARL23220.00	220	240.67	-	-	-	-	239.58	-0.45%	239.79	-0.37%	239.63	-0.43%	239.82	-0.35%
SHELL_SARV43220.00	220	240.69	238.08	-1.08%	238	-1.12%	239.51	-0.49%	239.7	-0.41%	239.92	-0.32%	240.05	-0.27%
DUP_ST_CLR23220.00	220	240.68	-	-	-	-	239.6	-0.45%	239.8	-0.37%	239.64	-0.43%	239.83	-0.35%
DUP_ST_CLR43220.00	220	240.71	238.11	-1.08%	238.03	-1.11%	239.52	-0.49%	239.71	-0.42%	239.94	-0.32%	240.06	-0.27%
ST_CLR_ECV41220.00	220	240.5	237.25	-1.35%	237.16	-1.39%	239.47	-0.43%	239.67	-0.35%	239.57	-0.39%	239.75	-0.31%
ST_CLR_ECJ43220.00	220	240.43	237.69	-1.14%	237.61	-1.17%	239.28	-0.48%	239.49	-0.39%	239.62	-0.34%	239.77	-0.27%
SCOTT_TS 220.00	220	239.84	236.78	-1.28%	236.68	-1.32%	238.69	-0.48%	238.92	-0.38%	238.9	-0.39%	239.1	-0.31%
SCOTT_TS_KP 118.05	118.05	120.7	119.06	-1.36%	119.03	-1.38%	120.08	-0.51%	120.21	-0.41%	120.19	-0.42%	120.3	-0.33%

Table 10: Voltage analysis results for Double contingencies

Double Contingencies														
Monitored Bus	Base kV	Pre cont	L27V+L28C contingency				L28C+L29C contingency				L29C+ Breaker failure			
			Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
			kV	% change	kV	% change	L25V	% change	kV	% change	kV	% change	kV	% change
LAMBTON_P1K1220.00	220	243.14	243.27	0.05%	243.2	0.02%	242.74	-0.16%	242.74	-0.16%	243.29	0.06%	243.34	0.08%
LAMBTON_P2K2220.00	220	243.6	243.5	-0.04%	244.07	0.19%	242.58	-0.42%	242.58	-0.42%	243.21	-0.16%	243.23	-0.15%
N_MOORE_L25V220.00	220	241.59	241.36	-0.10%	241.23	-0.15%	241.24	-0.14%	241.26	-0.14%	-	-	-	-
N_MOORE_L27V220.00	220	241.59	-	-	-	-	241	-0.24%	240.99	-0.25%	240.78	-0.34%	240.79	-0.33%
N_CORUNN_L27220.00	220	241.13	-	-	-	-	240.64	-0.20%	240.62	-0.21%	240.26	-0.36%	240.28	-0.35%
N_CORUNN_V41220.00	220	241.19	240.94	-0.10%	240.79	-0.17%	240.87	-0.13%	240.88	-0.13%	238.88	-0.96%	238.95	-0.93%
SHELL_SARL23220.00	220	240.67	240.59	-0.03%	240.42	-0.10%	240.35	-0.13%	240.37	-0.12%	239.83	-0.35%	239.91	-0.32%
SHELL_SARV43220.00	220	240.69	239.84	-0.35%	239.64	-0.44%	240.3	-0.16%	240.29	-0.17%	239.76	-0.39%	239.8	-0.37%
DUP_ST_CLR23220.00	220	240.68	240.6	-0.03%	240.43	-0.10%	240.37	-0.13%	240.38	-0.12%	239.84	-0.35%	239.93	-0.31%
DUP_ST_CLR43220.00	220	240.71	239.85	-0.36%	239.65	-0.44%	240.31	-0.17%	240.31	-0.17%	239.78	-0.39%	239.81	-0.37%
ST_CLR_ECV41220.00	220	240.5	240.35	-0.06%	240.18	-0.13%	240.23	-0.11%	240.25	-0.10%	238.99	-0.63%	239.05	-0.60%
ST_CLR_ECJ43220.00	220	240.43	239.92	-0.21%	239.72	-0.30%	240.11	-0.13%	240.11	-0.13%	239.43	-0.42%	239.47	-0.40%
SCOTT_TS 220.00	220	239.84	239.74	-0.04%	239.53	-0.13%	239.59	-0.10%	239.6	-0.10%	238.68	-0.48%	238.75	-0.45%
SCOTT_TS_KP 118.05	118.05	120.7	120.65	-0.04%	120.53	-0.14%	120.56	-0.12%	120.57	-0.11%	120.08	-0.51%	120.11	-0.49%

Table 11: Voltage analysis results for Double contingencies

5.5. Motor switching analysis

Motor switching analysis was done to verify the impact of starting the largest motor at NOVA Chemicals when the rest of the load at this facility is already running. The largest motor on the facility is the new synchronous motor. The applicant has confirmed that this motor will be started using direct online method and the initial start will be as an induction motor.

The rest of the load in the load facility was simulated to operate at 0.9 lag power factor prior to starting the motor. For performing the switching study, the equivalent admittance corresponding to the starting current of motor was calculated and simulated as a load.

The switching study was assuming two scenarios. One with Lambton units (G3 and G4), Greenfield GS and St. Clair GS (three units) in service and Lambton bus split. Second, with Lambton GS, Greenfield GS and St. Clair GS out of service and Lambton bus closed.

The following sub scenarios were studied:

i) All elements in service
ii) One element out of service.

The results summarized in Tables 12 and 13 show that there is no significant impact on the system voltages in the surroundings of the load facility due to motor switching.

– End of Section –

Lambton GS (unit 3and 4), Greenfield GS and St. Clair GS (3 units) in service and 230 kV Lambton bus split

Motor Switching										
Bus	Base Voltage	With all elements in service			L25V out of service before switching			L27V out of service before switching		
		Voltage		% change	Voltage		% change	Voltage		% change
		before starting the motor	after starting the motor		before starting the motor	after starting the motor		before starting the motor	after starting the motor	
LAMBTON_P1K1220.00	220	242.78	241.85	-0.38%	243.34	242.85	-0.20%	240.81	239.66	-0.48%
LAMBTON_P2K2220.00	220	247.61	246.83	-0.32%	247.44	246.54	-0.36%	251.07	250.89	-0.07%
N_MOORE_L25V220.00	220	241.91	240.54	-0.57%	-	-	-	239.2	237.35	-0.77%
N_MOORE_L27V220.00	220	244.41	243.1	-0.54%	244.06	242.46	-0.66%	-	-	-
N_CORUNN_L27220.00	220	243.56	242.34	-0.50%	243.18	241.79	-0.57%	-	-	-
N_CORUNN_V41220.00	220	241.66	240.4	-0.52%	240.42	239.55	-0.36%	238.77	237.12	-0.69%
SHELL_SARL23220.00	220	241.31	240.3	-0.42%	241.13	240.34	-0.33%	238.33	237.16	-0.49%
SHELL_SARV43220.00	220	242.71	241.56	-0.47%	242.31	241.09	-0.50%	237.8	236.66	-0.48%
DUP_ST_CLR23220.00	220	241.32	240.32	-0.41%	241.14	240.36	-0.32%	238.35	237.17	-0.50%
DUP_ST_CLR43220.00	220	242.73	241.58	-0.47%	242.32	241.1	-0.50%	237.82	236.67	-0.48%
ST_CLR_ECV41220.00	220	241.26	240.16	-0.46%	240.5	239.64	-0.36%	238.16	236.83	-0.56%
ST_CLR_ECJ43220.00	220	242.08	240.99	-0.45%	241.65	240.58	-0.44%	237.89	236.75	-0.48%
SCOTT_TS 220.00	220	240.86	239.82	-0.43%	240.38	239.48	-0.37%	237.54	236.36	-0.50%
SCOTT_TS_KP 118.05	118.05	121.24	120.72	-0.43%	121	120.55	-0.37%	119.56	118.97	-0.49%

Table 12: Motor switching analysis – scenario 1 results

Lambton GS, Greenfield GS and St. Clair GS out of service and 230 kV Lambton bus closed

Motor Switching										
		All elements in service			L25V out of service			L27V out of service		
		Voltages			Voltages			Voltages		
Bus	Base Voltage	before staring the motor	after starting the motor	% change	before staring the motor	after starting the motor	% change	before staring the motor	after starting the motor	% change
LAMBTON_P1K1220.00	220	236.1	234.71	-0.59%	236.15	235.04	-0.47%	236.15	235.06	-0.46%
LAMBTON_P2K2220.00	220	236.1	234.71	-0.59%	236.15	235.04	-0.47%	236.15	235.06	-0.46%
N_MOORE_L25V220.00	220	235.02	233.12	-0.81%	0	0	-	234.43	232.55	-0.80%
N_MOORE_L27V220.00	220	234.94	233.03	-0.81%	234.44	232.52	-0.82%	0	0	-
N_CORUNN_L27220.00	220	234.67	232.85	-0.78%	234.09	232.34	-0.75%	0	0	-
N_CORUNN_V41220.00	220	234.77	232.96	-0.77%	233.15	231.8	-0.58%	234.06	232.34	-0.73%
SHELL_SARL23220.00	220	234.53	232.99	-0.66%	233.94	232.66	-0.55%	233.9	232.64	-0.54%
SHELL_SARV43220.00	220	234.42	232.67	-0.75%	233.76	232.14	-0.69%	233.06	231.74	-0.57%
DUP_ST_CLR23220.00	220	234.55	233.01	-0.66%	233.96	232.67	-0.55%	233.92	232.66	-0.54%
DUP_ST_CLR43220.00	220	234.43	232.69	-0.74%	233.77	232.15	-0.69%	233.07	231.75	-0.57%
ST_CLR_ECV41220.00	220	234.37	232.69	-0.72%	233.23	231.88	-0.58%	233.57	232.09	-0.63%
ST_CLR_ECJ43220.00	220	234.3	232.62	-0.72%	233.57	232.06	-0.65%	233.15	231.82	-0.57%
SCOTT_TS 220.00	220	234.1	232.51	-0.68%	233.27	231.92	-0.58%	233.23	231.91	-0.57%
SCOTT_TS_KP 118.05	118.05	117.68	116.87	-0.69%	117.26	116.58	-0.58%	117.24	116.57	-0.57%

Table 13: Motor switching analysis – scenario 2 results

6. Fault Levels

With the installation of new synchronous and induction motors the fault levels in the area are expected to remain within the short circuit current interrupting capability of high voltage breakers on the surrounding transmission system. Hence no short circuit study has been conducted.

However, the applicant is advised to perform a short circuit study to ascertain that the fault current interrupting capability of the equipment within the plant is sufficient to interrupt the fault currents.

– End of Section –

Appendix A Thermal Analysis Results

All elements in service

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	333.53	24.71%	18.53%	15.37%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	293.36	21.73%	16.30%	13.52%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	239.31	17.73%	13.30%	11.03%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	203.46	15.07%	11.30%	9.38%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	204.05	15.11%	11.34%	9.40%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	179.44	13.29%	9.97%	8.27%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	892.24	66.09%	49.57%	41.12%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1191.53	88.26%	66.20%	54.91%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	1132.37	83.88%	62.91%	52.18%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	1097.56	81.30%	60.98%	50.58%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	1020.3	75.58%	56.68%	47.02%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1346.01	99.70%	74.78%	62.03%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	549.49	51.84%	39.25%	33.92%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	504.54	47.60%	36.04%	31.14%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	761.09	71.80%	57.22%	50.40%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	717.9	67.73%	51.28%	44.31%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	691.53	65.24%	51.99%	45.80%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	488.27	46.06%	36.71%	32.34%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	418.51	39.48%	29.89%	25.83%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	295.69	27.90%	21.12%	18.25%

L23N contingency

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	476.44	35.29%	26.47%	21.96%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	437.8	32.43%	24.32%	20.18%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	438.21	32.46%	24.35%	20.19%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	412.37	30.55%	22.91%	19.00%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1131.48	83.81%	62.86%	52.14%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1241.64	91.97%	68.98%	57.22%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	1185.3	87.80%	65.85%	54.62%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	1152.04	85.34%	64.00%	53.09%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	1032.15	76.46%	57.34%	47.56%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1361.28	100.84%	75.63%	62.73%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	584.62	55.15%	41.76%	36.09%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	539.93	50.94%	38.57%	33.33%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	744.96	70.28%	56.01%	49.34%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	701.64	66.19%	50.12%	43.31%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	666.14	62.84%	50.09%	44.12%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	464.58	43.83%	34.93%	30.77%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	457.86	43.19%	32.70%	28.26%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	332.17	31.34%	23.73%	20.50%

L25V contingency

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	497.7	36.87%	27.65%	22.94%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	454.31	33.65%	25.24%	20.94%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	23.19	1.72%	1.29%	1.07%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	711.37	52.69%	39.52%	32.78%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1230.32	91.13%	68.35%	56.70%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	1132.44	83.88%	62.91%	52.19%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	1096.06	81.19%	60.89%	50.51%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	1021.87	75.69%	56.77%	47.09%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1350.14	100.01%	75.01%	62.22%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	572.98	54.05%	40.93%	35.37%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	528.25	49.83%	37.73%	32.61%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	749.11	70.67%	56.32%	49.61%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	705.81	66.59%	50.42%	43.57%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	673.28	63.52%	50.62%	44.59%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	471.59	44.49%	35.46%	31.23%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	444.39	41.92%	31.74%	27.43%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	319.08	30.10%	22.79%	19.70%

L27V contingency

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	654.87	48.51%	36.38%	30.18%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	588.62	43.60%	32.70%	27.13%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	593.06	43.93%	32.95%	27.33%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	494.2	36.61%	27.46%	22.77%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	494.46	36.63%	27.47%	22.79%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	436.06	32.30%	24.23%	20.09%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1175.17	87.05%	65.29%	54.16%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	53.89	3.99%	2.99%	2.48%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	290.97	21.55%	16.17%	13.41%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	295.51	27.88%	21.11%	18.24%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	249.05	23.50%	17.79%	15.37%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	1273.99	120.19%	95.79%	84.37%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	1232.74	116.30%	88.05%	76.10%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	1302.66	122.89%	97.94%	86.27%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	1087.23	102.57%	81.75%	72.00%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	100.47	9.48%	7.18%	6.20%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	153.4	14.47%	10.96%	9.47%

Double contingency- L23N + L25V without GR

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	21.61	1.60%	1.20%	1.00%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	718.7	53.24%	39.93%	33.12%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1491.94	110.51%	82.89%	68.75%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	1394.03	103.26%	77.45%	64.24%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	1355.76	100.43%	75.32%	62.48%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	1236.44	91.59%	68.69%	56.98%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1570.94	116.37%	87.27%	72.39%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	780.74	73.65%	55.77%	48.19%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	737.17	69.54%	52.66%	45.50%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	653.71	61.67%	49.15%	43.29%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	610.03	57.55%	43.57%	37.66%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	522.84	49.32%	39.31%	34.63%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	327.29	30.88%	24.61%	21.67%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	685.92	64.71%	48.99%	42.34%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	552.75	52.15%	39.48%	34.12%

L24L+L26L+GR at Lambton for unit running at 225 MW

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	482.83	35.77%	26.82%	22.25%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	440.93	32.66%	24.50%	20.32%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	380.94	28.22%	21.16%	17.55%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	343.56	25.45%	19.09%	15.83%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	343.89	25.47%	19.11%	15.85%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	319.11	23.64%	17.73%	14.71%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1051.39	77.88%	58.41%	48.45%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1220.97	90.44%	67.83%	56.27%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	1163.58	86.19%	64.64%	53.62%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	1129.79	83.69%	62.77%	52.06%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	1055.35	78.17%	58.63%	48.63%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1389.85	102.95%	77.21%	64.05%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	0	0.00%	0.00%	0.00%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	902.83	85.17%	67.88%	59.79%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	702.28	66.25%	52.80%	46.51%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	660.16	62.28%	47.15%	40.75%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	533.4	50.32%	38.10%	32.93%

L24L+L29C+GR at Lambton for unit running at 225 MW

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	795.43	58.92%	44.19%	36.66%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	736.75	54.57%	40.93%	33.95%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	695.7	51.53%	38.65%	32.06%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	646.59	47.90%	35.92%	29.80%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	646.64	47.90%	35.92%	29.80%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	616.18	45.64%	34.23%	28.40%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1351.45	100.11%	75.08%	62.28%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	578.46	42.85%	32.14%	26.66%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	532.58	39.45%	29.59%	24.54%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	504.63	37.38%	28.04%	23.25%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	443.62	32.86%	24.65%	20.44%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	755.4	55.96%	41.97%	34.81%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	799.2	75.40%	60.09%	52.93%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	719.01	67.83%	51.36%	44.38%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	831.82	78.47%	62.54%	55.09%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	533.28	50.31%	40.10%	35.32%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%

L25V +L28C+GR at Lambton for unit running at 225 MW and Greenfield units (G2+G3)

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	579.09	42.90%	32.17%	26.69%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	514.11	38.08%	28.56%	23.69%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	519.99	38.52%	28.89%	23.96%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	420.43	31.14%	23.36%	19.37%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	420.73	31.17%	23.37%	19.39%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	361.02	26.74%	20.06%	16.64%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1095.68	81.16%	60.87%	50.49%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	54.88	4.07%	3.05%	2.53%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	286.55	21.23%	15.92%	13.21%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	192.63	18.17%	13.76%	11.89%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	146.86	13.85%	10.49%	9.07%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	1120.73	105.73%	84.27%	74.22%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	1078.99	101.79%	77.07%	66.60%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	0	0.00%	0.00%	0.00%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	0	0.00%	0.00%	0.00%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	293.76	27.71%	20.98%	18.13%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	288.76	27.24%	20.63%	17.82%

L28C+L29C+GR at Lambton unit running at 225 MW and Greenfield unit G3

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	485.25	35.94%	26.96%	22.36%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	438.68	32.49%	24.37%	20.22%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	384.57	28.49%	21.37%	17.72%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	343.82	25.47%	19.10%	15.84%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	344.06	25.49%	19.11%	15.86%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	317.65	23.53%	17.65%	14.64%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	1047.49	77.59%	58.19%	48.27%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	924.07	68.45%	51.34%	42.58%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	870.13	64.45%	48.34%	40.10%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	838.12	62.08%	46.56%	38.62%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	767.94	56.88%	42.66%	35.39%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1097.57	81.30%	60.98%	50.58%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	635.69	59.97%	45.41%	39.24%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	591.05	55.76%	42.22%	36.48%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	735.83	69.42%	55.33%	48.73%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	692.12	65.29%	49.44%	42.72%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	0	0.00%	0.00%	0.00%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	0	0.00%	0.00%	0.00%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%

L29C + Breaker failure at L25L29 (trips L25V along with L29C)

Circuit	From Bus Name	To Bus Name	Conductor Rating			Amps	Cont	LTE	STE
			Continuous	LTE	STE		% loading		
L23N	LAMBTON_P1K1220.00	TALFORD_JL23220.00	1350	1800	2170	768.54	56.93%	42.70%	35.42%
L23N	TALFORD_JL23220.00	SCOTT_TS 220.00	1350	1800	2170	718.7	53.24%	39.93%	33.12%
L25V	LAMBTON_P1K1220.00	N_MOORE_JL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
L25V	N_MOORE_JL25220.00	N_CHEM_SSL25220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	N_CHEM_SSV41220.00	NOVA_SS_JV41220.00	1350	1800	2170	0	0.00%	0.00%	0.00%
V41N	NOVA_SS_JV41220.00	ST_CLR_ECJ41220.00	1350	1800	2170	24.28	1.80%	1.35%	1.12%
V41N	ST_CLR_ECJ41220.00	SCOTT_TS 220.00	1350	1800	2170	711.87	52.73%	39.55%	32.81%
L27V	LAMBTON_P2K2220.00	N_MOORE_JL27220.00	1350	1800	2170	1074.26	79.57%	59.68%	49.51%
L27V	N_MOORE_JL27220.00	NOVA_SS_JL27220.00	1350	1800	2170	974.53	72.19%	54.14%	44.91%
V43N	N_CHEM_SSV43220.00	TALFORD_JV43220.00	1350	1800	2170	938.81	69.54%	52.16%	43.26%
V43N	TALFORD_JV43220.00	ST_CLR_ECJ43220.00	1350	1800	2170	871.25	64.54%	48.40%	40.15%
V43N	ST_CLR_ECJ43220.00	SCOTT_TS 220.00	1350	1800	2170	1199.46	88.85%	66.64%	55.27%
L24L	LAMBTON_P1K1220.00	LONGWOODJL24220.00	1060	1400	1620	721.19	68.04%	51.51%	44.52%
L24L	LONGWOODJL24220.00	LONGWOOD_TS 220.00	1060	1400	1620	677.01	63.87%	48.36%	41.79%
L26L	LAMBTON_P2K2220.00	LONGWOODJL26220.00	1060	1330	1510	775.21	73.13%	58.29%	51.34%
L26L	LONGWOODJL26220.00	LONGWOOD_TS 220.00	1060	1400	1620	731.98	69.05%	52.28%	45.18%
L28C	LAMBTON_P2K2220.00	LYNWOOD_JL28220.00	1060	1330	1510	824.52	77.78%	61.99%	54.60%
L28C	LYNWOOD_JL28220.00	CHATHAM_SS 220.00	1060	1330	1510	518.27	48.89%	38.97%	34.32%
L29C	LAMBTON_P1K1220.00	LYNWOOD_JL29220.00	1060	1400	1620	0	0.00%	0.00%	0.00%
L29C	LYNWOOD_JL29220.00	CHATHAM_SS 220.00	1060	1400	1620	0	0.00%	0.00%	0.00%