

January 30, 2012

Mr. Ibrahim El Nahas
Manager, Transmission Planning - North
Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5



Dear Mr. El Nahas:

***Shunt Reactors at Marathon TS
Notification of Conditional Approval of Connection Proposal
CAA ID Number: 2011-EX576***

Thank you for the information regarding the proposed installation of shunt reactors at Marathon TS. The IESO has concluded that the proposed changes will not result in a material adverse impact on the reliability of the integrated power system. The IESO is therefore pleased to grant “**conditional**” approval as detailed in the attached expedited System Impact Assessment report. Please note that any material changes to your proposal may require a re-assessment by the IESO and may nullify your conditional approval.

You may now initiate the IESO’s “Market Entry” process. To do so, please contact Market Entry at market.entry@ieso.ca at least eight months prior to your expected energization date. The SIA report, attached hereto, details the requirements that your company must fulfill during this process, including demonstrating that the equipment *as installed* will not be materially different from the equipment *as approved* by the IESO. The document entitled “**Market Entry: A Step-by-Step Guide**” provided in the approval email describes the key steps in the Market Entry process.

When your company has successfully completed the IESO’s “Facility Registration/Market Entry” process, the IESO will provide you with a “**final**” approval, thereby confirming that the facility is fully authorized to connect to the IESO-controlled grid.

For further information, please contact me via connection.assessments@ieso.ca.

Yours truly,

Michael Falvo
Manager – Market Facilitation
Telephone: (905) 855-6209
Fax: (905) 855-6319
E-mail: mike.falvo@ieso.ca
cc: IESO Records

All information submitted in this process will be used by the IESO solely in support of its obligations under the *Electricity Act, 1998*, the *Ontario Energy Board Act, 1998*, the *Market Rules* and associated policies, standards and procedures and in accordance with its licence. All information submitted will be assigned the appropriate confidentiality level upon receipt.

**Expedited System Impact Assessment
Hydro One Networks Inc.**

1.0 GENERAL DESCRIPTION & PROPOSED MODIFICATIONS

Under low power flow conditions on the 230 kV circuits around Marathon TS, voltages at the corresponding 230 kV stations may exceed the maximum voltage limit of 250 kV. Hydro One Networks Inc. is proposing to install two 40 MVAR air core (dry type) reactors on the tertiary windings of autotransformers T11 and T12 at Marathon TS to help control area voltages.

The proposed arrangement is shown in Figure 1 below.

The proposed in-service date is December 1, 2014.

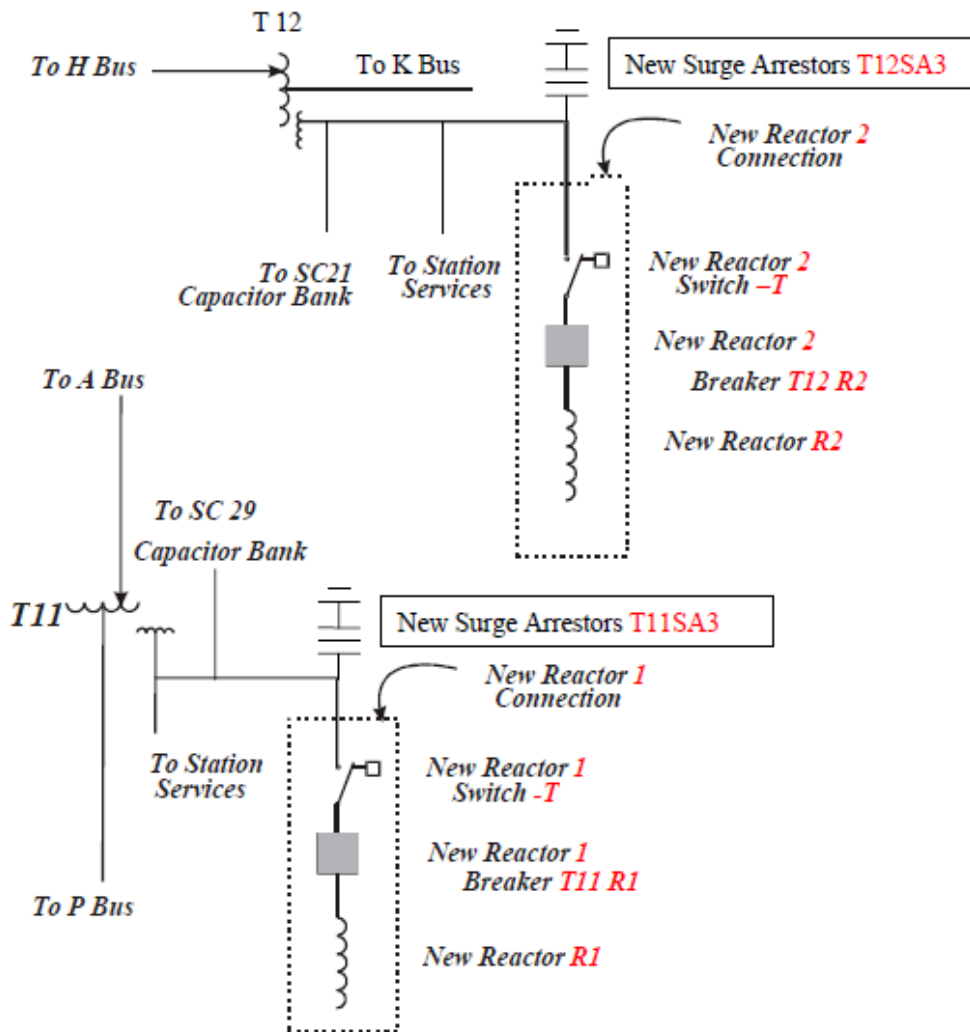


Figure 1 – Proposed arrangement of new shunt reactors at Marathon TS

2.0 TECHNICAL SPECIFICATIONS

The technical specifications for the new installations are given below.

Shunt Reactors at Marathon TS	
Nomenclature to be provided	
Number	2
Connection	Ungrounded Wye
Rated Power	40 MVAR @ 14.1 kV
System Nominal Voltage	13.8 kV
Short Circuit Withstand Capability	25 kA

Circuit Breaker & Disconnect Switches for Reactors at Marathon TS	
Nomenclature to be provided	
Number	2
System Nominal Voltage	13.8 kV
Rated Max. Voltage	15.2 kV
Rated Cont. Current	2200 A
Short Circuit Withstand Capability	25 kA

3.0 REQUIREMENTS

The proponent must notify the IESO as soon as it becomes aware of any changes to the assumptions made in the connection assessment. The IESO will determine whether these changes require a re-assessment.

IESO Monitoring Requirements

In accordance with the telemetry requirements for transmitters (see Appendices 4.16, 4.20 and 4.21 of the Market Rules) the connection applicant must install equipment at this project with specific performance standards 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.

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 connection 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 market 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.

4.0 ASSESSMENT & CONCLUSIONS

4.1 Scenarios

Switching is mainly affected by the short circuit level at the bus under inspection. According to Equation (1), as the short circuit level decreases the change in voltage at the time of switching increases. Hence, the reactor switching was examined under reasonably low short circuit level conditions, which was achieved by taking out of service transmission elements and generators in close proximity to Marathon TS.

$$\Delta V = \frac{\Delta Q}{I_{sc}} \tag{1}$$

Four scenarios were prepared to examine the impact of the new reactors. Each scenario was then re-examined with Aubrey Falls and Wells GS in service. The reactor was switched in under high voltage conditions occurring at reduced flows, and was switched out under lower voltage conditions with higher flows.

Table 1 and Table 2 list the system conditions for each scenario used for the switching study:

Table 1: Switching in Scenarios

Scenario	Outage	EWTE Interface Flows (MW)	Total Northwest Generation (MW)	Total Northwest Demand (MW)	Generators o/s near Marathon TS
S1	None	-25	476	480	Aguasabon G2 Umbata Falls G2 Terace Bay Aubrey Falls GS Wells GS
S2	W21M	-2	508	480	
S3	Lakehead T7	13	520	480	
S4	M23L	-16	492	480	

Table 2: Switching out Scenarios

Scenario	Outage	EWTE Interface Flows (MW)	Total Northwest Generation (MW)	Total Northwest Demand (MW)	Generators o/s near Marathon TS
S1	None	-205	331.65	512	Aguasabon G2
S2	W21M	-100	427	500	Umbata Falls G2
S3	Lakehead T7	-195	366	528	Terace Bay
S4	M23L	-182	355	501	Aubrey Falls GS Wells GS

4.2 Findings

The results for reactor switching under the described scenarios are listed in Appendix A of the report.

As per Chapter 4 of the Market Rules, reactive devices should be sized to ensure that voltage declines or rises at delivery point buses on switching operations will not to exceed 4% of steady state rms voltage before tap changer action using a voltage dependent load model.

The results show that switching a 40 MVAR reactor at Marathon TS results in a voltage change less than 4% in most of the cases. Voltage changes marginally greater than 4% were recorded only under outage conditions, specifically with W21M out of service or M23L out of service when Aubrey and Wells were not connected to the system.

Under those conditions it was observed that switching out a 40 MVAR reactor at Marathon TS at voltages above 122 kV can result in voltages exceeding the maximum Marathon 115 kV voltage limit of 126 kV. Operational measures during switching may be needed to prevent voltages departing from the acceptable range.

4.3 Conclusions

This expedited System Impact Assessment concludes that the installation of the proposed shunt reactors is not expected to have a material adverse impact on the IESO-controlled grid.

Appendix A

Switching-In 40 MVAR										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S1 (All elements in service)					S1 (All elements in service) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	244.8	243.9	244.05	244.05	-0.36	244.7	243.8	244.0	244.0	-0.35
Dryden 230 kV	249.3	248.0	248.16	248.17	-0.52	249.2	247.9	248.2	248.2	-0.51
Fort Frances 230 kV	249.3	248.0	248.16	248.17	-0.52	249.2	247.9	248.2	248.2	-0.51
Mackenzie 230 kV	249.0	246.8	246.88	246.90	-0.85	248.7	246.6	246.9	246.9	-0.83
Lakehead 230 kV	240.9	237.6	237.60	237.60	-1.35	240.4	237.3	237.6	237.6	-1.32
Marathon 230 kV	248.8	242.9	243.50	242.16	-2.41	248.2	242.4	243.1	241.8	-2.34
Rabbit Lake 115 kV	123.2	122.8	122.92	122.92	-0.30	123.2	122.8	122.9	122.9	-0.29
Dryden 115 kV	122.8	122.2	122.29	122.30	-0.50	122.7	122.1	122.3	122.3	-0.49
Fort Frances 115 kV	120.9	120.4	120.38	120.38	-0.38	120.9	120.4	120.4	120.4	-0.37
Mackenzie 115 kV	118.2	117.3	117.31	117.33	-0.82	118.1	117.2	117.3	117.3	-0.80
Moose Lake 115 kV	119.2	118.2	118.27	118.29	-0.81	119.1	118.1	118.3	118.3	-0.79
Birch 115 kV	123.2	121.6	121.48	121.61	-1.26	122.9	121.4	121.5	121.6	-1.23
Lakehead 115 kV	124.4	122.8	122.76	122.89	-1.27	124.2	122.7	122.8	122.9	-1.23
Marathon 115 kV	125.1	120.5	120.97	123.37	-3.70	124.9	120.3	120.8	123.2	-3.64
Pic_DS 115 kV	125.1	120.5	120.97	123.37	-3.70	124.9	120.3	120.8	123.2	-3.64
Pic DS 24.9 kV	25.4	24.4	24.48	25.38	-3.71	25.3	24.4	24.5	25.4	-3.64
MARATHN_DS_J 115 kV	124.9	120.4	120.87	123.21	-3.64	124.7	120.2	120.7	123.1	-3.58
Marathon Pulp 13.8 kV	14.4	13.8	13.90	14.17	-3.64	14.3	13.8	13.9	14.2	-3.58
Marathon DS 25 kV	26.1	25.1	25.17	26.32	-3.65	26.0	25.1	25.1	26.3	-3.58
INMET_WES_LK 115 kV	123.2	120.4	121.26	122.18	-2.26	123.0	120.3	121.2	122.1	-2.22
INMET WEST LK 2.4 kV	2.1	2.1	2.11	2.12	-2.26	2.1	2.1	2.1	2.1	-2.22
TER_BAY_PULP 115 kV	122.5	119.3	120.32	121.48	-2.61	122.4	119.2	120.3	121.4	-2.56
TER BAY PULP 13.8 kV	14.0	13.6	13.70	13.84	-2.61	13.9	13.6	13.7	13.8	-2.56
SCHREIBER_DS 115 kV	122.9	120.0	120.9	121.9	-2.4	122.8	119.9	120.9	121.9	-2.33
SCHREIBER DS 12.5 kV	14.3	14.0	14.07	14.18	-2.38	14.3	13.9	14.1	14.2	-2.34
WILLIAMS_MIN 115 kV	127.5	127.2	127.63	127.63	-0.27	127.5	127.2	127.6	127.6	-0.26
WILLIAM M L2 13.8 kV	13.8	13.4	13.36	13.65	-3.53	13.8	13.3	13.3	13.6	-3.47
WILLIAM M L1 4.2 kV	4.1	4.0	4.00	4.09	-3.53	4.1	4.0	4.0	4.1	-3.47
DAVID_BELL 115 kV	120.6	116.4	116.59	118.94	-3.52	120.4	116.2	116.4	118.8	-3.46
DAVID BELL 4.2 kV	4.0	3.9	3.87	3.95	-3.52	4.0	3.9	3.9	3.9	-3.46
WHITE_RIVER 115 kV	120.7	116.5	116.72	119.08	-3.52	120.5	116.3	116.6	118.9	-3.46
WHITE RIVER 24.9 kV	25.6	24.7	24.75	25.26	-3.52	25.6	24.7	24.7	25.2	-3.46

Shunt Reactors at Marathon TS

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Switching-In 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S2 (W21M outage)					S2 (W21M outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	244.5	243.5	244.55	244.56	-0.41	245.0	244.0	245.0	245.0	-0.40
Dryden 230 kV	248.9	247.5	248.97	248.99	-0.59	249.6	248.2	249.7	249.7	-0.59
Fort Frances 230 kV	248.9	247.5	248.97	248.99	-0.59	249.6	248.2	249.7	249.7	-0.59
Mackenzie 230 kV	248.3	245.9	248.34	248.36	-0.97	249.6	247.2	249.6	249.6	-0.95
Lakehead 230 kV	239.8	236.1	239.80	239.80	-1.54	242.0	238.3	242.0	242.0	-1.51
Marathon 230 kV	247.9	240.9	243.61	242.08	-2.83	248.4	241.5	244.3	242.7	-2.78
Rabbit Lake 115 kV	123.1	122.7	123.12	123.12	-0.33	123.3	122.9	123.3	123.3	-0.33
Dryden 115 kV	122.6	121.9	122.66	122.66	-0.56	122.9	122.3	123.0	123.0	-0.56
Fort Frances 115 kV	120.7	120.2	120.76	120.76	-0.43	121.1	120.5	121.1	121.1	-0.42
Mackenzie 115 kV	117.9	116.8	117.98	118.00	-0.93	118.4	117.3	118.5	118.5	-0.92
Moose Lake 115 kV	118.9	117.8	118.93	118.96	-0.91	119.3	118.2	119.4	119.4	-0.90
Birch 115 kV	122.5	120.8	122.94	123.10	-1.42	122.4	120.7	122.8	123.0	-1.39
Lakehead 115 kV	123.8	122.0	124.20	124.35	-1.42	123.6	121.9	124.0	124.2	-1.40
Marathon 115 kV	124.6	119.5	120.94	123.26	-4.07	124.8	119.8	121.2	123.5	-4.03
Pic_DS 115 kV	124.6	119.5	120.94	123.25	-4.07	124.8	119.8	121.2	123.5	-4.03
Pic DS 24.9 kV	25.2	24.2	24.48	25.36	-4.08	25.3	24.3	24.5	25.4	-4.03
MARATHN_DS_J 115 kV	124.4	119.4	120.85	123.09	-4.01	124.6	119.7	121.1	123.4	-3.96
Marathon Pulp 13.8 kV	14.3	13.7	13.90	14.16	-4.01	14.3	13.8	13.9	14.2	-3.96
Marathon DS 25 kV	26.6	25.5	25.80	26.29	-4.01	26.6	25.6	25.9	26.4	-3.97
INMET_WES_LK 115 kV	122.6	119.5	121.31	122.20	-2.47	122.6	119.6	121.4	122.3	-2.44
INMET WEST LK 2.4 kV	2.1	2.1	2.11	2.12	-2.47	2.1	2.1	2.1	2.1	-2.44
TER_BAY_PULP 115 kV	122.0	118.5	120.34	121.45	-2.85	122.1	118.7	120.5	121.6	-2.82
TER BAY PULP 13.8 kV	13.9	13.5	13.71	13.84	-2.85	13.9	13.5	13.7	13.9	-2.82
SCHREIBER_DS 115 kV	122.4	119.2	121.0	121.9	-2.6	122.4	119.3	121.1	122.0	-2.57
SCHREIBER DS 12.5 kV	14.2	13.9	14.07	14.18	-2.60	14.2	13.9	14.1	14.2	-2.57
WILLIAMS_MIN 115 kV	127.6	127.2	127.56	127.55	-0.30	127.5	127.1	127.5	127.5	-0.30
WILLIAM M L2 13.8 kV	13.8	13.3	13.36	13.63	-3.88	13.8	13.3	13.4	13.7	-3.84
WILLIAM M L1 4.2 kV	4.1	4.0	4.00	4.08	-3.88	4.1	4.0	4.0	4.1	-3.84
DAVID_BELL 115 kV	120.1	115.5	116.56	118.83	-3.87	120.3	115.7	116.8	119.1	-3.83
DAVID BELL 4.2 kV	4.0	3.8	3.87	3.95	-3.88	4.0	3.8	3.9	4.0	-3.83
WHITE_RIVER 115 kV	120.3	115.6	116.69	118.97	-3.87	120.5	115.9	117.0	119.3	-3.83
WHITE RIVER 24.9 kV	25.5	24.5	24.75	25.24	-3.87	25.6	24.6	24.8	25.3	-3.83

Shunt Reactors at Marathon TS

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Switching-In 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S3 (Lakehead T7 outage)					S3 (Lakehead T7 outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	238.9	238.1	238.31	238.18	-0.33	238.7	238.0	238.2	238.0	-0.32
Dryden 230 kV	241.7	240.5	240.84	240.64	-0.49	241.5	240.4	240.7	240.3	-0.47
Fort Frances 230 kV	241.7	240.5	240.84	240.64	-0.49	241.5	240.4	240.7	240.3	-0.47
Mackenzie 230 kV	241.7	239.7	240.06	239.68	-0.82	241.3	239.4	239.8	239.1	-0.79
Lakehead 230 kV	241.8	238.6	239.17	238.56	-1.30	241.2	238.2	238.7	237.6	-1.25
Marathon 230 kV	249.5	243.6	244.67	243.05	-2.37	248.5	242.8	243.8	239.7	-2.28
Rabbit Lake 115 kV	124.2	123.8	123.93	123.88	-0.28	124.1	123.8	123.9	123.8	-0.27
Dryden 115 kV	125.5	124.9	125.05	124.95	-0.47	125.4	124.8	125.0	124.8	-0.45
Fort Frances 115 kV	123.1	122.7	122.69	122.59	-0.35	123.0	122.6	122.6	122.4	-0.34
Mackenzie 115 kV	123.1	122.1	122.28	122.11	-0.78	122.9	122.0	122.1	121.9	-0.75
Moose Lake 115 kV	123.6	122.7	122.86	122.70	-0.77	123.5	122.5	122.7	122.5	-0.74
Birch 115 kV	123.2	121.8	121.78	121.53	-1.15	122.9	121.5	121.5	121.3	-1.11
Lakehead 115 kV	124.3	122.8	122.93	122.69	-1.15	124.0	122.6	122.7	122.5	-1.11
Marathon 115 kV	125.4	120.8	121.48	123.76	-3.67	125.0	120.5	121.1	125.3	-3.59
Pic_DS 115 kV	125.4	120.8	121.48	123.75	-3.67	125.0	120.5	121.1	125.3	-3.59
Pic DS 24.9 kV	25.0	24.1	24.20	25.46	-3.67	25.3	24.4	24.5	25.4	-3.59
MARATHN_DS_J 115 kV	125.2	120.7	121.37	123.58	-3.61	124.8	120.4	121.0	125.1	-3.53
Marathon Pulp 13.8 kV	14.4	13.9	13.96	14.21	-3.61	14.3	13.8	13.9	14.4	-3.53
Marathon DS 25 kV	26.1	25.2	25.28	26.40	-3.61	26.0	25.1	25.2	26.1	-3.53
INMET_WES_LK 115 kV	123.3	120.5	121.52	122.31	-2.23	123.1	120.4	121.3	122.8	-2.17
INMET WEST LK 2.4 kV	2.1	2.1	2.11	2.13	-2.23	2.1	2.1	2.1	2.1	-2.17
TER_BAY_PULP 115 kV	122.7	119.5	120.61	121.66	-2.57	122.4	119.4	120.4	122.4	-2.51
TER BAY PULP 13.8 kV	14.0	13.6	13.74	13.86	-2.58	14.0	13.6	13.7	13.9	-2.51
SCHREIBER_DS 115 kV	123.0	120.2	121.2	122.1	-2.3	122.8	120.0	121.0	122.7	-2.28
SCHREIBER DS 12.5 kV	14.3	14.0	14.10	14.20	-2.35	14.3	14.0	14.1	14.3	-2.29
WILLIAMS_MIN 115 kV	127.0	126.7	127.08	127.10	-0.26	127.0	126.7	127.1	127.1	-0.25
WILLIAM M L2 13.8 kV	13.9	13.4	13.42	13.69	-3.50	13.8	13.4	13.4	13.9	-3.42
WILLIAM M L1 4.2 kV	4.2	4.0	4.02	4.10	-3.50	4.1	4.0	4.0	4.2	-3.42
DAVID_BELL 115 kV	120.8	116.6	117.09	119.32	-3.49	120.5	116.4	116.7	120.7	-3.41
DAVID BELL 4.2 kV	4.0	3.9	3.89	3.96	-3.49	4.0	3.9	3.9	4.0	-3.41
WHITE_RIVER 115 kV	121.0	116.7	117.22	119.46	-3.49	120.6	116.5	116.8	120.9	-3.41
WHITE RIVER 24.9 kV	25.0	24.1	24.23	25.34	-3.49	24.9	24.1	24.2	25.6	-3.41

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	S4 (M23L outage)					S4 (M23L outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	244.0	243.3	244.00	244.01	-0.28	244.0	243.3	244.0	244.0	-0.27
Dryden 230 kV	247.3	246.2	247.29	247.29	-0.41	247.3	246.3	247.3	247.3	-0.40
Fort Frances 230 kV	247.3	246.2	247.29	247.29	-0.41	247.3	246.3	247.3	247.3	-0.40
Mackenzie 230 kV	247.5	245.8	247.54	247.55	-0.67	247.5	245.9	247.5	247.6	-0.65
Lakehead 230 kV	242.0	239.4	242.00	242.00	-1.06	242.0	239.5	242.0	242.0	-1.02
Marathon 230 kV	249.3	242.7	244.63	242.90	-2.65	249.3	243.0	244.8	243.1	-2.54
Rabbit Lake 115 kV	123.3	123.0	123.26	123.26	-0.23	123.3	123.0	123.3	123.3	-0.23
Dryden 115 kV	124.8	124.3	124.83	124.83	-0.40	124.8	124.3	124.8	124.8	-0.38
Fort Frances 115 kV	120.5	120.2	120.55	120.55	-0.30	120.5	120.2	120.6	120.6	-0.29
Mackenzie 115 kV	121.9	121.1	121.96	121.97	-0.65	121.9	121.2	122.0	122.0	-0.63
Moose Lake 115 kV	122.4	121.6	122.43	122.44	-0.64	122.4	121.6	122.4	122.4	-0.61
Birch 115 kV	122.0	120.8	122.24	122.33	-0.99	122.0	120.8	122.2	122.3	-0.96
Lakehead 115 kV	123.2	121.9	123.41	123.49	-1.00	123.2	122.0	123.4	123.5	-0.96
Marathon 115 kV	125.3	120.4	121.44	123.67	-3.90	125.3	120.5	121.5	123.8	-3.81
Pic_DS 115 kV	125.3	120.4	121.44	123.67	-3.90	125.3	120.5	121.5	123.8	-3.81
Pic DS 24.9 kV	25.4	24.4	24.58	25.44	-3.91	25.4	24.4	24.6	25.5	-3.81
MARATHN_DS_J 115 kV	125.1	120.3	121.33	123.49	-3.84	125.1	120.4	121.4	123.6	-3.74
Marathon Pulp 13.8 kV	14.4	13.8	13.95	14.20	-3.84	14.4	13.8	14.0	14.2	-3.74
Marathon DS 25 kV	26.1	25.1	25.27	26.38	-3.84	26.1	25.1	25.3	26.4	-3.75
INMET_WES_LK 115 kV	122.8	120.0	121.46	122.31	-2.28	122.8	120.1	121.5	122.3	-2.22
INMET WEST LK 2.4 kV	2.1	2.1	2.11	2.13	-2.28	2.1	2.1	2.1	2.1	-2.22
TER_BAY_PULP 115 kV	122.3	119.1	120.56	121.63	-2.68	122.3	119.2	120.6	121.7	-2.61
TER BAY PULP 13.8 kV	13.9	13.6	13.73	13.86	-2.68	13.9	13.6	13.7	13.9	-2.61
SCHREIBER_DS 115 kV	122.6	119.7	121.2	122.1	-2.4	122.6	119.7	121.2	122.1	-2.36
SCHREIBER DS 12.5 kV	14.3	13.9	14.09	14.20	-2.42	14.3	13.9	14.1	14.2	-2.36
WILLIAMS_MIN 115 kV	127.1	126.9	127.13	127.13	-0.22	127.1	126.9	127.1	127.1	-0.21
WILLIAM M L2 13.8 kV	13.9	13.3	13.42	13.68	-3.72	13.9	13.4	13.4	13.7	-3.63
WILLIAM M L1 4.2 kV	4.2	4.0	4.02	4.10	-3.72	4.2	4.0	4.0	4.1	-3.63
DAVID_BELL 115 kV	120.7	116.2	117.04	119.23	-3.71	120.7	116.3	117.1	119.3	-3.62
DAVID BELL 4.2 kV	4.0	3.9	3.89	3.96	-3.72	4.0	3.9	3.9	4.0	-3.63
WHITE_RIVER 115 kV	120.8	116.4	117.18	119.37	-3.71	120.9	116.5	117.2	119.5	-3.62
WHITE RIVER 24.9 kV	25.6	24.7	24.85	25.32	-3.71	25.6	24.7	24.9	25.3	-3.62

Shunt Reactors at Marathon TS

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Switching-Out 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S1 (All elements in service)					S1 (All elements in service) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	243.1	244.1	243.01	243.01	0.41	243.1	244.0	243.0	243.0	0.40
Dryden 230 kV	244.6	246.1	244.56	244.57	0.59	244.6	246.0	244.6	244.6	0.57
Fort Frances 230 kV	244.6	246.1	244.56	244.57	0.59	244.6	246.0	244.6	244.6	0.57
Mackenzie 230 kV	243.8	246.0	243.75	243.75	0.90	243.8	245.9	243.8	243.8	0.87
Lakehead 230 kV	236.9	240.2	236.94	236.94	1.36	236.9	240.0	236.9	236.9	1.31
Marathon 230 kV	239.8	245.8	243.43	243.43	2.51	239.5	245.3	243.0	243.0	2.42
Rabbit Lake 115 kV	123.9	124.4	123.89	123.89	0.39	123.9	124.4	123.9	123.9	0.37
Dryden 115 kV	123.7	124.5	123.71	123.71	0.58	123.7	124.4	123.7	123.7	0.56
Fort Frances 115 kV	120.0	120.5	119.99	119.99	0.42	120.0	120.5	120.0	120.0	0.40
Mackenzie 115 kV	118.8	119.9	118.77	118.77	0.89	118.8	119.8	118.8	118.8	0.85
Moose Lake 115 kV	119.4	120.4	119.31	119.31	0.88	119.4	120.4	119.3	119.3	0.85
Birch 115 kV	118.7	120.2	118.32	118.34	1.25	118.7	120.1	118.4	118.4	1.20
Lakehead 115 kV	120.6	122.1	120.23	120.23	1.26	120.6	122.1	120.3	120.3	1.21
Marathon 115 kV	122.4	127.2	125.84	125.84	3.88	122.3	126.9	125.7	125.7	3.79
Pic_DS 115 kV	122.4	127.2	125.84	125.84	3.88	122.3	126.9	125.7	125.7	3.79
Pic DS 24.9 kV	25.2	26.1	25.88	25.47	3.88	25.1	26.1	25.8	25.4	3.79
MARATHN_DS_J 115 kV	122.3	126.9	125.57	125.57	3.81	122.1	126.7	125.4	125.4	3.73
Marathon Pulp 13.8 kV	14.1	14.6	14.44	14.44	3.81	14.0	14.6	14.4	14.4	3.73
Marathon DS 25 kV	26.1	27.1	26.81	26.16	3.82	26.1	27.0	26.8	26.1	3.73
INMET_WES_LK 115 kV	121.1	124.0	122.32	122.32	2.34	121.1	123.9	122.3	122.3	2.28
INMET WEST LK 2.4 kV	2.1	2.2	2.13	2.13	2.34	2.1	2.2	2.1	2.1	2.28
TER_BAY_PULP 115 kV	120.5	123.8	122.11	122.11	2.70	120.5	123.7	122.0	122.0	2.64
TER BAY PULP 13.8 kV	13.7	14.1	13.90	13.90	2.71	13.7	14.1	13.9	13.9	2.64
SCHREIBER_DS 115 kV	121.0	123.9	122.2	122.2	2.5	120.9	123.8	122.2	122.2	2.40
SCHREIBER DS 12.5 kV	14.1	14.4	14.21	14.21	2.47	14.1	14.4	14.2	14.2	2.40
WILLIAMS_MIN 115 kV	124.3	124.8	124.24	124.25	0.43	124.3	124.8	124.2	124.3	0.41
WILLIAM M L2 13.8 kV	13.5	14.0	13.87	13.87	3.68	13.5	14.0	13.9	13.9	3.60
WILLIAM M L1 4.2 kV	4.0	4.2	4.15	4.15	3.68	4.0	4.2	4.1	4.1	3.60
DAVID_BELL 115 kV	117.9	122.2	121.01	121.01	3.67	117.8	122.0	120.9	120.9	3.59
DAVID BELL 4.2 kV	3.9	4.1	4.02	4.02	3.68	3.9	4.0	4.0	4.0	3.59
WHITE_RIVER 115 kV	118.0	122.3	121.14	121.14	3.67	117.9	122.1	121.0	121.0	3.59
WHITE RIVER 24.9 kV	25.0	25.9	25.69	25.69	3.68	25.0	25.9	25.7	25.7	3.59

Shunt Reactors at Marathon TS

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Switching-Out 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S2 (W21M outage)					S2 (W21M outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	244.3	245.4	244.71	244.41	0.42	244.4	245.4	244.6	244.6	0.41
Dryden 230 kV	248.0	249.5	248.57	248.28	0.60	248.0	249.5	248.4	248.4	0.59
Fort Frances 230 kV	248.0	249.5	248.57	248.28	0.60	248.0	249.5	248.4	248.4	0.59
Mackenzie 230 kV	245.5	247.8	246.48	246.12	0.95	245.5	247.8	246.1	246.1	0.93
Lakehead 230 kV	236.9	240.4	238.46	238.28	1.47	236.9	240.3	237.9	237.9	1.43
Marathon 230 kV	240.4	247.2	245.30	245.21	2.85	239.3	246.0	244.0	244.0	2.79
Rabbit Lake 115 kV	123.8	124.2	123.92	123.79	0.37	123.8	124.2	123.9	123.9	0.36
Dryden 115 kV	122.5	123.2	122.71	122.58	0.58	122.5	123.2	122.6	122.6	0.57
Fort Frances 115 kV	120.5	121.0	120.73	120.28	0.43	120.5	121.0	120.7	120.7	0.42
Mackenzie 115 kV	119.5	120.6	119.94	119.78	0.94	119.5	120.6	119.8	119.8	0.91
Moose Lake 115 kV	120.0	121.1	120.45	120.29	0.93	120.0	121.1	120.3	120.3	0.91
Birch 115 kV	120.0	121.6	120.66	120.56	1.33	120.1	121.7	120.4	120.4	1.30
Lakehead 115 kV	121.3	122.9	121.88	121.79	1.35	121.4	122.9	121.6	121.6	1.31
Marathon 115 kV	121.1	126.1	125.07	125.03	4.19	120.6	125.6	124.5	124.5	4.13
Pic_DS 115 kV	121.1	126.1	125.07	125.02	4.19	120.6	125.6	124.5	124.5	4.13
Pic DS 24.9 kV	25.3	26.3	26.12	25.30	4.19	25.2	26.2	26.0	25.2	4.13
MARATHN_DS_J 115 kV	120.9	125.9	124.83	124.79	4.11	120.5	125.4	124.3	124.3	4.06
Marathon Pulp 13.8 kV	13.9	14.5	14.36	14.35	4.11	13.9	14.4	14.3	14.3	4.06
Marathon DS 25 kV	25.8	26.9	26.65	26.64	4.12	26.3	27.4	27.2	26.5	4.06
INMET_WES_LK 115 kV	120.7	123.8	122.34	122.31	2.50	120.6	123.6	122.1	122.1	2.46
INMET WEST LK 2.4 kV	2.1	2.2	2.13	2.13	2.50	2.1	2.1	2.1	2.1	2.46
TER_BAY_PULP 115 kV	120.0	123.4	121.95	121.92	2.89	119.8	123.2	121.7	121.7	2.85
TER BAY PULP 13.8 kV	13.6	14.0	13.88	13.87	2.90	13.6	14.0	13.8	13.8	2.85
SCHREIBER_DS 115 kV	120.5	123.7	122.2	122.2	2.6	120.3	123.5	121.9	121.9	2.59
SCHREIBER DS 12.5 kV	14.0	14.4	14.21	14.20	2.64	14.0	14.3	14.2	14.2	2.59
WILLIAMS_MIN 115 kV	126.4	126.8	126.31	126.34	0.34	126.4	126.8	126.3	126.3	0.33
WILLIAM M L2 13.8 kV	13.3	13.9	13.79	13.79	3.98	13.3	13.8	13.7	13.7	3.92
WILLIAM M L1 4.2 kV	4.0	4.1	4.13	4.13	3.98	4.0	4.1	4.1	4.1	3.92
DAVID_BELL 115 kV	116.5	121.1	120.35	120.32	3.96	116.1	120.6	119.9	119.9	3.91
DAVID BELL 4.2 kV	3.9	4.0	3.99	3.99	3.97	3.8	4.0	4.0	4.0	3.91
WHITE_RIVER 115 kV	116.6	121.3	120.49	120.45	3.96	116.2	120.8	120.0	120.0	3.91
WHITE RIVER 24.9 kV	25.4	26.4	26.20	25.55	3.97	25.3	26.3	26.1	25.5	3.91

Shunt Reactors at Marathon TS

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Switching-Out 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S3 (Lakehead T7 outage)					S3 (Lakehead T7 outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	243.0	243.9	242.90	242.90	0.39	243.0	243.9	242.9	242.9	0.38
Dryden 230 kV	244.7	246.1	244.62	244.63	0.55	244.7	246.0	244.7	244.7	0.54
Fort Frances 230 kV	244.7	246.1	244.62	244.63	0.55	244.7	246.0	244.7	244.7	0.54
Mackenzie 230 kV	244.1	246.1	243.99	244.00	0.84	244.1	246.1	244.0	244.0	0.82
Lakehead 230 kV	236.9	239.9	236.94	236.94	1.26	236.9	239.9	236.9	236.9	1.24
Marathon 230 kV	240.4	246.2	244.18	244.18	2.42	239.6	245.3	243.2	243.2	2.38
Rabbit Lake 115 kV	123.9	124.3	123.83	123.84	0.36	123.9	124.3	123.8	123.8	0.35
Dryden 115 kV	123.8	124.5	123.76	123.76	0.54	123.8	124.5	123.8	123.8	0.53
Fort Frances 115 kV	119.7	120.2	119.70	119.70	0.39	119.8	120.2	119.7	119.7	0.38
Mackenzie 115 kV	119.4	120.4	119.33	119.33	0.83	119.4	120.4	119.3	119.3	0.81
Moose Lake 115 kV	120.2	121.1	120.08	120.08	0.82	120.2	121.1	120.1	120.1	0.80
Birch 115 kV	122.4	123.8	122.00	122.00	1.14	122.5	123.9	122.1	122.1	1.12
Lakehead 115 kV	124.0	125.5	123.63	123.63	1.15	124.1	125.5	123.7	123.7	1.13
Marathon 115 kV	121.3	125.9	124.76	124.76	3.79	122.4	127.0	125.8	125.8	3.75
Pic_DS 115 kV	121.3	125.9	124.76	124.76	3.79	122.4	127.0	125.8	125.8	3.75
Pic DS 24.9 kV	25.3	26.3	26.05	25.25	3.79	25.2	26.1	25.9	25.5	3.76
MARATHN_DS_J 115 kV	121.2	125.7	124.55	124.55	3.72	122.3	126.8	125.5	125.5	3.69
Marathon Pulp 13.8 kV	13.9	14.5	14.32	14.32	3.72	14.1	14.6	14.4	14.4	3.69
Marathon DS 25 kV	25.8	26.8	26.58	26.58	3.73	26.1	27.0	26.8	26.2	3.70
INMET_WES_LK 115 kV	121.5	124.2	122.67	122.67	2.25	121.9	124.6	123.1	123.1	2.24
INMET WEST LK 2.4 kV	2.1	2.2	2.13	2.13	2.25	2.1	2.2	2.1	2.1	2.24
TER_BAY_PULP 115 kV	120.5	123.6	122.07	122.07	2.61	121.0	124.2	122.6	122.6	2.60
TER BAY PULP 13.8 kV	13.7	14.1	13.89	13.89	2.61	13.8	14.1	14.0	14.0	2.60
SCHREIBER_DS 115 kV	121.1	124.0	122.5	122.5	2.4	121.6	124.5	122.9	122.9	2.36
SCHREIBER DS 12.5 kV	14.1	14.4	14.24	14.24	2.37	14.1	14.5	14.3	14.3	2.36
WILLIAMS_MIN 115 kV	124.1	124.6	124.05	124.07	0.41	124.1	124.6	124.1	124.1	0.41
WILLIAM M L2 13.8 kV	13.4	13.8	13.76	13.76	3.60	13.5	14.0	13.9	13.9	3.56
WILLIAM M L1 4.2 kV	4.0	4.1	4.12	4.12	3.60	4.0	4.2	4.2	4.2	3.57
DAVID_BELL 115 kV	116.7	120.9	120.09	120.09	3.58	117.9	122.1	121.0	121.0	3.55
DAVID BELL 4.2 kV	3.9	4.0	3.99	3.99	3.59	3.9	4.0	4.0	4.0	3.56
WHITE_RIVER 115 kV	116.9	121.0	120.23	120.23	3.59	118.0	122.2	121.1	121.1	3.55
WHITE RIVER 24.9 kV	25.4	26.3	26.14	25.50	3.59	25.0	25.9	25.7	25.7	3.56

Shunt Reactors at Marathon TS

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Switching-Out 40 MVar										
Bus	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)	Pre-Switch Voltage (kV)	Post-Switch Voltage (kV)	Pre-ULTC Voltage (kV)	Post-ULTC Voltage (kV)	Switching ΔV (%)
	S4 (M23L Outage)					S4 (M23L Outage) - Aubrey Falls & Wells GS in service				
Kenora 230 kV	243.3	244.0	243.21	243.21	0.32	244.2	245.0	244.2	244.2	0.30
Dryden 230 kV	246.1	247.2	246.00	246.00	0.45	247.7	248.8	247.7	247.7	0.42
Fort Frances 230 kV	246.1	247.2	246.00	246.00	0.45	247.7	248.8	247.7	247.7	0.42
Mackenzie 230 kV	244.1	245.8	244.04	244.04	0.69	245.0	246.6	244.9	244.9	0.66
Lakehead 230 kV	236.9	239.4	236.94	236.94	1.04	236.9	239.3	236.9	236.9	1.01
Marathon 230 kV	238.9	245.4	243.85	243.85	2.74	239.4	245.7	244.2	244.2	2.62
Rabbit Lake 115 kV	123.6	124.0	123.61	123.61	0.30	124.0	124.4	124.0	124.0	0.28
Dryden 115 kV	121.6	122.1	121.52	121.52	0.44	122.5	123.0	122.5	122.5	0.41
Fort Frances 115 kV	119.8	120.1	119.73	119.73	0.32	120.5	120.8	120.4	120.4	0.31
Mackenzie 115 kV	119.1	119.9	119.01	119.01	0.68	119.3	120.1	119.3	119.3	0.65
Moose Lake 115 kV	119.7	120.5	119.61	119.61	0.68	119.9	120.7	119.8	119.8	0.65
Birch 115 kV	122.9	124.1	122.65	122.65	0.96	121.1	122.3	120.9	120.9	0.93
Lakehead 115 kV	124.2	125.4	123.95	123.95	0.97	122.4	123.5	122.2	122.2	0.94
Marathon 115 kV	120.8	125.7	124.74	124.74	4.07	120.9	125.7	124.8	124.8	3.96
Pic_DS 115 kV	120.7	125.7	124.74	124.74	4.07	120.9	125.7	124.8	124.8	3.96
Pic DS 24.9 kV	25.2	26.2	26.05	25.24	4.07	25.2	26.2	26.1	25.3	3.97
MARATHN_DS_J 115 kV	120.6	125.5	124.52	124.52	4.00	120.8	125.5	124.6	124.6	3.89
Marathon Pulp 13.8 kV	13.9	14.4	14.32	14.32	4.00	13.9	14.4	14.3	14.3	3.89
Marathon DS 25 kV	26.3	27.4	27.23	26.58	4.00	25.8	26.8	26.6	26.6	3.90
INMET_WES_LK 115 kV	121.1	124.0	122.59	122.59	2.35	120.9	123.6	122.3	122.3	2.29
INMET WEST LK 2.4 kV	2.1	2.2	2.13	2.13	2.35	2.1	2.1	2.1	2.1	2.29
TER_BAY_PULP 115 kV	120.1	123.4	121.97	121.97	2.76	120.0	123.2	121.8	121.8	2.69
TER BAY PULP 13.8 kV	13.7	14.0	13.88	13.88	2.76	13.6	14.0	13.9	13.9	2.69
SCHREIBER_DS 115 kV	120.8	123.8	122.4	122.4	2.5	120.6	123.5	122.1	122.1	2.42
SCHREIBER DS 12.5 kV	14.0	14.4	14.22	14.22	2.49	14.0	14.4	14.2	14.2	2.43
WILLIAMS_MIN 115 kV	122.6	123.0	122.54	122.55	0.34	126.4	126.7	126.4	126.4	0.26
WILLIAM M L2 13.8 kV	13.3	13.8	13.76	13.76	3.86	13.3	13.8	13.8	13.8	3.76
WILLIAM M L1 4.2 kV	4.0	4.1	4.12	4.12	3.86	4.0	4.1	4.1	4.1	3.76
DAVID_BELL 115 kV	116.2	120.7	120.08	120.08	3.85	116.4	120.7	120.1	120.1	3.75
DAVID BELL 4.2 kV	3.9	4.0	3.98	3.98	3.86	3.9	4.0	4.0	4.0	3.75
WHITE_RIVER 115 kV	116.3	120.8	120.21	120.21	3.85	116.5	120.9	120.3	120.3	3.75
WHITE RIVER 24.9 kV	25.3	26.3	26.14	25.49	3.86	25.3	26.3	26.2	25.5	3.75