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LOCAL PLANNING REPORT

Manitoulin TS Low Voltage Regulation
Region: Sudbury-Algoma

Revision: Final
Date: September 30, 2015

Prepared by: Hydro One Networks Inc (Transmission & Distribution)

Study Team	
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Disclaimer

This Local Planning Report was prepared for the purpose of developing wires-only options and recommending a preferred solution(s) to address the local needs identified in the Needs Assessment (NA) report for the Sudbury-Algoma Region that do not require further coordinated regional planning. The preferred solution(s) that have been identified through this Local Planning Report may be reevaluated based on the findings of further analysis. The load forecast and results reported in this Local Planning Report are based on the information and assumptions provided by study team participants.

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LOCAL PLANNING EXECUTIVE SUMMARY

REGION	Sudbury to Algoma (the "Region")		
LEAD	Hydro One Networks Inc. ("Hydro One")		
START DATE	October 20, 2014	**END DATE**	September 30, 2015

1. INTRODUCTION

The purpose of this Local Planning (LP) report is to develop wires-only options and recommend a preferred solution that will address the local needs identified in the Needs Assessment (NA) report for the Sudbury-Algoma Region dated March 12, 2015. The development of the LP report is in accordance with the regional planning process as set out in the Ontario Energy Board's (OEB) Transmission System Code (TSC) and Distribution System Code (DSC) requirements and the "Planning Process Working Group (PPWG) Report to the Board".

Based on Section 6 of the NA report, the study team recommended that no further coordinated regional planning is required to address the needs in the Sudbury-Algoma region. These needs are local in nature and will be addressed by wires options through local planning led by Hydro One with participation of the impacted LDC.

2. LOCAL NEEDS ADDRESSED IN THIS REPORT

The Manitoulin TS Voltage Regulation is a local need addressed in this report.

3. OPTIONS CONSIDERED

Hydro One (Transmitter) and Hydro One Distribution (LDC) have considered addressing the above need with the following options;

Alternative 0 – Status Quo.
Alternative 1 - Install 44kV Capacitor Bank at Manitoulin TS
Alternative 2 - Install 115kV Capacitor Bank at Manitoulin TS

See Section 3 for further detail.

4. PREFERRED SOLUTION

The preferred solution at this time is Alternative 0 – Status Quo. See Section 4 for details.

5. NEXT STEPS

The next steps are summarized in section 5

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1 INTRODUCTION

The Needs Assessment (NA) for the Sudbury/Algoma ("Region") was triggered in response to the Ontario Energy Board's (OEB) Regional Infrastructure Planning process approved in August 2013. Prior to the new regional planning process coming into effect, planning activities were already underway in the Region to address some specific station capacity needs. The NA report can be found on Hydro One's Regional Planning website. The study team identified needs that are emerging in the Sudbury-Algoma Region over the next ten years (2014 to 2023) and recommended whether they should be further assessed through the transmitter-led Local Planning (LP) process or the IESO-led Scoping Assessment (SA) process.

1.1 Sudbury to Algoma Region Description and Connection Configuration

The Sudbury to Algoma Region includes Greater Sudbury Area, Manitoulin Island, and townships of Verner, Warren, Elliot Lake, Blind River and Walden. The boundaries of the Sudbury to Algoma Region are shown below in Figure 1.

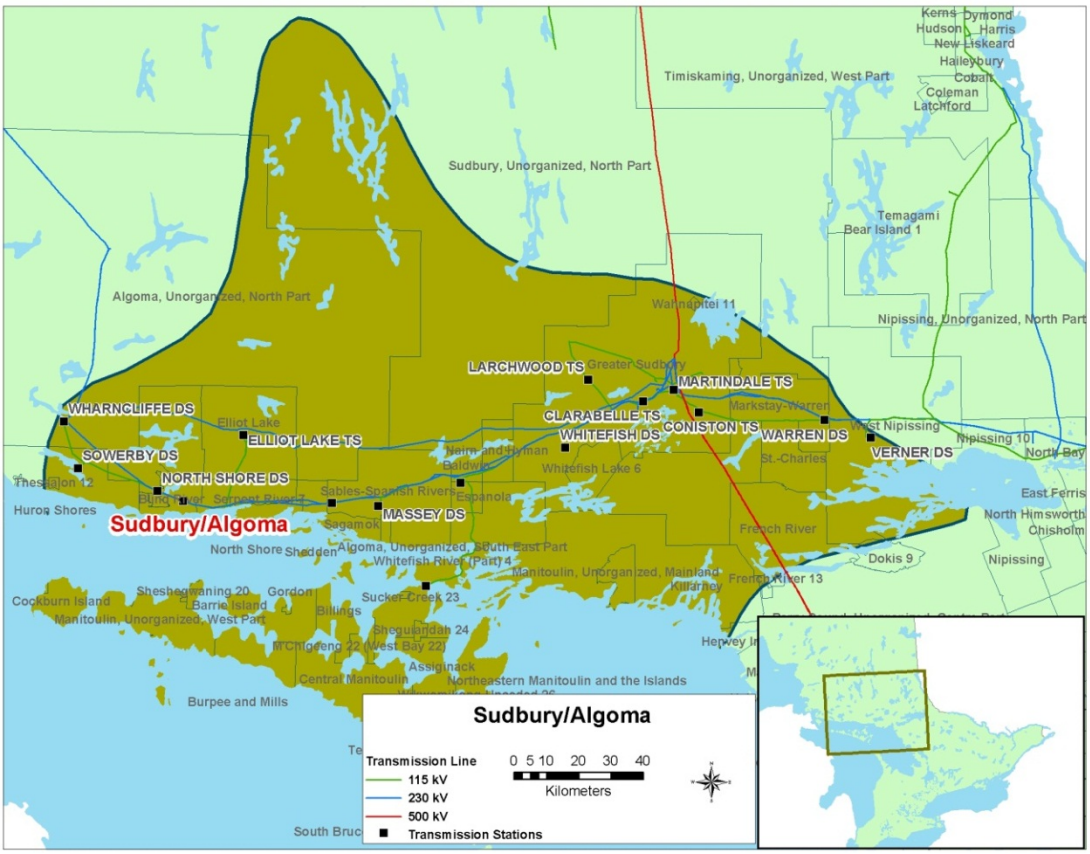

Figure 1: Sudbury to Algoma Region Map

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits supplied by autotransformers at Hanmer TS, Algoma TS and Martindale TS. This area is further reinforced through the 500kV circuits (P502X and X504/503E) connecting Hanmer TS (Sudbury) to both Porcupine TS (Timmins) and Essa TS (Barrie). It is also connected to Northwest Ontario through Mississagi TS. Table 2 below lists the major transmission circuits and Hydro One stations in the subject region.

This region has the following two local distribution companies (LDC):

- Greater Sudbury Hydro Inc.
- Hydro One Networks Inc. (Distribution)

Espanola Regional Hydro Distribution is a third LDC in this region embedded into the Hydro One Distribution system. Although invited, this LDC opted not to participate in the Study Team. However, the interests of this LDC were communicated and considered through Hydro One Distribution as a host LDC.

Transmission connected loads in the Sudbury to Algoma region form a large percentage (approximately 50%) of the overall demand. Although these customers are not explicitly participating in the regional planning process, Hydro One considered their impact in this analysis.

115kV circuits	230kV circuits	Hydro One Transformer Stations
S6F,S5M	X74P, X27A	ALGOMA TS
S2B,B4B	A23P, A24P	MARTINDALE TS
T1B, B3E	X23N, S21N	HANMER TS
B4E, L1S	X25S, X26S	CONISTON TS
	S22A	CLARABELLE TS
		ELLIOT LAKE TS
		ESPANOLA TS
		LARCHWOOD TS
		MANITOULIN TS

Table 1: Transmission Lines and Stations in Sudbury to Algoma Region

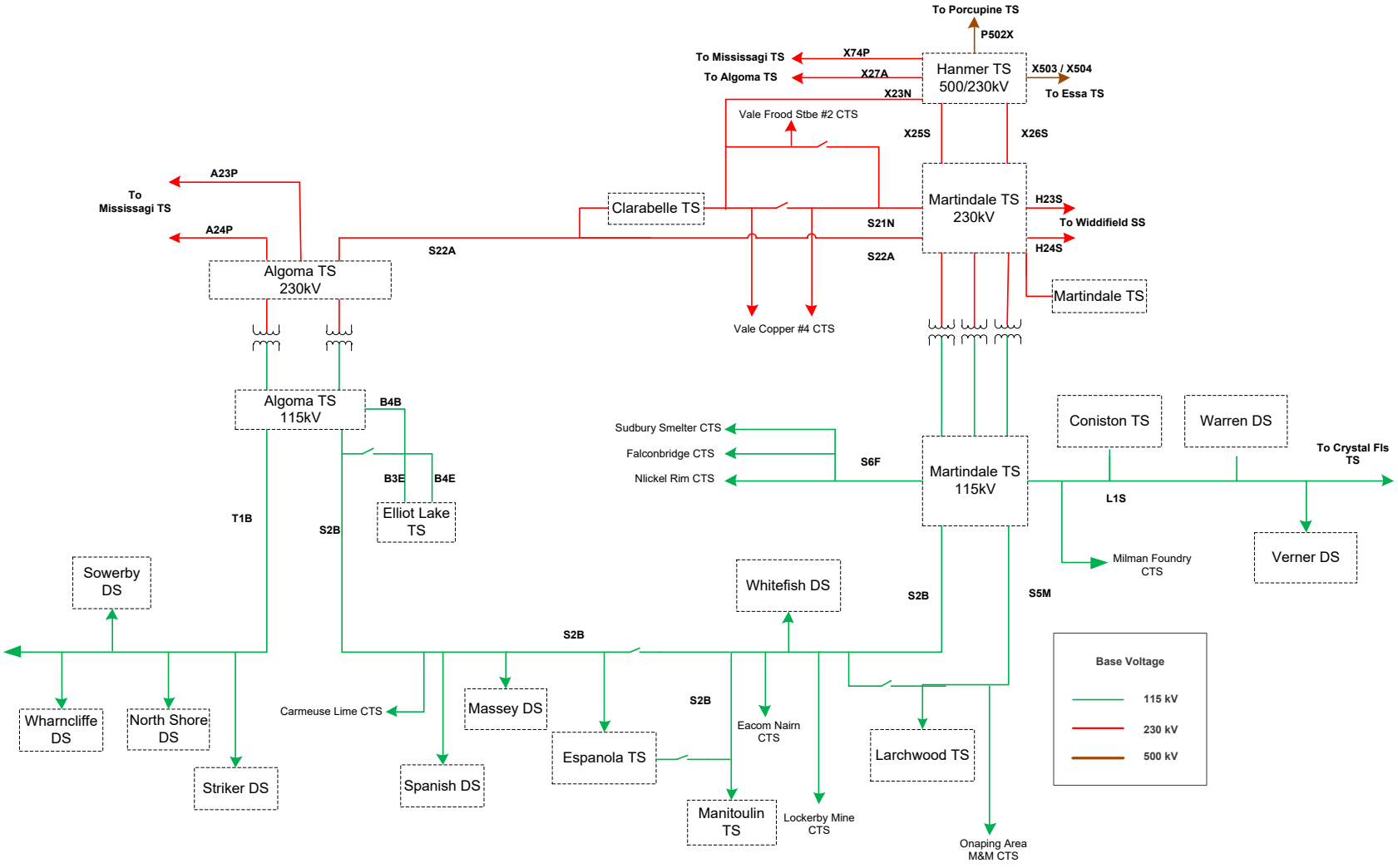

Figure 2: Single Line Diagram – Sudbury to Algoma Region

2 AREA NEEDS

2.1 Sudbury-Algoma Region Needs

As an outcome of the NA process, the study team did not identify any capacity needs based on LDCs load forecast. Only need identified was an issue with potential voltage regulation at Manitoulin TS in the Sudbury-Algoma Region to be addressed by a "localized" wires planning. Where local planning was recommended to address the needs, Hydro One, as transmitter, with the impacted LDC, further undertook planning assessments to address the need.

2.2 Needs Assessed by Hydro One led Local Planning

- Manitoulin TS Voltage Regulation – pre-contingency voltages at Manitoulin TS 115kV can at times fall below the ORTAC criteria of 113kV. Without McLean's mountain wind farm in service, and under peak load conditions, pre-contingency voltage at Manitoulin TS high voltage bus can be as low as 110kV when supplied from Algoma TS, and 112kV when supplied from Martindale TS.

3 ALTERNATIVES CONSIDERED

Hydro One transmission reviewed the above need and determined that the only LDC impacted by a low voltage at Manitoulin TS is Hydro One distribution which is directly supplied at the stations' 44kV bus. Following options were considered to address the needs identified in section 2 above.

Alternative 1 – Status Quo.

No further action is required at this time. Hydro One and LDC will monitor the load and voltages over the next three years. Further review will be undertaken in the next planning cycle or earlier if there is any evidence where load cannot be served or system cannot be operated in a safe, secure and reliable manner.

Alternative 2 – Install 44kV Capacitor Bank at Manitoulin TS

A 7MX low voltage capacitor bank can help improve high voltages regulation at Manitoulin TS. Manitoulin TS has a non-standard low voltage switch yard arrangement whereby each of the two feeders is supplied from a dedicated bus and associated transformer. There is currently no tie breaker between the two 44kV buses and thus, two 5.4MX capacitor banks will be required (for each of the busses). See figure 3.

Alternative 3 – Install 115kV Capacitor Bank at Manitoulin TS

A high voltage capacitor bank would also regulate the high voltage bus at Manitoulin TS. This alternative would require two high voltage breakers, and a motorized disconnect switch. See figure 4. Further investigation into this alternative indicated that 96MX capacitor bank is the smallest size available at this voltage. This large capacitor size would cause large voltage changes during switching and would violate operational criteria. Although this aspect would rule out this alternative it is shown illustration purposes in Table 3.

Table 3 below provides a budgetary cost summary of a cost of all options.

Options Considered	Cost
Alternative 1 – Hydro One to assess voltage performance of 115kV and 44kV bus with no immediate investment.	--
Alternative 2 – Install 44kV Capacitor Bank at Manitoulin TS	$4M
Alternative 3 – Install 115kV Capacitor Bank at Manitoulin TS	$6M

Table 2 – Budgetary Cost for Alternatives

4 PREFERRED SOLUTION AND REASONING

Hydro One Networks and the LDC have reviewed all alternatives and the preferred solution at this time is, Alternative 1 – Status Quo.

The study team acknowledges that the Manitoulin TS HV bus may experience voltages below ORTAC requirements only during limited operating scenarios. These scenarios are infrequent and the impacts of a low voltage at this point does not affect system stability or result in low voltages issues beyond the Manitoulin TS and Hydro One Distribution (LDC)

Manitoulin TS power transformers (T3/T4) are presently equipped with under load tap changers which have the ability to maintain 44kV bus voltages for wide array of voltage variations on the 115kV bus. ULTC ratings for both T3 and T4 are 44kV +/- 20% on 115.5kV at 42MVA load. These ratings are sufficient to maintain a customer delivery point performance within the rules of the Transmission System Code. The 44kV bus voltage will be maintained within 1.06 and 0.98pu for a 110kV (or lower) voltage.

Manitoulin TS voltage is constantly monitored by Hydro One's Ontario Grid Control Centre (OGCC) . OGCC's records will be reviewed regularly to ascertain the system conditions during peak load and its ability to operate the system and supply load to Manitoulin TS at acceptable voltage.

Voltage history will be reviewed with the LDC to determine if 44kV supply voltage remains within acceptable range for all distributed connected customers. The next planning cycle will take place within five years and an investment can be triggered at any time should there be a situation where load cannot be served or system cannot be operated safely and reliably.

5 NEXT STEPS

A summary of the next steps, actions/solutions and timelines required to address the local needs are as follows:

Need	Action / Recommended Solution	Lead Responsibility	Timeframe
Low Voltage at Manitoulin 115kV bus	• Status Quo –standard five year cycle	Hydro One Networks	Maximum five years

Table 3: Solutions and Timeframe

6 DIAGRAMS

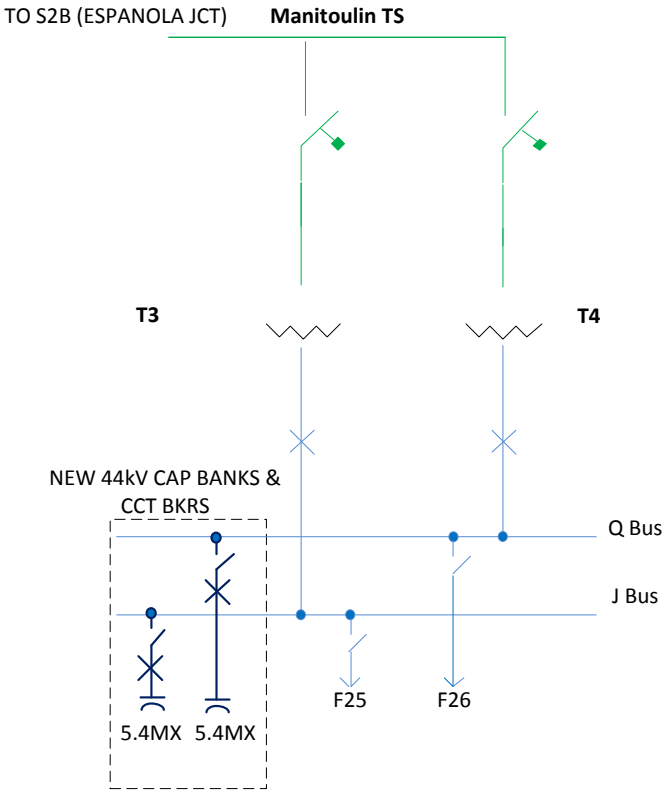

Figure 3 – New 44kV Capacitor Banks

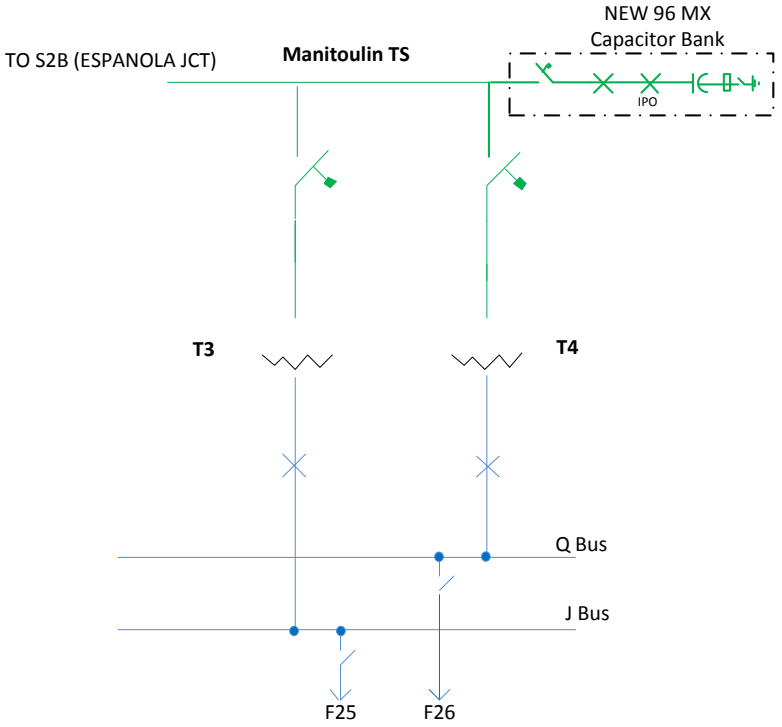

Figure 4 – 115kV Cap bank

7 REFERENCES

[1] Planning Process Working Group (PPWG) Report to the Board: The Process for Regional Infrastructure Planning in Ontario – May 17, 2013

[2] IESO Ontario Resource and Transmission Assessment Criteria (ORTAC)

[3] Sudbury-Algoma Needs Assessment Report

8 ACRONYMS

BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DSC	Distribution System Code
GS	Generating Station
GTA	Greater Toronto Area
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Planning
kV	Kilovolt
LDC	Local Distribution Company
LP	Local Planning
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low-voltage
MW	Megawatt
MVA	Mega Volt-Ampere
NA	Needs Assessment
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
OEB	Ontario Energy Board
OPA	Ontario Power Authority
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Planning
SIA	System Impact Assessment
SS	Switching Station
TS	Transformer Station
TSC	Transmission System Code
ULTC	Under Load Tap Changer

APPENDIX A – LOAD FORECAST FOR SUDBURY-ALGOMA STATIONS

Station Name	DESN ID	Customer Data (MW)	Historical Data (MW)			Near Term Forecast (MW)					Medium Term Forecast (MW)				
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Clarabelle TS	T1/T2	Gross Peak Load				106.7	105.8	104.9	103.9	103.0	102.1	101.3	100.4	99.5	98.6
		Net Load Forecast	87.4	78.7	114.3										
Coniston TS	T2/T3	Gross Peak Load				3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.8	3.8	3.8
		Net Load Forecast	9.0	10.8	7.1										
Elliot Lake TS	T1/T2/T3	Gross Peak Load				20.3	20.4	20.6	20.7	20.7	20.9	21.1	21.2	21.3	21.4
		Net Load Forecast	43.2	39.3	40.3										
Espanola TS	T1/T2/T3	Gross Peak Load				13.9	14.0	14.0	14.1	14.2	14.3	14.5	14.5	14.6	14.6
		Net Load Forecast	26.7	24.0	26.4										
Larchwood TS	T2	Gross Peak Load				13.2	13.3	13.4	13.5	13.6	13.8	13.9	14.0	14.1	14.2
		Net Load Forecast	25.2	27.1	26.2										
Manitoulin TS	T3/T4	Gross Peak Load				37.8	38.2	38.5	38.8	39.0	39.5	40.0	40.3	40.5	40.8
		Net Load Forecast	73.5	63.5	71.0										
Martindale TS	T25/T26	Gross Peak Load				149.5	151.5	152.3	153.0	153.6	154.5	155.3	155.9	156.5	157.9
		Net Load Forecast	97.7	88.3	95.0										
Massey DS	T1	Gross Peak Load				7.5	7.6	7.6	7.7	7.7	7.8	7.9	8.0	8.0	8.1
		Net Load Forecast	11.7	10.7	14.9										
North Shore DS	T1	Gross Peak Load				5.9	6.0	6.1	6.1	6.2	6.3	6.5	6.5	6.6	6.7
		Net Load Forecast	11.3	11.5	11.5										

LOAD FORECAST FOR SUDBURY-ALGOMA REGION (CONTINUED)

Station Name	DESN ID	Customer Data (MW)	Historical Data (MW)			Near Term Forecast (MW)					Medium Term Forecast (MW)				
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sowerby DS	T1	Gross Peak Load				4.7	4.7	4.8	4.8	4.8	4.8	4.9	4.9	4.9	5.0
		Net Load Forecast	10.3	9.7	9.3										
Spanish DS	T1	Gross Peak Load				4.0	4.1	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.6
		Net Load Forecast	7.7	6.7	7.9										
Striker DS	T1/T2	Gross Peak Load				10.0	10.1	10.3	10.4	10.5	10.7	10.8	11.0	11.1	11.2
		Net Load Forecast	16.8	14.0	19.6										
Verner DS	T1/T2	Gross Peak Load				6.3	6.4	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.8
		Net Load Forecast	12.1	10.8	12.5										
Warren DS	T1/T2	Gross Peak Load				8.0	8.1	8.1	8.2	8.2	8.3	8.4	8.5	8.5	8.6
		Net Load Forecast	14.6	13.0	15.5										
Wharncliffe DS	T1/T2	Gross Peak Load				5.3	5.3	5.3	5.4	5.4	5.4	5.5	5.5	5.5	5.6
		Net Load Forecast	9.9	9.1	10.5										
Whitefish DS	T1	Gross Peak Load				6.6	6.7	6.7	6.8	6.8	6.9	7.0	7.0	7.1	7.1
		Net Load Forecast	13.8	12.1	13.1										

1. CDM & DG Not included in this table.
2. Sudbury-Algoma region is winter peaking

DG & CDM Forecast for Sudbury-Algoma Stations

Station Name	DESN ID	BUS ID	Customer Data	Existing	Near Term Forecast					Medium Term Forecast				
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Clarabelle TS	T1/T2	M1/M3/M7	DG (MW)	5.93	6.19	6.20	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21
			CDM	-	-	-	-	-	-	-	-	-	-	-
Coniston TS	T2/T3	M1	DG (MW)	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
			CDM	-	-	-	-	-	-	-	-	-	-	-
Elliot Lake TS	T1/T2/T3	M1/M2/M3	DG (MW)	-	0	0	0	0	0	8.46	8.46	8.46	8.46	8.46
			CDM	-	-	-	-	-	-	-	-	-	-	-
Espanola TS	T1/T2/T3	M1	DG (MW)	-	-	-	-	-	-	2.54	2.54	2.54	2.54	2.54
			CDM	-	-	-	-	-	-	-	-	-	-	-
Larchwood TS	T2	M3/M4	DG (MW)	-	-	-	-	-	-	6.28	6.28	6.28	6.28	6.28
			CDM	-	-	-	-	-	-	-	-	-	-	-
Manitoulin TS	T3/T4	M25/M26	DG (MW)	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
			CDM	-	-	-	-	-	-	-	-	-	-	-
Martindale TS	T25/T26	M5/M6/M7	DG (MW)	5.98	5.98	6.40	6.40	6.40	6.40	8.49	8.49	8.49	8.49	8.49
			CDM	-	-	-	-	-	-	-	-	-	-	-
Massey DS	T1	F1/F3	DG (MW)		-	-	-	-	-					
			CDM	-	-	-	-	-	-	-	-	-	-	-
North Shore DS	T1	F1/F2	DG (MW)	1.71	1.71	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94
			CDM	-	-	-	-	-	-	-	-	-	-	-

DG & CDM Forecast for Sudbury-Algoma Stations (Continued)

Station Name	DESN ID	BUS ID	Customer Data	Existing	Near Term Forecast					Medium Term Forecast				
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sowerby DS	T1	F1/F2	DG (MW)	-	-	-	-	-	-	-	-	-	-	-
			CDM	-	-	-	-	-	-	-	-	-	-	-
Spanish DS	T1	F1/F2	DG (MW)	-	-	-	-	-	-	0.78	0.78	0.78	0.78	0.78
			CDM	-	-	-	-	-	-	-	-	-	-	-
Striker DS	T1/T2	F1/F2	DG (MW)	0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08	0.08
			CDM	-	-	-	-	-	-	-	-	-	-	-
Verner DS	T1/T2	F1/F2/F3	DG (MW)											
			CDM	-	-	-	0	0	0	0	0	0	0	0
Warren DS	T1/T2	F1/F2/F3/F4	DG (MW)	-	-	-	0	0	0.02	0.02	0.02	0.02	0.02	0.02
			CDM	-	-	-	-	-	-	-	-	-	-	-
Wharncliffe DS	T1/T2	F1/F2	DG (MW)	-	-	-	-	-	-	-	0.47	0.47	0.47	0.47
			CDM	-	-	-	-	-	-	-	-	-	-	-
Whitefish DS	T1	F1/F2/F3	DG (MW)	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02
			CDM	-	-	-	-	-	-	-	-	-	-	-

1. DG value (MW) is cumulative
2. DG MW Value is for winter peak
3. '-' indicates CDM or DG value not available