

CONNECTION ASSESSMENT & APPROVAL PROCESS

PRELIMINARY ASSESSMENT REPORT

APPLICANT: Cambridge and North Dumfries Hydro Inc.

PROJECT: New 230-27.6 kV Transformer Station

CAA ID No. 2000-030

Long Term Forecasts & Assessments Department

Date: *February 28, 2001*

PRELIMINARY ASSESSMENT REPORT

Cambridge and North Dumfries Hydro Inc. New 230-27.6 kV Transformer Station

Disclaimer

This report has been prepared solely for the purpose of assessing, on a preliminary basis, whether the connection applicant's proposed connection with the IMO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether a System Impact Assessment of the proposed connection should be conducted under Chapter 4, section 6 of the Market Rules. 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, Hydro One and the IMO in accordance with Chapter 4, section 6 of the Market Rules. The IMO assumes no responsibility to any third party for any use which it makes of this report. Any liability which the IMO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. The IMO may revise this report at any time, in its sole discretion, without notice to you. Although the IMO 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.

PRELIMINARY ASSESSMENT REPORT

Cambridge and North Dumfries Hydro Inc. New 230-27.6 kV Transformer Station

1.0 DESCRIPTION OF PROPOSAL

Cambridge and North Dumfries (C/ND) Hydro Inc. is proposing to build a new 230-27.6 kV Transformer Station (TS) on the east side of Conestoga Boulevard in Cambridge, Ontario, about 250 m north of Bishop Street. The new TS is a standard DESN (2x50/83 MVA transformers) configuration, connected via 230 kV circuit switchers, to the existing Hydro One owned 230 kV circuits M20D and M21D between Preston TS and Galt TS as shown in Figure 1. A single line diagram of the TS, provided by C/ND Hydro, is shown in Figure 2. Normally, the new 27.6 kV feeders would all be operated radial. Parallels would be made between feeders from the new TS and the existing TS's during switching operations.

The proposed in-service date is May 1, 2002.

2.0 LOAD

The radial sections of 230 kV circuits M20D/M21D currently supply loads at Galt TS, Preston TS and at Gerdau Courtice Steel. The actual 1999 summer peak load supplied by Cambridge and North Dumfries Hydro Inc was about 246 MW. About 98% of this load is supplied from Galt TS and Preston TS with the small remaining amount supplied from Wolverton DS. Galt TS and Preston TS had 1999 summer peak load of 159.3 MW and 89.2 MW respectively for a total of 248.5 MW. C/ND Hydro Inc. forecast their total load to grow at an annual rate of 4.5% to 2002 and 3.5% beyond. The 2000 peak load at Gerdau Courtice Steel was approximately 42 MW.

3.0 IMPACT ASSESSMENT

3.1 Impact On Reliability

With the proposed 230 kV circuit switchers on the HV side of the transformers and protections in accordance with Hydro One requirements, the connection of the proposed facilities should not have any significant detrimental impact on existing levels of supply reliability.

The Connection Applicant may use motorized 230 kV switches instead of breakers or circuit switchers provided that all requirements of the Transmission System Code are satisfied.

It is noted that, based on the Connection Applicant's forecast and other load in the area, the peak load on the 230 kV radial supply circuits M20D and M21D will exceed 300 MW by 2002 and 400MW by 2010. A double circuit line outage will, therefore, result in loss of this entire load.

It is worth noting that this would exceed the limit used in an earlier guideline for the transmission system, which required that facilities should be available to allow loads in excess of 250 MW be restored within 30 minutes, following a double circuit line contingency.

3.2 Impact on Transmission Line Loading

The proposed new TS as well as Galt TS and Preston TS are supplied at 230 kV via circuits M20D and M21D tapped to the Middleport TS x Detweiler TS 230 kV circuits M20D and M21D. Circuit M21D also supplies Gerdau Courtice Steel in Cambridge. The 1999 and projected 2002 - 2015 loads are listed in Table 1. Table 1 also shows transmission line loadings under contingency conditions.

It is noted that with no corrective measures taken, circuit M21D, Galt Jct x Preston TS, will be overloaded in 2006, with M20D out of service.

3.3 Impact on Transmission System Voltages

3.3.1 Power Factor Requirement:

Market rules require that wholesale customers and distributors connected to the IMO-controlled grid shall operate at a power factor within the range of 90% lagging to 90% leading as measured at the defined meter point. Our studies show that the power factor, assuming the meter point is on the 230 kV side of the new TS, will be 87.2% lagging in 2002 dropping to 86.5% lagging in 2005. Installation of 20 Mvar, 27.6 kV capacitor bank(s) at the new C/ND TS will bring the power factor to an acceptable level until beyond 2010.

3.3.2 Abrupt Voltage Changes

Market rules require that voltage changes shall not normally exceed 4% of steady state rms voltage for capacitor switching operations. Our studies show that this requirement is met over the entire 2002-2015 period.

Market rules also require that voltage changes shall not normally exceed 10% of steady state rms voltage for line switching operations. Our studies show that this requirement is met until about 2010 with 20 Mvar capacitor bank(s) installed or about 2014 with 40 Mvar capacitors.

3.3.3 Steady State Voltages

Under normal conditions, the steady state voltage for the nominal 230 kV portion of the IMO controlled grid is in the range of 220 – 250 kV in southern Ontario. Studies show that this requirement is met over the entire 2002-2015 period. Table 3 shows the actual measured voltage at Detweiler TS during the year 2000. The voltage (230 kV) at the location of the proposed new C/ND TS is expected to be approximately 5 kV below the level at Detweiler TS.

3.4 Summary of results

A summary of the system adequacy and possible remedial measures is given in the Table below. This summary is based on the detailed results given in Table 1.

MEASURES TAKEN	ADEQUATE UNTIL	DETAILS
(1) No Measures taken	2002	2002: Power factor < 0.9 2006: Loading M21D exceeds rating of 1120 A 2009: Loading M20D exceeds rating of 1120 A 2010 Ubrupt voltage change for line cont. > 10%
BASED ON ADEQUACY OF M21D WITH OUTAGE OF M20D		
(2) Adding 1 x 20 MVAR, 27.6 kV capacitor at the new C/ND Hydro TS	2005	2006: Loading M21D exceeds rating of 1120 A
(3) Adding additional 1 x 20 MVAR, 27.6 kV banks at the new C/ND Hydro TS	2006	2007: Loading M21D exceeds rating of 1120 A
(4) Increasing the capacity of the Galt Jct x Galt section of M21D up the max operating temperature of 150°C (feasibility and cost to be determined by Hydro One) (Estimated rating = 1350A)	2009	2010: Loading M21D exceeds rating of 1350 A 2010 Ubrupt voltage change for line cont. > 10%
(5) (4) + (2)	2010	2011: Loading M21D exceeds rating of 1350 A
(6) Increasing the capacity of the Galt Jct x Galt TS section of M21D by reconductoring with 1192.5 ACSR conductor strung for 150°C (feasibility and cost to be determined by Hydro One) (Estimated rating = 1580A)	2009	2010: Ubrupt voltage change for line cont. > 10% 2013: Loading M21D exceeds rating of 1580 A
(7) (6) + (2)	2011	2012: Ubrupt voltage change for line cont. > 10%
BASED ON ADEQUACY OF M20D WITH OUTAGE OF M21D		
(5) Increasing the capacity of the Galt Jct x Galt TS section of M20D by increasing operating temperature to 150°C. (Assumes 1x20Mvar capacitor installed)	2011	2012: Ubrupt voltage change for line cont. > 10%

4.0 REQUIREMENTS FOR CONNECTION

To accommodate the connection of the proposed new C/ND Hydro TS, the following additional work will be required to alleviate the impacts described above.

(1) 2002 (or I/S date) :

- Install capacitor bank(s) at the LV bus of the new C/ND Hydro TS to maintain the power factor above 90%, at 230 kV terminals. (20Mvar assumed in study) (Note i.)

(2) 2006 (or when total load on Galt/Preston/NewTS/Courtice Steel reaches ~ 405 MVA):

- Increase capacity of the Galt Jct x Preston Jct section of M21D by:
 - making modifications to allow operation at 150°C. This increases ampacity to approx 1350A and provides adequate capacity until about 2010 (or when total load on Galt/Preston/New TS/Courtice Steel reaches ~ 460 MVA) (Notes ii., iii.)
 - AND/OR
 - Reconductoring with larger/higher ampacity conductor. Assuming the use of 1192.5 kcmil ACSR conductor strung for 150°C operation , this will increase ampacity to approx 1580A and provides adequate capacity until 2014 (or when total load on Galt/Preston/New TS/Courtice Steel reaches ~ 522 MVA) (Notes ii., iii.)

(3) 2011 (or when total load on Galt/Preston/NewTS/Courtice Steel reaches ~ 475 MVA):

- Increase capacity of the Galt Jct x Preston Jct section of M20D (Notes iii.).

NOTES

- i. The Connection Applicant may chose to install capacitor(s) on distribution feeders instead of at the 27.6 kV station bus to reduce distribution losses and free up feeder capacity. This is acceptable as long as the required reactive support is provided to meet the power factor and abrupt voltage change requirements.
- ii. Based on the current forecast, this work can be deferred one year if additional 20 Mvar capacitor(s) is added.
- iii. Hydro One may consider alternative solutions to counteract the impacts identified. Feasibility and cost of the work to increase the capacity of the M20D/M21D line sections or any other work on the Hydro One system will be considered by Hydro One.
- iv. It is noted that, based on the load forecast provided by Cambridge and North Dumfries Hydro, the loading on the new C/ND TS will reach its 10-day LTR of 113 MVA about 2010. Additional transformation capacity or other remedial measures will have to be provided/implemented to supply load beyond 2010.

5.0 SYSTEM IMPACT ASSESSMENT

Based on the results of this Preliminary Assessment, it is concluded that no further analysis is required for this project, and, it is therefore recommended that the System Impact Assessment be foregone.

6.0 NOTIFICATION OF APPROVAL OF THE CONNECTION PROPOSAL

Based on the results of this Assessment, it is recommended that this project should receive a “Notification of Approval of the Connection Proposal” subject to acceptance by the Connection Applicant of the “Requirements for Connection” measures described in Section 4.0. Hydro One may consider alternative solutions to counteract the impacts identified. Feasibility and cost of the work to increase the capacity of the M20D/M21D line sections or any other work on the Hydro One system will be considered by Hydro One.

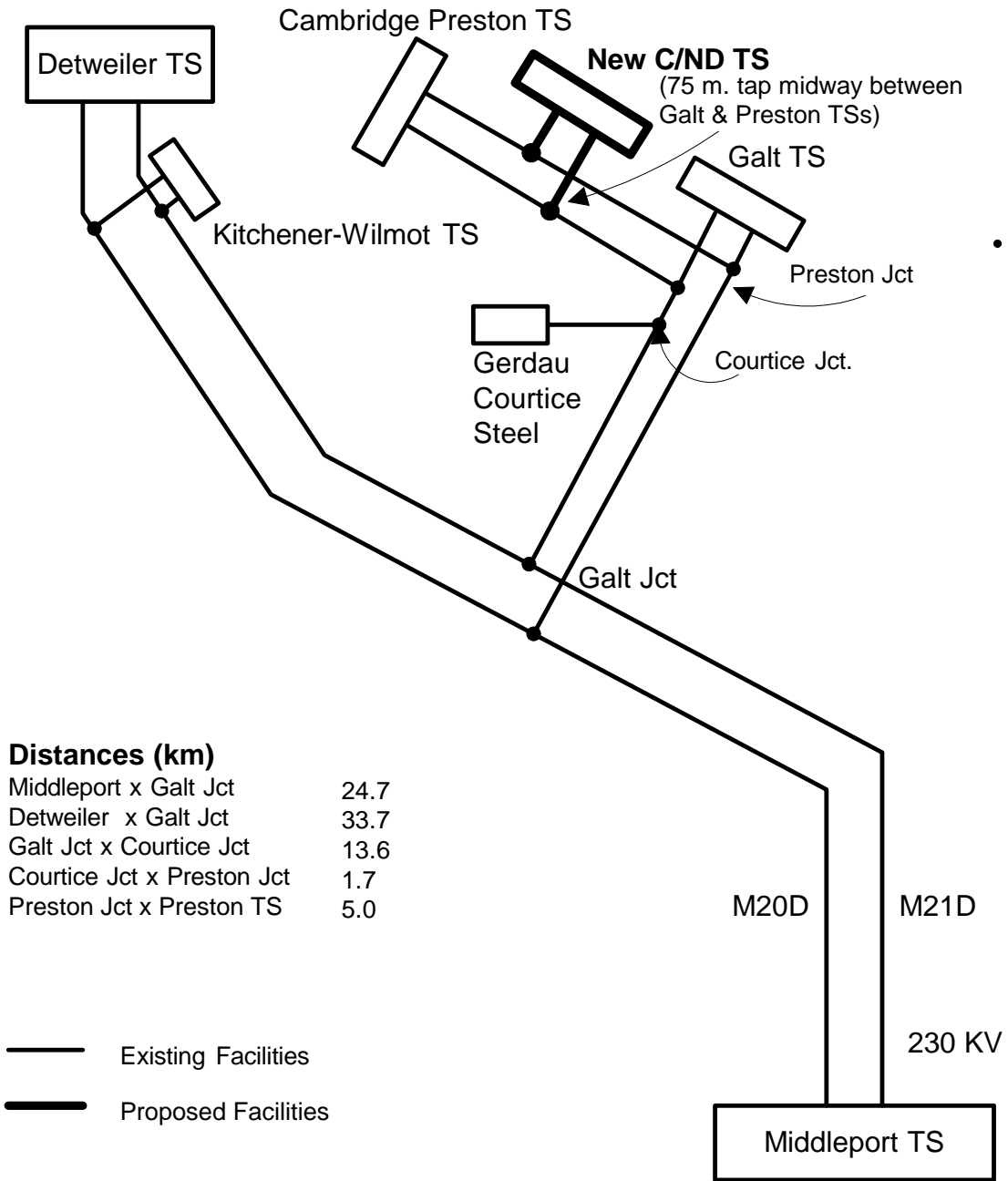


FIGURE 1
CAMBRIDGE & NORTH DUMFRIES HYDRO : NEW TS PROJECT

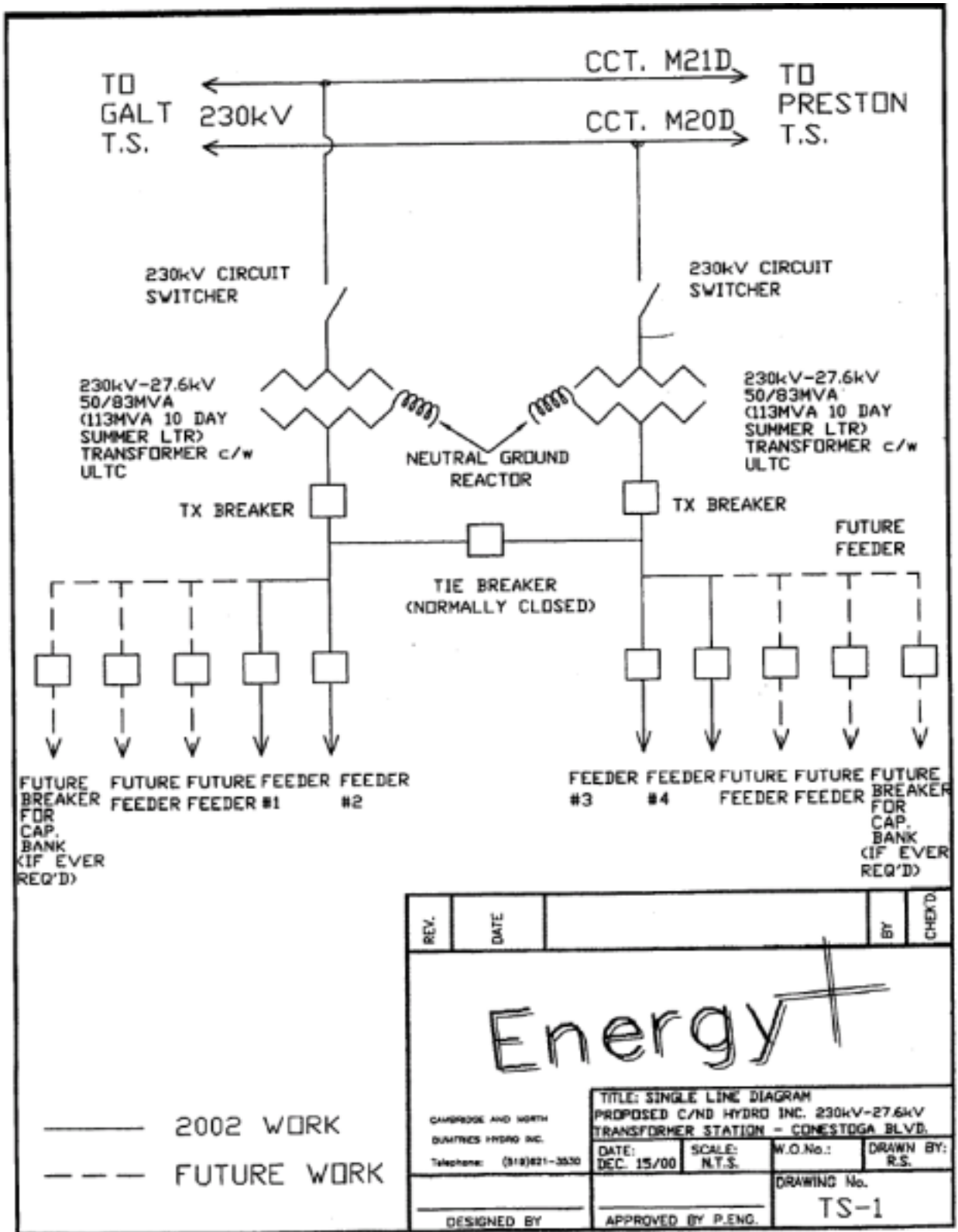


FIGURE 2

FIGURE 3
Detweiler TS 230kV Voltage Measured in Year 2000

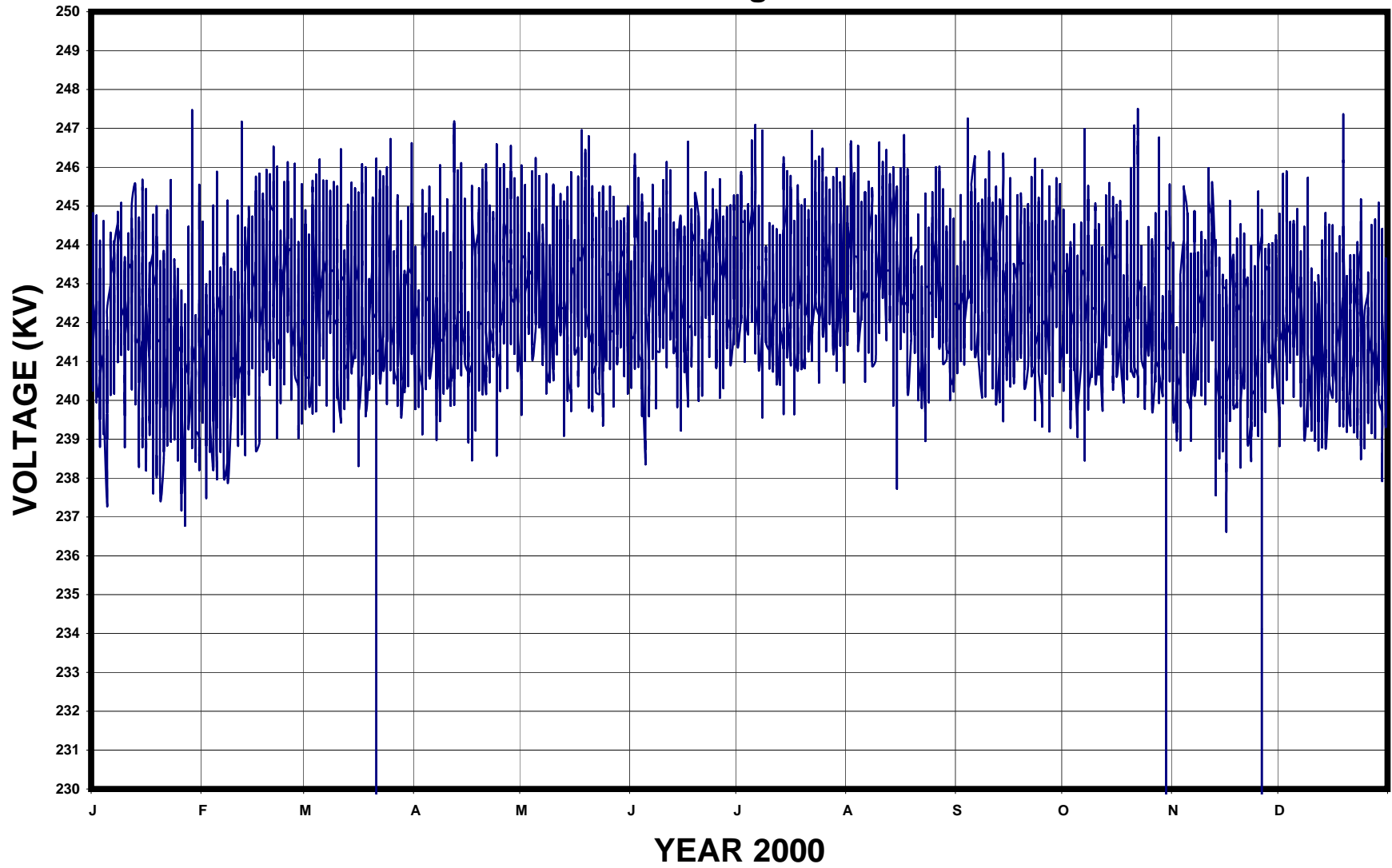


TABLE 1

	CAMBRIDGE & NORTH DUMFRIES AREA LOADS *										
	1999	2002	2003	2004	2005	2006	2007	2008	2009	2010	2015
Galt TS											
MW	159.3	146.1	149.3	152.5	155.5	158.4	161.1	163.5	165.7	167.5	199.5
MVAR	78.7	72.2	73.8	75.3	76.8	78.2	79.6	80.8	81.9	82.8	98.6
Cap Bank (MVAR)	40.8	40.8	40.8	40.8	40.8	40.8	40.8	40.8	40.8	40.8	40.8
MVAR (Net)	37.9	31.4	33.0	34.5	36.0	37.4	38.8	40.0	41.1	42.0	57.8
MVA	163.7	149.5	152.9	156.4	159.7	162.8	165.7	168.3	170.8	172.7	207.7
LTR (MVA)	178.2	178.2	178.2	178.2	178.2	178.2	178.2	178.2	178.2	178.2	178.2
Preston TS											
MW	89.2	92.7	94.7	96.7	98.7	100.5	102.2	103.7	105.1	106.3	126.6
MVAR	45.8	47.6	48.7	49.7	50.7	51.6	52.5	53.3	54.0	54.6	65.0
MVA	100.3	104.2	106.5	108.8	110.9	113.0	114.9	116.6	118.2	119.5	142.3
LTR (MVA)	120.8	120.8	120.8	120.8	120.8	120.8	121.8	122.8	123.8	120.8	120.8
New C/ND Hydro TS											
MW		45.0	49.8	55.2	61.1	67.6	74.9	82.9	91.8	101.7	121.1
MVAR		22.6	25.2	27.9	31.0	34.5	38.3	42.5	47.1	52.0	62.6
Power Factor (%)		89.4	89.2	89.2	89.1	89.1	89.0	89.0	89.0	89.0	88.8
MVA		50.3	55.9	61.8	68.5	75.9	84.1	93.2	103.2	114.2	136.3
LTR (MVA)		113.0	113.0	113.0	113.0	113.0	113.0	113.0	113.0	113.0	113.0
Courtice Steel (Based on Peak Load in 2000)											
MW	42.2	42.2	42.2	42.2	42.2	42.2	42.2	42.2	42.2	42.2	42.2
MVAR	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1
MVA	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TOTAL LOAD											
MW	290.7	326.0	336.1	346.6	357.5	368.7	380.4	392.3	404.9	417.7	489.4
MVAR (Net)	116.8	134.7	140.0	145.3	150.9	156.7	162.7	168.8	175.3	181.7	218.5
MVA	317.7	357.6	368.9	380.6	392.8	405.3	418.4	431.7	445.8	460.0	540.0
LINE LOADING ANALYSIS											
M21D With M20D O/S	Rating (A)	Amps unless otherwise noted									
Middleport x Galt Jct (1924 kcmil ACSR)	2,060	LINE LOADING IS WITHIN RATING									
Detweiler x Galt Jct (1924 kcmil ACSR)	2,060										
Preston Jct x Preston TS (795 kcmil ACSR)	860										
Galt Jct x Preston Jct (932.7 kcmil ACSR)											
(1) No Measures Taken	1,120	974	1,018	1,065	1,113	1,164	1,216	1,272	1,330	1,390	1,787
Power Factor @ C/ND TS (230kV) (%)		87.2	87.0	86.7	86.5	86.0	85.5	85.0	84.5	84.0	83.0
Abrupt Voltage Changes (%)										>10	>10
(2) Add 20MVar Capacitor bank(s) in 2002	1,120	947	989	1,032	1,077	1,123	1,172	1,223	1,276	1,332	1,693
(3) Add additional 20MVar cap bank(s) in 2006	1,120	947	989	1,032	1,077	1,083	1,128	1,175	1,223	1,274	1,599
(4) Upgrade Circuit to 150°C Operation	1,350	974	1,018	1,065	1,113	1,164	1,216	1,272	1,330	1,390	1,787
(5) (4) + (2)	1,350	947	989	1,032	1,077	1,123	1,172	1,223	1,276	1,332	1,693
(6) Increase Capacity by Reconductoring	1,580	974	1,018	1,065	1,113	1,164	1,216	1,272	1,330	1,390	1,787
(7) (6) + (2)	1,580	947	989	1,032	1,077	1,123	1,172	1,223	1,276	1,332	1,693
M20D With M21D O/S											
Middleport x Galt Jct (1924 kcmil ACSR)	2,060	LINE LOADING IS WITHIN RATING									
Detweiler x Galt Jct (1924 kcmil ACSR)	2,060										
Preston Jct x Preston TS (795 kcmil ACSR)	860										
Galt Jct x Preston Jct (932.7 kcmil ACSR)											
(1) No Measures Taken	1,120	816	855	897	940	985	1,033	1,083	1,135	1,190	1,587
(2) Add 20MVar Capacitor bank(s) in 2002	1,120	787	824	864	905	948	993	1,041	1,090	1,143	1,504
(3) Add additional 20MVar cap bank(s) in 2006	1,120	787	824	864	905	911	954	999	1,046	1,095	1,420
(4) Upgrade Circuit to 150°C Operation	1,350	816	855	897	940	985	1,033	1,083	1,135	1,190	1,587
(5) (4) + (2)	1,350	787	824	864	905	948	993	1,041	1,090	1,143	1,504
(6) Increase Capacity by Reconductoring	1,580	816	855	897	940	985	1,033	1,083	1,135	1,190	1,587
(7) (6) + (2)	1,580	787	824	864	905	948	993	1,041	1,090	1,143	1504**
VOLTAGE ANALYSYS											
Steady State Voltage Levels	Within range specified in "Grid Connection Requirements" (220 kV - 250 kV for 230 kV system)										
Abrupt Voltage Changes - Capacitor Switching	Less than 4% (meets Grid Connection Requirements)										
- Line Contingency	Less than 10% until 2009. 20 - 40 MVar cap bank(s) can extend this to approx 2012 - 2014										
Power Factor	Below 90% in 2002. 20 Mvar cap bank(s) would keep PF above 90% until about 2015										

* Excludes load on Wolverton DS (approx 6.5 MW)

** Additional 20 Mvar capacitor bank(s) needed in 2012 due to abrupt voltage change limitation. This extends adequacy to 2014.

Shaded areas indicate line loading exceeds rating or other requirement not met.