

July 27, 2007

John W. Grotheer,
President & CEO
Cambridge and North Dumfries Hydro Inc.
P.O. Box 1060/1500 Bishop Street
Cambridge, Ontario
N1R 5X6

Dear Mr. Grotheer:

**Cambridge MTS #1 – Install four new 27.6 kV Feeder Positions
Notification of Approval of Connection Proposal
CAA ID Number: 2006-EX287**

Thank you for the detailed information regarding the installation of four new 27.6 kV feeders at Cambridge MTS #1. After the new feeders have been installed, the existing load will be balanced over the eight feeders.

From the information provided, our review concludes that the proposed changes will not result in a material adverse effect on the reliability of the IESO-controlled grid. The IESO is therefore pleased to grant conditional approval for the proposed modifications, subject to the implementation of the requirements detailed in the attached assessment report. Any material changes to your proposal may require re-assessment by the IESO in accordance with Market Manual 2.10, and may nullify your conditional approval.

Final approval will be granted upon successful completion of the IESO Facility Registration process. During facility registration you will be expected to demonstrate that you have fulfilled the requirements and the modification is in line with the proposal assessed by the IESO. Please contact market.entry@ieso.ca if you have not received a Facility Registration Summary package within the next 10-days.

For further information, please contact the undersigned.

Yours truly,

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cc: IESO Records

Cambridge and North Dumfries Hydro Inc. acknowledges receipt of the System Impact Assessment Report setting out the IESO requirements for final approval, and commits to fulfill these requirements, and all other applicable Market Rules, before receiving final approval to connect to the IESO-controlled grid.

Dated: _____

Per: _____

Name: _____

Title: _____

ASSESSMENT SUMMARY

Cambridge and North Dumfries Hydro Inc.

1.0 GENERAL DESCRIPTION

Cambridge and North Dumfries Hydro Inc. has installed four additional 27.6 kV feeder positions at Cambridge MTS #1. Cambridge MTS #1 is connected to the 230 kV circuits M20D and M21D between Detweiler TS and Middleport TS as shown in figure 1. Cambridge MTS #1 station contains two 3 phase 230/27.6 kV transformers rated at 50/66.7/83.3 MVA.

The new 27.6 kV feeders will normally be operated radial. The connection to the 230 kV transmission system will not be changed.

The scheduled in-service date is the end of June 2007.

1.1 Background & Previous Findings

In 2001, the IESO performed a Preliminary Assessment and issued a preliminary assessment report ([CAA ID #2000-030](#)) and Notification of Approval for the new Cambridge MTS #1. The preliminary assessment conclusions and findings are summarized below:

- A. IESO studies showed that the power factor, assuming the meter point is on the 230 kV side, would be below 90% by 2002. The Notice of Approval for Cambridge MTS #1 was granted subject to certain requirements including the installation of LV shunt capacitors. The Connection Applicant may choose to install capacitors 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.
- B. 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 400 MW by 2010. A double circuit line outage will result in the 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 to be restored within 30 minutes following a double circuit line contingency.
- C. Circuit M21D, Galt Jct x Preston TS, with no corrective measures taken, will be overloaded in 2006 with M20D out of service.
- D. IESO studies showed that voltage changes will begin to exceed 10% of steady state rms voltage for line switching operations beginning in 2010 with 20 MVAR capacitor banks installed or beginning in 2014 with 40 MVAR capacitor banks installed.

2.0 PROPOSED MODIFICATION

This station has been in service since the summer of 2002. The existing 230/27.6 kV transformers were rated to accommodate four additional feeders at the time Cambridge MTS #1 was constructed. After the new feeders are installed, the existing load will be balanced over the eight feeders. For 2007 the peak load is estimated to be 9.25 MW per feeder (74 MW total as shown in Table 1) according to load projections from Cambridge and North Dumfries Hydro Inc.

A new 250MVA, 230/115 kV autotransformer at Preston TS is scheduled to be in-service by the end of 2007, connecting M20D/M21D with F11C/F12C (new extensions to D9G/D7G respectively). This report, CAA ID #2006-215 will be posted on the [Application Status](#) webpage.

A new Cambridge MTS#2 is scheduled to be in-service for 2012 (or later). It is not yet known if this station will be connected to the 115 kV or the 230 kV lines.

3.0 GENERAL REQUIREMENTS

3.1 Voltage Reduction Facilities

The *Market Rules* (Chapter 4 Appendix 4.3) require that distributors connected to the IESO controlled grid with directly connected load facilities of aggregated rating of 20 MVA or more and the capability to regulate distribution voltage under load, shall install and maintain facilities to provide voltage reduction capability to achieve load reduction during periods when supply resources are limited. Voltage reduction capability represents the capability of reducing demand by lowering the customer voltage by 3% and 5% and having the controlling authority to be able to effect the voltage reduction within five minutes of receipt of the direction from the IESO.

Cambridge MTS#1 voltage reduction capability that provides 3% and 5% voltage reduction within five minutes must be maintained.

3.2 On-line Monitoring

The Market Rules (Chapter 4 section 7.5) require that each distributor connected to the IESO shall provide the IESO on a continual basis with on-line monitored quantities as specified in Appendix 4.17. It is required that Cambridge and North Dumfries Hydro Inc. install all the equipment needed to monitor the information required by the IESO on a continuous basis. The IESO requires that the status of all isolating disconnect switches and breakers as well as 230 and 27.6 kV voltages, and active and reactive power flows over the transformers to be monitored and available to the IESO on a continual basis.

3.3 Underfrequency Load Shedding Requirements

The *Market Rules* (Chapter 5 section 10.4) require that each distributor and connected wholesale customer, in conjunction with the relevant transmitter, make arrangements to enable the automatic disconnection of up to 35% of its peak demand for conditions of system under-frequency.

The under frequency automatic load shedding should be provided by tripping 27.6 kV feeder breakers to achieve:

- Automatic load shedding of 12% of station load at a nominal set point of 59.3 Hz and
- Automatic load shedding of an additional 23% of station load at a nominal set point of 58.8 Hz, for a total load reduction of 35% of the total station load.

The under frequency threshold relays shall be set to a nominal operating time of 0.30 second, from the time when frequency passes through the set point to the time of circuit breaker trip initiation (including any communications time delay), when the rate of frequency decay is 0.2 Hertz per second.

Cambridge and North Dumfries Hydro Inc. are required to identify the UFLS feeder selection to the IESO.

4.0 ASSESSMENT

The 27.6 kV breaker specifications are not part of this assessment.

4.1 Load Projections vs. Actual Load

In the original preliminary assessment report for Cambridge MTS #1, the maximum load projected for 2006 at this TS was 67.6 MW and 34.5 MX or 75.9 MVA. A load projection from Cambridge and North Dumfries Hydro forecasted a slightly lower load peak for 2006 at 56.5 MW and 34.7 MX or 66.3 MVA.

The actual 2006 load peak of 72.6 MVA occurred on July 17, 2006 at 13:00. The peak station load coincident with the system peak of August 1, 2006 was 60.2 MVA between 12:45 and 13:20.

Table #1 compares the 2001 forecast used in the previous preliminary assessment report with the actual peak loads.

Station	Transformer Ratings (MVA)	Station Loads (MVA)		
		2001 Forecast of 2006 Station Loads ^A	Station Loads 2006 System Peak (August 1, 2006)	Station Loads 2006 Non-coincident Peak

Cambridge MTS #1	2 x 50/66.7/83.3 10-DAY LTR = 113	75.9	60.2 (12:45 to 13:20)	72.6 (July 17/06, 13:00)
Preston TS	2 x 75/100/125 10-DAY LTR = 125.5	113.0	118.0 (12:00)	118.0 (Aug 1/06, 12:00)
Galt TS	2 x 75/100/125 10-DAY LTR = 194.6	162.8	158.2 (15:00)	176.0 (July 17/06, 11:00)
Gerdau Cambridge	1 x 15/20 1 x 54/72/90 1 x 50/65	53.6	38.5 (20:00)	44.7 (Sept 29/06, 03:00)
Totals		405.3	374.9	n/a

Table 1: Comparison of Original 2006 Load Forecast with Actual 2006 Load Peaks

A. Data from preliminary assessment report (CAA ID #[2000-030](#)) for Cambridge MTS #1.

Table #2 contains a load forecast provided by Cambridge and North Dumfries Hydro. The maximum load at Gerdau Cambridge is assumed to be 44.7 MVA throughout this reporting period. This forecast does not extend past 2012 and therefore does not include the planned addition of MTS#2.

		Cambridge MTS #1	Galt TS	Preston TS	Gerdau Cambridge	Totals
2007	MVA	74.0	178.1	120.7	44.7	417.5
	pF	90%	95%	84%	89%	
2008	MVA	87.9	178.1	114.6	44.7	425.3
	pF	90%	95%	88%	89%	
2009	MVA	101.7	178.1	114.6	44.7	439.1
	pF	90%	95%	88%	89%	
2010	MVA	105.7	178.1	125.5	44.7	454.0
	pF	90%	95%	88%	89%	
2011	MVA	113.0	185.9	125.5	44.7	469.1
	pF	90%	95%	88%	89%	
2012	MVA	113.0	194.6	125.5	44.7	477.8
	pF	90%	94%	88%	89%	

Table 2: Load Forecasts for Cambridge MTS #1 and Area

The load at Cambridge MTS #1 is projected to increase, reaching a maximum of 113.0 MVA in 2011. This is lower than the earlier prediction.

The load at Galt TS is projected to reach a maximum of 194.6 MVA. This is higher than the earlier prediction.

The load at Preston TS is projected to reach a maximum of 125.5 MVA. This is higher than the earlier prediction.

The current forecast has not changed significantly from the 2001 forecast and therefore we can conclude that the requirements in the previous preliminary assessment report are still valid.

4.2 Cambridge MTS #1

Cambridge MTS #1 consists of two 83.3 MVA transformers. With the addition of four new feeders to redistribute existing load, the 2007 estimated peak load of 74 MVA is below the summer 10-DAY LTR of 113 MVA for one transformer. Based on the current load forecast, the station capability of 113 MVA will be reached by 2011.

4.3 M20D and M21D Tap Capabilities

The following table #3 provides the continuous and 15-MIN ratings of the M20D and M21D line sections supplying Galt TS, Preston TS, Cambridge MTS #1 and Gerdau Cambridge TS. Line voltages are assumed to be 235 kV during continuous operating conditions and 230 kV after a contingency according to load flow results using 2007 peak loads.

Circuit section ratings in MVA are dependant on the line voltage, conductor temperatures, ambient temperature and wind conditions and may vary slightly from other analyses.

Circuit Section	Continuous Rating (35° C ambient, wind 4 km/hr, 235 kV)	15-MIN LTR (35° C ambient, wind 4 km/hr, 75% pre-load, 230 kV)
M20D		
Preston Jct x Cambridge #1 Jct x Preston TS (strand 62, sections 9 & 10)	860 A, 350 MVA (conductor temp 96°C)	960 A, 382 MVA (conductor temp 96°C)
Galt Jct x Preston Jct (strand 56, section 6)	1130 A, 460 MVA (conductor temp 116°C)	1270 A, 506 MVA (conductor temp 116°C)
M21D		
Ameristeel Cambr Jct x Ameristeel Cambr CTS (strand 56, section 8)	1090 A, 444 MVA (conductor temp 127°C)	1210 A, 482 MVA (conductor temp 127°C)
Preston Jct x Cambridge #1 Jct x Preston TS (strand 62, sections 11 & 12)	860 A, 350 MVA (conductor temp 96°C)	1270 A, 506 MVA (conductor temp 96°C)
Galt Jct x Ameristeel Cambr Jct (strand 56 & 62, section 6)	1130 A, 460 MVA (conductor temp 116°C)	1270 A, 506 MVA (conductor temp 116°C)

Table 3: M20D & M21D Circuit Section Ratings

4.3.1 M20D Circuit Section Ratings

In this section we look at the ability of each M20D circuit section from Galt Jct to supply load if M21D is out of service. Peak loads at each transformer station are assumed to reach the summer 10-DAY LTRs of the transformers.

The M20D circuit sections #9 and #10 (Preston Jct x Cambridge #1 Jct x Preston TS) supplying T4 at Preston TS and T2 at Cambridge MTS#1 have a continuous rating of 350 MVA (860 A). The loss of M21D means this M20D circuit section has to supply 125.5 MVA to Preston T4 plus 113 MVA to MTS#1 T2 for a total of 238.5 MVA. The maximum load forecast for these stations is 238.5 MVA by 2011. This is equal to the continuous rating of this circuit section.

The M20D circuit section #6 (Galt Jct x Preston Jct) supplying T4 at Preston TS, T2 at Cambridge MTS#1 and T7 at Galt TS has a continuous rating of 460 MVA (1130 A). The loss of M21D means this M20D circuit section has to supply 125.5 MVA to Preston T4 plus 113 MVA to MTS1 T2 plus 194.6 MVA to Galt T7 for a total of 433.1 MVA. The maximum load forecast for these stations is 433.1 MVA by 2012. This is equal to the continuous rating of this circuit section.

4.3.2 M21D Circuit Section Ratings

In this section we look at the ability of each M21D circuit section to supply load if M20D is out of service. Peak loads at each transformer station (excluding Gerdau Cambridge) are assumed to reach the summer 10-DAY LTRs of the transformers. The maximum load at Gerdau Cambridge is assumed to not exceed 44.7 MVA through 2021, therefore, this value is used instead of the summer 10-DAY LTR.

The M21D circuit section #8 (Ameristeel Cambr Jct x Ameristeel Cambr CTS) supplying Gerdau Cambridge has a continuous rating of 444 MVA (1090 A). As the load to Gerdau Cambridge is not projected to exceed 44.7 MVA, this M21D circuit section is rated sufficiently high if M20D is lost.

The M21D circuit sections #11 and #12 (Preston Jct x Cambridge #1 Jct x Preston TS) supplying T3 at Preston TS and T1 at Cambridge MTS#1 have a continuous rating of 350 MVA (860 A). The loss of M20D means this M21D circuit section has to supply 125.5 MVA to Preston T3 plus 113 MVA to MTS1 T1 for a total of 238.5 MVA. The maximum load forecast for these stations is 238.5 MVA by 2011. This is equal to the continuous rating of this circuit section.

The M21D circuit section #6 (Galt Jct x Ameristeel Cambr Jct x Preston Jct) supplying Gerdau Cambridge, T3 at Preston TS, T1 at Cambridge MTS#1 and T8 at Galt TS has a continuous rating of 460 MVA (1130 A). Assuming that all stations would carry loads equivalent to their maximum capabilities, this M21D section has to supply 44.7 MVA to Gerdau Cambridge plus 125.5 MVA to Preston T3 plus 113 MVA to MTS1 T1 plus 194.6 MVA to Galt T8 for a total of 477.8 MVA if M20D is lost. This is higher than the continuous rating of this circuit section. The continuous rating of this M21D circuit section rating will be exceeded when the forecast load exceeds 460 MVA (based on 235 kV).

A similar conclusion was reached by Hydro One's Detweiler Area Supply Study in 2003 (draft 0.3) which stated that the flow on the Galt Jct x Courtice Jct (now Galt Jct x Ameristeel Cambr Jct) section of M21D will exceed its continuous rating in the future. The report made the statement that the line will have to be upgraded.

4.3.3 Power Factor

At present, Cambridge and North Dumfries Hydro Inc. do not meet the power factor requirements of the System Impact Assessment issued in 2002 for the station. The preliminary assessment report for Cambridge MTS #1, recommended that low voltage shunt capacitors be connected to the MTS #1 feeders to alleviate expected power factor deficiencies.

Operational information for a 3 year period show that the power factor at Cambridge MTS #1T1 and T2 has been below 0.9 for long periods of time. This is illustrated in figure 1 below.

Cambridge MTS #1 pF - July 2003 to July 2006

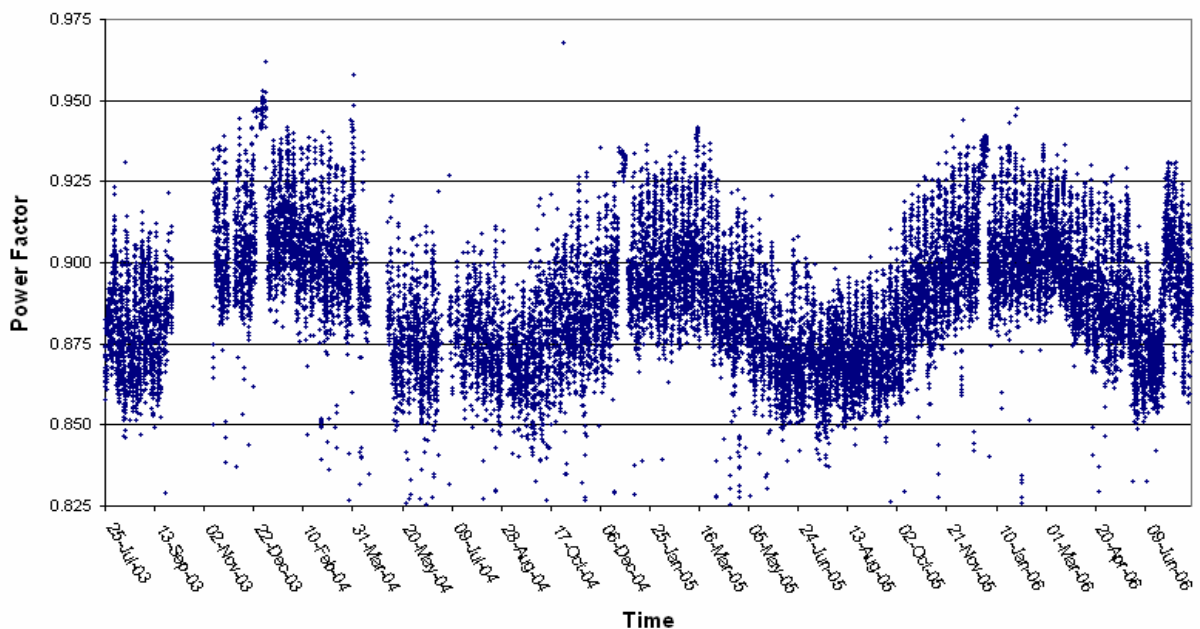


Figure 1: Historical Power Factor

Based on IESO records, the lowest pf point at Cambridge MTS #1 between July 2003 and July 2006 occurred on June 20, 2006 at 22:00 with a value of 0.724. The actual values were as follows:

Date	Time	CAMBRIDGE T1	CAMBRIDGE T1	CAMBRIDGE T2	CAMBRIDGE T2	pF

01/17/2006	22:00:00	15.42 MW	-6.27 MVar	16.77 MW	24.37 MVar	0.724
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According to Cambridge and North Dumfries Hydro Inc., there are two 1200 kVAr capacitor banks currently installed on low voltage feeders at Cambridge MTS #1 with plans to install an additional six 1200 kVAr capacitor banks during 2007. They have stated that they will achieve a power factor of 90% at Cambridge MTS#1 by the summer of 2007. This value will decline as the load increases, therefore, additional capacitor banks will have to be installed.

The 2007 forecast of 79.2 MVA @ 86% pF results in 68.1 MW and 40.4 MX. Adding capacitor banks totaling 9600 kVAr increases the power factor to 91.1 %.

Current power factor projections remain below 90% for Preston TS and Gerdau Cambridge throughout 2012.

4.4 Voltage Assessment

A detailed voltage decline study will be included in the report for the new Cambridge Preston autotransformer. (CAA ID #2006-215)

5.0 CONCLUSIONS

Current measurements confirm that the power factor at Cambridge MTS #1 is often below 90% and therefore Cambridge and North Dumfries Hydro Inc. does not currently meet the Market Rules requirements for power factor at this location. This conclusion was stated in section 1.1.A of the original assessment for Cambridge MTS#1 and is still valid.

Load projections for two other transformer stations on these taps (Preston TS and Gerdau Cambridge) predict that the power factor will also be lower than 90% at these stations.

Section 1.1.B reported that the peak load on the 230 kV radial supply circuits M20D and M21D will exceed 400 MW by 2010. Based on the load projections stated earlier in this report, the peak load on these lines will exceed 500 MW by 2013. This would exceed the limit in section 7.2 of the Ontario Resource & Transmission Assessment Criteria document, which requires that facilities should be available to allow loads in excess of 250 MW to be restored within 30 minutes following a double circuit line contingency.

Section 1.1.C reported that M21D, Galt Jct x Preston TS, with no corrective measures taken, will be overloaded in 2006 with M20D out of service. This report concludes that this overload situation will occur in the future when the forecast load exceeds the rating of the line section.

This expedited System Impact Assessment concludes that the addition of four new feeder positions at Cambridge MTS #1 is not expected to have a material adverse impact on the IESO-controlled grid. Specifically, the new feeders will not result in increased power flows exceeding the thermal capability of the station equipment or the taps that are directly supplying this station.

6.0 REQUIREMENTS & RECOMMENDATIONS

6.1 Cambridge and North Dumfries Hydro Inc. - Requirements

Based on this analysis it is required that:

- to achieve 90% lagging pF at Cambridge MTS#1, Cambridge and North Dumfries Hydro Inc. must provide to the IESO a plan, before September 1, 2007, to install the required power factor correction devices with in-service dates. Power factor devices installed on the station's LV bus will have to undergo a connection assessment and be approved by the IESO. Devices installed at the customer stations will have to be reviewed by the distributor.
- Cambridge and North Dumfries Hydro Inc. must ensure that sufficient under-frequency load shedding (UFLS) relays are installed to meet the Market Rules requirements for automatic disconnection of up to 35% of its peak demand for conditions of low system frequencies as per the Market Rules, chapter 5, section 10.4.
- Cambridge MTS#1 voltage reduction capability that provides 3% and 5% voltage reduction within five minutes must be maintained.
- Cambridge and North Dumfries Hydro Inc. identify the UFLS feeder selection to the IESO.
- the status of all isolating disconnect switches and breakers as well as 230 and 27.6 kV voltages, and active and reactive power flows over the transformers to be monitored and available to the IESO on a continual basis.

6.2 *Hydro One Networks Inc. - Recommendations*

It is recommended that Hydro One Networks Inc. consider plans for providing an alternative high voltage supply to the area load to satisfy the Load Restoration Criteria outlined in section 7.2 of the Ontario Resource & Transmission Assessment Criteria document which states:

"The transmission system must be planned such that, following design criteria contingencies on the transmission system, affected loads can be restored within the restoration times listed below: ...

- c. When the amount of load interrupted is greater than 250 MW, the amount of load in excess of 250 MW must be restored within 30 minutes."

7.0 *NOTIFICATION OF APPROVAL*

It is therefore recommended that a Notification of Approval of the Connection Proposal be issued subject to the implementation of the requirements listed in section 5.1.