

## **FINAL DRAFT REPORT**

### **WHITBY TS #1 – CAPACITOR BANK INSTALLATION IESO EXPEDITED ASSESSMENT – 2007-EX333 ASSESSMENT SUMMARY**

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#### **1.0 PROJECT DESCRIPTION**

Hydro One Networks is proposing to install one 21.6 MVar permanent shunt capacitor bank on the 44 kV bus at Whitby TS (DESN #1).

The need for the capacitor bank at Whitby TS #1 was identified in the System Impact Assessment Report (CAA ID 2005-198) for the addition of the 2nd DESN at Whitby TS. To meet the load power factor requirement a total of 40 MVar LV of shunt capacitor may be required to be installed at Whitby TS #1.

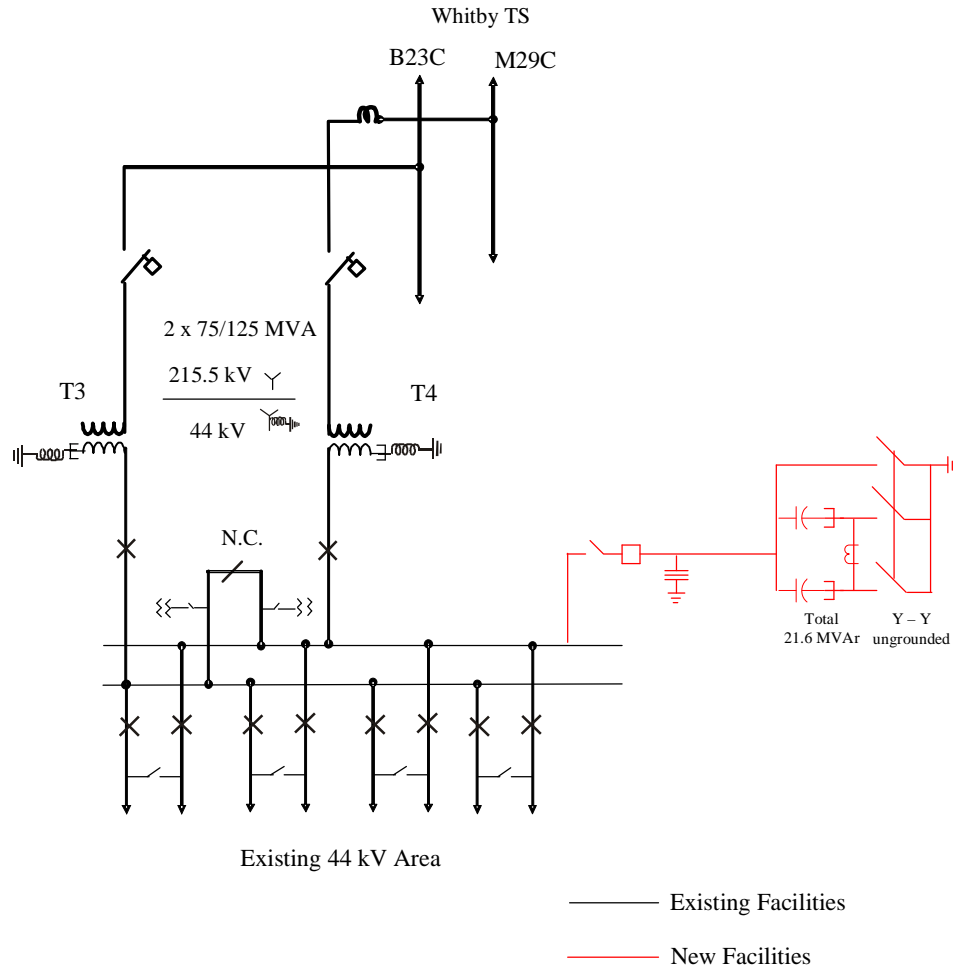
The LDCs (Whitby Hydro and Veridian Connections) that are supplied from Whitby TS #1 have indicated that they will provide power factor correction at customer level and distributor level to ensure that the power factor of their load on Whitby TS #1 remains above 0.9 prior to the 2008 summer load season. Hydro One will be adding 21.6 MVar of shunt capacitor bank at Whitby TS #1 as their contribution to correct the power factor to compensate for the reactive power loss of the transformers.

This study will examine the effect of the installation of LV shunt capacitor at Whitby TS #1 on the reliability of the IESO-Controlled grid.

The proposed ready for service date for the new capacitors is June 15, 2008.

#### **2.0 EQUIPMENT DATA**

The proposed project involves the installation of one 21.6 Mvar LV shunt capacitor bank and some related equipment as shown in the following figure.



Whitby TS – Exist DESN # 1  
Proposed One New Capacitor Bank

Hydro One provided specifications for shunt capacitor bank, together with disconnect switch and circuit breaker as follows:

**2.1 Shunt Capacitor Bank**

**Table 1 Specifications for Shunt Capacitor Bank**

Rated Capacitance	21.6 MVar @ 46 kV
Nominal System Voltage	44 kV
Rated Maximum Voltage	46.6 kV
System Frequency	60 Hz
Symmetrical Short Circuit Level	20 kA
Configuration	Wye- Wye ungrounded
Insulation level	250 kV BIL (min)
Loss evaluation	\$600/kW

## 2.2 Circuit Breaker

**Table 2 Specifications for Circuit Breaker**

Basic Insulation level	250 kV peak BIL (min)
Rated Maximum Voltage	46.6 kV rms
Rated Continuous Current	1200 A
Fault Interrupting Current	20 kA
Rated Momentary Current	54 kA peak
Capacitor current Interrupting Duty	370 A rms
Rated Transient Recovery Voltage duty for restriking free capacitor switching	113 kV peak
Rated Transient Inrush current with 0.5 mH series reactor	4.42 kA peak@1.4 kHz

## 2.3 Disconnect Switch

One 3-phase, disconnect switch is to be installed between the bus and the circuit breaker. This switch is to be rated as follows:

**Table 3 Specifications for Disconnect Switch**

Continuous current (min)	1200 A rms
Operating voltage	44 kV rms (nom.), 46.6 kV (Max continuous)
Insulation level (L-G and L-L) (min)	250 kV peak BIL
Short circuit withstand capability (min)	20 kA rms symmetrical

## 3.0 ASSESSMENTS

The requirements for abrupt voltage changes due to capacitor switching are listed in Appendix 4.4 in Market Rules as follows:

- Voltage changes shall not normally exceed 4% of steady state rms for capacitor switching operations.

Switching study was carried out to investigate the effect of the new LV shunt capacitor banks on the voltage changes at Whitby TS #1. The study was performed using the same July 2010 base case as used in Whitby TS #2 SIA study.

The voltages at LV bus and HV buses of M29C and B23C at Whitby TS #1 monitored and the results are shown in Table 4.

**Table 4 Voltage Changes at Whitby TS #1 for Shunt Switching**

LV			HV M29C			HV B23C		
PRE	POST	%	PRE	POST	%	PRE	POST	%
44.2	45.0	1.81	243.9	244.3	0.16	243.6	244.0	0.16

The study shows that the maximum steady state voltage change resulting from the capacitor switching is 1.81% which would be within the Market Rules requirement of 4%.

## **4.0 CONCLUSIONS**

The IESO has concluded that the proposed installation of LV shunt capacitor banks will improve power factor at Whitby TS #1 and not have a negative effect on the reliability of the IESO-controlled grid.

## **5.0 NOTIFICATION OF APPROVAL**

It is therefore recommended that a Notification of Approval of the Connection Proposal be issued.