

June 7, 2006
Mr. Ajay Garg
Manager–Transmission Load Connections
Hydro One Networks Inc.
483 Bay Street, 15th Floor – North Tower
Toronto, ON.,
M5G 2P5

Dear Mr. Garg,

Armitage TS: Replacement of LV Shunt Capacitors
Notification of Approval of Connection Proposal
CAA ID Number: 2006-211 Phase I

Thank you for the detailed information regarding the replacement of the four existing shunt capacitor banks (19.8 Mvar) with four larger units (32.4 Mvar) at Armitage TS which is Phase I of the proposed Holland TS project (CAA ID Number: 2006-211).

From the information provided, our review concludes that the new four larger units (32.4 Mvar) at Armitage TS meet the IESO Market Rules' requirements and will improve the voltage profile at Armitage TS. An assessment summary is attached to this notification. It can be concluded that the proposed project 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 installations. 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,

Michael Falvo
Manager - Transmission Assessments & Performance
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cc: IESO Record

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.

**ARMITAGE TS – CAPACITOR BANK REPLACEMENT
IESO SYSTEM IMPACT ASSESSMENT – 2006-211 PHASE I
ASSESSMENT SUMMARY**

1.0 PROJECT DESCRIPTION

Hydro One Networks Inc. is proposing to replace the four existing shunt capacitor banks (19.8 Mvar) at Armitage TS with larger units (32.4 MVA). The breakers for the existing capacitor banks are not to be replaced.

The peak summer loads on the two 230/44kV DESN stations at Armitage TS have exceeded the limited-time-ratings of the existing facilities. Summer 2005 peak load at Armitage TS was 375 MW, about 18% above the planning limit of 317 MW. Load growth in the area is averaging about 3% per year. The OPA, in their “Northern York Region Electricity Supply Study” dated September 30, 2005 (Section 6.2 – Phase 1 – York Region) recommended the following projects to develop a solution to address the ongoing load growth:

1. Increase the amount of static capacitors at Armitage TS by the summer of 2006.
2. Establish a new 230-44 kV, 75/125 MVA DESN station at Holland Junction, along with static capacitors at this station.

Hydro One has requested the IESO to precede with a CAA study for the new Holland TS and the replacement of capacitor banks at Armitage TS (CAA ID 2006-211). The replacement of capacitors at Armitage TS is assessed as Phase I of this CAA study.

This study will examine the effect of the replacement of capacitor banks on the reliability of the IESO-Controlled grid.

The proposed ready for service date for the new capacitors is June, 2006.

2.0 EQUIPMENT DATA

The proposed project involves replacement of the four existing 19.8 MVAR LV capacitor banks at Armitage TS, SC1, SC2, SC3 and SC4 with 32.4 MVAR shunt capacitor banks, and some related equipment. The following is a summary listing the equipment to be installed.

- Four 3-Phase Shunt Capacitor Banks
- Three Current Limiting Reactors
- Twelve Surge Arresters for Capacitor Banks
- Six Surge Arresters for Cable Sheath Protection

The data for new capacitors was provided by Hydro One and is summarized in Table 1.

Table 1 Specifications of Capacitor Banks

Rated Frequency	60 Hz
Rated MVAR	32.4 MVAR
Rated Voltage	46 kV
Nominal System Voltage	44 kV
Maximum Operating Voltage	46.6 kV
Symmetrical Short Circuit Level	20 kA
Maximum System Voltage Unbalance	2%
Configuration	Double wye ungrounded
Fusing	Internally Fused
Insulation Level	250 kV crest
Loss Evaluation	\$1800/kW

The existing three current limiting reactors (one per phase) associated with SC1 are to be replaced with new reactors with the following specifications in Table 2.

Table 2 Specifications of Series Reactor

Total Number	3 (one per phase)
Location	Between capacitor bank and breaker
Type	Air-core, current limiting
Size	1.0 mH
Maximum Voltage	46.6 kV (rms. line-to-line)
Continuous Current Rating	600 A
Symmetrical Fault Current	20 kA (rms.)
Asymmetrical Fault Current	54 kA (peak.)
Estimated Inrush Current	5.35 kA peak @ 1.117 kHz
Switching Duty	Daily
Insulation Level Across Coil	250 kV BIL
Insulation Level to ground	250 kV BIL
Loss Evaluation	\$1800 per kW (min)

The system performance standards listed in the Transmission System Code requires that the 44 kV systems fault levels not exceed 20 kA. This indicates that 44 kV equipment must be sized to interrupt 20 kA. The LV shunt capacitors and series reactors proposed for installation at Armitage TS meet the interrupting capability recommended by the Transmission System Code.

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 new LV shunt capacitor banks on the voltage changes at Armitage TS. The study was performed using June 2006 base case for the following scenarios:

- Keele Valley IN/OUT of service
- Different loading of Armitage TS: 200 MW, 317 MW and 366 MW

The voltages at LV buses T1/T3 and T2/T4, HV buses for T1/T3 and T2/T4 at Armitage TS were monitored and the results are shown in table 3 through table 6. It should be noted that results in tables 3, 4 and 5 were based on Keele Valley generation out of service which represents worse conditions for voltage change.

Table 3. Voltage Changes With 200 MW at Armitage TS

LV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1T3			T2T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	46.29	47.881	3.62	46.63	46.937	0.70
	T2T4	1 cap (30.99MX)	46.562	46.871	0.70	46.407	47.952	3.51
HV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1T3			T2T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	244.43	246.04	0.73	243.93	245.53	0.73
	T2T4	1 cap (30.99MX)	244.39	246.01	0.74	243.9	245.5	0.73

Table 4. Voltage Changes With 317 MW at Armitage TS

LV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	46.325	47.881	3.54	46.387	46.693	0.70
	T2T4	1 cap (30.99MX)	46.497	46.804	0.70	46.27	47.768	3.40
ALL O/S	T1T3	1 cap (30.99MX)	45.973	47.49	3.45	46.012	46.321	0.70
	T2T4	1 cap (30.99MX)	45.973	46.284	0.71	46.012	47.479	3.33
HV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	237.75	239.31	0.71	237.31	238.86	0.70

	T2T4	1 cap (30.99MX)	237.71	239.27	0.71	237.27	238.82	0.70
ALL O/S	T1T3	1 cap (30.99MX)	231.08	232.62	0.70	230.68	232.22	0.70
	T2T4	1 cap (30.99MX)	231.08	232.64	0.71	230.68	232.22	0.70

Table 5. Voltage Changes With 366 MW at Armitage TS

LV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	46.131	47.662	3.48	46.059	46.362	0.69
	T2T4	1 cap (30.99MX)	46.254	46.558	0.69	45.997	47.466	3.34
HV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	234.33	235.85	0.69	233.9	235.42	0.69
	T2T4	1 cap (30.99MX)	234.28	235.81	0.70	233.86	235.38	0.69

Table 6 Voltage Changes With Keele Valley In Service

LV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	46.323	47.906	3.60	46.463	46.721	0.59
HV (kV)								
INITIAL CONDITION	CAP SWITCHED IN		T1/T3			T2/T4		
			PRE	POST	%	PRE	POST	%
3 SC I/S	T1T3	1 cap (30.99MX)	244.59	246.15	0.71	244.09	245.64	0.70

The study shows that the maximum steady state voltage change resulting from the capacitor switching is 3.62% which would be within the Market Rules requirement of 4%.

4.0 CONCLUSIONS

The IESO has concluded that the proposed replacement of the shunt capacitor banks with the larger units will improve voltage profile at Armitage TS and will 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.