

January 19, 2006  
Mr. Kim Wong  
Senior Engineer-Technical Compliance  
Power Equipment Department  
EP Services Division, Electricity Production  
Ontario Power Generation

Dear Mr. Wong:

*Lennox GS Units 1- 4 Exciter Replacements  
Notification of Approval of Connection Proposal  
CAA ID Number: 2005-EX252*

Thank you for the information that you submitted regarding the replacement of the excitation systems on each of the four generating units at Lennox GS. Your letter indicates that the replacement is required due to aging of the equipment, and that the new exciter systems will functionally be the same as the old ones. The data supplied by OPGI for the excitation systems is attached to this notification.

From the information provided, our review concludes that the new excitation systems at Lennox GS represent like-for-like replacements and 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 [facility.registration@ieso.ca](mailto:facility.registration@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.

Ontario Power Generation 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: \_\_\_\_\_

## **LENNOX GS – EXCITER REPLACEMENT IESO EXPEDITED SYSTEM IMPACT ASSESSMENT – 2005-EX252**

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### **1.0 Project Description**

Ontario Power Generation Inc. (OPGI) is planning to replace the static exciters on all four Lennox units due to equipment obsolescence.

The generator capacity of units 1 to 4 at Lennox GS is 525 MVA and the four new exciters are to be identical. Currently, the four units at Lennox GS are equipped with the same General Electric Silcomatic analog-electronic full-static excitation system with a separate power system stabilizer (PSS). The replacement system will be of a digital design which offers fully-redundant microprocessor based control circuits (AVR & PSS).

The static exciters at Lennox GS are scheduled for replacements starting with one unit in 2005. The scheduled in service dates for these static exciters are as follows:

- G1 Generator: December 2006
- G2 Generator: December 2005
- G3 Generator: May 2006
- G4 Generator: October 2006

### **2. Market Rule Requirements**

The requirements for exciters on generation unit rated at 10 MVA or higher are listed in Reference 12 of Appendix 4.2 in Market Rules as follows:

- A voltage response time not longer than 50 ms for a voltage reference step change not to exceed 5%;
- A positive ceiling voltage of at least 200% of the rated field voltage, and
- A negative ceiling voltage of at least 140% of the rated field voltage.

In addition, the requirements for power system stabilizers (PSS) are described in Reference 15 of Appendix 4.2:

- Each synchronous generating unit that is equipped with an excitation system that meets the performance requirements shall also be equipped with a power system stabilizer. The power system stabilizer shall, to the extent practicable, be tuned to increase damping torque without reducing synchronizing torque.

### **3. Data Verification**

The connection applicant has provided complete dynamic models for the excitation systems and the stabilizers and indicated that the replacement exciters are intended to be functionally “like-for-like” replacements. The new excitation systems are specified to reproduce the existing overall

closed-loop performance and to maintain existing capabilities with the same ratings as the existing exciters:

- 5731 Adc Continuous
- 9192 Adc for 30 Sec.
- 973 Vdc Ceiling Voltage at 5407 Adc

### 3.1 Excitation System Model

The proposed new exciters are IEEE Type ST1A Potential Source Controlled Rectifier Exciter. The block diagram of excitation system provided by the connection applicant is shown in Figure 1. The parameters of the exciter are shown in Table 1.

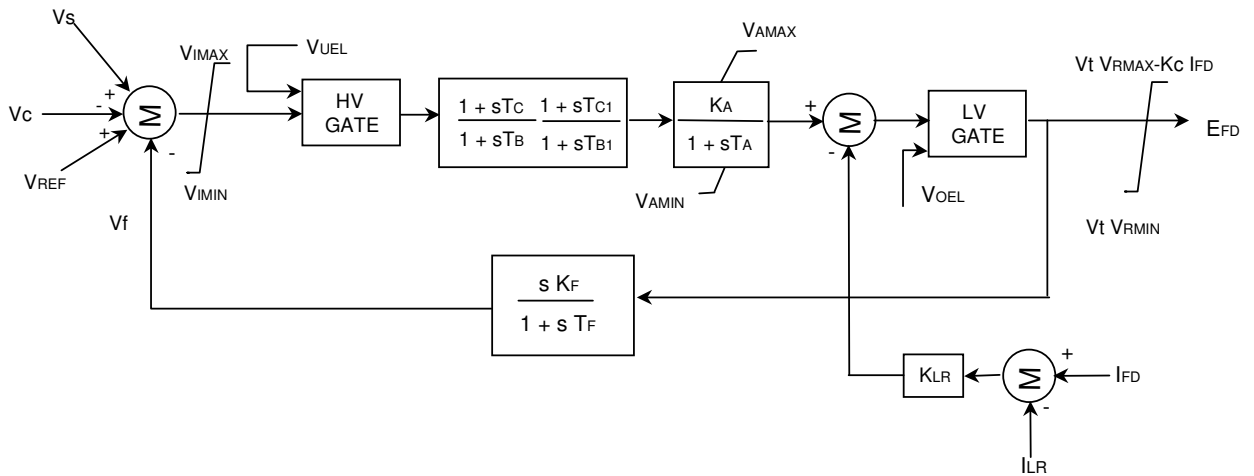


Figure 1. Block Diagram of Excitation System

**Table 1. IEEE Type ST1A Model for Lennox Units 1 - 4**

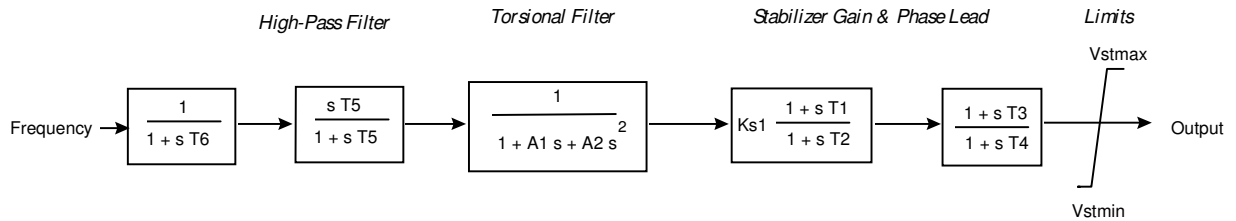
Description	Parameter	Value
Terminal voltage transducer T.C.	$T_r$	0.015
AVR upper limit	$V_{IMAX}$	999
AVR lower limit	$V_{IMIN}$	-999
AVR lead time constant	$T_C$	0.0
AVR lag time constant	$T_B$	0.0
AVR lead time constant	$T_{C1}$	0.0
AVR lag time constant	$T_{B1}$	0.0
AVR gain	$K_A$	220.0
AVR time constant	$T_A$	0.0
Positive regulator output limit	$V_{AMAX}$	999
Negative regulator output limit	$V_{AMIN}$	-999
Positive exciter output limit (ceiling)	$V_{RMAX}$	7.7
Negative exciter output limit (ceiling)	$V_{RMIN}$	-6.28
Rectifier regulation	$K_C$	0.143
Exciter feedback gain	$K_f$	0.0
Exciter feedback time constant	$T_f$	1.0
Field current limiter gain	$K_{LR}$	0
Field current limiter setting	$I_{LR}$	0

The models and data for the new exciters are the same as those for the existing exciter systems.

The performance of the new exciters not been verified through testing. After the installation of the new exciters, the proponent is required to perform commissioning tests to validate the control models and data. The test results must be supplied to the IESO within three months of in-service date. If the actual data differ materially from the data that was used in the assessment, then the analysis will need to be repeated.

**3.2 PSS Model**

OPGI has confirmed that each new exciter is to be equipped with a power system stabilizer. The PSS will be IEEE type PSS1A single input power system stabilizer. The block diagram of excitation system provided by the connection applicant is shown in Figure 2 and the parameters of the PSS are shown in Table 2.



**Figure 2. Block Diagram of PSS**

**Table 2. IEEE PSS1A Power System Stabilizer Model Parameters**

Description	Parameter	Value	Units
Gain	Ks	5.4	pu $E_{tref}$ /pu f
Positive output limit	Vstmax	0.29	pu $E_{tref}$
Negative output limit	Vstmin	-0.1	pu $E_{tref}$
Phase lead time constant	T1	0.154	s
Phase lag time constant	T2	0.045	s
Phase lead time constant	T3	0	s
Phase lag time constant	T4	0	s
Washout time constant (note 1)	T5	1.5	s
Transducer time constant	T6	0.01	s
Input type: Speed			

The models and data for the new PSS's are the same as those for the existing stabilizers.

The PSS model and data is to be confirmed by the connection applicants upon the completion of commissioning test and provided the IESO in view of completing the Facility Registration Process.

#### **4. Conclusions and Requirements**

This assessment covered a comparison between the existing excitation systems and the proposed new excitation systems at units 1 - 4 at Lennox GS. The assessment concluded that the replacement units are the same as the existing units and exhibit like-for-like behaviour. The studies also concluded that the new excitation system models meet the Market Rules requirements and the replacement of the exciters will not have a material adversely impact on the reliability of the existing IESO-controlled grid.

As soon as the commissioning tests are completed and actual data is available, the connection applicant is required to provide an updated block diagram model of the excitation system. Using these data the IMO will perform studies to verify the behaviour of the excitation system and establish the need for any new controls and adjustments, as part of the Facility Registration Process.

#### **5. Notification of Approval**

This assessment has identified IESO's requirements for excitation systems and has examined the models and parameters of new excitation systems on units 1 to 4 at Lennox GS to ensure no negative effect on the reliability of the IESO-controlled grid.

The replacement of the exciters is not expected have a material adverse impact the IESO-controlled grid and a Connection Assessment study would not be necessary. It is therefore recommended that a Notification of Approval for this proposal be issued to the applicant.