CONNECTION ASSESSMENT & APPROVAL PROCESS

ASSESSMENT SUMMARY

Applicant: Ontario Power Generation Inc.

Project: Abitibi GS Unit 4 Exciter Replacement

CAA ID: 2006-EX290

Final Report

Transmission Assessments & Performance Department

July 20, 2006

ABITIBI GS – REPLACEMENT OF EXCITATION SYSTEM
IESO EXPEDITED SYSTEM IMPACT ASSESSMENT – CAA ID 2006-EX290

PROJECT DESCRIPTION

Ontario Power Generation Inc. (OPGI) is planning to replace the excitation system on Unit 4 at Abitibi GS with new unit.

Presently Unit 4 at Abitibi GS is equipped with a rotating exciter which has reached its end of life. With the installation of the new static exciter the commutator brushes will be removed, thus resulting in a reduction in maintenance and related trouble calls.

The scheduled in service dates for the static exciter is July 29, 2006

The generator capacity of Unit 4 at Abitibi GS is 70 MVA.

SUMMARY OF REQUIREMENTS

The applicant is required to ensure that the performance of the exciter system installed on unit 4 at Abitibi GS is similar or exceeds the predicted performance observed in the simulation results obtained using the models in the application.

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 and data of the excitation system. If the models and data differ materially from those used in the studies, the IESO may be performing additional 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.

NOTIFICATION OF APPROVAL

It is recommended that a *Notification of Approval for Connection* be issued for this project subjected to implementation of the requirements given above.

If the new equipment either does not meet the specified performance standard when installed, or are subsequently determined not to meet those performance standards, the IESO connection approval may be withdrawn until the specified performance standards, or their equivalent can be demonstrated.

ABITIBI GS – REPLACEMENT OF EXCITATION SYSTEM
SYSTEM IMPACT ASSESSMENT REPORT – CAA ID 2006-EX290

1.0 INTRODUCTION

Ontario Power Generation Inc. (OPGI) is planning to replace the excitation system on unit 4 at Abitibi GS with new unit.

Presently Unit 4 at Abitibi GS is equipped with a rotating exciter which has reached its end of life and caused some problems during operation. With the installation of the new static exciter the commutator brushes will be removed, thus resulting in a reduction in maintenance and related trouble calls.

The scheduled in service dates for the static exciter is July 24, 2006.

The generator capacity of Unit 4 at Abitibi GS is 70 MVA.

2.0 MARKET RULES REQUIREMENTS

The requirements for the 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.

3.0 DATA VERIFICATION

The connection applicant has provided complete dynamic models for the new excitation system, load compensator and stabilizer.

3.1 EXCITER SYSTEM MODEL

The proposed new exciter is an IEEE Type ST4B 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. It should be noted that the data in Table 1 represent typical exciter system parameters and have not been verified through testing.

After the installation of the new exciter, 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.

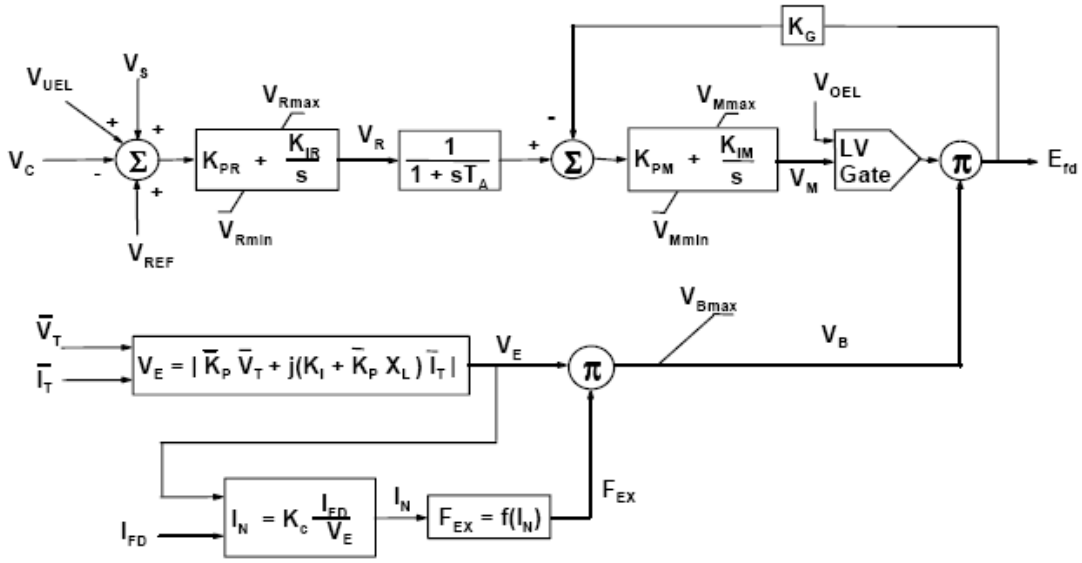


Figure 1. Block Diagram of Excitation System

Table 1. Parameters of the Exciter

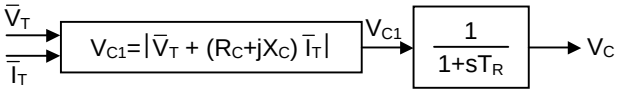
CONs	VALUE	DESCRIPTION
J	0	T_R, voltage transducer time constant (sec)
J+1	30.33	K_{PR}, AVR proportional gain pu Efd / pu Etref
J+2	2.02	K_{IR}, AVR integral gain
J+3	1	V_{RMAX}, maximum voltage regulator output (pu)
J+4	-0.87	V_{RMIN}, minimum voltage regulator output (pu)
J+5	0.01	T_A, voltage regulator time constant (sec)
J+6	1	K_{PM}, FVR (inner loop) proportional gain
J+7	0	K_{IM}, FVR (inner loop) integral gain
J+8	1	V_{MMAX}, maximum field regulator output (pu)
J+9	-0.87	V_{MMIN}, minimum field regulator output (pu)
J+10	0	K_G, inner loop feedback gain
J+11	6.59	K_P, compound source potential multiplier
J+12	0	K_I, compound source current multiplier
J+13	7.91	V_{BMAX}, maximum bridge output
J+14	0.082	K_C, commutating reactance drop
J+15	0	X_L, compound source reactance
J+16	0	THETAP, compound source potential angle (degrees)

3.2 LOAD COMPENSATOR MODEL

OPGI has provided the following load compensator model:

IEEEVC (Load Compensation)

Description	Parameter	Value
Resistive load comp. (-ve=droop)	Rc	0
Reactive load comp. (+ve=droop)	Xc	0.05



3.3 POWER SYSTEM STABILIZER MODEL

OPGI has confirmed that the new exciter is to be equipped with a power system stabilizer (PSS). The PSS will be IEEE type PSS2A Dual-Input Power System Stabilizer. The block diagram of the PSS provided by the applicant is shown in Figure 2 and the parameters of the PSS are shown in Table 2. It should be noted that the data in Table 2 represent typical PSS settings and have not been verified through testing.

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

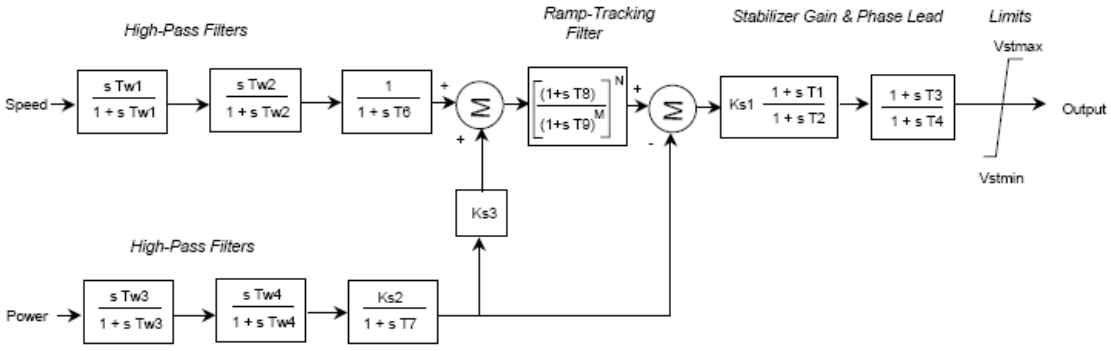


Figure 2. Block Diagram of PSS

Table 2. Parameters of PSS

Description	Parameter	Value
First stabilizer input code	ICS1	1
First remote bus number	REMBUS1	0
Second stabilizer input code	ICS2	3
Second remote bus number	REMBUS2	0
Ramp tracking filter order	M	5
Ramp tracking filter order	N	1
MVA rating	Sbase	70
Inertia	H	2.25
Washout time constant	T_{w1} (s)	10
Washout time constant	T_{w2} (s)	10
Filter time constant	T_6 (s)	0
Washout time constant	T_{w3} (s)	10
Filter time constant	T_{w4} (s)	0
Washout time constant	T_7 (s)	10
Gain	K_{S2} (= T_{W2}/2H)	2.22
Gain	K_{S3}	1
Ramp-tracking filter time constant	T_8 (s)	0.5
Ramp-tracking filter time constant	T_9 (s)	0.1
Stabilizer gain	K_{S1}	6
Phase lead time constant	T_1 (s)	0.07
Phase lag time constant	T_2 (s)	0.02
Phase lead time constant	T_3 (s)	0.07
Phase lag time constant	T_4 (s)	0.02
Output limits	V_{STMAX} (pu E_{TREF})	0.2
Output limits	V_{STMIN} (pu E_{TREF})	-0.05

4.0 EXCITATION SYSTEM PERFORMANCE TESTING

Dynamic simulations were performed to verify if the transient response of the new excitation system meets Market Rules requirements.

The results of the exciter system voltage response test to a 5% step change in reference voltage are displayed in Figure 3. Examination of the plots indicates that the exciter field voltage reaches 95% of the excitation ceiling voltage in 32 ms which is less than 50 ms, thus meeting the first requirement specified in section 2.

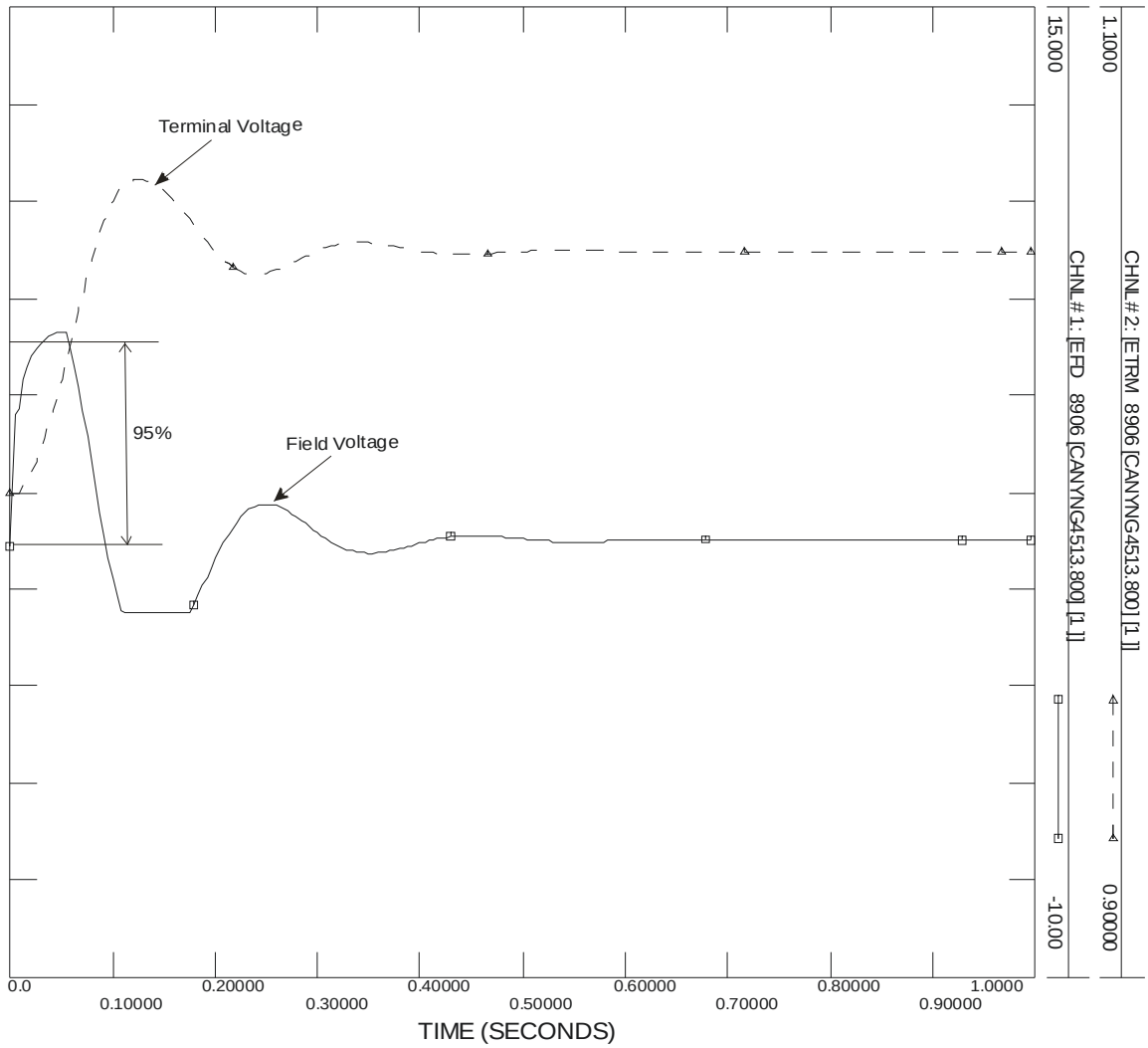


Figure 3. Open Circuit Test for the New Exciter

The results of the exciter system response ratio test shown in Figure 4 indicate that the exciter ceiling voltage exceeds the Market Rules requirements. The test results show that the exciter rated field voltage is 2.56 pu while the ceiling voltage is 6.45 pu, which is more than twice the rated field voltage.

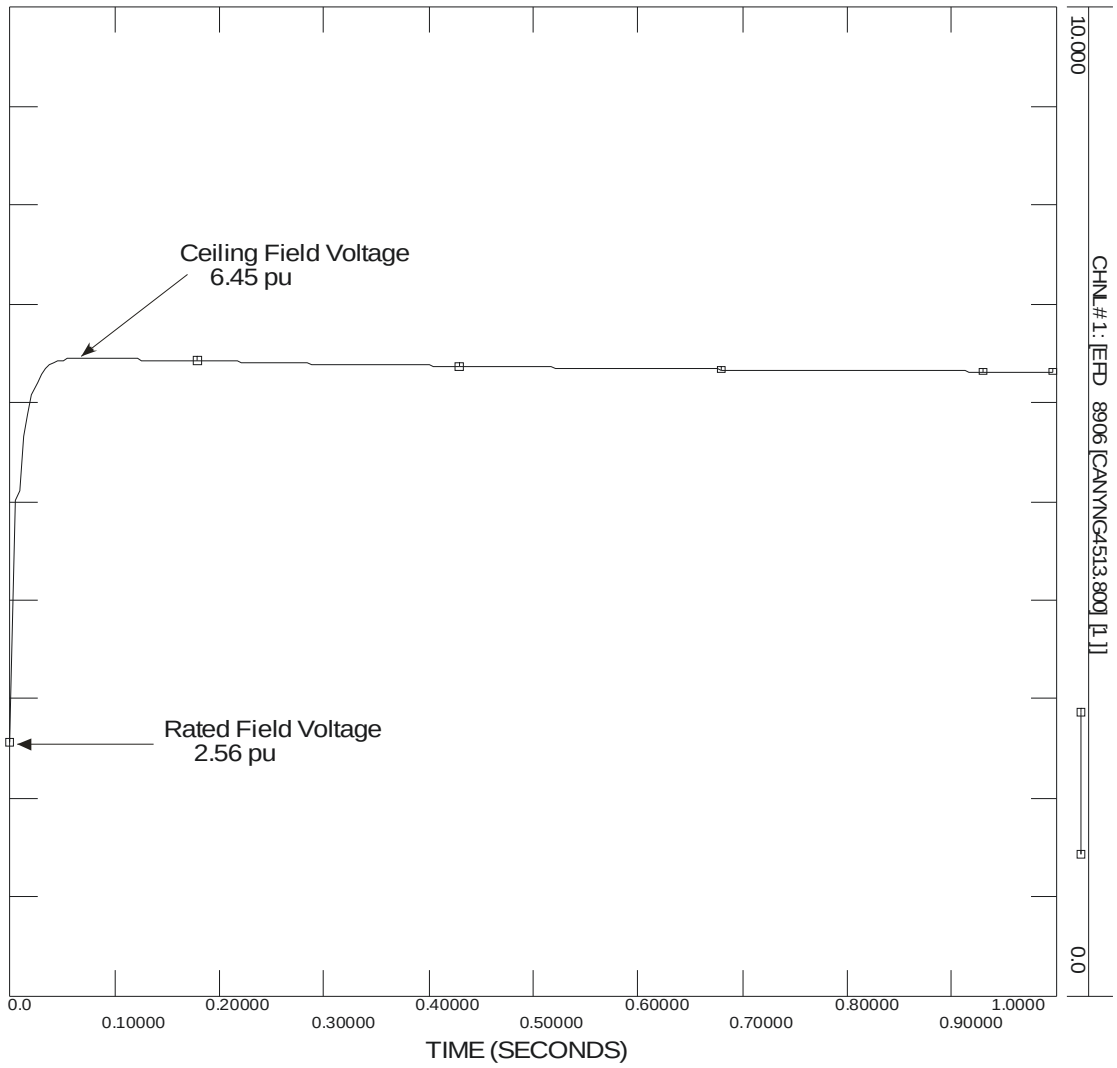


Figure 4. Response Ratio Test for the New Exciter

5.0 CONCLUSIONS AND REQUIREMENTS

This assessment examined the performance of the proposed new excitation system on unit 4 at Abitibi GS and its effect on the reliability of the IESO-controlled grid. The studies concluded that the new excitation system models meet the Market Rules requirements.

Therefore the replacement of unit 4 exciter at Abitibi GS will not have any adverse impact on the reliability of the IESO-controlled grid.

The applicant is required to ensure that the performance of the exciter system installed on unit 4 at Abitibi GS is similar or exceeds the predicted performance observed in the simulation results obtained using the above models.

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 and data of the excitation

system. If the models and data differ materially from those used in the studies, the IESO may be performing additional 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.

6.0 NOTIFICATION OF APPROVAL

The study results show that the new exciter is not expected to adversely impact the IESO-controlled grid. It is therefore recommended that a Notification of Approval for this proposal be issued to the applicant.