



December 8th, 2008

Mr. Xiaodong Sun
Senior Engineer
Electrical, P&C and Compliance, Hydro Engineering
Ontario Power Generation

Dear Mr. Sun:

*Decew Falls #2 GS G1 Pilot Exciter Replacement
Notification of Approval of Connection Proposal
CAA ID Number: 2008-EX388*

Thank you for the information that you submitted regarding the replacement of the pilot exciter for G1 at Decew Falls #2 GS.

From the information provided, our review concludes 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 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,

Barbara Constantinescu
Manager – Market Facilitation Department
Telephone: (:905) 855-6406
Fax: (905) 855-6372
E-mail: barbara.constantinescu@ieso.ca
cc: IESO Record

Ontario Power Generation acknowledges the IESO requirements in the subject report, and commits to fulfill these requirements, and all other applicable Market Rules, before receiving final approval to connect to the IESO-controlled grid and to participate in the IESO-administered market.

Dated: _____

Per: _____

Name: _____

Title: _____

CONNECTION ASSESSMENT & APPROVAL PROCESS

ASSESSMENT SUMMARY

Applicant: Ontario Power Generation Inc.

**Project: G1 Pilot Exciter Replacement
at Decew Falls #2 GS**

CAA ID: 2008-EX388

Final Report

Transmission Assessments & Performance Department

December 8th, 2008

DECEW FALLS #2 GS – G1 PILOT EXCITER REPLACEMENT IESO EXPEDITED SYSTEM IMPACT ASSESSMENT – 2008-EX388

1. Project Description

OPG is planning to replace the existing rotating pilot exciter of G1 at Decew Falls #2 GS due to equipment obsolescence. The new pilot exciter used for this replacement will be a modern Static Pilot Exciter (SPE) implementing a digital AVR designed with the latest technology.

The generator capacity of G1 at Decew Falls #2 GS is 82.2 MVA.

The SPE for G1 at Decew Falls #2 GS is scheduled for replacement in August 2009.

2. Equipment Data Verification

The connection applicant has provided complete dynamic models for the existing and new excitation systems.

The model for the existing exciter is IEEE T4 excitation system model.

The block diagram of the old excitation system provided by the connection applicant is shown in Figure 1. The parameters of the excitation system are shown in Table 1.

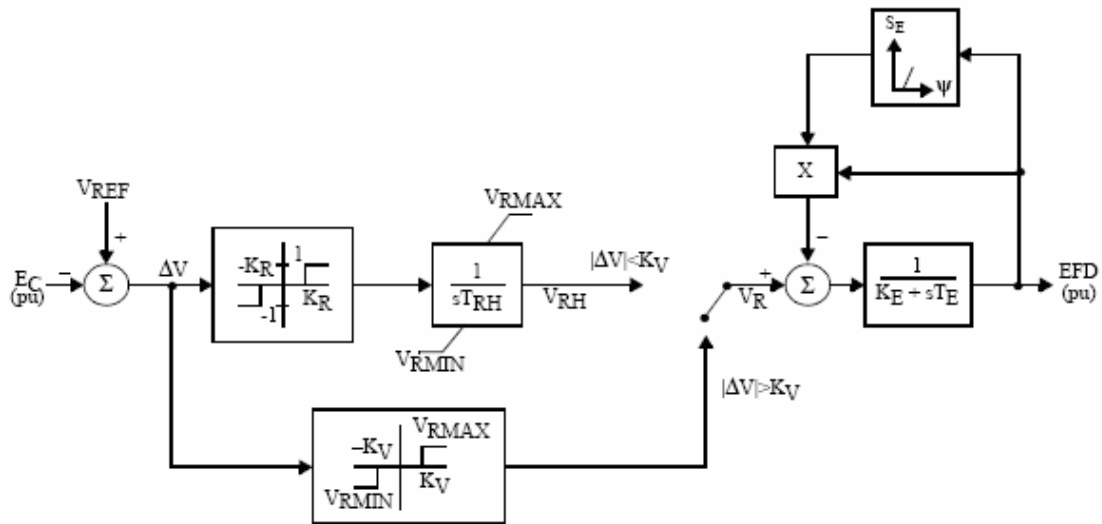


Figure 1: Block Diagram of Existing Excitation System

Table 1: Parameters of Existing Excitation System (IEEET4 Model)

Description	Parameter	Value
Deadband (at input V_{ERR})	K_R	0.02
Rheostat motor time constant	T_{RH}	75
Fast raise/lower contactor setting	K_V	0.05
Positive ceiling	V_{RMAX}	9.22
Negative ceiling	V_{RMIN}	0
Main exciter time constant	T_E	1
Shunt field rheostat setting	K_E	1
Exciter flux at knee of curve	$E1$	1.83
Saturation factor at knee	$S_E(E1)$	0.18
Maximum Flux	$E2$	2.44
Saturation factor at max flux	$S_E(E2)$	0.308

The model for the proposed new excitation system is PSS/E Type ESAC6A model.

The block diagram of the new excitation system provided by the connection applicant is shown in Figure 2. The parameters of the excitation system are shown in Table 2.

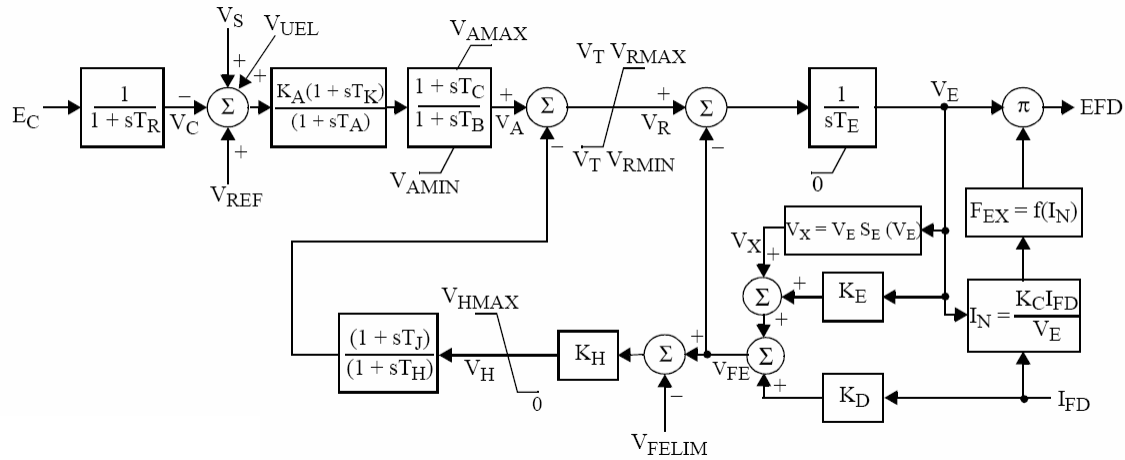


Figure 2: Block Diagram of New Excitation System

Table 2: Parameters of the New Excitation System (PSS/E Type ESAC6A)

Description	Parameter	Value
Voltage transducer time constant	T_R	0.02
AVR gain	K_A	500
AVR lead time constant	T_A	250
AVR lag time constant	T_K	7.5
AVR lead time constant	T_B	0.2
AVR lag time constant	T_C	1.0
Maximum regulator output limit	V_{AMAX}	9.22
Minimum regulator output limit	V_{AMIN}	0
Maximum exciter input limit	V_{RMAX}	9.22
Minimum exciter input limit	V_{RMIN}	0
Exciter time constant	T_E	1
Exciter current limit	V_{FELIM}	99
Exciter limiter gain	K_H	0
Exciter limiter upper limit	V_{HMAX}	99
Exciter limiter lag time constant	T_H	1.0
Exciter limiter lead time constant	T_J	1.0
Rectifier regulation factor	K_C	0
Exciter regulation factor	K_D	0
Exciter field proportional constant	K_E	1
Exciter flux at knee of curve	E1	1.83
Saturation factor at knee	$S_E(E1)$	0.18
Maximum flux	E2	2.44
Saturation factor at max flux	$S_E(E2)$	0.308

It should be noted that the data in Table 2 are preliminary and the excitation system model and data are to be finalized by the connection applicant upon the completion of commissioning test and be provided to the IESO in view of completing the Facility Registration Process.

3. Assessments of New Excitation System

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

- 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.

Since only pilot exciter is replaced in this project, the new excitation system will be acceptable if

- Performance of the new excitation system meets the Market Rules, or
- Performance of the new excitation system is not worse than that of the existing excitation in terms of response time and ceiling voltage.

Dynamic simulations are performed to compare the transient response of the new excitation system with that of the existing system and verify if the proposed new exciter can maintain or improve their performance.

3.1 Open Circuit Test

The results of the exciter system voltage response test to a 5% step change in reference voltage are displayed in Figure 3. It is straightforward in Figure 3 that the new exciter performance is much faster than the old exciter, thus meeting the above-mentioned requirements. Note that due to the deadband in the old exciter, the generator terminal voltage actually can not reach its desired reference value.

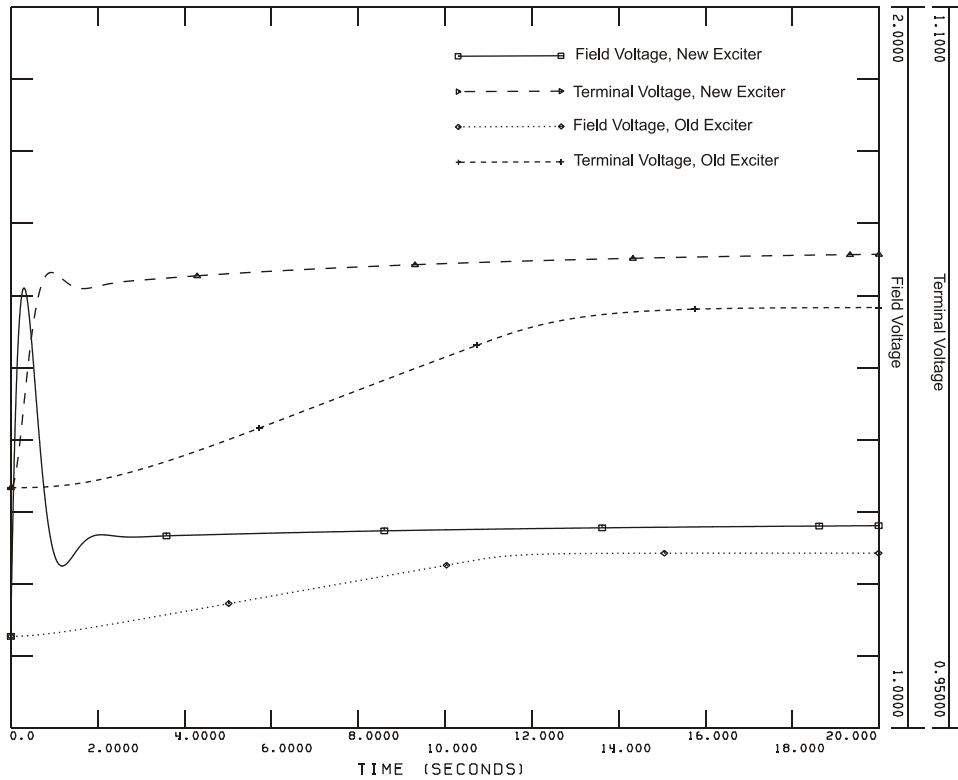


Figure 3 Open Circuit Test Results

3.2 Response Ratio Test

Response ratio test are conducted to evaluate the positive ceiling voltage for the excitation system. Each generator is initialized to its rated MVA at a 95% lagging power factor. At t=0, the voltage set point is raised suddenly to drive to the exciter’s ceiling voltage as quickly as possible. The results are shown in Figure 4.

Figure 4 shows that rated field voltage of both new and old exciters is about 3.17 pu. The ceiling voltage of both exciters is about 4.94 pu, which is less than twice the rated field voltage. However, the new exciter has the exactly same response as the old one, thus, meeting the above-mentioned requirements.

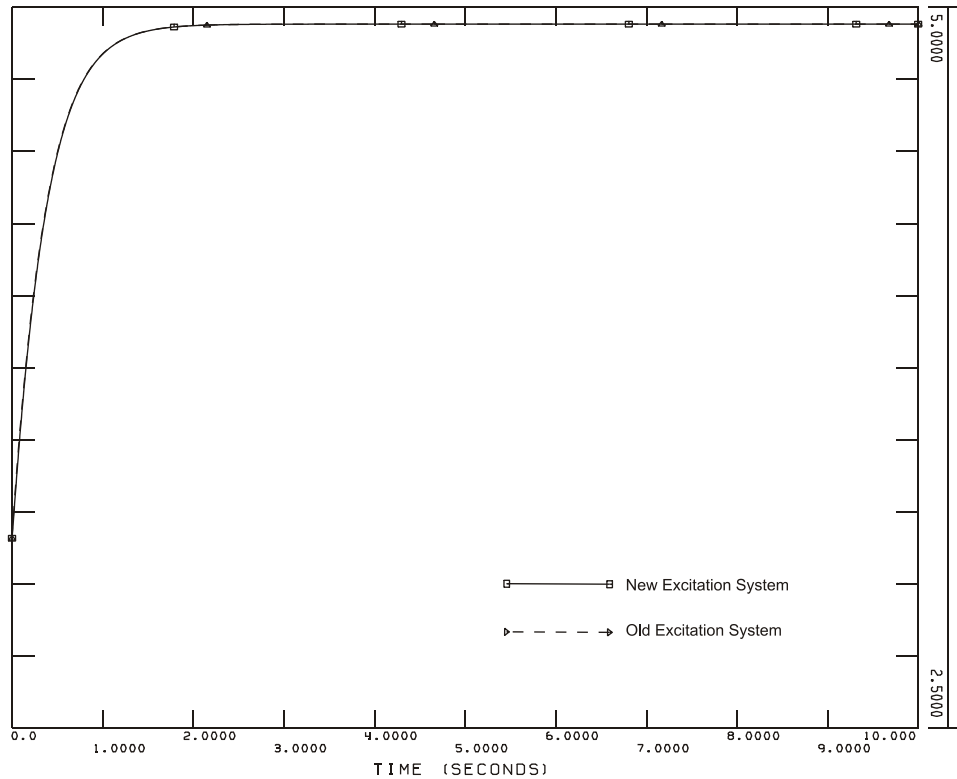


Figure 4 Response Ratio Test Results

3.3 Transient Stability Test

The transient stability analysis is performed for a 3-phase fault on 115-kV circuit D3A (from Allanburg TS to Decew Falls GS) close to Decew Falls GS, with normal clearing time. The generating unit field voltages, rotor angles, terminal voltages, and power outputs of G1/G2 at Decew Falls #2 GS and generators at Decew Falls #1 GS are investigated.

Figure 5 shows the G1 rotor angle at Decew Falls #2 GS, which indicates a smaller negative deviation of the rotor angle of G1 as compared with the old excitation system. Other simulation results show that G1 pilot exciter replacement at Decew Falls #2 GS has insignificant impact on dynamics of G2 at Decew Falls #2 GS and generators at Decew Falls #1 GS. These generating units all display stable performance for the defined fault.

Thus, the excitation system with new pilot exciter does not have material adverse impact on the system dynamic performance.

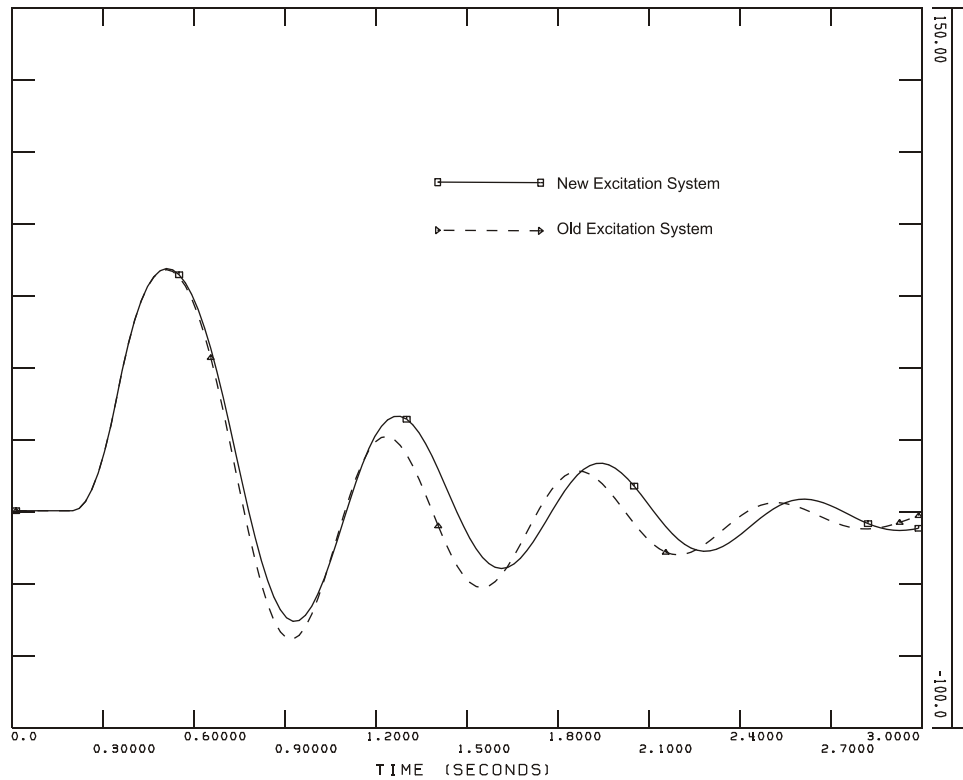


Figure 5: G1 Rotor Angle Response at Decew Falls #2 GS Due to a 3-Phase Fault

4. Conclusions and Requirements

This assessment examined the performance of the proposed new pilot exciter of G1 at Decew Falls #2 GS and its effect on the reliability of the IESO-controlled grid. The studies concluded that the new excitation system model has better performance than the existing excitation system; therefore the pilot exciter replacement will not have adverse impact on the reliability of the IESO-controlled grid.

The applicant is required to ensure that the performance of the equipment that is eventually supplied and installed at G1 of Decew Falls #2 GS is similar to or exceeds the predicted performance obtained using the proposed model. 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 IESO will perform studies to verify the behavior of the excitation system and establish the need for any new control and adjustment, as part of the Facility Registration Process.

5. Notification of Approval

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