

July 11, 2005

Mr. Dave Abbott
Bruce Power - Power Marketing
P.O Box 3000, B06
177 Tie Road, Municipality of Kincardine
RR#2, Tiverton ON
N0G 2T0

Dear Mr. Dave Abbott:

Bruce B Units Refurbishment
Conditional Notification of Approval of Connection Proposal
CAA ID Number: 2005-EX223

Thank you for the detailed information that you provided on the refurbishment of Bruce B units G5, G6, G7 and G8. This work will allow an increase in the power output of each unit by about 15 MW. The System Impact Assessment concluded that the proposed project would not have a negative impact on the reliability of the IESO-controlled grid.

The IESO is therefore pleased to grant **conditional approval** for the installation of the new equipment, as detailed in the attached *System Impact Assessment Report*. Any material changes to your proposal may require a 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 the project you have installed is materially unchanged from the proposal assessed by the IESO. Contact facility.registration@theieso.ca if you have not received a Facility Registration Summary package within the next 10 days. A copy of the Report will be posted on the IESO web site: www.theieso.ca

To commence the construction process, please follow the necessary procedures and obtain the required approvals, licences and permits as may be required by the OEB and other regulatory authorities.

For further information, please contact the undersigned.

Yours truly,

Mike Falvo
Manager – Transmission Assessment & Performance
Telephone: (905) 855-6209
FaxⓈ(905) 855-6921
E-mail: mike.falvo@ieso.ca

System Impact Assessment Report –Bruce B Units Refurbishment

For the stator rewound and the LP turbine replacement on all Bruce B Units

1.0 Project Description

Bruce Power has been undertaking the refurbishment of Bruce B units G5, G6, G7 and G8 consisting of:

- The rewinding of the generator stators
- The replacement of the low-pressure turbines blades,
- No modifications to the excitation systems, and
- No modifications to the governor systems.

The refurbishment on unit G6 has been completed, the work on unit G7 is scheduled for completion by July, 2005 and the work on units G5 and G8 will be completed in December 2005 and June 2006, respectively.

It is expected that the refurbishment will result in an increase of the gross Maximum Continuous Rating of each unit to 855 MW.

Bruce Power has indicated that the rewinding of the generator stators will preserve the original layout of the windings and the generator core. The design of the windings will be slightly changed with fewer hollow strands and more solid strands. The winding insulation has been improved from Micapal I to Micapal II., resulting in an efficiency improvement of about 0.1%.

Bruce Power has indicated that the LP turbines are to be replaced with a mono-bloc design and that these rotors will have a different weight, stiffness and rotational inertia.

2. Connection Arrangement

The connection of the Bruce B units to the IESO-controlled grid will remain unchanged.

3. Data Verification

The connection applicant has provided complete dynamic data for the generators and indicated that there will be no change to the excitation system model and data, and the governor system model and data.

3.1 Generator Model

The original generator model for each unit calculated on 1025 MVA base is as follows:

$$T'D0 = 10.4, T'Q0 = 0.431, T''D0 = 0.033, T''Q0 = 0.0582, H = 5.32,$$

$$XD = 1.943, XQ = 1.815, X'D = 0.368, X''D = 0.277, X'Q = 0.587,$$

$$XL = 0.2135, X2 = 0.277, X0 = 0.192$$

$$S(1.0) = 0.105, S(1.2) = 0.475$$

Data for the generator model for each unit calculated on 1025 MVA base after refurbishment is carried out, is as follows:

$$T'D0 = 10.441, T'Q0 = 0.443, T''D0 = 0.037, T''Q0 = 0.066, H = 5.32, \\ XD = 1.98, XQ = 1.85, X'D = 0.385, X''D = 0.305, X'Q = 0.604$$

$$XL = 0.235, X2 = 0.235, X0 = 0.195$$

$$S(1.0) = 0.105, S(1.2) = 0.475$$

Since Bruce Power conformed that the excitation systems and the governor systems will remain unchanged the models and data for the control systems were not modified.

Simulations performed using the PSS/E package with the new generator data provided by Bruce Power indicate that the transient performance of an upgraded Bruce B generator is better than that of the original generator.

4. System Impact Assessment

The step-up transformer for each generating unit has a maximum continuous capability of about 954 MVA which is sufficient to accommodate the maximum unit output of 855 MW at 0.9 power factor. In addition, the station service load (45-50 MW) is supplied off the LV side of the transformer, resulting in further unloading of the step-up transformer.

The Market Rules require that each synchronous generator connected to the IESO-Controlled Grid shall have the capability to supply reactive power within the range between 90% lagging (overexcited) and 95% leading (underexcited) power factor based on rated active power at rated voltage. For an 855 MW unit this requirement translates into a reactive power capability ranging from 414 Mvar overexcited to 281 Mvar leading. The generator Reactive Capability Curves provided for the original units as part of the facility registrations data shows that for an active power output of 855 MW the unit is capable to 420 Mvar overexcited to 280 Mvar underexcited.

This capability meets the Market Rules requirements with respect to the reactive power capability.

Bruce Power has indicated that the LP turbines are to be completely changed with a mono-bloc design and that these rotors will have a different weight, stiffness and rotational inertia. However, the inertia constant provided for the new turbine-generator model is the same as the inertia constant of the old unit at a value of 5.32. It is reasonable to expect that the inertia constant representing the rotating parts of the generator and the turbine will have changed with the change in the geometry of the LP turbine. Therefore, it is required that the inertia constant calculations be repeated and Bruce Power re-confirm this value.

Bruce Power is required to verify the unit inertia constant and resubmit this information.

Bruce Power provided performance test results for Unit 6. From the data provided, the no load field current was calculated to be 1620 A. This value was found to be much higher than the no load field current value obtained from the filed current/armature voltage saturation graph submitted with the SIA application. The value from the graph was calculated to be about 1300 A. Bruce Power explained that the higher field current value was obtained with unit 6 synchronized to the system and that the actual no load

filed current is about 1360 A. However, test results supporting this information have not been received by the IESO.

Bruce Power is required to provide performance test results that match the characteristics of the generator and exciter models submitted with the SIA application.

5.0 Conclusions

This System Impact Assessment examined the effect of the refurbishment of Bruce B units on the reliability of the *IESO-controlled grid*.

The assessment concluded that, subject to meeting the requirements identified in section 6.0 the refurbishment of Bruce B units has no adverse impact on the reliability of the existing *IESO-controlled grid* equipment and does not degrade the existing system transfer capability.

6.0 IESO Connection Requirements

This section summarizes the requirements identified during this SIA for the refurbishment of Bruce B units.

1. Bruce Power is required to complete the Facility Registration process with the IESO before commercial operation of the units is resumed.
2. Bruce Power is required to verify and confirm the unit inertia constants.
3. Bruce Power is required to provide performance test results that match the characteristics of the generator and exciter models submitted with the SIA application.

7.0 Notification of Approval

This System Impact Assessment has assessed the impact of the refurbishment of Bruce B units which results in increased output of up to 855 MW per unit, on the *IESO-controlled grid* and has identified IESO's requirements for connection to ensure no negative effect on the reliability of the *IESO-controlled grid*.

It is recommended that a conditional *Notification of Approval* be granted for this project, subject to the implementation of the requirements stipulated in section 6 of this report.