Fort St. James Green Energy

Interconnection Feasibility Study

Report No. TGI-2011-A238-FeS-R0

April 5, 2011
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EXECUTIVE SUMMARY

XXXXX, the Interconnection Customer (IC), proposes to develop the Fort St. James Green Energy project to deliver electric energy to BC Hydro (BCH) through the 2010 Bioenergy 2 power call. This project consists of a new thermal generator located in Fort St. James, British Columbia.

The Feasibility study is a preliminary evaluation of the system impact and cost of interconnecting the proposed project to the BCH transmission system. This report identifies the required system modifications for interconnecting the proposed Fort St. James Energy project.

The Point of Interconnection (POI) is 60L344, approximately 3 km east of the Fort St. James substation (FM2). The maximum power injection to the BCH system is 33 MW. The proposed Commercial Operation Date (COD) is January 1, 2014.

To interconnect the Fort St. James Green Energy project and its facilities to the BCH Transmission System at the POI, this Feasibility Study has identified the following issues and requirements:

- At the POI, a tap connection with three 1200 A disconnects is required to maximize the operating flexibility of the new generation into BC Hydro’s system.
- A CVT is required at Tachick substation (TAC).
- Protection modifications are required at TAC, including new relays.
- Anti-islanding power quality protection is required to trip the unit when islanded.
- Out-of-step protection is required at the Fort St. James facility.
- The non-binding good faith cost estimate for Interconnection Network Upgrades required to interconnect the proposed project to the BCH Transmission System is $1.75 million.
- The estimated time to construct the Interconnection Network Upgrades is 12 months.

The Interconnection System Impact Study and Facilities Study reports will provide greater details of the Interconnection Network Upgrade requirements and associated cost estimates and estimated construction timeline for this project.
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1.0  INTRODUCTION

The project reviewed in this Interconnection Feasibility Study report is as described in Table 1 below.

Table 1: Summary Project Information

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Fort St. James Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interconnection Customer</td>
<td>XXXXX</td>
</tr>
<tr>
<td>Point of Interconnection</td>
<td>60L344</td>
</tr>
<tr>
<td>IC Proposed COD</td>
<td>January 1, 2014</td>
</tr>
<tr>
<td>Type of Interconnection Service</td>
<td>NRIS  ERIS</td>
</tr>
<tr>
<td>Maximum Power Injection (MW)</td>
<td>33 (Summer) 33 (Winter)</td>
</tr>
<tr>
<td>Number of Generator Units</td>
<td>1</td>
</tr>
<tr>
<td>Plant Fuel</td>
<td>Thermal</td>
</tr>
</tbody>
</table>

XXX, the Interconnection Customer (IC), proposes to develop the Fort St. James Energy project to deliver electric energy to BC Hydro (BCH) through the 2010 Bioenergy 2 power call.

The Fort St. James Energy project is comprised of one thermal generator. The Point of Interconnection (POI) is 60L344, approximately 6 km east of Fort St. James substation (FM2).

The maximum power injection into the BCH system is 33 MW. The proposed Commercial Operation Date (COD) is January 1, 2014.

The project interconnection single-line diagram and the project location map can be found in Appendix A.

2.0  STUDY PURPOSE AND SCOPE

The Feasibility study is a preliminary evaluation of the system impact and cost of interconnecting the proposed project to the BCH transmission system. The study scope is restricted to power flow and short circuit analysis and investigates potential system constraints associated with the interconnection of the proposed project.

3.0  TERMS OF REFERENCE

This study investigates voltage and overloading issues of the transmission networks in the vicinity of Fort St. James as a result of the proposed interconnection. BCH planning methodology and criteria are used in the studies.

The Feasibility study does not investigate stability analysis, harmonic mitigation, electro-magnetic transient analysis, operating restrictions and other factors for possible second contingency outages. Subsequent internal network studies will determine the requirements for reinforcements or operating restrictions/instructions for those kinds of events.
4.0 STUDY ASSUMPTIONS

The study is based on the model and data information provided by the IC in the Generator Interconnection Data Form for this project. Reasonable assumptions are made to complete the study and the report, whenever such information is unavailable.

The customer has indicated that the actual POI will likely be on an existing load customer’s private transmission line. Apollo Forest Products (AFP) and the IC have agreed in principle to this arrangement. It has been assumed for the purposes of this study that the POI location change will not result in significant differences to the study conclusions. Subsequent study work will reflect the POI at a location close to the AFP facility, as opposed to a direct connection to 60L344.

The power flow conditions studied are base cases that include generation, transmission facilities, and load forecasts representing the queue position applicable to this project. Applicable seasonal conditions and the appropriate study years for the study horizon are also incorporated. The 2013-14 heavy winter, 2014 heavy summer and 2014 light summer load flow base cases were selected for this study.

Short circuit conditions studied include existing facilities and those under construction.

No remedial action schemes or other special protection and control facilities are specified to address or mitigate problems due to transient or temporary voltage excursions that may be identified as a result of future EMTP studies.

5.0 STUDY RESULTS AND REQUIRED UPGRADES

At the POI, a tap connection with three 1200 A disconnects is required to maximize the operating flexibility of the IC’s generation into BC Hydro’s system.

Upon the examination of the regional system from the POI up to the point of power delivery on the bulk transmission system, there are no network upgrades required for the interconnection of Fort St. James Energy project from a steady state power flow point of view. However, a minor overload issue was identified. The study indicates that the proposed new generation in the subject project would cause the transmission line 60L344 (FM2-Fort St. James IPP POI) to exceed the continuous rating by about 1% for loss of TFP transformer T1 in light summer conditions. Since the overload is very minor, no system reinforcement is recommended.

Islanding will occur if 60L344 is inadvertently opened at TAC or loss of TAC transformer T3. Since islanded operation is not a typical practice in BCH system and is not planned for the project, power quality protection will be required at the generating site to detect abnormal system conditions such as over/under voltage and over/under frequency and subsequently trip the generator.

As a standard practice, out-of-step protection is required at the Fort St. James Green Energy facility.

The short circuit assessment indicates that the proposed new generation in the subject project results in short circuit currents that do not generally exceed the interrupting capabilities of BCH equipment.
In order to prevent excessive desensitization of the 60L344 line protection at BC Hydro’s Tachick substation, the proponent must add a 16 ohm neutral reactor to the HV neutral point of their generator step-up transformer.

Protection modifications are required at TAC, including new relays for 60L344 and 2L253 and installation of a CVT on the 230 bus to trip the 60 kV breakers. This can be accomplished by adding two extra phases to the existing 2CC3 that is currently being used as a coupling capacitor.

Subsequent studies will determine if PLC communication to the IC from TAC is needed. The present scope does not include telecom to this IPP. If the need for telecom is identified, five 60 kV wave traps and two 60 kV coupling capacitors will be required.

Please note that the above conclusions are based on the steady state power flow study results and other system performance measures, such as transient stability, transient overvoltage, etc., have yet to be determined. These issues will be dealt with in the System Impact Study stage and may indicate the need for additional network upgrades.

Appendix A contains single line drawings reflecting the electrical orientation of the project within the BCH system and a map that identifies the proposed project within the BCH system.

6.0 COST ESTIMATE and PROJECT SCHEDULE

Table 4 identifies facilities and system upgrades required to interconnect the proposed project to the BCH system. It also provides a non-binding good faith cost estimate for these upgrades that would be the responsibility of the IC.

<table>
<thead>
<tr>
<th>Work Definition</th>
<th>Facilities</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&amp;C</td>
<td>New 60L344 and 2L253 line protection at TAC</td>
<td>$500 k</td>
</tr>
<tr>
<td>Station</td>
<td>Tap connection on 604L344</td>
<td>$1000 k</td>
</tr>
<tr>
<td></td>
<td>New CVT on TAC 230 kV bus</td>
<td>$250 k</td>
</tr>
<tr>
<td><strong>Estimated Interconnection Cost:</strong></td>
<td><strong>$1750 k</strong></td>
<td></td>
</tr>
</tbody>
</table>

The estimated time to construct the system upgrades required to interconnect the project to the BCH system is indicated in Table 5 below. This estimate assumes subsequent study work has been completed and a Standard Generator Interconnection Agreement has been executed.
Table 5: Estimated Project Schedule

<table>
<thead>
<tr>
<th>Time Range</th>
<th>0 - 6 months</th>
<th>6 - 12 months</th>
<th>12 - 18 months</th>
<th>18 - 24 months</th>
<th>24 – 30 months</th>
<th>30 – 36 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>×</td>
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</tr>
<tr>
<td></td>
<td>36 - 42 months</td>
<td>42 - 48 months</td>
<td>48 - 54 months</td>
<td>54 - 60 months</td>
<td>60 – 66 months</td>
<td>66 – 72 months</td>
</tr>
</tbody>
</table>

This study does not include stability analysis, harmonic mitigation, electro-magnetic transient analysis, and other analytical studies or calculations or site visits which normally form part of a comprehensive system study. Equipment that may be determined during more comprehensive studies is not included in the cost estimate or considered in the estimated schedule provided herein.

7.0 OTHER INFORMATION

Based on the system strength at the POI and the size of the IC’s transformer, it is likely that the IC will need to take measures to reduce the voltage dip in the BC Hydro system for energization of their step up transformer.

The customer is responsible for ensuring the voltage drop is within the tolerances specified in BC Hydro’s TIR. A plant pick-up study may be required for this purpose.

8.0 CONCLUSION & DISCUSSION

To interconnect the Fort St. James Green Energy project and its facilities to the BCH Transmission System at the POI, this Feasibility Study has identified the following issues and requirements:

- At the POI, a tap connection with three 1200 A disconnects is required to maximize the operating flexibility of the IC’s generation into BC Hydro’s system.
- A CVT is required at Tachick substation.
- Power flow studies indicate that 60L344 could be slightly overloaded during certain conditions. As the overload is very minor, no system reinforcement is recommended.
- Protection modifications are required at TAC, including new relays.
- Anti-islanding power quality protection is required as islanded operation is not planned for this project.
- Out-of-step protection is required at the Fort St. James facility.
- The non-binding good faith cost estimate for Interconnection Network Upgrades required to interconnect the proposed project to the BCH Transmission System is $1.75 million.
- The estimated time to construct the Interconnection Network Upgrades is 12 months.
The Interconnection System Impact Study and Facilities Study reports will provide greater details of the Interconnection Network Upgrade requirements and associated cost estimates and estimated construction timeline for this project.
APPENDIX A – PROJECT SINGLE LINE DIAGRAM and PROJECT LOCATION MAP

PROJECT SINGLE LINE DIAGRAM

Fort St. James Green Energy

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PROJECT LOCATION MAP
APPENDIX B – OTHER STUDY ASSUMPTIONS

Assumptions related to the BCH transmission system:

Power Flow

Power flow study is based upon the base case that includes generation, transmission facilities, and load forecast representing the queue position of the project applicable to the study of this project. Applicable seasonal conditions and the appropriate number of study years for the study horizon have also been incorporated.

Short Circuit

Short circuit study is based upon on complete short circuit model of BC Hydro System including contributions from the interconnecting utilities and private power generators. The model not only includes the existing facilities but also all those under construction.

Financial and Estimating Assumptions

Cost estimates are based on an order of magnitude assumption and are non-binding and provided in good faith. The cost estimate included in this report does not and cannot account for a variety of issues not under the control of BCH including, but not limited to:

- The impact of additional equipment required as the result of more detailed comprehensive studies;
- Actual equipment specified during engineering design;
- Fluctuations in costs over time;
- First Nation considerations;
- Property-related costs and issues;
- Any Certificate of Public Convenience and Necessity (CPCN) required from the British Columbia Utilities Commission (BCUC);
- Physical space constraints in network facilities.