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System Impact Study for Increased Interior to Lower Mainland Transfer (without new transmission line)

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Executive Summary

Further to the 5 March 2001 "Assessment of Interior to Lower Mainland Transmission Network" report (http://gridops.bchydro.bc.ca/transmission_system/studies/Assessment_of_LT_Firm_ATC.pdf) which identified 0 MW Available Transfer Capability (ATC) over the Interior to Lower Mainland (ILM) transmission network, this System Impact Study identifies extra-ordinary Network Upgrades, without the use of new right-of-way (i.e. without adding a new transmission line), that would provide ATC over the ILM transmission network. The base conditions for the study are the BC Hydro native load requirements from 2001 to 2007, and prior commitments on the BCHA × BPAT path. Power flow and stability studies were performed in compliance with the BC Hydro, Western Systems Co-ordinating Council (WSCC), and North American Electric Reliability Council (NERC) reliability criteria. This System Impact Study only addresses the capability of the BC Hydro ILM transmission network and does not consider capabilities of adjacent systems either internal or external to BC Hydro.

The System Impact Study concluded that approximately 1090 MW of ATC is available. Further ATC over the ILM transmission network would be available with the addition of a new 500 kV transmission line.

Uprating of the ILM transmission network - The Network Upgrades required for the 1090 MW ATC include:

- *Series capacitor banks on 5L81, 5L82 and 5L87 upgraded for 4.0 kA operation*
- *Series capacitor banks on 5L41 upgraded for 3.5 kA operation*
- *Series capacitor banks on 5L42 upgraded for 3.4 kA operation*
- *Summer ratings of 5L81, 5L82 and 5L87 upgraded to 4.0 kA*
- *Summer ratings of 5L41 upgraded to 3.5 kA*
- *Summer ratings of 5L40, 5L42 and 5L44 upgraded to 3.4 kA*
- *Summer ratings of 5L51 and 5L52 upgraded to 3.0 kA*
- *Summer ratings of 1L243, 2L1, 2L2, 2L90 and 2L91 upgraded up to 2 kA*
- *Addition of approximately –300 and +1000 MVAr of dynamic compensation and 2000 MVAr of switched shunt compensation*
- *5L40, 5L41, 5L42, 5L44, 5L81, 5L82 and 5L87 circuit breakers (27 in total) replaced with 4 kA circuit breakers*
- *5L51 circuit breakers (2 in total) replaced with 3 kA circuit breakers*
- *Modification and addition of N-2 Remedial Action Schemes.*

Facilities Study work is required to:

1. *Determine the feasibility of the Network Upgrades identified in this System Impact Study and other Network Upgrades including a new transmission line; and*
2. *Specify the cost and schedule of the required Network Upgrades.*

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1. Introduction

Previous System Impact Studies for providing transmission service on the BCHA × BPAT Path concluded that a new transmission line would be the preferred Network Upgrade to relieve constraints over the ILM (Interior to Lower Mainland) transmission network. The conclusions from these previous System Impact Studies were published in the "Assessment of Interior to Lower Mainland Transmission Network" bulletin.

In consideration to all the transmission customers remaining on the queue that require the ILM transmission network, this System Impact Study was initiated to determine if any other alternative Network Upgrades would provide additional ATC (Available Transfer Capability).

Power flow and stability studies were performed to verify that the Network Upgrades will be in compliance with the BC Hydro, Western Systems Co-ordinating Council (WSCC), and North American Electric Reliability Council (NERC) reliability criteria.

2. Terms of Reference

The base conditions for the study are the BC Hydro native load requirements until 2007/08 and prior firm export and transfer commitments. The Point-of-Delivery (POD) for the transmission service is the BC-US Border, and the Point-of-Receipt (POR) are generators in the BC Interior and interconnections other than to the US. However, this System Impact Study is limited to the ILM transmission network and does not address other constraints in the BC Interior.

3. System Impact Study Results

Planning studies were performed as per T&D's Transmission System Planning Criteria and Study Methodology. These studies were conducted to:

- Determine the ATC of the ILM transmission network.
- Assess the elements constraining the ATC.
- Determine Network Upgrades other than a new transmission line that would relieve the constraints.

3.1. N-1 Thermal Capability

The ILM transmission network was confirmed to be N-1 thermal constraining and to have 0 MW of ATC. Many alternatives were considered to provide additional ATC including increased series compensation, flow control, and uprating of the 500 kV and underlying transmission systems.

Studies were also performed to ensure that these alternatives would not jeopardize the nearby sub-systems and to determine the losses of increasing the loading on the existing system.

The studies concluded that uprating the 500 kV and underlying transmission systems is the only alternative which would provide significant amounts of transfer capability. It was also determined that the incremental ILM losses (not including the losses from the POR to the Kelly-Lake and Nicola substations) was 9% for all the transfer capability in this alternative.

N-1 was not the most limiting in some cases as described below. The 500 kV transmission system upgrades required for providing the additional N-1 transfer capability include:

- Series capacitor banks on 5L81 and 5L82 upgraded for 4.0 kA operation
- Series capacitor banks on 5L41 and 5L42 upgraded for 3.0 kA operation
- Summer ratings of 5L51 and 5L52 upgraded to 3.0 kA
- 5L81 and 5L82 circuit breakers (8 in total) replaced with 4 kA circuit breakers
- 5L51 circuit breakers (2 in total) replaced with 3 kA circuit breakers.

3.2. N-1 during Maintenance Thermal Capability

Uprating the 500 kV transmission system for providing the additional N-1 transfer capability significantly increased the loading on individual system elements to the extent that much maintenance (does not include lengthy planned outages for reconductoring or line rebuilds) opportunity was lost, even after optimal redispatch of transmission flows.

N-1 During Maintenance studies confirmed that providing the identified transfer capability with only the N-1 upgrades would preclude much of the maintenance opportunities (i.e. during summer weekends or at 65% of Winter Peak load) without more significant upgrades.

Additional upgrades required for providing 1090 MW of ATC in 2007/08 are:

- Series capacitor bank on 5L87 upgraded for 4.0 kA operation
- Series capacitor banks on 5L41 upgraded for 3.5 kA operation
- Series capacitor banks on 5L42 upgraded for 3.4 kA operation
- Summer ratings of 5L81, 5L82, and 5L87 upgraded to 4.0 kA
- Summer ratings of 5L41 upgraded to 3.5 kA
- Summer ratings of 5L40, 5L42 and 5L44 upgraded to 3.4 kA
- Summer ratings of 1L243, 2L1, 2L2, 2L90 and 2L91 upgraded up to 2.0 kA
- 5L40, 5L41, 5L42, 5L44 and 5L87 circuit breakers (19 in total) replaced with 4 kA circuit breakers.

3.3. Stability

With an additional 1090 MW of export, it was possible to meet transient and voltage stability criteria with approximately -300 and +1000 MVAr of dynamic compensation and 2000 MVAr of switched shunt compensation. Modification and addition of N-2 Remedial Action Schemes is also necessary.

4. Available Transfer Capability

The ATC over the ILM transmission network to the BCHA × BPAT Path depends on the BC coastal generation, native load and firm export commitments, Capacity Benefit Margin (CBM), and Transmission Reliability Margin (TRM).

Initial planning estimates suggest that 1090 MW of ATC is available around 2007/08.

The earliest possible in-service date of Network Upgrades is considered to be 31 December 2004.

5. Conclusions

The System Impact Study concluded that alternative Network Upgrades, other than a new transmission line, are available to provide approximately 1090 MW of ATC on the ILM transmission network.

Facilities Study work is required to:

1. Determine the feasibility of the Network Upgrades identified in this System Impact Study and other Network Upgrades including a new transmission line; and
2. Specify the cost and schedule of the required Network Upgrades.