

**System Impact Study for  
Power Supply 1000 MW Import on the  
BPAT × BCHA Path**

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**Network Performance Planning Department  
T&D Engineering**



## ***Executive Summary***

*BC Hydro Power Supply (Power Supply) submitted OASIS request 273602 to the BC Hydro Transmission & Distribution (T&D) for Long Term Firm Point-to-Point transmission service under the Wholesale Transmission Service (WTS) tariff to import 1000 MW on the BPAT × BCHA Path from 1 January 2002 to 31 December 2020.*

*This System Impact Study identifies system constraints and options, additional Direct Assignment Facilities or Network Upgrades required to provide the requested service. The base conditions for the study are the BC Hydro native load requirements from 2002 to 2009, and prior import commitments on the BPAT × BCHA path throughout the whole time period. Power flow and transient stability studies were performed to examine whether the Power Supply transmission request can be accomplished 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 system and does not consider capabilities of adjacent systems.*

*The System Impact Study concluded that the Power Supply 1000 MW import request could not be accommodated without significant Network Upgrades to the system although partial service is available. Simultaneous imports into the BC Hydro system create a Frequency Excursion restriction on the BPAT × BCHA Path.*

*There are no Direct Assignment Facilities associated with this request for Transmission Service.*

*To provide for the full 1000 MW of import request, a Facilities Study is required to determine cost, schedule and capability of this 500 kV circuit and other associated equipment.*

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## 1. Introduction

BC Hydro Power Supply (Power Supply) submitted an OASIS Request No. 273602 to BC Hydro Transmission and Distribution (T&D) for Long-Term Firm Point-to-Point Transmission Service for 1000 MW on the BPAT × BCHA for the period 1 January 2002 to 31 December 2020.

Pursuant to the WTSA, T&D determined that a System Impact Study was required for the Application.

Power flow and transient stability studies were performed to examine whether the Power Supply transmission request can be accomplished 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

A summary of the Terms of Reference is provided below.

- (a) T&D will use its existing planning and operating criteria, standards and procedures which conform with WSCC Reliability Criteria, to determine necessary transmission system reinforcements and other options.
- (b) Specifically, the following studies will be done under this Study Agreement:
  - Thermal, transient and voltage stability studies to determine the system capability to permit the 1000 MW import.
  - Identify system transmission constraints and any Network Upgrades.
  - Analyse load shedding, generator shedding and other options, generation reserve, tie-line transfer limit and network curtailment remedial action schemes required for the reliable operation of the interconnected system.
- (c) The study will assess the generation reserve issues as required by the WSCC.
- (d) The above technical studies will be done for the following system conditions:
  - The system configurations will be based on the provided resource allocations and network loads, and reserved Long-Term Firm Point-to-Point Transmission Service up to the 2009/2010 period.
  - High stress system conditions, including but not restricted to the 2002 summer low load case.
  - If the transmission system is not capable of providing for the requested transmission service, then lower stress system conditions will be required to determine the present capability of the transmission system.
  - Transmission losses will be assumed to be supplied by the BC Hydro system.
- (e) The studies will not identify any constraints on neighbouring systems, as it is the Transmission Customer's responsibility to ensure that any neighbouring utility limitations are addressed.

### **3. System Study Conditions**

The base conditions for the study are the BC Hydro native load requirements and prior firm import and transfer commitments, including prior pending WTS applications.

#### **3.1. Resources for Transmission Request**

The Point-of-Receipt (POR) for the transmission service is the BC-US Border. The resources for the import are located in the US transmission system. In BC, the Network Resources are reduced such that the imports are used to serve the Network Load.

#### **3.2. Transmission System Assumptions for Transmission Request**

Transmission System assumptions for this Transmission Service request are contained in Appendix A.

### **4. System Requirements for Transmission Request**

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

Only those portions of BC Hydro's transmission system that require reinforcements have been addressed below.

#### **4.1. BPAT × BCHA Path**

The WSCC South to North Path Rating is 2000 MW. An assessment of the path capability and reactive equipment requirement was done to determine if the 1000 MW import could be accomplished.

##### **4.1.1. Frequency Excursion**

The firm import capability is restricted by frequency excursion, caused by a simultaneous forced outage of 5L51 and 5L52, to less than 2000 MW during Summer Light loads. Without more generators on-line, this restriction can only be removed by adding a third 500 kV circuit to prevent the separation of the BC/Alberta system from the US system.

### **5. Available Transfer Capability**

The Available Transfer Capability (ATC) on the BPAT × BCHA Path depends on the generation pattern, existing firm commitments on the BC system, firm import, Capacity Benefit Margin (CBM), and Transmission Reliability Margin (TRM).

The following table provides the anticipated ATC of the system with both the minimum generation and with more generators on-line to meet frequency excursion and reactive requirement restrictions for the BC Hydro system, and assumes in-service of expected transmission reinforcements:

	Rotational Energy	
	23,380 MJ	33,460 MJ
2002	106	409
2003	101	395
2004	101	395
2005 - 2020	0	49

If constructed, a third 500 kV transmission circuit to the US, with an in-service date of 2010, may be able to accommodate the full 1000 MW import request.

## 6. Conclusions

The System Impact Study concluded that the Power Supply 1000 MW import request could not be accommodated without significant Network Upgrades to the system, such as an additional 500 kV circuit to the US, although partial service may be provided as above.

There are no Direct Assignment Facilities associated with this request for Transmission Service.

To provide for the full 1000 MW of import request, a Facilities Study is required to determine cost, schedule and capability of this 500 kV circuit and other associated equipment.

## **Appendix A.**

# **Transmission System Assumptions for Transmission Request**

## **A.1 Prior Uncompleted Firm Point-to-Point Requests**

The are no prior uncompleted Firm Point-to-Point requests for Transmission Service on the BPAT × BCHA or EAL × BCHA Paths.

## **A.2 Modifications to the Power-Flow Base Cases**

The following were added in the power-flow base cases:

- All existing Transmission Service reservations were included. However, since Counter-Flow Scheduling on a bi-directional path will not increase the amount of Firm Transfer Capability on the path, transfers have been set to zero with the following exceptions.
- The transfers for Transmission Request # 257654 is included.
- Network Resources decreased as per Resources for Transmission Request.



## **Appendix B.**

# **System Requirements for Transmission Request**

## **B.1 BPAT × BCHA Path**

Several studies were conducted to

- Assess reactive requirements at light loads using load flow simulations.
- Assess frequency excursion for various import levels using transient stability programs.
- Determine the Total Transfer Capability of the WSCC South-to-North Path Rating.

### **B.1.1 Reactive Requirements**

Load flow simulations were performed with a summer light load base case and 2000 MW import from the US (Net BC Hydro Transfer of 2170 MW) to ensure that the WSCC criteria for single contingency and the BC Hydro reactive power planning criteria are met.

Simulations were done for:

- single contingencies such as loss of one reactor, a 500 kV transmission line, a transformer, and Dunsmuir SVC
- double contingencies such as the loss of a reactor when another reactor is in maintenance, two transmission lines, a transmission line and a reactor
- multiple contingency such as the loss of Vancouver Island.

Voltages at the main buses were monitored for each contingency and verified against equipment ratings. Resulting voltages were within acceptable limits except for the simultaneous loss of 5L51 & 5L52. A simultaneous loss of 5L51 & 5L52 transfer trips the Nelway tie and causes the system to become extremely lightly loaded. Voltages were not within acceptable limits without more generation units on-line and without taking lines out-of-service prior to the contingency.

### **B.1.2 Frequency Excursion**

Dynamic simulations of the BC Hydro, Alberta, West Kootenay and Alcan systems were performed to assess system behaviour after simultaneous loss of 5L51 & 5L52. Studies were done for loads ranging from 3600 MW to 8000 MW and included loads modelled as frequency dependent where applicable, and Under Frequency Load Shedding (UFLS) data.

Simulations were done for various levels of import. After losing 5L51 & 5L52, the Nelway tie will open after 12 cycles (as per existing schemes), and the BC Hydro system will separate from Alcan, Alberta and West Kootenay via operation of under frequency, step or undervoltage relays. The islanded BC Hydro system is short of capacity equal to the amount previously imported from these other systems and UFLS will reduce loads to restore the frequency to near 60 Hz but not before an excursion to a lower frequency.

It was determined that with the expected rotational energy of 23,380 MJ online, the ATC would be severely limited.

However, more generators on-line to provide a higher amount of Rotating Energy online will enable some ATC to be available.

### **B.1.3 Total Transfer Capability**

The firm import capability of the BC system is limited by the simultaneous loss of 5L51 & 5L52 and transfer trip of the Nelway tie. This could be due to a disturbance on the lines, or a transfer trip resulting from other disturbances.

The BC/Alberta system islands and is short of capacity equal to the amount previously flowing on the intertie. UFLS will drop loads to restore the frequency to near 60 Hz but not before an excursion to a lower frequency. Aside from the frequency excursion, imports greater than existing obligations will also require additional reactive absorption.

To provide for the full 1000 MW of import request for all load levels, a Facilities Study is required to determine cost, schedule and capability of this 500 kV circuit and other associated equipment. With such additional circuit, during a simultaneous loss of 5L51 & 5L52, the separation of the BC/Alberta system from the rest of the WSCC system and the ensuing high voltages and frequency excursion will be prevented.

Increasing the WSCC South-to-North Path Rating above the presently approved 2000 MW rating will require going through the WSCC Path Rating process and WSCC approval, and should be done when adding the additional 500 kV circuit.