BC Transmission
CORPORATION
Building Connections

NITS System Impact Study

Canoe Creek IPP Project

Report No. SPPA 2009-158

November 2009

System Planning and Performance Assessment

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Executive Summary

This report identifies the network upgrades required for providing transmission service to the 5.5 MW Canoe Creek independent power producer (CNO IPP) Project proposed by the Canoe Creek Hydro Co and designated as Network Resource by BC Hydro. The CNO IPP is connected to 60L129 via a tap line at 30 km from the existing 60 kV substation of Long Beach (LBH). This IPP project consists of one hydro synchronous unit, injecting 5.3 MW maximum power to the Transmission System.

The following findings have been derived from the NITS System Impact Study and documented in this report:

- No unacceptable voltage conditions were observed in the load flow and transient stability studies due to the CNO IPP under normal and N-1 contingencies;
- No unacceptable equipment overload conditions were observed in the load flow and transient stability studies due to the CNO IPP under normal and N-1 contingencies; and
- With the upgraded protection schemes (as identified in the Interconnection System Impact Study – report SPPA 2009-137), it was observed in the transient stability study that the generator had acceptable stability performance and no further upgrades were required to provide NITS transmission service to BC Hydro for the proposed Network Resource.

This report addresses the transmission service requirement only, and any requirements for interconnection were identified in the Interconnection System Impact Study.

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1.0 Introduction

BC Hydro designates the Canoe Creek IPP Project (CNO IPP) proposed to be developed by Canoe Creek Hydro Co. The Project consists of one 6.1 MVA, 0.9 power factor synchronous generator. The maximum power to be fed into the Transmission System is 5.3 MW in summer and winter seasons. The location of the proposed generating facility site is 30 km east of the Long Beach (LBH) substation on Vancouver Island. The proposed point of interconnection is near Marion-3 Creek on 60L129. The proposed Commercial Operation Date (COD) is April 15, 2010.

The following diagram shows the connection of the CNO IPP. To connect the CNO IPP to 60L129, a 0.1 km of 60 kV overhead transmission line will be constructed by the proponent. The area network is a radial system with an existing local load at LBH, end of 60L129 and three existing IPPs connected onto 60L129. Power will be imported to the area in winter, and can be exported to the Transmission System in summer. The overall area network is shown in Figure 1.

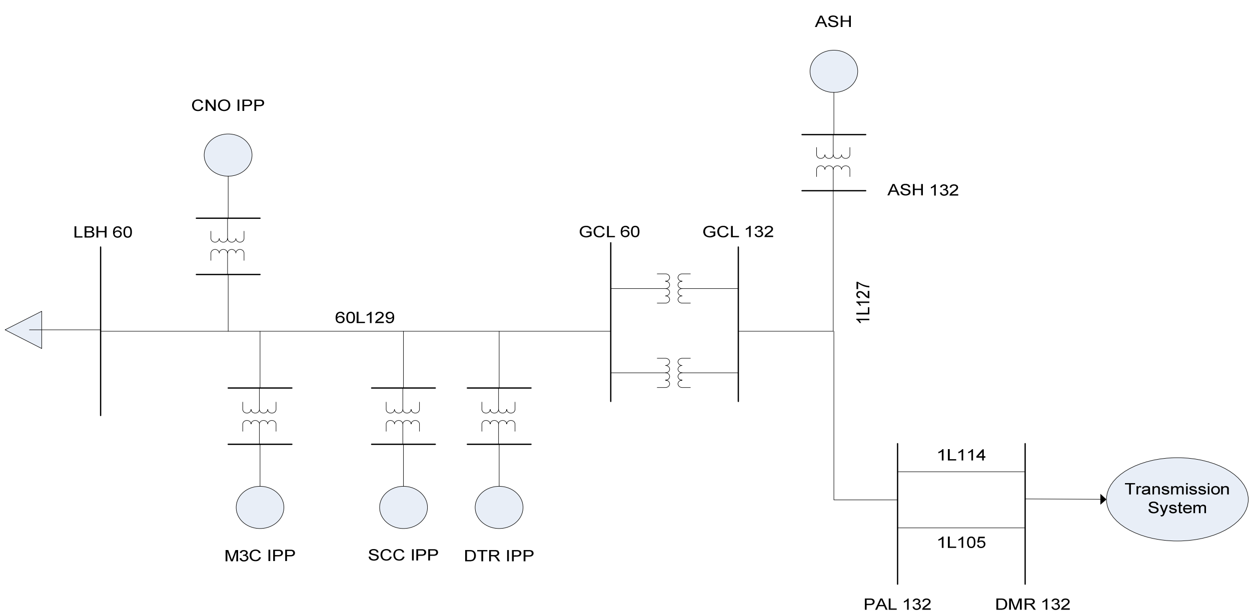

Fig 1. The area network for interconnecting the CNO IPP.

2.0 Purpose of Study

The purpose of this NITS System Impact Study is to assess the impact of the CNO IPP on the transmission system and to identify the requirements for providing NITS to BC Hydro. This study will identify constraints and network upgrades required for the reliable operation of the inter-connected system.

3.0 Terms of Reference

The study investigates and addresses the voltage and overloading issues of the transmission networks in the vicinity of CNO IPP generating station as a result of providing NITS transmission service. Power flow is based upon the base case that includes generation, transmission facilities, and load forecast representing the queue position applicable to this project. The 2010 heavy winter, heavy summer and light summer load flow base cases were selected for this study. Transient stability of the transmission system was also investigated. BCTC planning criteria described in the BCTC System Operating Limit Methodology are used in the studies.

The study is based on the model and data information provided by the proponent in the form of Generator Interconnection Equipment Statement (GIES) sheets for this project. This study assumes that any upgrades identified in the Canoe Creek IPP Interconnection System Impact Study (report SPPA 2009-137) are implemented.

4.0 System Studies

Power flow, short circuit, and transient stability studies were carried out to evaluate the impact of the proposed CNO IPP. Studies were also performed to determine the protection, control and communication requirements.

4.1 Steady State Pre-outage Power Flows

Two sets of pre-outage power flows were prepared to assess the impact to the transmission system, one with and the other without the CNO IPP. Each set included three load/generation conditions: the 2010 heavy winter (HW), and 2010 heavy summer (HS) and light summer (LS) load conditions.

Results indicate that under system normal conditions, the thermal loadings of equipment and the voltage profiles of the interconnected BCTC-CNO IPP systems are within acceptable operational ranges. Summary of steady state load flow study results in pre-outage are shown in Table 1.

Table 1 Pre-outage Steady State Power Flow Study Results for CNO IPP Study

System Load Condition	System configuration	MW Injection from CNO IPP	Bus Voltage (in per unit)				Power Flow (MW)		
			LBH 60	TRR 60	GCL 132	PAL 132	1L105 (DMR-PAL)	1L127 (PAL-GCL)	60L129 (GCL-LBH)
2010 HW Heavy winter	Normal	5.5	1.04	1.10	1.06	1.06	66.6	-18.2	26.2
2010 HS Heavy summer	Normal	5.5	1.04	1.08	1.06	1.06	70.2	-10.2	18.7
2010 LS Light summer	Normal	5.5	1.14	1.13	1.07	1.07	10.8	-16.5	6.5

1L114 and 1L105 are double circuits of similar design from PAL- DMR.

Normal Ratings: 1L105, 1L114 - 143MVA (summer), 184MVA (winter);
1L127 - 90MVA (summer), 129MVA (winter);
60L129 – 31MVA (summer), 57MVA (winter)

4.2 Power Flow Based Post Contingency Study

Power flow based single contingency (N-1) studies show that there is no transmission equipment over-loading problem and no voltage violation conditions due to the addition of the CNO IPP. Summary of steady state load flow study results in post-outage are shown in Table 2.

Table 2 Post-outage Steady State Power Flow Study Results for CNO IPP Study

System Condition	Single Contingency	MW Injection from CNO IPP	Bus Voltage (in per unit)				Power Flow (MW)		
			LBH 60	TRR 60	GCL 132	PAL 132	1L105 (DMR-PAL)	1L127 (PAL-GCL)	60L129 (GCL-LBH)
2010 HW Heavy winter	Loss of 1L114	5.5	1.03	1.10	1.04	1.03	134.9	-18.2	26.2
2010 HS Heavy summer	Loss of 1L114	5.5	1.04	1.08	1.04	1.04	142.3	-10.1	18.7
2010 LS Light summer	Loss of 1L114	5.5	1.14	1.13	1.07	1.07	21.7	-16.5	6.5

1L114 and 1L105 are double circuits of similar design from PAL- DMR.
Normal Ratings: 1L105, 1L114 - 143MVA (summer), 184MVA (winter);
1L127 - 90MVA (summer), 129MVA (winter);
60L129 – 31MVA (summer), 57MVA (winter).

4.3 Short Circuit Study

Refer to Interconnection Facilities Study Report number SPPA2009-138.

4.4 Voltage Stability Study

There is no voltage stability issue due to addition of the CNO IPP.

4.5 Transient Stability Study

The CNO IPP and three existing IPPs tapped on the 60L129 line have a total generation of 21 MW. There is a nearby Ash River (ASH) generating station to provide additional supply in the area. Excess power can be transferred to the Transmission System via 1L127 to the 138 Port Alberni (PAL) substation.

A series of transient stability studies has been performed for a range of possible system disturbances in the Transmission System in order to determine the stability upgrade requirement of the CNO IPP. For the various system faults, electrical angle, electrical power, speed/ frequency deviation, and bus voltage are monitored. Transient stability results are analyzed in accordance with the NERC/WECC Reliability Criteria and BCTC standards.

The Interconnection System Impact Study recommended that PAL zone 1 fault clearing time be 6 cycles or less and PAL zone 2 fault clearing be 10 cycles or less in order to maintain system stable conditions. This study assumes those recommendations were implemented.

Table 3 Transient Stability Study Results

case	Outage	Three Phase Fault Location	Clearing time (cycles)	Max CNO IPP Rotor Swing (deg)	Minimum voltage level (pu)	Duration of voltage dip below 0.8 pu (s)	Comments
2010 Heavy Winter Case							
1	1L114 or 1L105	PAL132	PAL 6	54	0.96 @ LBH60	0.	Acceptable – 6 cycle 3 ph faults
2	1L114 or 1L105	86% from PAL end	DMR 5 PAL 7	47	0.99 @ LBH60	0.	Acceptable – New PAL Zone 2 fault clearing scheme.

4.6 Islanding

Assessed in the Interconnection System Impact Study.

4.7 Protection, Control and Telemetry Requirements

No additional P&C and telemetry requirements identified.

4.8 Black Start Capability

Assessed in the Interconnection System Impact Study.

4.9 Transmission Line Upgrade Requirements

None identified.

5.0 Conclusions

In order to provide NTIS transmission service to BC Hydro for the CNO IPP Network Resource, the findings in the System Impact Study are summarized below:

- No unacceptable voltage conditions were observed in the load flow and transient stability studies due to the CNO IPP under normal and N-1 contingencies;

- No unacceptable equipment overload conditions were observed in the load flow and transient stability studies due to the CNO IPP under normal and N-1 contingencies; and

- With the upgraded protection schemes (as identified in the Interconnection System Impact Study), it was observed in the transient stability study that the generator had acceptable stability performance and no further upgrades were required to provide NITS transmission service to BC Hydro for the proposed Network Resource.

Appendix

Fig A1 Generator Data and Models

GENSAL

Salient Pole Generator Model

This model is located at system bus CNO-IPP G1

CONs	#	Value	Description
J		5.0	T'do (>0) (sec)
J+1		0.03	T"do (>0) (sec)
J+2		0.11	T"qo (>0) (sec)
J+3		2.2	Inertia, H
J+4		1.0	Speed damping, D
J+5		1.2	Xd
J+6		0.79	Xq
J+7		0.37	X'd
J+8		0.24	X"d = X"q
J+9		0.14	Xl
J+10		1.07	S(1.0)
J+11		1.18	S(1.2)

Note: X_d, X_q, X'_d, X''_d, X''_q, X_l, H, and D are in pu, machine base of 6.1 MVA.
X''_q must be equal to X''_d.

A1-1 Models for IPP power plant excitation control system (be cont'd).

ESAC8B--- Basler DECS

This model is located at system bus CNO-IPP G1

CONs	#	Value	Description
J		0.0	TR (sec)
J+1		80.	KP
J+2		5.	KI
J+3		10.	KD
J+4		0.1	TD (sec)
J+5		1.0	KA
J+6		.004	TA
J+7		2.7	VRMAX or zero
J+8		0.	VRMIN
J+9		1.2	TE > 0 (sec)
J+10		1.0	KE or zero
J+11		6.5	E1
J+12		0.3	SE(E1)
J+13		9.0	E2
J+14		3.0	SE(E2)

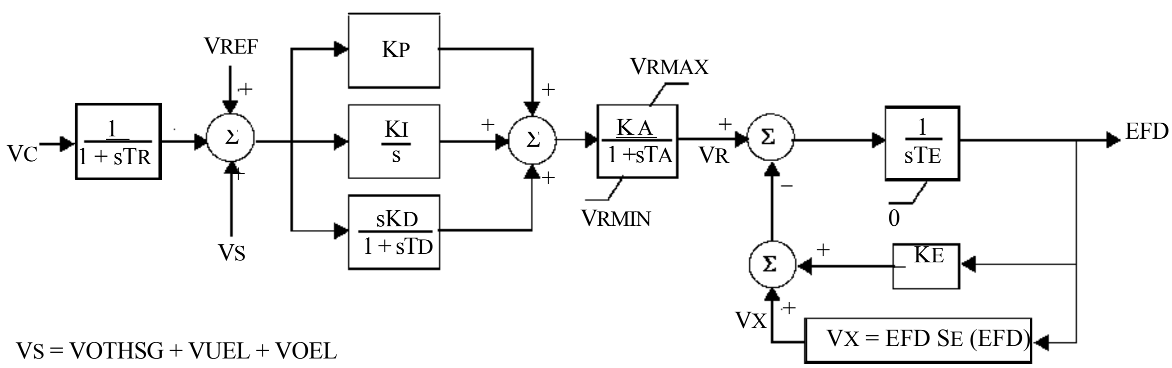

Fig. A1-2 Models for IPP power plant excitation control system.

