Alberta Export GRAS

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	Name	Signature	Date
Prepared:	Kapil Saxena, E.I.T.		
Prepared:	Jagtar Tatla, P. Eng.		
Approved:			

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1 Background

The 240 kV N-S back bone is a major transmission path for the excess north generation to serve the southern load and export to BC. The total transfer capability of the N-S cut plane, defined as SOK-240 in the recent OPP-304 updates, constrain the north generation's ability to serve export during light to medium AIL load levels. The main constraint at present is the N-2 contingencies of the double circuit N-S back bone 240 kV lines. The Alberta to BC export capability is also constrained by N-1 and N-2 contingencies on the BCTC transmission system. The system effects of some of these AB and BC contingencies can be mitigated using a generator shed remedial action scheme (GRAS) to instantaneously (within cycles) off-load the SOK-240 cut plane in Alberta, the AB-BC tie-line, and transmission circuits within BC by tripping a northern generator in AB. The Alberta Export GRAS report, posted on the AESO website on Oct 27, 2005, estimated that a GRAS trigger would occur once every 12.07 years. Additional analysis has been completed to revise the original estimated number of GRAS triggers due to intra-Alberta contingencies. The BCTC historical outage data was also available and used to determine the estimated number of GRAS triggers due to intra-BC contingencies. These revisions/additions are discussed below and the results for intra-Alberta and intra-BC triggers are listed in this report.

2 Summary of Study Results and Explanation

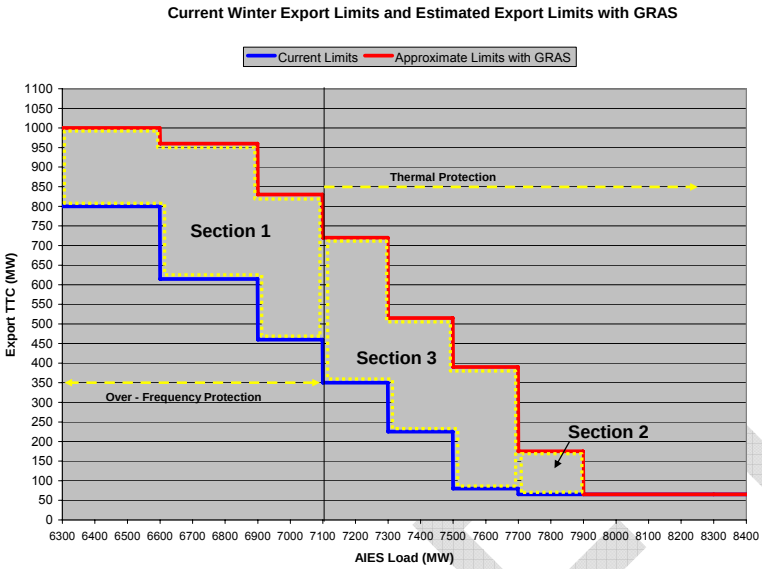
Intra-Alberta GRAS Triggers

The estimated number of GRAS triggers due to intra-Alberta contingencies has been modified from 1 trip every 12.07 years, to 1 trip in 7.48 years. This increase in frequency of GRAS triggers is due to the updated data which is now based on total number of hours of GRAS exposure, rather than the number of export hours gained by using GRAS, and the use of GRAS to support high AIES load. The previous report had number of export opportunity hours gained using GRAS based on the following criteria:

- the number of hours when forecasted load would be at or below a load level that would allow export opportunity > 800 MW during one year.
- the number of hours gained for export opportunity using GRAS at load levels where there was no export opportunity available without GRAS.

The new estimate also includes hours in which, based on the estimated limits stated in the GRAS report, there would already be export capability, but GRAS would boost the capability to an TTC < 800 MW (please refer to Figure 1 shown below, the hours in Section 3 are now included in the estimate).

Figure 1: Export MW Gain Breakdown



An additional change to the estimated number of GRAS triggers for intra-Alberta contingencies is that the new estimate includes the use of GRAS to off load the 240 kV N-S cut plane (SOK-240) in order to support load only. Using GRAS in this manner would significantly increase SOK-240 flow limit as the limiting contingency would be N-1 and not N-2. This will enhance the ability of the north generation to support the Calgary area and southern load. The estimated number of hours in which GRAS may be used to support load is determined by including 50 % of all hours in which AIES load forecast would be over 8000 MW and when SOK-240 flow may exceed its N-2 limit in 2006; for the remaining hours SOK-240 limit based on N-2 is considered to be sufficient to serve south load as market conditions are expected to bring south generation on line or to encourage imports on the tie lines from BC and/or Saskatchewan. The inclusion of these hours resulted in an increased estimate for the frequency of GRAS triggers for intra-Alberta contingencies by almost 1.8 years; from one trip every 9.37 years to one trip every 7.48 years.

Table 1 below, which was originally presented in the Export GRAS report (as Table 6), shows the detailed calculation for determining the revised estimate for the number of GRAS triggers.

Table 1: GRAS Exposure[1] and Triggers for intra-Alberta Transmission Contingencies

Item	N-1 Contingencies	N-2 Contingencies	
	TTC ≥ 800 MW	TTC ≤ 800 MW	Alberta Load RAS (AIL > 8000MW)
	During Export		Non-Export
Exposure Hours	186	2993	2368[1]
Triggers per year	0.0725	0.0342	0.0270
Sub-total Triggers	0.0725 per year	0.0612 per year	
Sub-total Triggers	0.1067 per year		0.0270 per year
Total Triggers	0.1337 per year		
	One trigger per 7.48 years		

Intra-BC GRAS Triggers

The estimated number of GRAS triggers due to BC contingencies is one trip every 2.1 years. This number was originally estimated as more than three trips per year. The high number of triggers per year suggested that alternative methods might be more appropriate to mitigate some BC contingencies. Therefore it was determined that for the loss of 5L92, which was the major contributor to the BC contingency related estimated number of triggers per year, we will continue to trip the 1201L/5L94 AB to BC tie line when export to BC is 100 to 800 MW. When exports are greater than 800 MW, the 5L92 N-1 trip will trigger GRAS to northern AB generators in addition to other N-1 and N-2 BC contingencies depending upon real time conditions on the BCTC system. In addition, BCTC has installed single pole trip and reclose protection schemes (SPTR) on most of their transmission lines that are affecting AB-BC interchange flow. The SPTR is expected to reduce BCTC triggers to 20% of the historical outage data which is based on three pole trips for all types of line faults. This change in procedure and SPTR allowed us to re-calculate the estimated frequency of GRAS triggers, and the result now is estimated as one trip every 2.1 years. BCTC contingencies that are considered for GRAS application are export scenarios with the loss of 5L92 (AB-BC export >800), the loss of 5L91 or 5L98 (AB-BC export > 700 MW), and the double circuit loss of 5L81 &

[1] Exposure is based on historical data for 2004 & 2005. As export opportunity may be available at higher loads in future depending upon south generation on line, the GRAS arming exposure hours and trigger frequency for exports may increase and decrease for loads in the future.

5L82 (AB-BC export > 500 MW), 5L76 & 5L79 (AB-BC export > 100 MW) and 5L51 & 5L52 (AB-BC export > 100 MW).

Note that BC contingencies will not have to be mitigated in order to use GRAS to support high Alberta load.

The Table 2 below shows the detailed calculation used to estimate the GRAS triggers considering BC contingencies and Table 3 lists the consolidated triggers considering AB and BC contingencies.

Table 2: GRAS Exposure and Triggers for intra-BC Transmission Contingencies

Item	GRAS Arming Export Level	N-1 Contingencies		N-2 Contingencies	
		Yearly exposure	Trip Frequency per year	Yearly exposure	Trip Frequency per year
5L91	> 700	568	0.11177		
5L92	>800	186	0.08023		
5L96/5L98	>700	568	0.23528		
5L51 & 5L52	>100			3179	0.00325
5L76 & 5L79	>100			3179	0.01035
5L81 & 5L82	>100			1290	0.03538
Sub-Total		0.42728 triggers per year		0.04898 triggers per year	
Total Triggers		Expected frequency is 0.4763 triggers per year			
		One trigger is expected every 2.1 years			

Table 3: Consolidated GRAS trigger frequency for AB and BC contingencies

Item	AB Trigger Frequency Per Year		BC Trigger Frequency per year
	Load	Export	Export
N-1	0	0.0725	0.42728
N-2	0.0270	0.0342	0.04898
Sub-total N-2	0.0612		0.04898
Sub-total for AB and BC	0.1337		0.4763
	One trigger per 7.48 years		One trigger every 2.1 years
Total AB & BC	0.6100 triggers per year		
	One trigger every 1.64 years		