Alberta Intertie Restoration Initiative Discussion Paper

March 25, 2010

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1.0 Executive Summary

Alberta currently has two interties with other jurisdictions, and these interties are subject to congestion that reduces the available transfer capability (ATC). The BC intertie is rated at 1200 MW for imports and 1000 MW for exports, but Alberta has never scheduled power flows to these levels due to reliability requirements. Recent ATC limits with all transmission elements in operation are a maximum of 600 MW for imports and 735 MW for exports. The Saskatchewan intertie is rated at 153 MW for both imports and exports, but export capability is currently restricted to a maximum 75 MW.

This paper discusses the development of specific services that support the restoration of intertie capacity. Alberta policy has consistently indicated that the interties should be restored for both imports and exports. The first section of this document outlines the policy and legislative background behind the recommendation to proceed with the development of intertie restoration products. This policy section also details the cost allocation rationale. This paper suggests that intertie support products should be treated as non-wires solutions to resolving transmission constraints; in this instance, the constraints limit ATC.

The remainder of this paper is divided into two areas of focus: options for restoring import capacity from BC via a load based product and options for increasing export capacity via a generator based product.

Import restoration is generally a function of protecting the Alberta system against the loss of the BC intertie when imports are at a high level. If imports are greater than 450 MW, the intertie is the single largest contingency on the system and system stability must be maintained following the loss of this supply. Frequency responsive load shed service (LSS) and Interruptible Load Remedial Action Scheme (ILRAS) are two products that are currently used to support imports. ILRAS is available during emergencies and LSS is limited to 150 MW of permanently armed load. As a result, import ATC from BC is currently limited to 600 MW or lower under normal operating conditions.[1]

An armable LSS service called LSSi is an option to increase import ATC from its current levels to between 625 MW to 715 MW under normal operating conditions, depending on load levels. LSSi must be dispatched by the system controller, which requires that suppliers be able to respond to arming and disarming dispatches. Scheduled imports above 715 MW on the BC intertie cannot be readily achieved via the development of an LSSi product given the current system configuration. This paper does not consider options to increase import ATC beyond 715 MW from BC at the current time. As the system changes, the AESO will consider alternatives to further increase ATC to the extent technically workable.

Export restoration requires resolving a range of constraints that currently limit export ATC to a maximum of 735 MW and an average of less than 400 MW. SOK limits are one of the limiters of export flows. Export limits are at the maximum when there is more

[1] Under OPP 801, the AESO can arm ILRAS which allows imports to be increased above 600 MW in emergency conditions.

southern generation online and/or southern load is low. Voltage stability limits, over-frequency protection for the loss of the intertie and BC internal constraints also serve to limit export capacity.

In order to restore export capacity, a System Generator Remedial Action Scheme (GRAS) is required. Integrating the wind generation forecast into the export ATC determination may also be an option to increase export ATC. The primary GRAS option will be designed to allow exports above the current 735 MW limit. This GRAS must be coordinated with the BC Transmission Corporation as export levels over 735 MW may be limited by BC conditions. This GRAS program may allow export flows up to 935 MW under ideal system conditions.

An option to increase export ATC by increasing limits on SOK flows through a GRAS is not being pursued at this time. SOK constraints would require complex GRAS programs to address the contingencies involved, and studies would need to be undertaken to determine if a GRAS is a feasible technical solution. Given the numerous changes expected to the transmission system in the next several years, GRAS to increase SOK flows solution will only be required for a short time prior to its need being obviated. Therefore, the AESO will not explore GRAS options to address short term SOK flow limitations.

In order to advance the intertie capacity restoration initiatives, the AESO will form two working groups (LSSi group and GRAS group) to work on refining options, identifying system studies where required, developing a procurement plan and moving toward ultimate implementation. The projects will proceed independently. There is no interdependence between the two products. Both workgroups are in the process of being initiated.

2.0 Intertie Capacity Restoration Policy Background

The AESO's mandate is set out in government legislation, regulation and policy. At the highest level, the AESO has two overarching duties: operate the market in a manner that promotes the fair, efficient and openly competitive (FEOC) exchange of electricity, and provide for the safe, reliable and economic operation of the interconnected electric system.

Restoring intertie capacity has implications with respect to promoting the FEOC market. It supports enhanced competition from external suppliers and access to external markets for surplus energy. The availability of increased import levels reduces the likelihood of a supply shortfall, and export capacity supports the long term viability of the market by stabilizing price cycles and allowing Alberta to develop more baseload generation than would be possible without connections to an external marketplace. The Transmission Regulation specifically obligates the AESO to restore intertie capacity.

2.1 Obligation to Restore Intertie Transfer Capacity

The Transmission Regulation, Alberta's Electricity Policy Framework and the Provincial Energy Strategy all provide guidance relevant to restoring intertie capacity. As noted, the Transmission Regulation directs the AESO to develop a plan to restore the capacity of existing interties:

> 16(1) In making rules under section 20 of the Act, and in exercising its duties under section 17 of the Act, the ISO must prepare a plan and make arrangements to restore each intertie that existed on August 12, 2004 to, or near to, its path rating.
>
> (2) The plan to restore interties to their path ratings must specify how the ISO intends to restore and maintain each intertie to, or near to, its path rating without the mandatory operation of generating units.
>
> (3) The plan to restore and maintain interties must be incorporated into and form part of the transmission system plan as soon as practicable.

Two interties are impacted by Transmission Regulation: Saskatchewan and British Columbia. The 2003 Transmission Development Policy Paper provides further direction as to the AESO's obligation to restore the existing interties:[2]

> Under normal conditions, the Alberta transmission system should be reinforced so that the BC Inter-tie is capable of transferring about 1,000 MW for exports subject to availability of generation RAS schemes and about 800 MW for imports subject to suitable load RAS schemes. Imports in excess of 800 MW on the BC Inter-tie require more careful consideration since they may place the Alberta system at considerable risk. The Saskatchewan Inter-tie should be capable of transferring 150 MW for import and export.

Alberta's Electricity Policy Framework gives rationale for expanding intertie capacity and links access to external markets to both reliability and FEOC concepts.[3]

> Transmission interconnections with neighboring jurisdictions are essential to a well-functioning power market as they support reliability, price stability, generation development and continued economic growth in Alberta. Albertans benefit from these interconnections by having the ability to import or export power as needed.
>
> **Recommendations**
>
> As noted previously, the Transmission Policy and Regulation provide certain direction regarding interties. The ISO is required to create long term plans including consideration of interties and is also provided with direction to reinforce the transmission system internal to Alberta so that existing intertie capacity is restored to its design path rating. The Transmission Policy and Regulation also provides a framework for the development of privately funded merchant transmission lines for import and export of electric energy.
>
> The Department recommends that the ISO evaluate additional tie-line capacity with neighboring systems in its 20-year Transmission Outlook documents and plans. Supporting export capability of surplus energy could stimulate generation development in the province which would directly enhance system adequacy and reliability. Exports would be recallable in times of system supply shortages.

Alberta's Provincial Energy Strategy (PES) [4] continues to support the concept that increasing the ability to transfer power to and from external markets is a key aspect of a healthy market. It also highlights that intertie capacity allows for greater ability to

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[2] Transmission Development - The Right Path for Alberta - A Policy Paper. Government of Alberta, November 2003. Page 9.

[3] Alberta's Electricity Policy Framework: Competitive – Reliable – Sustainable. Alberta Department of Energy, June 6, 2005, pp 38-39.

[4] Launching Alberta's Energy Future - Provincial Energy Strategy. Government of Alberta, December 11, 2008, page 43.

connect wind generation in Alberta.

> Adopt and implement a policy to build interties to other markets to ensure an adequate supply of electricity to Alberta as well as to facilitate development of additional wind generation.

The legislative and policy framework clearly identify import and export capacity as cornerstones of a healthy electricity market. Increasing intertie capacity is part of the AESO's duty both to maintain reliability as well as to promote a FEOC market.

2.2 Cost Allocation

A key issue in developing services to restore intertie capacity is whether they should be treated as system services and funded by load, or whether they should be treated as 'market' services and funded by the individual users of the service. For example, a service to restore export capacity could be funded by exporters, or it could be funded by load generally as an ancillary service cost.

The Transmission Development Policy paper[5] states that services to restore intertie capacity should be allocated to load.

> Inter-ties are an essential part of a competitive market both as a means to import power when needed, and to export surplus energy and to support effective functioning of the wholesale market. Without such capabilities, market signals and wholesale prices are distorted and unreflective of true market conditions. Since the ability of inter-ties to exchange electricity in both directions (i.e. import and exports) is essential to a robust wholesale market and a reliable electric system, the cost for internal reinforcements and RAS arrangements to allow the inter-ties to function as designed will be allocated to load.

The Alberta market model is premised on unconstrained access to transmission. There are no transmission rights, and transmission costs are allocated to load. The AESO has an obligation to eliminate congestion generally (with limited exceptions) and to specifically restore the interties to their path rating for imports and exports per the Transmission Regulation. Intertie capacity restoration services are, in effect, a 'non-wires' solution to specific instances of congestion that impact the ability of the market to access the intertie for both imports and exports. The provision of these services should result in similar outcomes in the market as would occur if a wires solution was used, and therefore it would be inappropriate to charge the direct cost of the services to either importers or exporters.

Services to restore intertie capacity may have variable cost components that are only triggered through actual use of the service. It may be appropriate to charge these components to users of the service, i.e. importers and exporters. This would be consistent with the treatment of losses to generators, as losses are a variable cost of transmission that vary with the use of the system. The Electric Utilities Act (EUA) provides direction in this area under ISO duties, which are outlined in Section 17. In particular:

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[5] Transmission Development - The Right Path for Alberta - A Policy Paper. Government of Alberta, November 2003. Page 9.

> 17 (c) to determine, according to relative economic merit, the order of dispatch of electric energy and ancillary services in Alberta and from scheduled exchanges of electric energy and ancillary services between the interconnected electric system in Alberta and electric systems outside Alberta, to satisfy the requirements for electricity in Alberta;

To the extent imports and exports trigger variable costs, it may be argued that these costs influence the relative economic merit of imports and exports. Additionally, users of opportunity services, such as imports and exports, are charged the variable costs associated with the service as per previous ISO tariffs. Firm import and export tariffs, if they are developed, will also require an evaluation of intertie capacity restoration services from a cost allocation perspective.

In summary, import capacity restoration services and export capacity restoration services will be allocated to load as per provincial policy, although the AESO is considering whether direct variable costs associated with the service may be charged to users of the service. These services remove constraints on the existing transmission system and allow the wholesale market to function in a more FEOC manner.

Import Capacity Restoration

Current operating limits for imports over the BC intertie are constrained because at high import flows, the intertie is the largest single supply contingency in Alberta. There are additional reliability concerns for high imports under specific system conditions, but the primary binding limit relates to contingency concerns. The options for restoring the intertie amount to developing services that maintain reliability when supply over the intertie line is unexpectedly lost.

It is appropriate to fund the direct costs of import capacity restoration services from load customers. The services act as virtual transmission and support the competitive and reliable function of the Alberta market. The impact of these services allows existing physical transmission infrastructure to be more fully utilized while maintaining reliable operations. Cost allocation of the variable costs associated with the service will be developed through consultation.

Import capacity restoration services should be charged to load for the following reasons:

- These services meet the obligation on the AESO to restore intertie limits contained in the Transmission Regulation
    - Allocating costs to load is consistent with policy direction;
    - Consistent with previous treatment of both ILRAS and LSS – does not represent a change in cost allocation
- The product acts as a transmission infrastructure substitute. There is no viable transmission investment option in the near or medium term that will address import capacity limitations
    - Allows more efficient use of the existing transmission infrastructure, consistent with Transmission Regulation 15 (2) (b)
- There are widespread system benefits across multiple parties
    - Numerous participants import power on the intertie and increased import ATC results in greater competition within Alberta
    - Supports FEOC through competition and access to external markets

    - Some options that increase import ATC also provide protection for Alberta during islanded conditions
    - Increased total capacity available to the market supports supply adequacy
- Variable costs associated with import capacity restoration services may be allocated to the product user
    - Consistent with the policy of charging system losses to generators
    - Consistent with existing treatment of variable costs under opportunity service tariffs
    - Policy states intertie restoration services should be allocated to load

Export Capacity Restoration

The existing operational limits on exports over the BC intertie are a function of several variables described in OPP 304, which include provincial load levels and southern generation levels. Once capacity on the Saskatchewan intertie for exports is restored, BC and SK exports compete for limited export capacity as both export paths load the system on the SOK pathway.

It is appropriate for load to fund services for export capacity restoration where those services act as virtual transmission for resolving constraints within Alberta and restoring the capacity of the intertie to its rated level. In order to preserve the FEOC market, solutions to increase export ATC should not interfere with the overall energy or ancillary services markets. As such, export must run generation and bifurcating ancillary services products into north and south zones will not be considered as solutions.

Export capacity restoration may also be facilitated through the development of procedures that more accurately reflect the reduction in SOK flows driven by wind generation and new thermal generation located in southern Alberta. Since the majority of wind generation is in the south, increases in wind energy reduce SOK flows and thereby increase export capability. The wind forecasting project will feed this process information to allow higher export capability.

Export capacity restoration services should be charged to load for the following reasons:

- Services that reduce transmission constraints without impacting normal market operations are akin to virtual transmission which is charged to load
- It is consistent with the policy direction provided by the Government of Alberta
    - Required to restore interties by the Transmission Regulation
- Improves ability to absorb wind capacity
- Supports the development of the FEOC market by providing access to wider markets, particularly for baseload generation
- Variable costs associated with export capacity restoration services may be allocated to the product user
    - Consistent with the policy of charging system losses to generators
    - Consistent with existing treatment of variable costs under opportunity service tariffs
    - Policy states intertie restoration services should be allocated to load

3.0 Import Capacity Restoration

This section will examine several potential options to restore import capacity on the interties. The focus is on the BC intertie, as the Saskatchewan intertie is not significantly constrained for imports.

3.1 Historical Background

Alberta has used and continues to use two distinct products to reduce constraints on imports over the BC interconnection. ILRAS service has been in place since 1998, when it was originally implemented by TransAlta. ILRAS is an armable service that allows loads to be tripped when the intertie is tripped under high import conditions. Load Shed Service is also used to support import transactions. LSS is a frequency responsive product that trips loads anytime the system frequency drops below 59.5 Hz, irrespective of interchange levels or system load conditions.

Prior to 2007, ILRAS was available to the system to support import transactions under normal operating conditions. In 2007, FortisAlberta changed its ILRAS contract with the AESO due to concerns FortisAlberta customers had in providing the service. ILRAS continues to be available under emergency situations (supply shortfall conditions).

When the ILRAS contract was altered, the AESO issued a request for expressions of interest (EOI) in late 2006 to competitively procure ILRAS from alternative providers. After receiving limited response, the AESO determined that ILRAS was not a contestable service, partly due to the fact that distribution service providers indicated they could not participate. The AESO proposed that ILRAS be provided by distribution companies as a mandatory service in late 2007, but this proposal was rejected.

An expanded LSS product to support higher import limits was explored as part of the Demand Response Working Group (DRWG) in 2009. The DRWG examined barriers to demand response (DR) in the Alberta market. A revised form of LSS was identified as a potential product for greater participation by loads within the context of Alberta's market design.

3.2 Current Situation

Import capacity on the BC intertie is limited to a maximum of 600 MW under normal conditions. The current import ATC limits are driven by system load (AIL) and LSS availability. Typically, 100 MW to 150 MW of LSS is available to support import capacity. During emergency conditions (supply shortfall) when ILRAS is available to be armed, import ATC may be increased to 715 MW, but this does not occur in a material number of hours annually.

Figure 1 - LSS and ILRAS Required at Various AIL and Import Levels (Current)

	AIL								
Import Level	<6300	6300 to 6599	6600 to 6899	6900 to 7199	7200 to 7499	7500 to 7799	7800 to 8099	8100 to 8399	?8400
<300	0	0	0	0	0	0	0	0	0
300 to 325	0	0	0	0	0	0	0	0	0
326 to 350	0	0	0	0	0	0	0	0	0
351 to 375	35	0	0	0	0	0	0	0	0
376 to 400	70	40	0	0	0	0	0	0	0
401 to 425	105	80	40	0	0	0	0	0	0
426 to 450	140	120	80	45	0	0	0	0	0
451 to 475	175	160	120	90	45	0	0	0	0
476 to 500	210	200	160	135	90	45	0	0	0
501 to 525	245	240	200	180	135	90	50	0	0
526 to 550	280	280	240	225	180	135	100	50	0
551 to 575	*	320	280	270	225	180	150	100	55
576 to 600	*	*	320	315	270	225	200	150	110
601 to 625	*	*	*	360	315	270	250	200	165
626 to 650	*	*	*	*	360	315	300	250	220
651 to 675	*	*	*	*	*	360	350	300	275
676 to 700	*	*	*	*	*	*	380	350	330

Figure 1 is taken from the current version of OPP 312 which describes the use of ILRAS and LSS to support import capacity from BC. As illustrated in the table, with 100 MW to 150 MW of LSS typically available, import volumes above 600 MW are only available under emergency conditions.

System studies have determined that reliability cannot be maintained with more than 150 MW of LSS, given the current technical specifications of the product. LSS in excess of 150 MW creates risk to the system under high export conditions[6], and since ILRAS is only available under emergency conditions, import limits cannot be increased beyond their current levels without either new products or readily available ILRAS.

3.3 Options

The AESO has determined that it is technically feasible to restore the import ATC for BC to approximately 715 MW under high load conditions, and 565 MW under low load conditions with services that protect the system from the loss of the intertie, as illustrated below in Figure 2. These ratings will prevail under normal system conditions, i.e. with no planned or forced outages at transmission facilities.

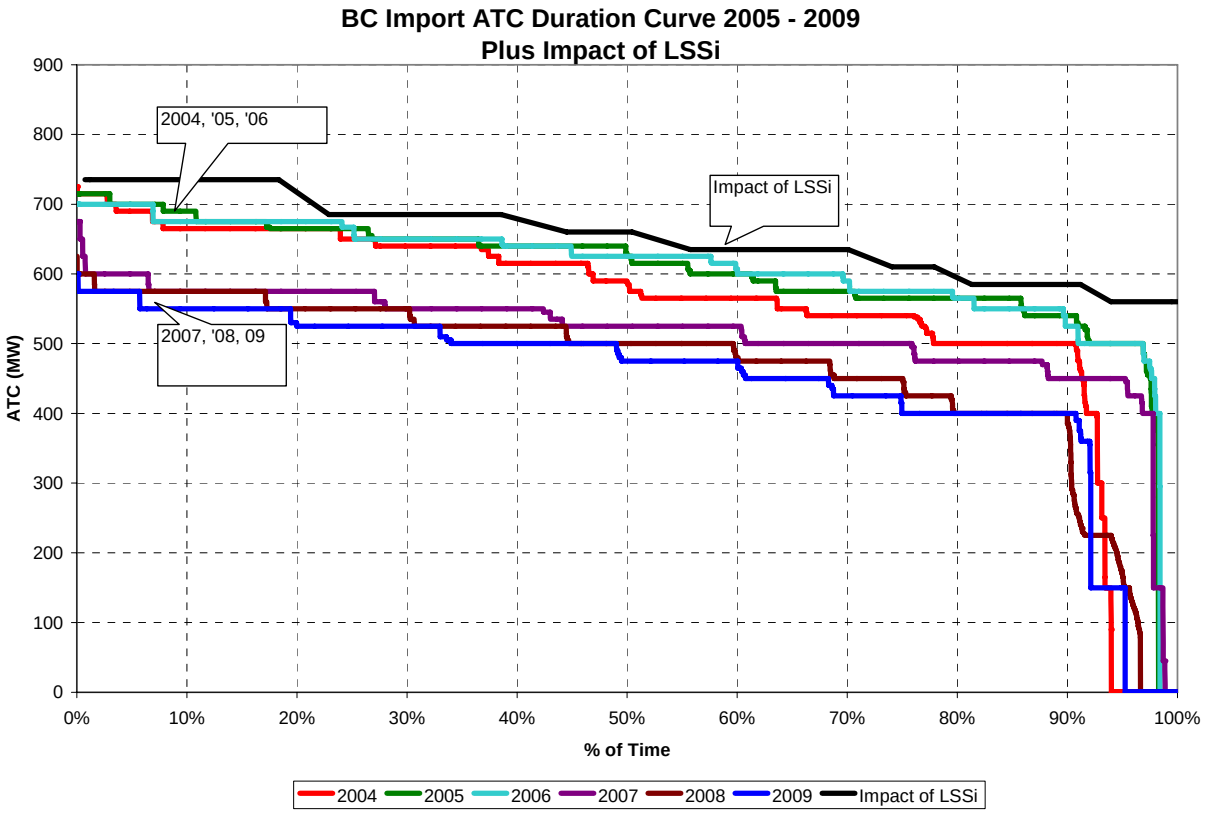
Although from a strictly technical viewpoint ILRAS is best suited to increase import ATC, given previous efforts to procure an ILRAS service, the AESO does not believe it is a viable competitive option. Therefore, the AESO will develop a refined LSS service (identified as LSSi). The key elements of the new LSSi product are (see the Appendix for the full technical details):

- LSSi will be armable and disarmable by the System Controller
- The System Controller will have real-time visibility of the volume and armed status of available LSSi
- Armed LSSi will automatically trip within 12 cycles, as required to stop further frequency decay, whenever system frequency falls below 59.5 Hz

[6] If WECC frequency drops to 59.5 Hz or lower during high export, the LSS load is shed resulting in excess supply in Alberta that adds to the export flow. The Alberta AGC frequency bias also results in an additional export flow. These effects combined increase the risk of the intertie tripping, leaving the WECC system with less supply at a time of generation shortage. This not acceptable to WECC.

In order to achieve the maximum ATC across all load levels, 480 MW of LSSi is required.

Figure 2 - Impact of LSSi on BC Import ATC



As shown in Figure 2, LSSi adds 150 MW to 200 MW of import ATC across the entire duration curve. The line in the figure is drawn on the assumption that 480 MW of LSSi is available, and does not include the impact of transmission contingencies (about 10% of hours see lower import limits). Current import limits typically range from 400 MW to 600 MW, which is 100 MW to 200 MW below the levels that were seen in 2004 through 2006 when ILRAS was available for use in the majority of hours.

It is not technically feasible to increase import ATC significantly beyond 715 MW on the BC intertie. This is due to system reliability concerns that would result from the loss of the intertie when importing above this level. As the system grows and the configuration changes with new infrastructure, this limit may be revised depending on the results of subsequent AESO operational studies.

3.4 Next Steps

Based on discussions undertaken during the effort to procure ILRAS in 2007 and consultation with load participants in the Demand Response Working Group, the AESO has determined that LSSi is the best option to pursue for restoring import capacity on the BC intertie. The draft technical standards for the service are included in the Appendix of this paper. The AESO plans to initiate a working group to pursue the development of a procurement process and pricing methodology. In addition, the AESO

will be consulting on operational aspects of the LSSi product:

- Revise OPP 304 to reflect impact of LSSi and current system conditions
- Revise OPP 312 (Setting import ATC)
- Supplier rights and responsibilities
- Supplier terms and conditions

4.0 Export Capacity Restoration

This section will examine several potential options to restore export capacity on the interties. The discussion will focus on the internal constraints that limit total export flows on the BC and Saskatchewan interties, but it is important to note that solutions to increase export capacity need to be coordinated with external systems.

4.1 Historical Background

There has been a policy directive in place to restore intertie capacity since 2003 when the Transmission Development Policy was released. The AESO initiated the first of several studies in 2003 to examine transfer limits on the Alberta BC intertie, and later formed a stakeholder working group that explored a number of intertie initiatives.

Studies completed in 2004 indicated that southern Alberta is subject to voltage collapse for contingencies during conditions of high demand, high exports, or low southern generation. As a result, capacitor banks in the Calgary area were installed to reduce voltage stability concerns under high north to south flows. These capacitor banks have addressed the voltage stability concerns for southern Alberta, and one of the secondary benefits was an increase in export capability.

The South of Keephills-Ellerslie-Genesee (SOK) cutplane concept was developed in order to maximize utilization of the transmission system for north to south flows. This operational practice allows simplified operation of the system and facilitates the contribution to export ATC from southern generation.

The concept of generator remedial action schemes (GRAS) to increase export limits has been explored as well, but did not proceed beyond an expression of interest issued in 2005. Studies indicated that GRAS would allow export limits to be increased because they could be used to mitigate the impact of contingency events that reduce available SOK flow capability. However, with subsequent transmission infrastructure added to the system and the work currently underway on de-bottlenecking the KEG area and adding a 240 kV substation in the Crowsnest area, it is no longer clear that the type of GRAS previously studied would be effective today. The constraints this type of GRAS would address will be removed with the integration of the north south transmission upgrade.

A broader GRAS could be used to mitigate BC contingencies and potential overfrequency conditions in Alberta when the intertie is lost. These situations will exist even after internal transmission is reinforced, and therefore a GRAS of this nature would have a lasting benefit.

4.2 Current Situation

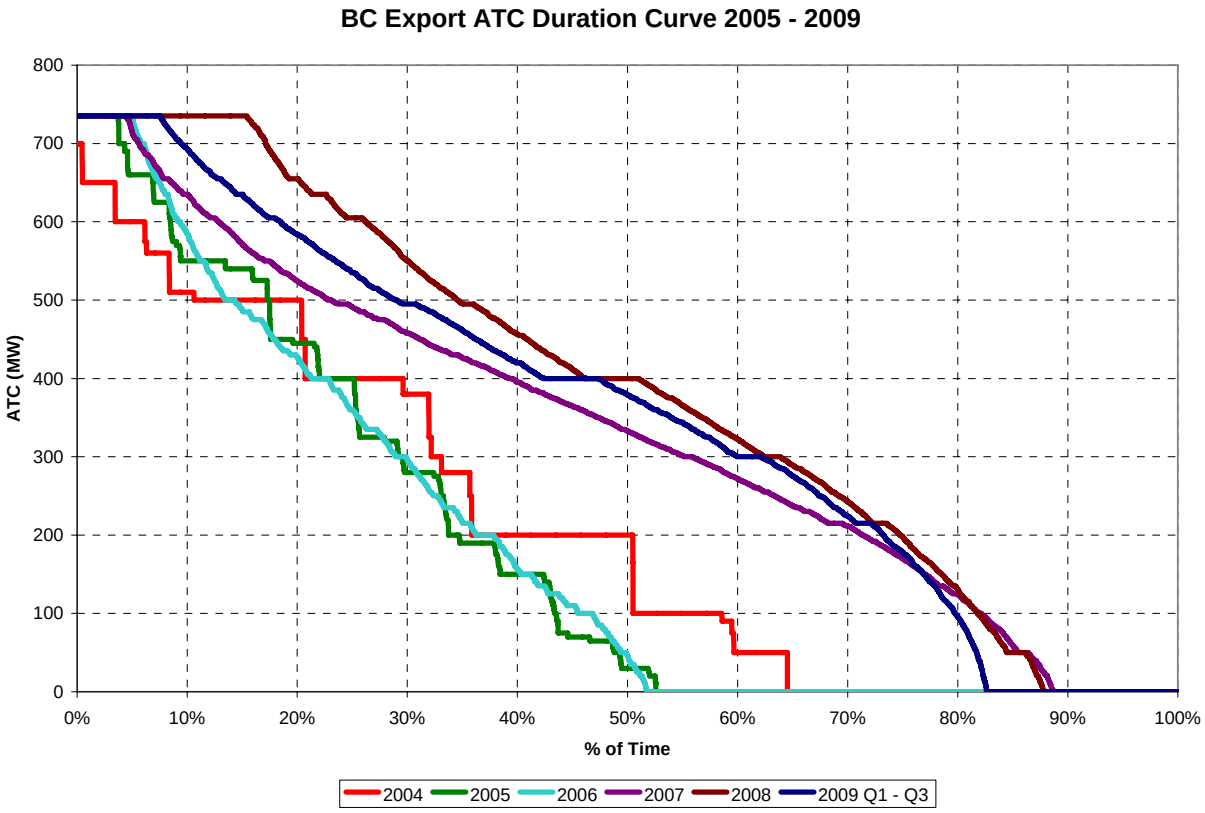
Exports are currently limited to a maximum of 735 MW on the BC intertie and 75 MW on the Saskatchewan intertie under normal operating conditions. However, these maximum flow limits are generally reduced as AIL load increases, as well as by SOK flow limits per OPP 304. Table 1 illustrates the summer and winter limits for BC exports as a function of AIL.

Table 1 - Maximum BC Export ATC

AIL	Maximum Export ATC (BC) System Normal	
	Summer	Winter
>9200	0	0
9000 to 9199	0	300
8800 to 8999	0	735
8600 to 8799	215	735
8400 to 8599	495	735
8200 to 8399	605	735
8000 to 8199	635	735
7800 to 7999	655	735
7600 to 7999	735	735
7400 to 7599	735	735
7200 to 7399	735	735
<7200	735	735

Actual ATC limits for the BC line are generally further reduced according to the process described in OPP 304. Export ATC limits increased in 2007 relative to prior years, largely due to the installation of capacitor banks in the Calgary area that reduced transmission constraints. Current SOK limits reduce export ATC below 735 MW in over 80% of hours. Figure 3 presents duration curves for export ATC limits to BC over the past 6 years.

Figure 3 - BC Export ATC Duration Curves (2005 to 2009)



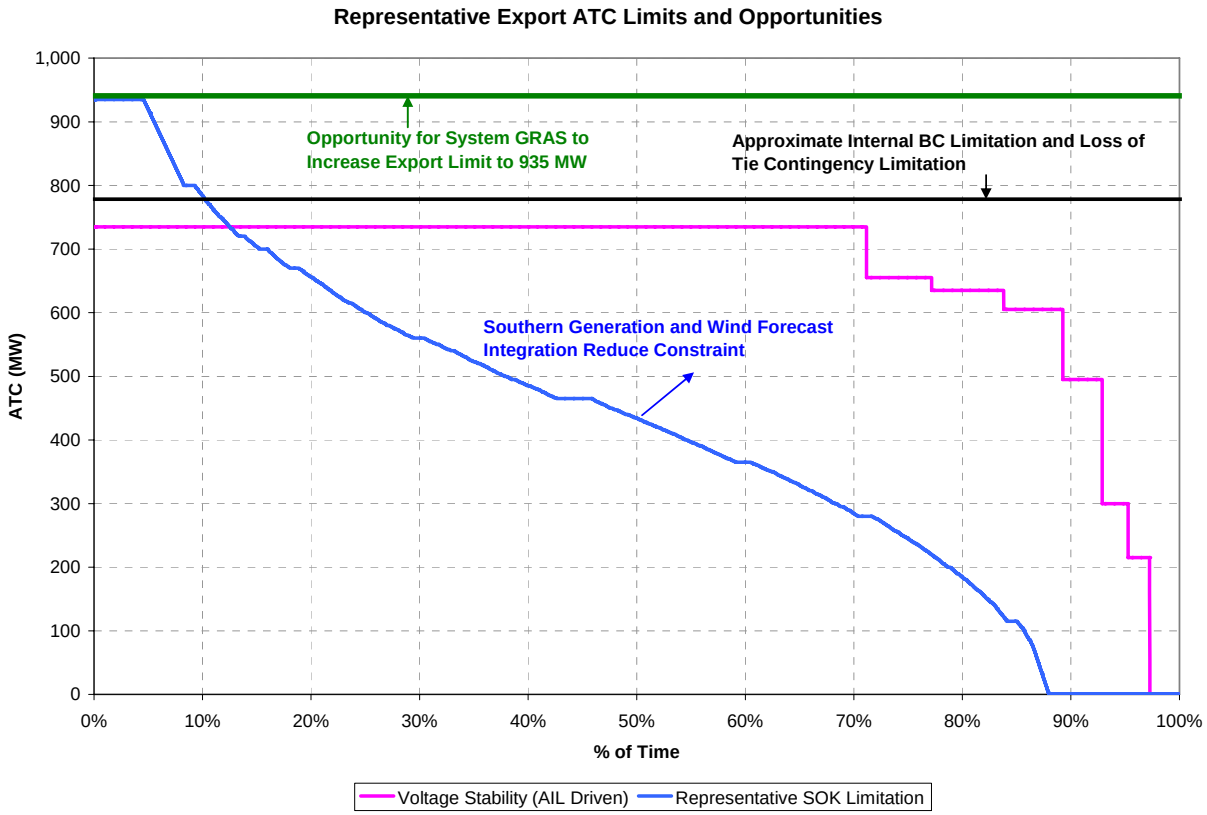
Saskatchewan export ATC is limited to 75 MW or below the majority of the time due to local area constraints. However, with the installation of capacitor banks at the McNeil substation in summer 2010, export ATC will return to the original 153 MW.

In order to increase export limits above their current level of 735 MW, several limitations must have mitigation plans in place. The key conditions that limit export ATC are:

- Voltage stability in southern Alberta at high load levels
    - This may be mitigated by wind generation in the south equipped with voltage support capability, but studies are required
    - Other new southern generation will also reduce this limitation
- SOK-240 flow limits are currently 2050 MW to 2150 MW under normal conditions
- Loss of the intertie at high export levels may result in an over frequency issue
- Exports greater than 735 MW may require GRAS in Alberta to be available for use in response to contingency events in BC
    - Without this GRAS or another solution, BC may limit Alberta exports

Figure 4 illustrates an approximation of the current limits on export ATC with the four key limitations listed above illustrated. The constraint that most often limits ATC is SOK capability, as shown by the blue line in the figure. The exact location of each limitation will be refined in system studies.

Figure 4 - Representative Export ATC Limiters



4.3 Options

It is technically feasible to increase export ratings on the BC intertie by reducing constraints that limit export ATC to 735 MW. BC constraints could potentially be addressed through a GRAS program that would allow export ATC to increase in hours where SOK flow limits and/or voltage stability are not a constraint. This will result in export ATC limits increasing in some hours. Export ATC will still be limited by SOK flow limits in many hours until the north south transmission upgrade is complete.

The extent to which export limits can be increased will vary with the specific technical solution or portfolio of solutions combined with the real-time state of the system, but the maximum ATC achievable will be less than or equal to 935 MW. The technical solution will need to evolve over time as the configuration of the system changes.

The AESO will work to maximize the capability of the system as more southern generation comes online. Since this generation will include wind capacity, integrating export ATC posting with wind forecasting may allow the AESO to increase available export ATC in hours where wind is producing energy. A GRAS program could potentially include wind generators, and the AESO would like to explore this opportunity through the working group consultation.

The AESO does not plan to pursue a GRAS designed to reduce SOK flow constraints at this time. This type of GRAS would be complex, limited to a small number of potential providers and have value only until the North-South transmission upgrades are

completed. It is unclear that this type of GRAS would be effective in resolving the constraint.

4.4 Next Steps

High level technical requirements for GRAS are included in the Appendix of this paper. These are performance standards and do not include arming conditions or expectations for the number of trips.

An export capacity restoration working group will be formed with the intent of developing a product or set of products that can be competitively procured as well as the compensation method. This product, or set of products, will be followed by a call for expressions of interest from suppliers, at which time detailed specifications for the product will be provided. In particular, the AESO will be studying the expected exposure to trips GRAS providers will face under different options. The working group may also explore GRAS options that would include options to mitigate internal BC constraints. This work will require coordination with BCTC.

5.0 Conclusions and Next Steps

Intertie capacity restoration initiatives will proceed for both imports and exports. An LSSi product will be developed for import support, and a GRAS product(s) will be developed for export support. The AESO has a clearly established mandate to pursue capacity restoration of existing interties, and these products have been identified as the practical options from a technical standpoint.

Government policy explicitly calls for these services to be charged to load customers. Those elements of the services that are truly variable in nature may be appropriately allocated to users of the service as per the existing practice for opportunity services. The AESO is seeking feedback on this.

The services will be procured on a competitive basis. Integrating intertie restoration services with intertie products, to the extent that they are developed in the intertie working group, is not contemplated as part of this discussion paper. While this may be a possible future outcome, this paper is focused on near term implementation of intertie capacity restoration services.

In order to advance the intertie capacity restoration initiatives, the AESO will form two working groups (LSSi group and GRAS group) to work on refining options, identifying system studies where required, developing a procurement plan and moving toward ultimate implementation. The projects will proceed independently because there is no interdependence between the two products.

A comment matrix is attached to facilitate stakeholder feedback on the concepts in the paper regarding development of system services to restore import and export capability.

6.0 LSSI Technical Requirements (Draft)

1.0 Introduction

This document outlines the requirements that a Market Participant offering Load Shed Service for Import (LSSI) to the Alberta Electric System Operator (AESO) needs to comply with in order to be able to operate as a LSSI Service Provider.

1.1 Eligibility to provide LSSI

1. The transmission or distribution connected load asset offered for LSSI shall be located within the Alberta Balancing Authority Area and be connected to the Alberta Interconnected Electric System (AIES).
2. A specific load block of a load asset may provide only one Demand Response Service at any one time. Once the Service Provider has received a dispatch to arm the LSSI scheme the Service Provider may no longer provide any other Demand Response Service.
3. Distribution loads that provide LSSI have the responsibility to make the necessary arrangements with their Distribution Service Provider.
4. Aggregation of several individual loads from various facilities throughout the AIES into one load asset is allowed, irrespective of whether the individual loads are electrically separated from each other via transmission or not. In the case of aggregation, the Aggregator becomes the LSSI Service Provider and is responsible for compliance purposes.

2.0 Requirements

The technical requirements described in the sections below shall apply equally to individual Service Providers or to Aggregators, as the case may be.

2.1 Telemetry and Communications

1. The Service Provider shall maintain reliable voice communication facilities as per ISO OPP 003.3 “Operational Voice Communications for the AIES”, under the category of “Participants who are required to receive ancillary service dispatches”.
2. The Service Provider shall be able to receive and respond to electronic or voice dispatch messages received from the AESO System Controller, for the purpose of arming, disarming the LSSI scheme and for load restoration.
3. The Service Provider shall maintain appropriate and reliable telemetry signals to the System Controller as per ISO OPP 003.1 “Electric Facility Data and Communications”. In addition to ISO OPP 003.1 the following data shall be telemetered to the AESO Coordination Centre:
    a. The amount of the real power of the load subject to LSSI;
    b. Armed or disarmed status of the LSSI scheme.

2.2. Operational Requirements

1. The Service Provider shall arm or disarm the LSSI scheme in response to a dispatch from the AESO System Controller. Such dispatch may be electronic or verbal. The AESO may use the same electronic dispatch tool as it uses for energy and other Ancillary Service dispatches. In the event that an electronic dispatching system is used, the Service Provider must be able to receive and acknowledge the electronic dispatches.
2. After a trip event, where the LSSI scheme has operated and the load has been shed, the Service Provider may commence restoring the load only as directed by the System Controller or after a maximum of 60 minutes have elapsed from the trip event instant.
3. The Service Provider must coordinate planned outages to the service through the AESO Operations Coordination Group.
4. The Service Provider shall comply with the provisions of OPP 312.

2.3 Technical requirements

1. The Service Provider shall have the capability to automatically trip the offered amount of load within 0.2 seconds (12 cycles) of the frequency reaching 59.50 Hz (+/- 0.02 Hz). The 0.2 seconds is the sum of the frequency measurement time plus any time required to trip the load.
2. The LSSI scheme shall be developed using solid state devices, with the possible exception of the circuit breaker that trips a load.
3. The Service Provider shall be able to arm and disarm the LSSI scheme. Arming means enabling the LSSI scheme's functionality such that it is continuously measuring system frequency and operates when the target frequency is reached. Disarming means disabling the LSSI scheme's functionality such that no load shedding happens as a result of a frequency deviation.
4. Once the LSSI scheme is armed, the real power (MW) amount of the load that will be tripped by the scheme must remain within 95% to 120% of the dispatched volume.
5. Any load that is tripped cannot automatically be restored or taken over by another feeder at any other point within the AIES.
6. The minimum amount of load offered for the LSSI scheme by a Service Provider shall be 5 MW.
7. The maximum amount of load offered for the LSSI shall not exceed 250 MW at any one geographical location or by any one Service Provider. This maximum may be further limited on a site by site basis depending on the local operational constraints.
8. The LSSI scheme shall be capable of recording the time and real power (MW) for the trip event. Trip event records shall be digital records with a sampling rate of no less than 20 ms.

9. The above record shall be retained by the Service Provider for a minimum of one (1) year after any trip event.
10. The Service Provider shall be capable of providing the trip event record in digital form, preferably in “csv” format to the AESO upon request. The record shall show the value of the load subject to the LSSI scheme for 60 s prior to the trip event, during the trip event and for 60 s after the event.

2.4 Monitoring

The AESO will monitor the response of load assets to trip events through the normal telemetry (SCADA) system. However, should the telemetry system not provide sufficient detail for any given event, the AESO may request the Service Provider (ISO rule 12.2.3) to provide a copy of the electronic record referred to in items 2.3.8 through 2.3.10 above.

2.5 Testing

The AESO requires test reports confirming the operating time of the relay(s) and the load breaker(s) that will shed the LSSI load. The AESO also requires a report demonstrating the data collection and retention ability of the scheme that meets the requirements described in sections 2.3, items 8 through 10.

The AESO does require an actual test of the LSSI scheme where it trips the load, however the AESO does recommend that the LSSI provider consider such a test to ensure it is able to meet the requirements described in section 2.3.

7.0 GRAS Technical Requirements (Preliminary)

1.0 Introduction

A Generation Shed Remedial Action Scheme (GRAS) to trip one or more Alberta generators will assist in the mitigation against conditions that currently limit the Alberta to BC export ATC. These requirements are high level only and will be further developed via system studies. The GRAS may be armed by BCTC to mitigate effects for contingencies in order to support additional exports from Alberta to BC.

2.0 Location of GRAS Generation Units/Plants

Potential location requirements have not yet been determined. Generation units contracted for TMR services may not participate in GRAS services because any generation trip via GRAS cannot be replaced via another TMR or contingency reserve dispatches.

3.0 GRAS Service Withdrawal

The GRAS service may be subject to withdrawal at the AESO determination during periods of increased system risk such as weather, (tornado, ice storm, etc.) and abnormal operating conditions where loss of generation due to GRAS trip would create an additional reliability risk.

4.0 GRAS Speed

The maximum total trip time of the generation block is expected to be 14 cycles from the time of initial trigger to generation breaker opening. This includes all protection and auxiliary relay operate times, telecommunication time and breaker open times. The final time specification may be further revised due to site location and as a result of AESO and BCTC dynamic studies.

5.0 Redundancy of GRAS Equipment (GRAS Reliability)

In order to meet the WECC RAS application standards, there must be at least two independent GRAS schemes for the same function to make sure no single component failure would cause the failure of GRAS operation when required. This does not include generation breaker. Considering this requirement, the location of the GRAS generation units should be such that there is currently two independent telecommunication paths using Micro Wave and/or Fibre Cable or combination of two modes.

6.0 Required Transmission Facilities

The contingencies requiring initiation of GRAS trip signals must be provided from transmission facilities, protection and control systems and telecommunications equipment provided by, owned and operated by Alberta Transmission Facilities Owners and BCTC. The facilities include relays, telecommunications, remote control and indication systems. Transmission facilities required on the Alberta transmission system are subject to Alberta regulatory processes including; need identification, EUB approval, project specification, direct assign rules and the EPC practices of TFOS. BCTC transmission facilities are subject to BC regulatory processes.

304 ALBERTA-BC INTERCONNECTION TRANSFER LIMITS

1. Purpose

To define the policies and procedures for establishing the transfer limits on the Alberta-BC interconnection while ensuring system reliability on the AIES.

2. Background

The north-south transfer limits, named the South of Keephills/Ellerslie/Genesee (KEG) or SOK-240 operating limits, are defined in OPP 521. The SOK-240 operating limits, together with SOK generation and SOK load, will determine the total Alberta export capability. The sum of net exports on the Alberta-BC interconnection and the Alberta-Saskatchewan interconnection must not exceed the total Alberta export capability.

3. Policy

3.1 Transfer limits - general

- The Alberta to BC (export) total transfer capability (TTC) and BC to Alberta (import) TTC, are defined as the maximum transfer levels that meet all of the specified pre-contingency and post-contingency criteria. The TTC levels are determined by system studies under various Alberta internal load (AIL) and contingency conditions.
- TTC is a Path 1 system operating limit (SOL). If the actual transfer exceeds the TTC, actions must be taken to reduce the actual transfer to below the TTC value within 20 minutes.
- The Alberta-BC import and export available transfer capability (ATC), both calculated as the TTC minus the transmission reliability margin (TRM), are the transfer volumes that are available for commercial activity. TRM is usually 65 MW except under certain system conditions as described in Table 1.
- Events that occur on the AIES that require the limits to be adjusted, beyond those identified in this OPP, will be addressed in the ISO's System Coordination Plan or by the SC in real time.
- The transfer limits on the Alberta-BC interconnection are determined as the lesser of:
  - Transfer limits as determined by the ISO based on Alberta's system conditions and constraints (as posted on the AESO web site).
  - Transfer limits as determined by BCTC (BC Transmission Corporation) based on BC's system conditions and constraints.
- The AESO, as path operator, will perform the "lesser of" determination and send the transfer limits to BCTC and the Vancouver Reliability Coordinator (VRC). BCTC will post the "lesser of" transfer limits on its Open Access Same Time Information System (OASIS) .

3.2 Import TTC

- The Alberta-BC import TTC, corresponding to various AIL ranges under system normal conditions, are listed in Table 2.
- The Alberta-BC import TTC, corresponding to various transmission element/generating unit status, are listed in Table 3. This table will supersede Table 2 when any of the conditions in Table 3 exist.
- The Alberta-BC import TTC may be constrained if the available load under the ILRAS and the LSS are insufficient. Refer to OPP 312 for details.

3.3 Export TTC

- The Alberta-BC export TTC depends on the SOK-240 operating limits (refer to OPP 521), and is calculated as:

  [SOK-240 ATC *minus* Forecast SOK load *plus* Forecast SOK generation] *multiplied* by Export Conversion Factor

  where:

  - SOK-240 ATC is defined in OPP 521, and
  - Forecast SOK load is the sum of the forecast loads downstream of the SOK cut plane as defined in OPP 521, and
  - Forecast SOK generation is the estimated in-merit generation downstream of the SOK cut plane as defined in OPP 521, and
  - Export Conversion Factor is 0.95. It has been determined and confirmed by studies as a factor to convert SOK capability to export capability and to account for the associated increase in losses.
- For any given system condition, the export TTC can not exceed the maximum export TTC as specified in Table 4.
- For multiple outages to more than one transmission facility (Table 4), or for accumulated capacitor bank unavailability in the Calgary area greater than 395 MVAr, the maximum export TTC limits must be determined by studies based on the particular system conditions at the time of the multiple outages or unavailability. If such studies are not available, the export TTC will be reduced to 65 MW.
- If the total submitted e-tags for the Alberta-BC interconnection and the Alberta-Saskatchewan interconnection exceeds the total Alberta export capability as determined by the SOK-240 operating limits, then the exports on both interconnections must be managed in real-time. The SC must monitor the actual SOK-240 flow. The export on both interconnections may be curtailed on a pro-rata basis based on the actual schedule.

4. Responsibilities

4.1 ISO

The ISO must:

- Review the Alberta-BC interconnection transfer limits as required, ensuring the reliable operation of the system. The review will be carried out in coordination with the TFOs and BCTC.
- Submit the "OTC Certification Form (Form A.6)" to the WECC office within 30 days following the start of the operating season.
- Post the ATC for the Alberta-BC interconnection on the AESO website at www.aeso.ca.

System Controller

The SC must:

- Determine the TTC, ATC and TRM on the Alberta-BC interconnection based on AIES conditions in real-time and:
  - Adjust the ATC posted on the AESO's website, if required, in real-time.
  - Inform the BCTC transmission operator of any adjustment to the export or import ATC on the Alberta-BC interconnection based on AIES conditions in real-time.
- Report unusual operating conditions or difficulties in adhering to the transfer limits for review to the manager, System Coordination Centre.

4.2 BC Transmission Corporation (BCTC)

The BCTC operator must:

- Carry out engineering studies to establish TTC and ATC for the Alberta-BC interconnection.
- Inform the SC of their transfer limits based on BC's system conditions and constraints.
- Post the transfer limit for the Alberta-BC interconnection on the BCTC OASIS as instructed by the SC.

4.3 Transmission Facility Operator

Each TFO operator must:

- Inform the SC of the status of the transmission elements listed in Table 4.

5. System Controller Procedures

5.1 Determine export transfer limit

Prior to T-70 minutes before each scheduling hour, and also on an as required basis when operating conditions change, the SC must:

1. Determine the SOK-240 ATC as described in OPP 521.
2. Determine the forecast SOK load and forecast SOK generation including wind generation for the next scheduling hour.
3. Calculate the export TTC using the following:

   Export TTC = [SOK-240 ATC *minus* forecast SOK load *plus* forecast SOK generation including wind generation] *multiplied* by 0.95.
4. Determine the maximum export TTC based on the status of the transmission elements listed in Table 4. If the transmission element status changes during the hour, use the status

that poses greater constraint on the TTC (i.e., assume that it is out of service for the entire hour).

5. Determine the AESO's export TRM using Table 1.
6. Obtain from BCTC their import TTC and TRM limit based on BC's system conditions and constraints.
7. Determine the export TTC to be "the lesser" of the results from steps 3, 4 and 6.
8. Determine the export TRM to be "the greater" of the results from steps 5 and 6.
9. Calculate the export ATC by subtracting export TRM from export TTC.

5.2 Determine import transfer limit

The SC mustl:

1. Forecast the minimum AIL for each hour.
2. Establish the hourly import TTC as the lowest of the following:
    a. Import TTC based on transmission element/generating unit statuses for the hour, according to Table 3. If the transmission element status is expected to change during the hour, use the status that poses greater constraint on the TTC limit (i.e., assume that it is out of service or on recloser block for the entire hour).
    b. Import TTC based on system normal conditions and the forecast minimum AIL for the hour, according to Table 2, if none of the transmission element/generating unit status in Table 3 exists.
    c. Import TTC based on the forecast minimum AIL and the available total ILRAS and LSS load, according to Table 1 in OPP 312. The amount of ILRAS load available for arming and the amount of LSS load on-line can be obtained from the HIMP energy management system display (# 6975).
3. Determine the AESO's import TRM using Table 1.
4. Obtain from BCTC their export TTC and TRM limit based on BC's system conditions and constraints.
5. Determine the import TTC to be "the lesser" of the results from steps 2 and 4.
6. Determine the import TRM to be "the greater" of the results from steps 3 and 4.
7. Calculate the import ATC by subtracting import TRM from import TTC.

5.3 Re-post the hourly BC to Alberta transfer limit

If the import or export ATC is changed from those posted on the AESO website, the SC will:

1. Revise the hourly ATC on the Alberta-BC interconnection by:
    a. Logging onto the Interconnection Transfer Capability Posting System (ITC) and follow the instructions in the "ATC Postings Override Maintenance User Document" to enter the revised ATC.
    b. Confirming that the ATC posting has been updated on the AESO's website.
2. Call and inform the BCTC operator of the revised limit parameters (TTC, ATC and TRM) on the Alberta-BC interconnection, considering the following guidelines:

- For immediate transfer limit changes within the current hour, call immediately or as soon as possible.
- For transfer limit changes effective the next scheduling hour, endeavour to call by hh:05.
- For future hourly transfer limit changes, provide as much advance notice as possible.

6. Figures and Tables

Table 1

Transmission Reliability Margin (TRM) under various system conditions

** Under other system conditions that are not listed below, the SC may change the TRM if it is so required to ensure system reliability.

System Conditions	Import TRM (MW)	Export TRM (MW)
System Normal, or 1201L OOS	65	65
1201L in service **and** Alberta single largest contingency (SLC) > contingency reserve obligation (CRO) to the Northwest Power Pool	The greater of: • 65 • SLC – CRO	65
1201L in service **and** the Ford Elk area load is served by Alberta[1] **and** • 887L/1L274 open at Natal or open between Natal and Pocaterra(T48S), or • Both 887L/1L274 and 786L/1L275 open at Natal	65 + MW flow on 887L/1L274 at Pocaterra	65
1201L in service **and** the Ford Elk area load is served by Alberta[1] **and** • Two parallel transformers at Natal OOS, or • 2L113 in the BC system is OOS	65 + MW flow on 887L/1L274 + MW flow on 786L/1L275	65
When 1203L or 1209L OOS for various Genesee SLC level[2]	TTC using Table 2/Table 3 *minus* ATC as described in Table 3 in OPP 517	65

Note:

1. For details refer to OPP 303, Section 3.8.
2. For details refer to OPP 517, Section 3.6.

Table 2

Import TTC during system normal condition for various Alberta internal load (AIL) levels

Alberta Internal Load (AIL) (MW)		Import TTC (MW)[1]
From	To	
0	6,599	605
6,600	6,899	630
6,900	7,199	655
7,200	7,499	680
7,500	7,799	705
7,800	8,099	730
8,100	8,399	755
8,400	And above	780

Note:

1. Limits are extrapolated from an import limits graph.

Table 3 [1]

Import TTC corresponding to system conditions at all Alberta internal load (AIL) levels

Transmission Element / Generating Unit	Import TTC (MW)
1201L (102S Langdon-Cranbrook) out of service (OOS) (see Note 1)	65
1201L (102S Langdon-Cranbrook) recloser block	As per Table 1 in OPP 312 with ILRAS load = 0 MW
102S Langdon SVC OOS	465
BCTC 2L294 OOS[2]	As per Table 1 in OPP 312 with ILRAS load = 0 MW
936L (102S Langdon-74S Janet) or 937L (102S Langdon-74S Janet) OOS	565
One of the following north-south 240 kV lines OOS 928L, 906L, 922L, 903L, 190L, 910L, 914L, 926L, 918L, 932L, 929L, 925L, 901L	565

Note:

1. If any of the transmission element/generating unit status exists, Table 3 supersedes Table 2.
2. For contingency reserve requirements refer to OPP 402 Supplemental and Spinning Reserve Services.

Table 4

Maximum Export TTC[5] - summer season (May 1 to October 31)

All units in MW

Alberta Internal Load (AIL)[1]	System Normal	1201L OOS	SVC OOS	936L or 937L OOS	One 240 kV Backbone Line OOS[2,4]	Accumulated Capacitor Bank Unavailability in the Calgary Area[3,5,6]		
						>81 MVAr and ≤184 MVAr	>184 MVAr and ≤314 MVAr	>314 MVAr and ≤395 MVAr
8800 to 10000	65	65	65	65	65	65	65	65
8600 to 8799	280	115	65	65	280	65	65	65
8400 to 8599	560	115	65	65	560	400	65	65
8200 to 8399	670	115	65	65	670	495	200	65
8000 to 8199	700	115	65	65	700	540	320	65
7800 to 7999	720	115	465	240	720	615	440	290
7600 to 7799	800	115	465	240	800	705	520	340
7400 to 7599	800	115	465	240	800	800	685	595
7200 to 7399	800	115	465	240	800	800	775	690
0 to 7199	800	115	465	240	800	800	800	800

Note:

1. AIL means the total load within Alberta including behind-the-fence-load. AIL represents the total domestic demand of AIES connected loads in Alberta and includes industrial loads served by on-site generation, and the City of Medicine Hat's load served by the city's generators.
2. North-south 240 kV backbone lines refer to 928L, 906L, 922L, 903L, 190L, 910L, 914L, 918L, 929L, 925L, 926L, 901L and 900L; OOS - out of service.
3. Calgary area capacitor banks refer to capacitor banks at substations T42S, T74S, C21S, T5S, C31S, C38S, C14S, C41S and T17S.
4. If one of the 240 kV backbone lines is out of service and the accumulated capacitor bank unavailability falls into one of the first two columns (>81 MVAr and ≤184 MVAr or >184 MVAr and ≤314 MVAr) then the maximum export TTC limit is the value indicated in the next largest accumulated capacitor bank unavailability column. For example, if 928L is OOS and the accumulated capacitor bank unavailability is 108 MVAr and the system load is 8,300 MW, then the maximum export TTC limit is 200 MW, as indicated in the >184 MVAr and ≤314 MVAr capacitor bank unavailability column.
5. In case of multiple outages to more than one transmission facility in the table columns, or accumulated capacitor bank unavailability in the Calgary area greater than 395 MVAr, the maximum export TTC limits must be determined through studies based on the particular system conditions. If such studies are not available, the export TTC will be reduced to 65 MW.
6. When Benalto T17S capacitor (110 MVAR) is unavailable for dispatch, treat it as 54 MVAR capacitor out of service in Calgary area.

Table 5

Maximum Export TTC[5] - winter season (November 1 to April 30)

All units in MW

Alberta Internal Load (AIL)[1]	System Normal	1201L OOS	SVC OOS	936L or 937L OOS	One 240 kV Backbone Line OOS[2,4]	Accumulated Capacitor Bank Unavailability in the Calgary Area[3,5,6]		
						>81 MVAr and ≤184 MVAr	>184 MVAr and ≤314 MVAr	>314 MVAr and ≤395 MVAr
9200 to 10000	65	65	65	65	65	65	65	65
9000 to 9199	365	115	65	65	365	190	65	65
8800 to 8999	800	115	465	65	800	450	190	65
8600 to 8799	800	115	465	65	800	550	335	175
8400 to 8599	800	115	465	65	800	770	455	330
8200 to 8399	800	115	465	65	800	800	530	415
8000 to 8199	800	115	465	65	800	800	615	520
7800 to 7999	800	115	465	240	800	800	685	600
7600 to 7799	800	115	465	240	800	800	800	710
7400 to 7599	800	115	465	240	800	800	800	760
7200 to 7399	800	115	465	240	800	800	800	800
0 to 7199	800	115	465	240	800	800	800	800

Note:

1. AIL means the total load within Alberta including behind-the-fence-load. AIL represents the total domestic demand of AIES connected loads in Alberta and includes industrial loads served by on-site generation, and the City of Medicine Hat's load served by the city's generators.
2. North-south 240 kV backbone lines refer to 928L, 906L, 922L, 903L, 190L, 910L, 914L, 918L, 929L, 925L, 926L, 901L and 900L; OOS - out of service.
3. Calgary area capacitor banks refer to capacitor banks at substations T42S, T74S, C21S, T5S, C31S, C38S, C14S, C41S and T17S.
4. If one of the 240 kV backbone lines is out of service and the accumulated capacitor bank unavailability falls into one of the first two columns (>81 MVAr and ≤184 MVAr or >184 MVAr and ≤314 MVAr) then the maximum export TTC limit is the value indicated in the next largest accumulated capacitor bank unavailability column. For example, if 928L is OOS and the accumulated capacitor bank unavailability is 108 MVAr and the system load is 8,300 MW, then the maximum export TTC limit is 530 MW, as indicated in the >184 MVAr and ≤314 MVAr capacitor bank unavailability column.

5. In case of multiple outages to more than one transmission facility in the table columns, or accumulated capacitor bank unavailability in the Calgary area greater than 395 MVAr, the maximum export TTC limits must be determined through studies based on the particular system conditions. If such studies are not available, the export TTC will be reduced to 65 MW.
6. When Benalto T17S capacitor (110 MVAR) is unavailable for dispatch, treat it as 54 MVAR capacitor out of service in Calgary area.

7. Revision History

Issued	Description
2010-01-22	Supersedes 2008-11-13
2008-11-13	Supersedes 2007-12-12
2007-12-12	Supersedes 2007-09-27
2007-09-27	Supersedes 2006-12-22
2006-12-22	Supersedes 2006-10-17
2006-10-17	Approved for interim implementation, supersedes 2006-08-09
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2006-07-10	Approved for interim implementation, effective 2006-07-10; supersedes 2006-05-16
2006-05-16	Supersedes 2006-04-27
2006-04-27	Supersedes 2006-01-30
2006-01-30	Approved for interim implementation, effective 2006-01-27, Supersedes 2005-12-22
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2005-12-15	Approved for interim implementation, effective 2005-12-15; supersedes 2005-11-01
2005-11-01	Approved for interim implementation, effective 2005-11-01; supersedes 2005-08-31
2005-08-31	Approved for interim implementation, effective 2005-08-31
2005-07-27	Supersedes 2005-05-25
2005-05-25	Supersedes 2004-08-04
2004-08-04	Supersedes 2004-03-03
2004-03-03	Approved for interim implementation
2003-07-28	Power Pool POP-303 and POP-304 combined with Transmission Administrator OP-366

312 IMPORT LOAD REMEDIAL ACTION SCHEME (ILRAS) AND LOAD SHED SERVICE (LSS)

1. Purpose

To define the policies and procedures for the system controller (SC) in the application of the import load remedial action scheme (ILRAS) and the Load Shed Service (LSS), in order to facilitate increased import capability on the Alberta-BC interconnection for energy and reserve services.

2. Background

The Alberta-BC interconnection is a critical transmission element to the Alberta Interconnected Electric System (AIES). It improves the reliability of the AIES as well as provides access to additional supply capacity and energy for Alberta.

The import limit for the Alberta-BC interconnection is constrained to ensure the AIES does not experience unacceptable under-voltage or under-frequency should the interconnection trip. However, the Alberta-BC interconnection import limit can be increased if adequate ILRAS loads are armed in combination with the LSS.

ILRAS service, if armed, provides interruptible loads that will be automatically tripped following the loss of the Alberta-BC interconnection during high import levels. LSS provides loads that will be automatically tripped when the AIES frequency drops to 59.5 Hz or below, which may occur when the Alberta-BC interconnection trips at high import levels. However, if the Alberta-BC interconnection has tripped and the AIES frequency does not fall to 59.5 Hz or below, and the AIES contingency reserve is insufficient to recover the loss of the BC import energy, LSS loads may be manually curtailed.

The available transfer capability (ATC) specified in OPP 304 assumes that the required amount of ILRAS loads is armed and the LSS load is on-line in accordance with Table 1. If there is insufficient ILRAS load or LSS load, then the import transfer levels must be adjusted to the level corresponding to the required ILRAS and LSS amount in Table 1.

3. Policy

3.1 ILRAS Loads

- Fortis Alberta Inc. is obliged to provide ILRAS loads until such time as the service is no longer required, in accordance with direction given by the ISO and in accordance with the ILRAS service agreement with Fortis Alberta Inc.

3.2 LSS loads

- All available LSS loads will be applied towards the combined ILRAS and LSS load requirements in Table 1, before determining the amount of ILRAS load required to be armed.

3.3 Application of ILRAS and LSS

- ILRAS is currently only available for arming during a supply shortfall condition as per OPP 801.

- The required amount of ILRAS loads to be armed is the greater of the following two factors:

  1. The minimum amount of combined ILRAS and LSS load requirement based on the Alberta-BC interconnection import schedule and Alberta internal load (AIL) as indicated in Table 1, minus the LSS load on-line.

  2. **Net Import – LSS – CRO + ER**

     If external reserve services are offered over the Alberta-BC interconnection and are dispatched, where:

     Net Import is the net import of the Alberta-BC interconnection.

     LSS is the total amount of LSS load on-line

     CRO is the contingency reserve obligation for NWPP reserve sharing.

     ER is the amount of dispatched external reserves over the Alberta-BC interconnection.

- As noted in Table 1, when 5L92 is out of service, ILRAS will be armed according to the total of Alberta-BC import and the single largest generation contingency in the AIES.

- The ILRAS arming level is normally set at the beginning of the scheduling hour. However the ILRAS arming level will be modified if the requirement changes during the scheduling hour by an amount exceeding 15 MW.

- Upon notification from the ILRAS service provider of a change in the ILRAS loads availability, import ATC and any imports scheduled, and/or external reserve dispatched on the Alberta-BC interconnection must be reviewed and, if necessary, adjusted to the import level for the corresponding combined ILRAS loads and LSS amount in Table 1.

- If 1201L trips when ILRAS has been armed, the ILRAS operation will trip the armed ILRAS loads immediately. The AIES may experience under-frequency at a level that will trip the LSS loads.

- After an ILRAS operation, while maintaining system reliability, restoration priority is (1) the ILRAS loads, then (2) contingency reserves and then (3) LSS loads.

- Additional ILRAS loads will be armed if doing so will reduce the AIES reserve requirement (since the AIES is in a supply shortfall). For further details refer to OPP 801 and OPP 402.

3.4 Arming and disarming ILRAS

- The SC will dispatch the arming and disarming of ILRAS.

- Under special circumstances, the ILRAS service provider will also be able to withdraw and disarm the ILRAS as outlined further in Section 3.5.

3.5 Unavailability of ILRAS and LSS

- The ILRAS service provider must advise the SC immediately of full or partial unavailability of ILRAS.
- The LSS provider will make reasonable commercial efforts to advise the SC of LSS load unavailability, if the unavailable portion of the load is greater than 20% of the contracted volume and the unavailability period exceeds one hour.

3.6 Hunting the AIL

- If the AIL falls right on, or very close to, the boundary of ILRAS and LSS level requirements as defined in Table 1, the higher level of ILRAS will be armed during the hour that the load is expected to be at the boundary.

3.7 Withdrawing or changing ILRAS levels*

- ILRAS is a key system protection in facilitating a tie import schedule above certain specified levels. The ILRAS service provider may only withdraw the service under the following conditions:
  - Wind speeds in excess of 100 km/hr as measured at the Mabutte weather station.
  - Lightning activity near the 1201L (5L94) line.
  - Increased risk to equipment damage, personnel or public safety.
- Service withdrawal will require close coordination with the SC to facilitate timely adjustments to interconnection schedules or reserve services dispatch.
- The ILRAS service provider will monitor the lightning activity near the 1201L (5L94) line and endeavour to provide as much advance warning to the SC as possible before withdrawing the service. Upon receipt of notification to withdraw service by the ILRAS service provider, curtailment of the schedule with BCTC will be initiated by the SC as quickly as possible, if required. The ILRAS service provider will be advised by the SC after the schedule has been curtailed. To limit the risk of tripping ILRAS load, the SC will endeavour to complete the schedule curtailment within 15 minutes of receiving the notice from the ILRAS service provider.

* Note that ILRAS is currently not available for use except for supply shortfall conditions as detailed in OPP 801. When ILRAS load is armed in accordance with OPP 801, the conditions in Section 3.5 will apply.

3.8 Curtailing import during the scheduling hour

- If there is insufficient ILRAS load or LSS load as a result of the withdrawal of ILRAS or unavailability of LSS, the import transfer level must be adjusted to the level corresponding to the required ILRAS and LSS amount in Table 1. The policy and procedures regarding curtailment of interchange transactions during the scheduling hour are contained in OPP 303.

3.9 Restoring ILRAS and LSS loads

- The ILRAS and LSS loads, if tripped by the activation of the ILRAS or under the terms of LSS respectively, must not be restored until authorized by the SC.

- The ILRAS and LSS providers will be given permission by the SC to restore any load tripped. If a permanent fault remains on the 500 kV interconnection, the tripped ILRAS load will be restored by the SC as additional supply resources become available. The priority is to restore the ILRAS loads, then the reserves and the LSS loads.

3.10 Separation between ILRAS, LSS and SUPL reserves

- The ILRAS service provider will provide a clear indication to the ISO if any SUPL reserves are being offered at any time as load under the ILRAS Service. The load that is offered under the ILRAS may not be counted as part of the operating reserve defined in OPP 402.
- During the term of LSS supply, the LSS provider will not contract for operating reserve with the same load offered as LSS.

3.11 Interface with Reserve Management during system emergencies

- OPP 801 will be followed during periods of supply shortfall. If ILRAS is available under system emergency conditions (i.e., capacity shortages or frequency conditions), ILRAS will be armed by the SC to increase the import capability and/or reduce the AIES reserve requirement.
- During an AIES supply shortfall event, LSS load may be curtailed as described in OPP 801.

3.12 Real-time telemetry of ILRAS and LSS loads

- The ILRAS service provider will provide the SC with real-time telemetry of the ILRAS load available to be armed as well as the amount of load currently armed.
- The LSS providers will provide the SC with real-time telemetry of the LSS load available to be curtailed.

4. Responsibilities

4.1 ISO

The ISO must:

- Communicate planned outages that affect LSS via the System Coordination Plan.
- Contract for the ILRAS loads and LSS loads.

System Controller

The SC must:

- Dispatch the arming and disarming of ILRAS loads.
- Adjust import schedules on the Alberta-BC interconnection if the ILRAS or LSS load availability changes.
- Re-post import available transfer capability (ATC) on the Alberta-BC interconnection if the ILRAS or LSS load availability changes.

4.2 ILRAS Service Provider (note that the AltaLink Control Centre Operator is the real-time operations contact)

The ILRAS service provider must:

- Develop corresponding operating procedures consistent with this OPP.
- Arm and disarm ILRAS loads as dispatched by the SC.
- Notify the SC of any changes in the ILRAS loads availability due to the planned switching of feeder loads, giving as much advance notice as possible.
- Notify the SC if the dispatched amount of ILRAS load cannot be maintained.
- Monitor lightning activity near the 1201L (5L94) line and providing as much advance warning to the SC as possible before withdrawing the service.
- Provide a clear indication to the ISO if any SUPL reserves are being offered at any time as load under the ILRAS service.
- Provide the SC with real-time telemetry of the ILRAS load available to be armed and the amount of load currently armed.

4.3 LSS Provider

The LSS provider must:

- Develop corresponding operating procedures for their facilities to comply with this OPP.
- Inform the Operations Coordination of any planned changes to the availability of the LSS load as soon as reasonably practicable. Updates of the schedule, if any, must be directed to the SC.
- With reasonable commercial efforts, inform the SC of unplanned LSS load unavailability, if the unavailable portion of the load is greater than 20% of the contracted volume and the unavailability period exceeds one hour, and provide the cause and anticipated duration of the unavailability.
- Provide the SC with real-time telemetry of the LSS load available.

5. System Controller Procedures

5.1 Arming ILRAS in normal system conditions

The SC must:

1. Confirm the net Alberta-BC interchange schedule with the BC Hydro real-time scheduler for the next scheduling hour as described in OPP 301.
2. Determine the amount of ILRAS load that needs to be armed by:
    a. Estimating the minimum AIL in the next scheduling hour.
    b. Using Table 1 to determine the minimum amount of combined ILRAS and LSS load required corresponding to the net import schedule and the estimated minimum AIL for the next scheduling hour. Note that if 5L92 is out of service, then ILRAS will be armed corresponding to the total of net import schedule and the AIES single largest generation contingency.

c. Determine the amount of external reserve services that are offered over the Alberta-BC interconnection that will be dispatched for the next scheduling hour (i.e., in-merit according to the AS merit order).

d. Refer to the HIMP energy management system display (#6975) to obtain the total amount of LSS loads on-line.

e. Calculate the amount of ILRAS loads to be armed, which is the greater of:

i. The minimum amount of combined ILRAS and LSS loads required as indicated in Table 1, determined in step b, minus the total amount of LSS loads on-line, as determined in step d. Assume zero if the result is a negative value; or

ii. Net import for the next scheduling hour, minus LSS loads determined in step d, minus Alberta CRO, plus external reserves determined in step c. Assume zero if the result is a negative value.

3. If ILRAS loads are required to be armed, contact the ILRAS service provider at least 10 minutes before the start of the next scheduling hour and issue a dispatch for:

a. The amount of ILRAS loads required to be armed; and

b. The time the ILRAS loads are to be armed (at the start of the ramp if ramping up or at the end of the ramp if ramping down).

5.2 Adjusting the amount of armed ILRAS load during the scheduling hour

The SC must:

1. Monitor the following factors which may affect the required amount of ILRAS loads to be armed:

a. The import schedule, which may be required to change as result of a change to the BC-to-Alberta Import ATC (see OPP 304) or a directive for external reserve from BC.

b. The AIL.

c. The amount of LSS loads on-line, by referring to the HIMP energy management display (#6975).

d. The dispatch volume of external reserves over the Alberta-BC interconnection.

2. If the required amount of ILRAS load has changed by more than 15 MW, contact the ILRAS service provider to dispatch the arming of ILRAS load to the new required amount.

5.3 Adjusting import schedule and external reserve dispatch on the Alberta-BC interconnection due to changes in ILRAS or LSS load availability

Upon receiving notification from the service provider of full or partial unavailability of ILRAS or LSS load, or withdrawal of ILRAS service, the SC must:

1. Note the reasons for the change in availability. For withdrawal of ILRAS service, the reasons may be one or more of the following:

a. Wind speeds in excess of 100 km/hr as measured at the Mabutte weather station.

b. Lightning activity in the vicinity of 1201L/5L94 line.

c. Increased risk to equipment damage, personnel or public safety.

2. Using Table 1, determine the new import limit on the Alberta-BC interconnection based on the revised availability level of ILRAS and/or LSS load.

3. If the current import schedule is higher than the new import limit:

   a. Within 15 minutes, curtail the import schedule to the new import limit.

   b. After ramp down is complete, contact the ILRAS service provider, if required, to dispatch the amount of ILRAS load to be disarmed.

4. If the future hourly import ATC on the Alberta-BC interconnection is revised, then re-post the hourly import ATC as per procedures in OPP 304.

5. If the change in ILRAS load availability affects the amount of external reserves that can be used, adjust the AS dispatches as required.

5.4 Restoration after a 1201L trip and an ILRAS operation

After the system frequency has recovered to 60 Hz, the SC must:

1. Set the Alberta-BC interchange schedule to zero MW.

2. Coordinate with the BCTC operator and the AltaLink transmission operator to restore 1201L.

3. If 1201L is restored successfully, perform the following in coordination with reserve management:

   a. Give permission to the ILRAS service provider to restore ILRAS loads that were tripped.

   b. Give permission to the LSS provider(s) to restore the LSS loads that were tripped.

   c. Resume the import schedule on the Alberta-BC interconnection at a time mutually agreed with BCTC.

   d. Dispatch the required amount of ILRAS load to be armed for the time when the import schedule resumes.

   e. Resume the normal external reserve dispatch, starting the next scheduling hour.

4. If 1201L is not restored successfully, dispatch on the Energy Market Merit Order to increase energy supply in order to restore load and reserves in the following priority:

   a. ILRAS loads that were tripped.

   b. Contingency reserves.

   c. LSS loads that were tripped.

5.5 Arming ILRAS during AIES supply shortfall conditions

When the AIES is experiencing or expects an imminent supply shortfall and 1201L is in service, the SC will arm ILRAS in accordance with the procedures in OPP 801.

6. Figures and Tables

Table 1

Minimum amount of combined ILRAS and LSS load requirement based on import schedule and AIL

Import Level (MW) (note 3)	Minimum amount of combined ILRAS and LSS load required (MW) (note 1)								
	AIL (MW) (note 2)								
	<6300	6300 to 6599	6600 to 6899	6900 to 7199	7200 to 7499	7500 to 7799	7800 to 8099	8100 to 8399	≥8400
<300	0	0	0	0	0	0	0	0	0
300 to 325	0	0	0	0	0	0	0	0	0
326 to 350	0	0	0	0	0	0	0	0	0
351 to 375	35	0	0	0	0	0	0	0	0
376 to 400	70	40	0	0	0	0	0	0	0
401 to 425	105	80	40	0	0	0	0	0	0
426 to 450	140	120	80	45	0	0	0	0	0
451 to 475	175	160	120	90	45	0	0	0	0
476 to 500	210	200	160	135	90	45	0	0	0
501 to 525	245	240	200	180	135	90	50	0	0
526 to 550	280	280	240	225	180	135	100	50	0
551 to 575	*	320	280	270	225	180	150	100	55
576 to 600	*	*	320	315	270	225	200	150	110
601 to 625	*	*	*	360	315	270	250	200	165
626 to 650	*	*	*	*	360	315	300	250	220
651 to 675	*	*	*	*	*	360	350	300	275
676 to 700	*	*	*	*	*	*	380	350	330

Note:

1. ILRAS is armed only after the available LSS is fully used. For example, if 130 MW LSS is on line and available, only 120 MW ILRAS needs be armed for an import of 626 to 650 MW when the AIL is between 8100 and 8,399 MW. If only 100 MW of LSS is on line and available, then 150 MW of ILRAS will have to be armed.
2. If the AIL falls on or very close to a boundary of the above ranges, use the lower AIL range to determine the combined amount of ILRAS to be armed and LSS on line, i.e., arm the higher amount of ILRAS.
3. When 5L92 is out of service, use the total of BC-Alberta import and AIES's single largest generation contingency as import level in applying Table 1.

7. Revision History

Issued	Description
2009-09-01	Supersedes 2008-05-28
2009-05-28	Supersedes 2008-12-01
2008-12-01	Approved for interim implementation effective 2008-12-01; supersedes 2008-05-01
2008-05-01	Supersedes 2008-01-01
2008-01-01	Approved for interim implementation, supersedes 2007-03-15
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2004-03-03	Supersedes 2003-07-28
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