Q. Please provide the criteria that guides Hydro's operation of thermal generation, including emergency and standby generation, in support of the Island and Avalon reserve requirements.

A. In recent years, Hydro has engaged with the Board and intervenors on several proceedings regarding reliable system supply. Hydro has carefully considered the input from the Board, its consultants, and the intervenors in each proceeding and has evolved its practises to account and adjust for the input received during those proceedings. This includes the current approach to dispatch of all generation sources.

Hydro operates its generation fleet (including thermal generation, emergency and standby generation) to position the power system to withstand the single worst contingency event. The single worst contingency event is *a failure of a single electrical element or the failure of multiple elements that are physically or electrically linked and fail together as one single event. This is an event that may occur in the future, that needs to be dealt with, and therefore must be prepared for*.[1]

Following the *March 4, 2015 Voltage Collapse* event, Hydro reviewed its transmission reliability criteria. The Board's Consultant (Liberty) concluded in its summary report, following a review of these events, that.

> *"… when events begin to require special measures, caution dictates concern and a special preparedness for identifying next contingencies that might take*

[1] NERC *Reliability Concepts* report, Version 1.0.2, December 2007.

> *major sectors of or even the whole system down. Hydro's approach does not sufficiently consider such possibilities, because the ability to shed even more load remains as the primary response."* [2]

Hydro currently operates such that it is equally prepared for the first contingency event as it is for the next contingency event. The Avalon Peninsula, under its current configuration, is transmission constrained and the security of supply to customers is exposed under the loss of a major 230 kV transmission line or Holyrood generating unit. Following the March 4, 2015 event, Hydro developed an Avalon operating instruction which provides for the method of assessment, stakeholder notification criteria, and operator dispatch guidelines related to Avalon capability and reserves (please refer to NP-NLH-022, Attachment 1). Hydro also conducted a series of load flows, with various equipment in/out of service configurations, to identify the levels of Avalon loading or "thresholds" for which the system operators dispatch Avalon generation (including standby sources) in order to withstand the next single worst contingency. Transmission line thermal ratings as well as delivery point voltages are key considerations when developing these thresholds. Generation is dispatched in advance of the contingency in order to mitigate the potential of sustained interruption to customers.

The Island Interconnected reserve criterion was also reviewed and spinning reserve targets were established to cover the loss of the single largest operating unit. This is typically in the range of 150-170 MW, depending on the largest unit in operation. Maintaining this level of spinning reserve positions the system for an expedient restoration of customers in the event of the loss of a major generating unit. As the

[2] *Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse* – Liberty Consutants, October 2015.

current system remains isolated from the remainder of the North American Grid, there is no ability to draw upon neighbouring utilities under such an event.[3]

Hydro operates all of its generation resources to position the system to withstand the single worst contingency event. Hydro's reliance on standby generation to provide for reliable service to customers has increased significantly in recent years. Standby units make up a material portion of the overall Island generation fleet. With the load growth in recent years, the use of standby generation is required to maintain adequate reserves for the Island Interconnected and Avalon systems. The following table illustrates the composition of the Island generation (assuming full unit availability).[4]

Table 1 Island Generation

Source	Total MW
Hydroelectric[5]	1,130
Thermal[6]	490
Purchases[7]	90
Standby[8]	297
Total Generation	**2,007**

Standby generation is critical to Hydro's ability to reliably supply customers. Standby generation comprises 15% of the overall total Island generation. In Hydro's

[3] Hydro is reviewing its reserve criteria as the Island Interconnected System approaches interconnection with the North American grid.
[4] As filed in Hydro's 2017 GRA Application, Volume 2, Exhibit 1.
[5] Hydro and Customer Owned.
[6] Holyrood Thermal Generating Station.
[7] Hydro purchases including Exploits.
[8] Hydro owned, Newfoundland Power owned and Vale.

view, standby generation operation for spinning reserve as required, or availability as non-spinning reserve, is prudent. To further illustrate the critical role of standby generation in maintaining reserves, the forecast P50 Island peak load for the upcoming winter (2017/2018) is 1,734 MW[9]. In order to maintain spinning reserves to cover the loss of the single largest unit (typically a Holyrood unit at 170 MW during the peak winter months), up to 195 MW of standby generation could be required to be on-line during the peak hours. Similarly, the maintenance of contingency reserves on the Avalon has become equally dependent on standby generation in the current period with the load growth in this region.[10,11]

Hydro has made significant improvements to its operating culture and reliability focus in recent years, and dispatches its generation fleet (including standby generation) to cover the full load expectations of its customers with due regard for single worst contingency events.

[9] Filed with the Board in Hydro's *Energy Supply Risk Assessment* Report, November 30, 2016.
[10] Holyrood thermal units are also dispatched for reliability considerations as well as to support system energy requirements with associated fuel costs managed through the existing Rate Stabilization Account.
[11] The in-service of TL267 is expected to reduce gas turbine production from levels observed in 2015 and 2016 due to less reliance for Avalon transmission support.

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INTRODUCTION

In order to ensure that customer service is maintained, the Energy Control Centre (ECC) shall exercise its authority to reduce risks to the Avalon capability and maintain sufficient Avalon reserves to meet current and anticipated customer demands. The ECC shall be prepared to deal with reserve deficiencies and take appropriate actions in order to maintain the reliability of the Avalon system.

Avalon reserve is required to replace generation or transmission capacity lost due to equipment forced outage, to cover performance uncertainties in generating units or to cover unanticipated increases in demand. Sufficient reserve is required to meet current and forecasted demands under a worst case contingency.

PROCEDURE

A. Calculation of *Total Avalon Capability and Available Avalon Reserve*

Total Avalon Capability is determined using load flow analysis[1] and is based on the availability of equipment on the Avalon for each day. This would include the following:

1. Generation on the Avalon (Holyrood thermal units, Hardwoods GT, Holyrood CT, Holyrood Diesels, Newfoundland Power hydro, Newfoundland Power standby, Fermeuse Wind[2] and Vale Capacity Assistance[3])
2. Transmission Availability (230 kV transmission lines on the Avalon, 138 kV transmission lines from Stony Brook – Sunnyside and Western Avalon - Holyrood)
3. Reactive resources (capacitor banks in Oxen Pond, Hardwoods and Come By Chance)

Available Avalon Reserve shall be calculated for the current day and the following six days in the manner as indicated below:

Available Avalon Reserve for each day =
Total Avalon Capability ; *less*
Forecasted Avalon Peak Load (adjusted for Voltage Reduction[4] when applicable)

[1] Base case load flows will be used to determine the Avalon Capability.
[2] Included for the current day based on actual wind output, but assumes no wind generation for the following six days.
[3] *Capacity Assistance* (when available) from Vale through operation of standby diesel units with a combined capacity of up to 15.8 MW.
[4] Up to 10 MW of Avalon load reduction (on peak) is expected to be achieved through the *Voltage Reduction* strategy. This is approximated as one-half the total Island reduction.

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PROCEDURE (cont'd.)

B. Assessment and Notification of Available Avalon Reserve

The available Avalon reserve will be calculated for the current day and the following six days and an assessment will be made against the criteria in the table below and a notification will be issued to stakeholders when available Avalon reserve is below the stated thresholds.

Available Avalon Reserve	Expected Action	Level
> Impact of largest contingency + min reserve[5]	none	0
< Impact of largest contingency + min reserve	Prepare for potential Load Reduction	1
< Impact of largest contingency	Load Reduction	2
< Impact of ½ largest contingency	Conservation	3
Zero/deficit	Rotating Outages	4

Based on the assessment above, perform the following:

- Level 0 - If the available Avalon reserve is anticipated to be greater than the impact of the largest contingency plus min reserve, the ECC are not expected to perform any further actions, other than to advise the on-call Executive member (Exec On-call) of NLH's Corporate Emergency Response Plan (CERP), Corporate Relations and Newfoundland Power's Control Centre that the available Avalon reserve has returned to normal following a prior Level 1, 2, 3 or 4 notice.
- Level 1 - If the available Avalon reserve is anticipated to be less than the impact of the largest contingency plus min reserve, the ECC will notify Newfoundland Power's Control Centre, advising of possible requirements for load reduction to maintain sufficient Avalon reserve, if the available Avalon reserve should decrease.
- Level 2- If the available Avalon reserve is anticipated to be less than the impact of the largest contingency, the ECC will notify Exec On-call (CERP)[6] Corporate Relations[7] and Newfoundland Power's Control Centre[8], advising of load reduction strategies to maintain sufficient Avalon reserve, if the capability shortfall is not corrected.

[5] Min reserve is 35 MW.
[6] As part of the CERP, the Exec On-Call makes the decision to activate the Corporate Emergency Operations Centre (CEOC) and issues alert notifications. If activated, a partial mobilization is recommended consisting of Deputy Incident Commander, Operations Liaison and Communications Support.
[7] Corporate Relations is responsible for activating the joint communication plan between NLH and Newfoundland Power.
[8] ECC will advise the NP Control Centre once internal alignment is achieved on the alert level through the CERP process.

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PROCEDURE (cont'd.)

- Level 3- If the available Avalon reserve is anticipated to be less than the impact of half the largest contingency, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power's Control Centre, advising of customer conservation strategies to help maintain sufficient Avalon reserve, if the capability shortfall is not corrected.
- Level 4 - If the available Avalon reserve is anticipated to approach zero or fall into a deficit, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power's Control Centre, advising of rotating outages in order to maintain supply point voltages and transmission line loadings within acceptable ranges.

The following is the standard message that will be communicated if it is anticipated that a notification is to be made under Level 1, 2, 3 or 4; or a return to Level 0:

> *"System Operations is advising that the available Avalon reserve is at a notification level [0-4] for [insert date here]. The available Avalon reserve is expected to be [insert reserve amount in MW], calculated from the total Avalon capability of [insert available capacity in MW] and a peak Avalon load forecast of [insert peak forecast in MW]."*

C. Operational requirements to cover largest contingency

The ECC shall maintain sufficient Avalon reserve to cover performance uncertainties in generating units and transmission equipment and unanticipated increases in demand. Such actions include the following: placing in service all available generating and transmission capacity, cancelling outages to generating units and transmission equipment that have a short recall, deploying all available standby resources, including Vale Capacity Assistance, cancelling Avalon industrial interruptible load and reducing Avalon load, through procedures such as public conservation notices, voltage reductions, curtailing interruptible loads and non-essential firm loads.

The ECC shall use the following guideline in the sequence outlined in order to cover the largest contingency, maintain the reliability of the Avalon and minimize service impacts to customers:

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PROCEDURE (cont'd.)

Normal Sequence

1. Determine the Avalon capability under worst case contingency and the Avalon load threshold for operating standby units.
2. Based on this threshold and expected loads, determine requirements for staffing and potential operation for standby generation on the Avalon and notify appropriate personnel of standby staffing requirements.

To position the Avalon power system in order to cover off the single largest contingency, perform the following:

3. Ensure all NLH static reactive resources are in service (i.e. capacitor banks).
4. Request Newfoundland Power to maximize Avalon hydro generation.
5. Increase Holyrood real and reactive power up to the maximum Holyrood capability.
6. Start and load (to minimum) standby generators on the Avalon, both Hydro's and Newfoundland Power's, to cover the largest contingency once the Avalon load threshold for operation is exceeded. (At this point in time it is important to notify Avalon customers taking non-firm power and energy that if they continue to take non-firm power, the energy will be charged at higher standby generation rates.)
7. Request Newfoundland Power to curtail its interruptible loads on the Avalon (typically up to 10 MW and can take up to 2 hours to implement).
8. Request Vale for Capacity Assistance (7.6 MW) and to put all its available capacitor banks in service.
9. Request Praxair for Capacity Assistance (5 MW).

Load Reduction

10. Cancel all non-firm power delivery to customers and ensure Avalon industrial customers are within contract limits.
11. Inform Newfoundland Power of Hydro's need to reduce supply voltage at Hardwoods and Oxen Pond to minimum levels to facilitate load reduction. Implement voltage reduction (if not already in a reduced voltage condition).
12. Request Avalon industrial customers to shed non-essential loads, informing them of system conditions.

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PROCEDURE (cont'd.)

Rotating Outages

If the Avalon reserve continues to decrease below the minimum level, the Avalon voltages and transmission line loadings should be watched closely. Delivery point voltages at CBC (212 kV) and Hardwoods and Oxen Pond (62.5 kV) need to be maintained. Transmission line loadings need to be kept to within thermal ratings. If voltages or line loadings deviate outside of acceptable operating ranges, perform the following:

13. Request Newfoundland Power to shed load by rotating feeder interruptions.

** Part of the Emergency Response Plan

REVISION HISTORY

Version Number	Date	Description of Change
0	2015-06-26	Original Issue
1	2016-12-22	Added Praxair Capacity Assistance

PREPARED: J. Tobin	**APPROVED:**