Q. **Reference:** ***Combustor Inspection Major and Overhaul, Holyrood Combustion Turbine*** **report, August 29, 2016, page 2**

"The Holyrood CT provides several critical functions in reliably supplying customer demand requirements. It is operated to support spinning reserves on the Island Interconnected System and provides a critical backup in the event of a contingency, such as the loss of a major generating unit or the loss of a major transmission line."

Does Hydro have a written procedure for determining the least cost generator to dispatch for the purpose of providing spinning reserve? If so, please provide a copy. If not, please fully describe Hydro's dispatch methodology including a description of how and when the Holyrood CT is dispatched for spinning reserve.

A. Hydro's written procedure for determining the least cost generator to dispatch for the purpose of providing spinning reserve is contained in its Technical Operating Instruction – T-001, attached as NP-NLH-002, Attachment 1. Following the March 4, 2015 event, Hydro also developed a specific instruction (T-096) for maintaining reserves on the Avalon Peninsula, attached as NP-NLH-002, Attachment 2.

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SYSTEM OPERATING INSTRUCTION

STATION:	GENERAL	**Inst. No.**	T-001
TITLE:	GENERATION RESERVES *, **	**Page** 1	**of** 5

INTRODUCTION

In order to ensure that customer service is maintained, the Energy Control Centre (ECC) shall exercise its authority to reduce risks to the generation supply and maintain sufficient generation reserves to meet current and anticipated customer demands. The ECC shall be prepared to deal with generation shortages and take appropriate actions in order to maintain the reliability of the Island Interconnected System.

Generation reserve[1] is required to replace generation capacity lost due to an equipment forced outage, to cover performance uncertainties in generating units or to cover unanticipated increases in demand. Sufficient generation reserve is required to meet current and forecasted demands under a contingency of the largest generating unit.

PROCEDURE

A. Calculation of *Available Generation Reserve*[2]

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

Available Generation Reserve for each day =
Available Generation of NLH (Hydro + Thermal + *Standby*[3] + *Purchases*[4]); *plus*
Available Generation of NP (Hydro + Standby); *plus*
Available Generation of DLP (60 Hz Hydro); *plus*
Capacity Assistance of Vale (Standby)[5]; *less*
Forecasted Island Peak Load (adjusted for CBPP Capacity Assistance[6] and Voltage Reduction[7])

A plot is provided on the EMSView – Production - Load Forecast page for reference.

[1] *Generation Reserve* is defined as the quantity of available generation supply that is in excess of demand, and includes spinning reserve[8]. It is equal to Available Generation Supply less Current / Forecasted Demand.
[2] *Available Generation Reserve* is associated with generation that is in service or standby generation that can be placed in service within 20 minutes. NP's mobile generation may take up to 2 hours to place in service.
[3] *Standby* generation includes combustion turbine / diesel generation, including the new CT at Holyrood.
[4] *NLH Purchases* includes wind for the current day based on actual wind output, but assumes no wind generation for the following six days.
[5] *Capacity Assistance* (when available) from Vale through operation of standby diesel units with a combined capacity of 10.8 MW.
[6] *Capacity Assistance* (when available) from CBPP through load interruption in 20, 40 or 60 MW blocks.
[7] Up to 20 MW of load reduction (on peak) is expected to be achieved through the *Voltage Reduction* strategy.
[8] *Spinning reserve* is defined as unloaded generation that is synchronized to the power system and ready to serve additional demand.

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PROCEDURE (cont'd.)

B. Assessment and Notification of Available Generation Reserve

The available generation 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. A notification will be issued to stakeholders when available generation reserve is below the stated thresholds for anytime within the next week.

Available Reserve	Expected Action	Level
> Largest Generating Unit + min. spinning reserve	none	0
< Largest Generating Unit + min. spinning reserve	Prepare for Potential Load Reduction	1
< Largest Generating Unit	Load Reduction	2
< ½ Largest Generating Unit	Conservation	3
Zero/deficit; hold f=59.8 Hz	Rotating Outages	4

Based on the assessment above, perform the following:

- Level 0 - If the available reserve is anticipated to be greater than the largest available generating unit capacity plus minimum spinning 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 that available reserve has returned to normal following a prior Level 1, 2, 3 or 4 notice.
- Level 1 - If the available reserve is anticipated to be less than the largest available generating unit capacity plus the minimum spinning reserve, the ECC will notify Newfoundland Power's Control Centre, advising of possible requirements for load reduction to maintain sufficient spinning reserve, if the available generation reserve should decrease.
- Level 2 - If the available reserve is anticipated to be less than the largest available generating unit capacity, the ECC will notify Exec On-Call (CERP)[9], Corporate Relations[10] and Newfoundland Power, advising of load reduction strategies to maintain sufficient spinning reserve, if the generation shortfall is not corrected.

[9] As part of the CERP, the Exec On-Call makes the decision to activate the Corporate Emergency Operations Centre (CEOC) and issues alert notifications.
[10] Corporate Relations is responsible for activating the joint communication plan between NLH and Newfoundland Power.

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SYSTEM OPERATING INSTRUCTION

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PROCEDURE (cont'd.)

- Level 3 - If the available reserve is anticipated to be less than half of the largest available generating unit capacity, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power, advising of a requirement for customer conservation strategies to help maintain sufficient spinning reserve, if the generation shortfall is not corrected.
- Level 4 - If the available reserve is anticipated to approach zero or fall into a deficit, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power, advising of a requirement for rotating outages to help maintain frequency near the 60 Hertz standard, if the generation shortfall is not corrected.

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 Island generation reserve is at a notification level [0-4] for [insert date here]. The available generation reserve is expected to be [insert reserve amount in MW], calculated from an available generation capacity of [insert available capacity in MW] and a peak load forecast of [insert peak forecast in MW]."

C. Maintaining Spinning Reserve

The ECC shall maintain sufficient spinning reserve to cover performance uncertainties in generating units, especially wind and other variable generation, and unanticipated increases in demand. The ECC will take appropriate action to maintain a minimum spinning reserve level equal to 70 MW. Such actions include the following: placing in service all available generating capacity, cancelling outages to generating units that have a short recall, deploying all available standby resources, including CBPP and Vale Capacity Assistance, cancelling industrial interruptible load and reducing system load, through procedures such as public conservation notices, voltage reductions, curtailing interruptible loads and non-essential firm loads.

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PROCEDURE (cont'd.)

The following guideline shall be followed by the ECC Shift Supervisor and System Operator in the sequence outlined in order to maintain sufficient spinning reserve, maintain the reliability of the Island Interconnected System and
minimize service impacts to customers:

Normal Sequence

1. Place in service all of Hydro's available hydroelectric generation.
2. Request Newfoundland Power to maximize their hydroelectric generation.
3. Make a Capacity Request of Deer Lake Power to maximize their hydroelectric generation.
4. Request Non-Utility Generators to maximize their hydroelectric and wind generation.
5. Maximize Holyrood thermal generation.
6. Start and load standby generators, both Hydro and Newfoundland Power units, in order of increasing average energy production cost with due consideration for unit start-up time, while holding the least efficient NLH standby combustion turbine unit in reserve. (At this point in time it is important to notify 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 (typically up to 10 MW and can take up to 2 hours to implement).
8. Request Corner Brook Pulp and Paper for Capacity Assistance (20, 40 or 60 MW).
9. Request Vale for Capacity Assistance (11 MW).
10. Start and load the remaining NLH standby combustion turbine unit.

Load Reduction

11. Cancel all non-firm power delivery to customers and ensure all industrial customers are within contract limits.
12. Inform Newfoundland Power of Hydro's need to reduce supply voltage at Hardwoods and Oxen Pond and other delivery points to minimum levels to facilitate load reduction. Implement voltage reduction.
13. Request Newfoundland Power to implement voltage reduction on its system.

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PROCEDURE (cont'd.)

Load Reduction (cont'd)

14. Request industrial customers to shed non-essential loads, informing them of system conditions.
15. Request Corner Brook Pulp and Paper Supplemental Capacity Assistance (to a maximum of 30 MW). Note that this is above the Capacity Assistance request and a request for the full 30 MW will likely reduce CBPP Mill load to that required for essential services. Upon request for Supplemental Capacity Assistance, arrangements should be made with TRO-Central to close the load break bus tie switch B2B4-1 at Massey Drive.

Rotating Outages

If the spinning reserve continues to decrease below the minimum level, the system frequency should be watched closely. In order to minimize outages to customers, utilize the reserve as much as possible and maintain the system frequency at 59.8 Hz.

16. Request Newfoundland Power to shed load by rotating feeder interruptions. At the same time, shed load by rotating feeder interruptions in Hydro's rural distribution areas. Follow instruction for rotating outages, T-042.

* Part of the Environmental Plan
** Part of the Emergency Response Plan

REVISION HISTORY

Version Number	Date	Description of Change
0	1992-07-16	Original Issue
12	2015-09-11	Minor editorial changes

PREPARED: J. Barnard

APPROVED:

2015-09-15

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SYSTEM OPERATING INSTRUCTION

STATION:	GENERAL	**Inst. No.**	T-096
TITLE:	AVALON CAPABILITY AND RESERVES **	**Page** 1	**of** 5

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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SYSTEM OPERATING INSTRUCTION

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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 all available Capacity Assistance and to put all its available capacitor banks in service.

Load Reduction

9. Cancel all non-firm power delivery to customers and ensure Avalon industrial customers are within contract limits.
10. 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).
11. 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:

12. 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

PREPARED: J. Tobin	**APPROVED:**