

Island Interconnected System Power Outage – March 4, 2015

Public Utilities Board Briefing

March 10, 2015 (Updated April 10, 2015)

Boundless Energy



Outline

- Safety Moment
- Overview
- Background
- Prior to Event
- Sequence of Events
- System Recovery
- Coordination with Customers
- Communications
- Conclusions

Safety Moment

- Step Back 5x5

Overview

- Review circumstances of March 4 power outage event
- Unanticipated generation issues on the Avalon caused voltages to decline
- Power interruptions caused by low voltage are extremely rare
- At the height of the event ~83,000 customers affected
- ~50,000 customers restored within one hour, most others restored within ~3 hours, remaining restored in ~5 hours
- Hydro personnel responded immediately to restore power in a safe and efficient manner
- Hydro very aware of inconvenience caused by the outage and is reviewing for any necessary improvements

Background

- Planned emergency repair to Holyrood Unit 1
- Contingency plan in place
- Avalon transmission constraints

Days Prior to March 4

- Holyrood Unit 1 lubrication oil leak:
 - Condition identified and monitored
 - Unit had to be taken offline to be repaired
 - Planned with contractor who was dispatched to assist
 - Removed from service Fri, February 27, 12:00
 - Expected return late evening Tues, March 3
- Reserves met as required from Feb 27 to Mar 3
 - Holyrood CT – operated 3 days
 - Hardwoods GT – operated 3 days
 - Stephenville GT – operated 4 days

Planning for March 4

- On Tue, March 3, the reserve forecast for morning peak Wed, March 4 was 520 MW with Holyrood Unit 1 and 350 MW without Unit 1
- Planned to operate Hardwoods, Stephenville and Holyrood Turbines on Wed, March 4 for Avalon transmission requirements and spinning reserve support
- Expected reserves for March 4 were well above thresholds for public communications

Island System Supply: Prior to Event

Supply Source	Normal <u>Firm</u> Supply (MW)	March 4, 00:00 (MW)
Hydro Owned and Operated	1,692.6	1,497.6 ¹
Purchased	99.8	152.0 ²
Corner Brook Pulp and Paper	99.1	99.1
Newfoundland Power	117.9	99.8
Total	2,009.4	1,848.5

1. Holyrood Unit 1 (170 MW) and Hardwoods End B (25 MW) unavailable.
2. Increase in purchased supply is primarily due to available wind generation at that time, which declined throughout the hours leading to the event.

Early hours March 4

- Unit 1 delayed coming online and not available for peak

March 4 Sequence of Events

Newfoundland Power & Newfoundland and Labrador Hydro March 4 th , 2015 Timeline	
Time	Event
February 27 th , 2015	Hydro's Holyrood 170 MW Unit 1 taken out of service until March 3 rd , 2015 at 2000 hours.
Time	Event
March 3 rd , 2015	Hydro's Holyrood 170 MW Unit 1 not returned to service as planned.
Time	Event
March 4 th , 2015	
5:23 AM	Hydro's ECC requests NP's SCC to maximize all available hydro production.
6:10 AM	Stephenville CT (50 MW) online.
6:12 AM	Holyrood CT initial unsuccessful start.
6:17 AM	Hardwoods CT (25 MW) online.
6:19-6:30 AM	Additional unsuccessful start attempts on Holyrood CT.
6:28 AM	Hydro's ECC requests NP's SCC to operate Greenhill and Wesleyville gas turbines.
6:30 AM	Voltage at Come by Chance 223.1 kV (97%); at Oxen Pond 67.3 kV (102%).
6:30 AM	Available Island reserves 301 MW.
6:32 AM	Between 6:32 and 7:00 AM Greenhill gas turbine started twice from NP's SCC but unit would not synchronize to system and shut down.
6:36 AM	Hydro requested 20 MW block from Corner Brook Pulp & Paper Capacity Assistance.
6:37 AM	Voltage at Western Avalon 218 kV (95%).
6:45 AM	Voltage at Come by Chance 221.4 kV (96%); at Oxen Pond 66.5 kV (101%).
6:45 AM	Available Island reserves 259 MW.

1. Hydro normally requests NP hydraulic generation on a daily basis and will request standby units if load requires.
2. Acceptable steady state voltage range 95%-105%. Emergency range of 90% to 110%.

March 4 Sequence of Events

Newfoundland Power & Newfoundland and Labrador Hydro March 4 th , 2015 Timeline (Cont'd)	
6:48 AM	Holyrood Units 2 and 3 at maximum voltage support.
6:50 AM	Voltage at Come by Chance 220.4 kV (96%); at Oxen Pond 65.7 kV (100%).
6:50 AM	Available Island reserves 253 MW.
6:51 AM	Hydro's ECC advises NP's SCC that the Holyrood CT would not start and 230 kV system voltage was down to 216 kV.
7:00 AM	Vale Capacity Assistance requested (10 MW).
7:01 AM	NP's Director of Operations advised by Hydro's Manager System Operations that Holyrood Unit 1 did not get back in service, unable to start 123 MW Holyrood CT and system spinning reserves were dropping and currently around 70 MW.
7:04 AM	Hydro's ECC advises NP's SCC that St. John's 66 kV infeed voltages down to 64.6 kV (98%) and soon will have to start shedding load.
7:04 AM	Hardwoods CT at maximum voltage support.
7:08 AM	Corner Brook Pulp & Paper Capacity Assistance increased to 60 MW.
7:09 AM	Rocky Pond hydro plant tripped due to low voltage.
7:10 AM	Voltage at Come by Chance 209.6 kV (91%); at Oxen Pond 62.5 kV (95%).
7:10 AM	Available Island reserves 230 MW.
7:14 AM	Voltage at Come by Chance 199.8 kV (87%); at Oxen Pond 61.9 kV (94%).
7:14 AM	Hydro's capacitor banks (4) at Come by Chance tripped, removing voltage support.
7:14 AM	All NP hydro plants on the Avalon and Bonavista Peninsulas tripped off line.

March 4 Sequence of Events

Newfoundland Power & Newfoundland and Labrador Hydro March 4 th , 2015 Timeline (Cont'd)	
7:14 AM	Between 7:14 and 7:15 AM, NP's transmission lines trip on under voltage protection and 35 substations lost power. Areas affected include Clarenville area and Bonavista Peninsula, Gander Bay and Bonavista North areas, Placentia Bay and St. Mary's Bay areas, Conception Bay North area, Southern Shore and parts of west end St. John's. 57,000 customers without power.
7:15 AM	Holyrood Unit 3, Hardwoods CT, Stephenville GT and Star Lake generation tripped.
7:15 AM	Transmission Line TL208 supplying Vale tripped. North Atlantic Refining at partial load.
7:17 AM	Hydro's ECC advises NP's SCC that Unit 3 tripped at Holyrood, and requested NP to shed additional load as the 66 kV system voltages were down to 52.9 kV.
7:19 AM	NP's SCC asks Hydro's ECC how much more load to shed. Hydro's ECC advises voltages still down to 52 kV and to shed additional load. NP's SCC load sheds a total of 31 feeders in the St. John's area by 7:23 AM (total of 83,000 customers without power).
7:23 AM	Hawke's Bay diesels started.
7:25 AM	Holyrood CT started.
7:27 – 7:41 AM	NP's SCC restores power to 16 feeders in St. John's (approx. 20,000 customers).
7:29 AM	NP's Director Operations confirms with Hydro's Manager System Operations a significant loss of supply outage will remain until Holyrood Unit 3 returned to service. Advises NP's Corporate Communications staff to get message to customers to conserve energy and prepare for rotating power outages.
7:31 – 7:32 AM	Come by Chance Capacitor Banks 2 and 3 back in service.
7:36 AM	NP starts restoring power to customers off the Avalon as there is generation available off the Avalon.
7:37 – 7:39 AM	Come by Chance Capacitor Banks 1 and 4 back in service.
7:40 AM	Stephenville GT re-started.
7:44 AM	TL208 (Vale restored).

March 4 Sequence of Events

Newfoundland Power & Newfoundland and Labrador Hydro March 4 th , 2015 Timeline (Cont'd)	
7:47 AM	NP's Greenhill gas turbine switched to manual voltage control and placed on line.
7:52 AM – 10:05 AM	Fermeuse Wind and NP Southern Shore hydro generation re-started.
8:04 AM	St. Anthony diesels started.
8:05 – 10:30 AM	NP starts rotating outages in the St. John's area. Rotated 17 feeders at an average of 41 minutes power off time.
8:07 AM	Power restored to Clarenville, Bonavista Peninsula, Gander Bay and Bonavista North areas (25,000 customers).
8:44 AM	Vale Capacitors placed in-service.
8:44 – 9:16 AM	Vale generation on line.
8:54 AM	Power restored to Southern Shore.
9:13 AM	Holyrood Black Start diesels started.
9:13 AM	NP Wesleyville started.
9:27 AM	Hardwoods CT re-started.
10:14 AM	Holyrood Unit 3 re-started.
10:16 AM	All power restored to customers in St. John's area.
10:30 AM	All power restored to Placentia Bay and St. Mary's Bay areas.
12:32 PM	All power restored to Conception Bay North area.
3:17 PM	Star Lake re-started.
4:00 PM	Holyrood Unit 1 – back in service.

Concurrent System Issues 07:15

- Equipment protection systems operated to remove:
 - Generating units :
 - Star Lake (18 MW)
 - Hardwoods CT (25 MW)
 - Stephenville CT (50 MW)
 - Holyrood Unit 3 (150 MW)
 - Transmission line – TL 208, supplying Vale

Concurrent System Issues 07:15, con't

- North Atlantic Refining partial load
- Various Newfoundland Power transmission trips – cause was ‘under-voltage’ protection, resulted in loss of power to 35 substations
- Additional customers lost power due to requirement to shed load to control voltage (31 feeders by 7:23 am)
- **At height of event, 450 MW of load or ~83,000 customers affected**

Customer Restoration

- Commenced immediately
- Hydro ECC coordinated with NP Control Centre to restore customers power
- Within first hour, ~ 50,000 customers restored
- By 10:30, approximately 7,000 customers remaining to be restored
- **All customers restored by 12:32**

Island System Supply: Post Event

Supply Source	Normal <u>Firm</u> Supply (MW)	March 4, 16:00 (MW)
Hydro Owned and Operated	1,692.6	1,667.6 ¹
Purchased	99.8	118.0
Corner Brook Pulp and Paper	99.1	99.1
Newfoundland Power	117.9	96.4
Total	2,009.4	1,981.1

1. Holyrood Unit 1 available. Hardwoods End B unavailable.

Post–Event: Initial Findings

- Unanticipated generation issues on the Avalon caused delivery point voltages to decline.
- Holyrood CT: delayed start due to a minor fuel valve adjustment requirement. Had regularly started with no issue. Adjustment made and unit online 07:25.
- Holyrood Unit 1: delayed return to service.
- The Come By Chance capacitor banks tripped on 85% under voltage, causing a further decline of the delivery point voltages on the Avalon.

Post-Event: Preliminary Findings to-date

- The under-voltage condition resulted in operation of the under-voltage protection and the tripping of Newfoundland Power transmission lines.
- Hydro directed load shed by NP Control Centre to restore voltage to acceptable levels.
- Causes of trips under investigation for the following:
 - TL208, Hardwoods, Stephenville, Holyrood Unit 3, Star Lake

Coordination with Customers

Newfoundland Power: Normal Activities

- Daily system coordination meeting on equipment status and reserves.
- Routine communication between control centres regarding system requirements for generation and voltage control.
- Recent enhancement is sharing real time data, including the Available and Spinning reserves.

Coordination with Customers

Newfoundland Power: Event Activities

- Hydro and NP coordinate the restoration following the disturbance event.
- Hydro and NP executed the conservation effort and associated customer messaging to reduce system demand.
- Hydro requested NP interrupt curtailable customers.

Coordination with Customers

Corner Brook Pulp and Paper: Normal and Event Activities

- Request to maximize their hydro generation to assist in meeting system peak demands.
- Requesting Capacity Assistance through load curtailment as per agreement with Hydro.

Coordination with Customers

Vale: Event Activities

- Capacity Assistance through operation of standby diesel generation as per agreement with Hydro.
- Use of Vale capacitor banks to support the transmission voltages.
- Coordinated restoration of TL208 to return primary supply to Vale.

North Atlantic Refining: Event Activities

- Co-ordinated restoration of customer load.

Alert Levels	Generation Reserves ²	Stakeholder Notifications	NLH Actions	NP Actions	Customer Notifications
Normal Conditions (T-001 ³ Level 0)	7-Day Generation Reserve Forecast indicates available reserves greater than the largest generating unit plus minimum spinning reserves	Daily Supply and Demand Status Report and 7-Day Forecast for the <i>Island Interconnected System</i> sent to Public Utilities Board (PUB) and Newfoundland Power.	Normal Operations	Normal Operations	None
Stage 1 Power Advisory (T-001 Level 1)	7-Day Generation Reserve Forecast indicates available reserves less than the largest generating unit plus minimum spinning reserves	Stage 1 - Power Advisory Notifications: Hydro System Operations notifies Newfoundland Power System Operations.	Follow System Operating Instruction T-001 as required to maintain minimum spinning reserves	Support Hydro with implementing T-001 measures	None
Stage 2 Power Watch (T-001 Level 2)	24-Hour Generation Reserve Forecast indicates available reserves less than the largest generating unit	Stage 2 - Power Watch Notifications: Hydro System Operations notifies Newfoundland Power, Hydro Regulatory Affairs notifies PUB and Hydro Communications notifies Newfoundland Power Communications and FES.	Follow System Operating Instruction T-001	Support Hydro with implementing T-001 measures	NP gives advance notification to its curtailable customers Utilities <u>may</u> issue ⁴ press release, update website, engage social media (or other communications tools) stating: "Power Watch in Effect - Conservation Request Likely" -Specify when conservation may be required. -Indicate what is the most effective ways for customers to conserve.
Stage 3 Power Warning (T-001 Level 3)	Current Day Generation Reserve Margin less than half the largest generating unit	Stage 3 - Power Warning Notifications: Hydro System Operations notifies Newfoundland Power, Hydro Regulatory Affairs notifies PUB and Hydro Communications notifies Newfoundland Power Communications and FES.	Follow System Operating Instruction T-001	Support Hydro with implementing T-001 measures	Utilities <u>will</u> issue press release, update website, engage social media (or other communications tools) stating: "Power Warning in Effect - Customers Requested to Conserve Electricity: Rotating Outages Likely" -Request NP curtailable customers to curtail. -Specify when conservation is required. -Indicate the most effective ways for customers to conserve.
Stage 4 Power Emergency (T-001 Level 4)	⁵ Generation Shortfall Imminent - No reserves margin	Stage 4 - Power Emergency Notifications: Hydro System Operations notifies Newfoundland Power, Hydro Regulatory Affairs notifies PUB and Hydro Communications notifies Newfoundland Power Communications and FES.	Follow System Operating Instruction T-001	Support Hydro with implementing T-001 measures and implement Newfoundland Power SRP-001 ⁶ for Rotating Power Outages	Customers to be notified immediately if a generation shortfall is anticipated. Utilities <u>will</u> issue press release, update website, engage social media (or other communications tools) stating: "Power Emergency in Effect - Conserve Electricity-Rotating Power Outages in Effect" - Inform customers of the actual impact (MW) conservation efforts are having on the electricity system. -Indicate what are the most effective ways for customers to conserve.

¹ Island Interconnected Supply Shortfall refers to **all** Firm Generating Capacity on the Island Electricity System.

² Operating Reserves = ((Island Interconnected System Available Generation / Island Interconnected System Forecast Peak) - 1) x 100%

³ NLH System Operating Instructions for Generation Reserves

⁴ Where desirable, utilities may undertake joint communications; however, each utility will communicate with its respective customers and key stakeholders directly according to its established protocols.

⁵ In the event of an immediate loss of supply (unanticipated and unable to be forecast) this protocol will eliminate Stages 1-3 and begin with Stage 4: this applies to both a generation and transmission issue. Exception may be an underfrequency load trip that would result in a prompt power restoration.

⁶ NP System Restoration Plan for Rotating Power Outages

Public Communication

- Corporate Communications advised at 7:18. Unique situation required time to gather information and connect with appropriate parties in order to communicate accurately with the public.
- First statement was made on Twitter at 07:53
- Followed by subsequent posts identifying Notification Level – Power Emergency and requesting conservation.
- Information posted to Hydro website on Power Emergency, how to conserve and details of event.
- Interviews conducted with media outlets (radio, print) throughout the morning and into mid-day.
- Press conference (joint with NP) held at 13:30
- Ongoing information on social media throughout the day
- Evening news – CBC Here & Now live and hosted NTV for remotes from lobby.

InterUtility Communications

- Hydro and NP Control Centres communicating well in advance of peak and throughout event.
- Followed the new Joint Storm/Outage Communication Plan.
- Hydro and NP had several discussions deciding upon Advance Notification Level: resulted in classifying as Power Emergency (this is level three communications response in the joint plan).
- All timelines outlined in the joint plan were met.
- Through an event debrief, Hydro identified several adjustments to some of the communication targets.

Regulator Communication

Communication	Timeline Target
Stakeholder relations (as required)	Minimum of twice daily in the a.m. and p.m.

See Page 15 of Joint Storm/Outage Communication Plan

Communication	Timeline Target	Met Y/N	Adjustments Proposed?
Initial social media acknowledgment	Within 30 minutes for a confirmed Level 2 or Level 3 event.	Y	Shorten target to holding statement within 15 minutes
Media holding statement	Within 1 hour for a Level 3 event. For Level 2, use discretion.	Y	Holding statement within 15 minutes
Internal communication	Within 1 hour for a confirmed Level 2 or 3 event if required.	Y	Within 30 minutes depending on situation
Media release	Within 1.5 hours of mobilizing the communication team for a Level 3 crisis. For a Level 2 crisis, use discretion.	Y	Within one hour for a level 3 following holding statement, depending on situation and availability of information
Media conference (if required)	Before end of business day for a Level 3 event (use discretion). Ideal timing would be prior to the noon news (11:00 a.m.) or early afternoon.	Y	Adjust depending on situation.
Formal updates for prolonged events (as required): News releases, internal updates, media conferences, social media	As new information comes in: <ul style="list-style-type: none"> • Media updates via interviews or media release as substantial information changes are confirmed – use discretion. • Internal updates (as needed). • Social media/website (ongoing). 	Y	
Stakeholder relations (as required)	Minimum of twice daily in the a.m. and p.m.	Y	Clarify expectations and appropriate notification window for Regulator

See Page 15 of Joint Storm/Outage Communication Plan

Conclusions

- Hydro very aware of the inconvenience caused by the outage to customers
- Outage resulted from Avalon transmission constraints
- This was a rare low voltage event
- Protection systems operated as they should have, for low voltage conditions, which caused customer interruptions
- ~50,000 customers restored within one hour, most others restored within ~3 hours, remaining restored within ~5 hours
- Hydro personnel responded immediately to restore customers in a safe and efficient manner
- Systems analysis ongoing
- Communication plan and Advanced Notification Protocol are being reviewed and will evolve considering the nature of this event

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