Island Interconnected System
Supply Disruptions – January 2 to 6, 2014

Public Utilities Board Briefing

January 8, 2014

Boundless Energy

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The following presentation was prepared by NL Hydro to provide an overview to the Board of Commissioners of Public Utilities, as requested, on the current power system situation on the Island Interconnected System. The information presented represents an interim analysis of events as of January 8, 2014. As further investigation and analysis are completed the information presented in this report may be subject to updates or changes.

Outline

1. Introductions
2. Safety Moment
3. Sequence of Events Preceding Rotating Outages
4. January 4 and 5 Incidents Overview
    a) Sunnyside Transformer T1 Fault
    b) Sunnyside 230 KV Bus Lockout
    c) Holyrood 230 KV Switchyard Fault and B1L17 Breaker Fail
5. Current Generation Status
6. Coordination with Customers
7. 2014 Winter Season
8. Public Communication Plan
9. Conclusions

Introductions and Safety Moment

- Portable generator safety precautions
  - Never use a portable generator indoors, including inside a garage or other enclosed or partially enclosed area.
  - Only operate portable generators outdoors and at a location where the exhaust cannot enter into your home or other buildings through doors or windows.
  - If you start to feel dizzy, nausea, a headache or tired while using a generator, get to fresh air immediately and seek medical attention.
  - Use a battery operated CO detector at home.

Island Interconnected System Supply

Installed Capacity	
Hydro owned and operated	1,507.5 MW
Purchased	178.8 MW
Customer Owned	259.8 MW
Total Supply	1,946.1 MW

Island Interconnected System Capacity (MW)

		Firm (Dependable)	Additional	Total
Newfoundland and Labrador Hydro				
Owned	Hydroelectric	927.3	-	927.3
Owned	Holyrood	465.5	-	465.5
Owned	Gas Turbine	100.0	-	100.0
Owned	Diesel	14.7	-	14.7
	Total	1,507.5	-	1,507.5
Purchased	Hydroelectric	78.0	31.8	109.8
Purchased	Co-Generation	8.0	7.0	15.0
Purchased	Wind	-	54.0	54.0
	Total	86.0	92.8	178.8
Total NLH System		1,593.5	92.8	1,686.3
Customer Owned				
Corner Brook Pulp and Paper	Hydroelectric	99.1	22.3	121.4
Newfoundland Power	Hydroelectric	78.7	18.2	96.9
Newfoundland Power	Gas Turbine	36.5	-	36.5
Newfoundland Power	Diesel	5.0	-	5.0
Newfoundland Power	Total	120.2	18.2	138.4
Total Island Interconnected System		1,812.8	133.3	1,946.1

Hydro Generation Status December 1, 2013

Owned	1,432.5 MW
Purchased	88.0 MW
Total	1,520.5 MW

Unavailable

- Hardwoods 50 MW – Completing overhaul and alternator replacement. Scheduled completion December 20
- Stephenville 25 MW- Cooling problem – Insulating blankets on order for early January install

Peak Demands

- Forecast Winter Peak Demand 1,453.7 MW
- Previous record peak 1,406 MW in 2004
- December 14 set new record of 1,501 MW*
  - Met with no customer impact
  - Exploits and Wind contributed 22 and 49 MW above firm respectively
  - Reserve approximately 100 MW

* Previously reported at 1496 MW subsequently updated.

Events Preceding Rotating Outages

- December 15-16, 2013
  - Exploits reduced to 38 MW from typical 63 MW in winter due to issues with frazil ice
- December 21, 2013
  - Hardwoods GT (50 MW) unit unavailable; final testing following unit overhaul revealed fuel valve issues
- December 26, 2013
  - Holyrood Unit 3 forced draft fan failure – 100 MW unavailable
  - Also ongoing, minor de-rating of Holyrood Unit 2 and Granite Canal (issues corrected January 2, 2014)

Events Preceding Rotating Outages

- December 29, 2013
  - Began implementation of Generation Shortage Protocol steps to implement Newfoundland Power voltage reductions and call on curtailable customers
  - Received assistance from Corner Brook Pulp and Paper
  - Peak demand of 1,420 MW
- December 30, 2013
  - Determination made that immediate resolution of Holyrood and Hardwoods generation issues not possible
  - Initiated discussions with Corner Brook Pulp and Paper regarding short-term capacity agreement

Events Preceding Rotating Outages

- December 31, 2013
  - Review of weather forecasts highlights January 2-3 demand levels expected to be high
  - Called on Corner Brook Pulp and Paper to assist; finalized arrangements for a short-term capacity agreement to provide up to 60 MW
  - Notified Public Utilities Board of extended capacity issues with the Stephenville Gas Turbine, Hardwoods Gas Turbine and Holyrood Unit 3

Initiation of Rotating Outages

- January 2, 2014
  - Conservation request discussion initiated with Newfoundland Power in the early morning
  - Conservation request issued at 2:00 pm Thursday to all island customers
  - Rotating outages began shortly after 4:00 pm
  - Reached 1,492 MW with curtailments (wind at 28 MW)
- January 3, 2014
  - Outages continued through very cold and windy conditions
  - Reached 1,532 MW with curtailments (wind at 47 MW)

January 4 and 5 Incidents Overview

January 4 Pre-event Preparation

- Blizzard Conditions and Heavy Snowfall forecast
- Crews prepared for storm response
  - Vehicles fueled up
  - Vehicles sent home with workers prepared to respond
  - 0800 hours crews dispatched to major Avalon stations
  - Remote hydroelectric plants staffed – Cat Arm and Granite Canal
  - Road to Upper Salmon maintained open

January 4 Pre-event System Status

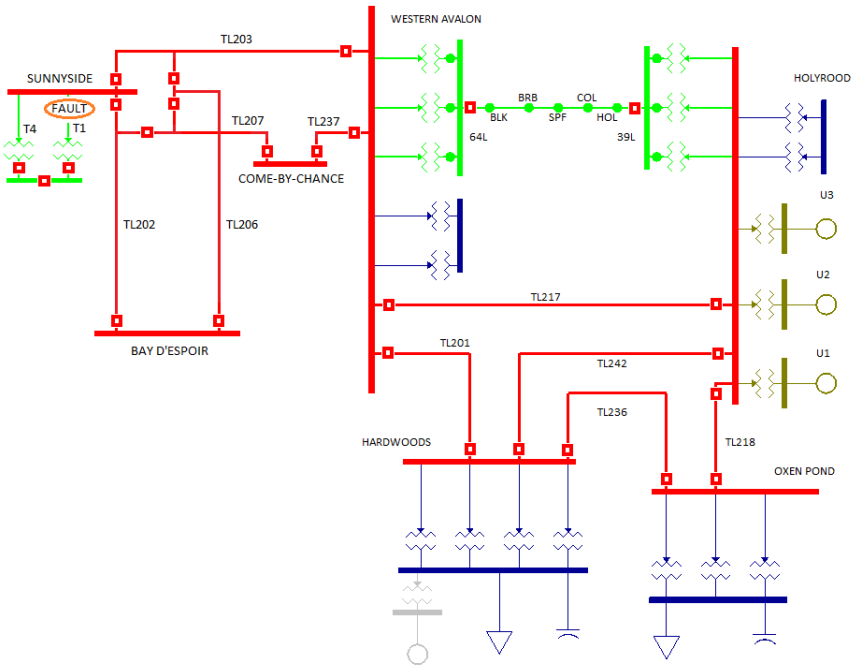
- Transmission System - All available and in-service
- Generation Supply – 1485 MW Available*
  - Unavailable Capacity
    - Holyrood Unit 3 reduced to 50 MW
    - Stephenville GT reduced to 25 MW (one end)
    - Hardwoods GT (50 MW) unavailable
    - Exploits reduced to 38 MW (frazil ice)
    - No capacity assumed for Corner Brook Co-Gen, Rattle Brook and the two Wind Farms
- Hydro supplied load – 1459 MW immediately prior to the event

* Includes 60 MW from CBPP. NP Thermal generation excluded.

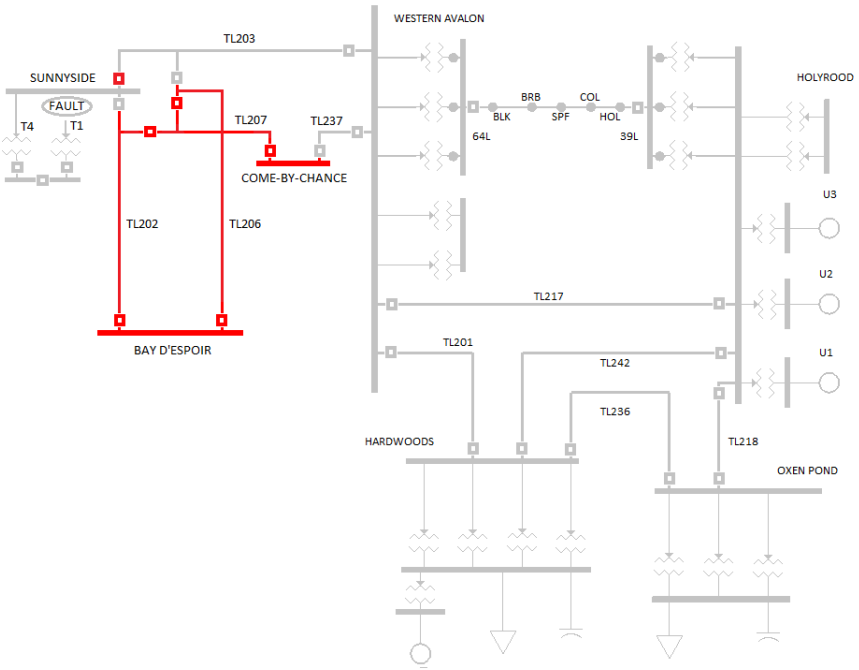
System Impact

January 4 0905 hours – Sunnyside T1 Transformer Fault

Pre-Event Conditions



Post-Event Conditions



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System Impact (cont'd)

Sunnyside T1 Transformer Fault

- Avalon Peninsula including the Holyrood Generating Station interrupted
- Disturbance results in shutdown of generation at Cat Arm, Hinds Lake, Granite Canal, Upper Salmon, Stephenville GT, St. Anthony and Hawkes Bay diesels, Star Lake, and Exploits to shutdown. The cause of these generation outages is currently under investigation.
- Total Hydro supplied load immediately following the event was approximately 400 MW.

Customer Restoration

January 4 0905 Hours Event – Sunnyside T1 Transformer Fault

- Workers in station reported fire and initiated quick reporting
- Hydro ECC coordinated with NP Control Centre
- Supply to Holyrood restored by transmission
- Customers restored as generation and transmission restored

<u>Generation Restoration</u>

Stephenville GT – 09:57
Upper Salmon – 10:08
Granite Canal – 10:12
St. Anthony diesels – 10:35
Hawkes Bay diesels – 10:36
Cat Arm – 12:19
Hinds Lake – 15:12
Holyrood Unit 2 – 21:34
Holyrood Unit 3 – 01:40 (January 5)

<u>230 KV Transmission Restoration</u>

TL237 – 09:41 (WAV 230 KV re-energized)
TL201 – 09:51 (HWD 230 KV re-energized)
TL242 – 10:22 (HRD 230 KV re-energized)*
TL236 – 10:41 (OPD 230 KV re-energized)
TL217 – 12:23
TL203 – 12:23
TL218 – 12:30

*To restore Holyrood station service. The NP standby units located at Holyrood were also started following this event.

Sunnyside T1 Transformer (Post Fault)

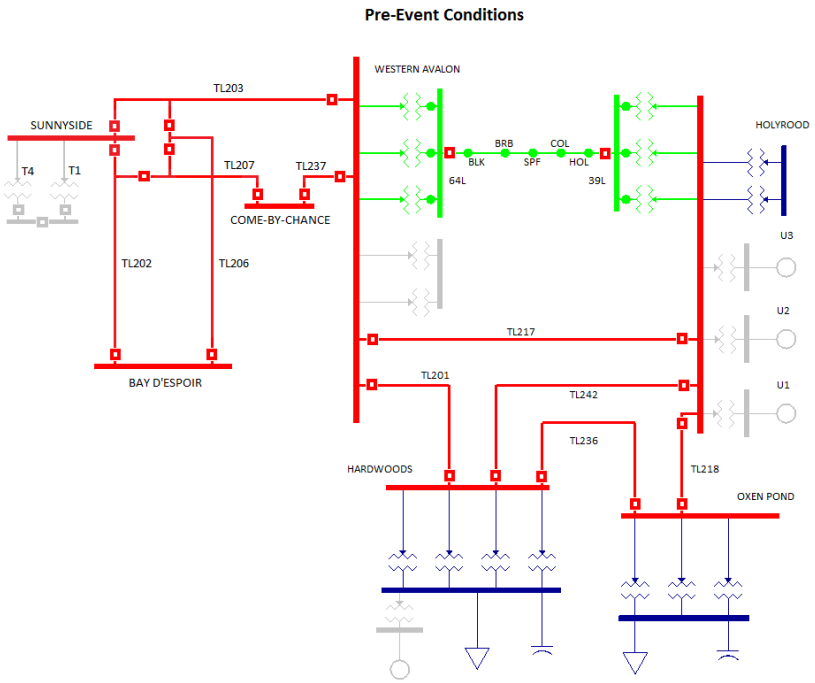
January 4 1533 Hours Disturbance – Pre-event Status

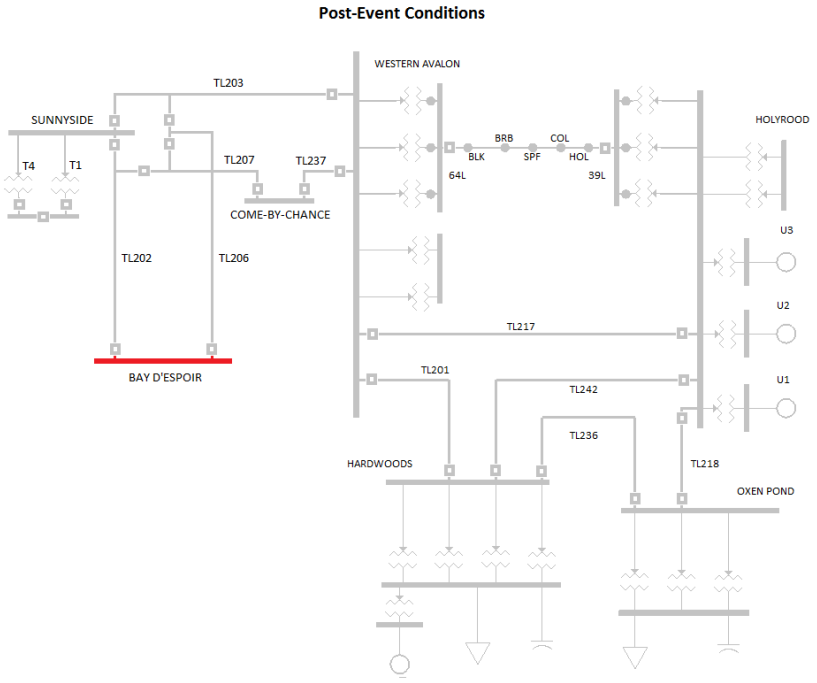
- Transmission System - All available and in-service except for the SSD T1/T4, TL212 and TL219
- Generation Supply – 1097 MW Available*
  - Unavailable Capacity
    - No Holyrood units online
    - Stephenville GT reduced to 25 MW (one end)
    - Hardwoods GT (50 MW) unavailable
    - Exploits reduced to 38 MW (frazil ice)
    - Star Lake unit tripped
    - No capacity assumed for Corner Brook Co-Gen, Rattle Brook and the two Wind Farms
- Hydro Supplied System Load – 950 MW

* Includes 60 MW from CBPP. Excludes NP thermal.

System Impact

January 4 1533 Hours – Sunnyside 230 KV Bus Lockout





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System Impact (cont'd)

January 4 1533 Hours – Sunnyside 230 KV Bus Lockout

- Total outage to the Avalon Peninsula
- Lines TL202/TL206 from Bay d'Espoir to Sunnyside
- Bay d'Espoir Units 5 and 6, both Cat Arm units, Granite Canal, the Stephenville GT and the Hawkes Bay diesels shut down. The cause of these generation trips is currently under investigation.
- Come By Chance Oil Refinery interrupted.
- Total Hydro supplied load following the event was approximately 400 MW.

Customer Restoration

January 4 1533 Hours Event – Sunnyside 230 KV Bus Lockout

- Hydro ECC coordinated with NP Control Centre
- Transmission and generation in service quickly
- Customers were restored as the generation and transmission became available

Generation Restoration

Stephenville GT – 15:56
BDE Unit 6 – 16:05
BDE Unit 5 – 16:06
Cat Arm – 16:06
Hawkes Bay diesels – 16:11
Granite Canal – 16:26
Holyrood Unit 2 – 21:34
Holyrood Unit 3 – 01:40 (January 5)

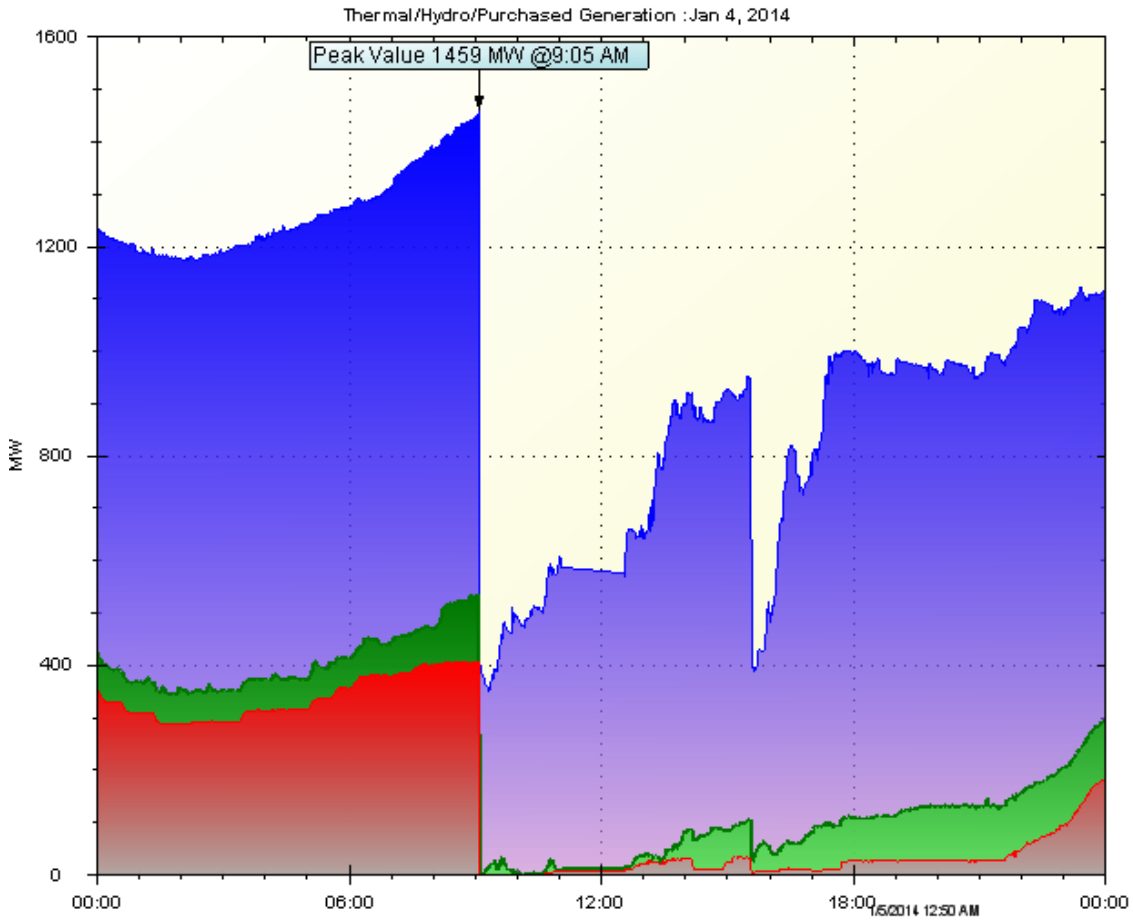
*To restore Holyrood station service

230 KV Transmission Restoration

TL206/207 – 15:39 (CBC 230 KV re-energized)
TL237 – 15:49 (WAV 230 KV re-energized)
TL203 – 15:53
TL201 – 15:54 (HWD 230 KV re-energized)
TL242 – 16:02 (HRD 230 KV re-energized)*
TL236 – 16:05 (OPD 230 KV re-energized)
TL202 – 16:11
TL217 – 16:19
TL218 – 17:20

Hydro Supplied Load

January 4, 2014



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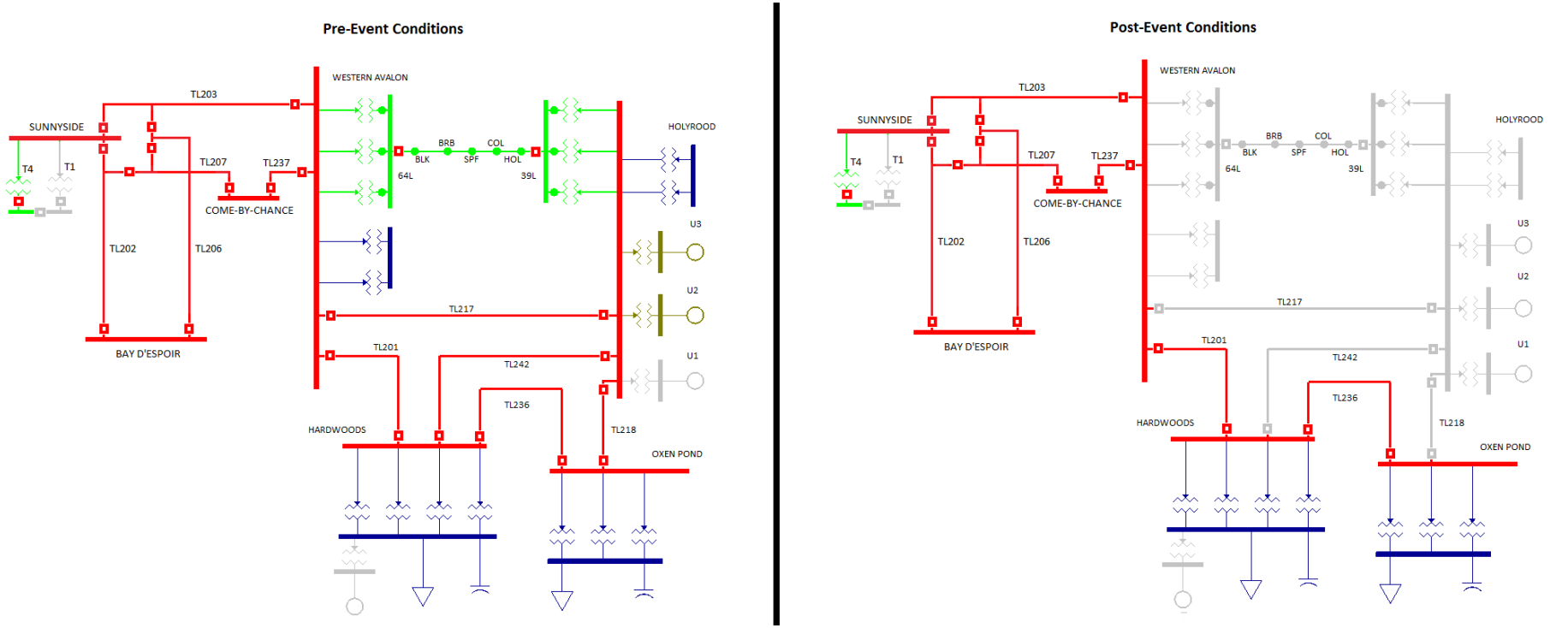
January 5 2127 Hours Disturbance – Pre-event Status

- Transmission System – All available and in-service except for the SSD T1 and TL212
- Generation Supply – 1302 MW Available*
  - Unavailable Capacity
    - Holyrood Unit 1 unavailable
    - Holyrood Unit 3 reduced to 50 MW
    - Stephenville GT reduced to 25 MW (one end)
    - Hardwoods GT (50 MW) unavailable
    - Exploits reduced to 38 MW (frazil ice)
    - No capacity assumed for Corner Brook Co-Gen, Rattle Brook and the two Wind Farms
- Hydro Supplied System Load – 1255 MW

* Includes 60 MW from CBPP. NP Thermal generation excluded.

System Impact

January 5 2127 Hours – Holyrood Switchyard Fault and B1L17 Breaker Fail Operation



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System Impact (cont'd)

January 5 2127 Hours – Holyrood Switchyard Fault and B1L17 Breaker Fail Operation

- In addition to the outage to the Holyrood Generating and Terminal Stations there were trips to the Stephenville GT and Hawkes Bay diesels. The cause of these generation outages is currently under investigation.
- Total Hydro Supplied System Load following the event and additional customer load shedding was approximately 630 MW

Customer Restoration

January 5 2127 Hours Event – Holyrood Switchyard Fault and B1L17 Breaker Fail Operation

- Hydro ECC coordinated with NP Control Centre
- Customers were restored as the generation and transmission became available

<u>Generation Restoration</u>

Stephenville GT – 22:31
Holyrood Unit 2 – 05:29 (January 6)
Holyrood Unit 3 – 07:17 (January 6)
Hawkes Bay diesels – 07:52 (January 6)

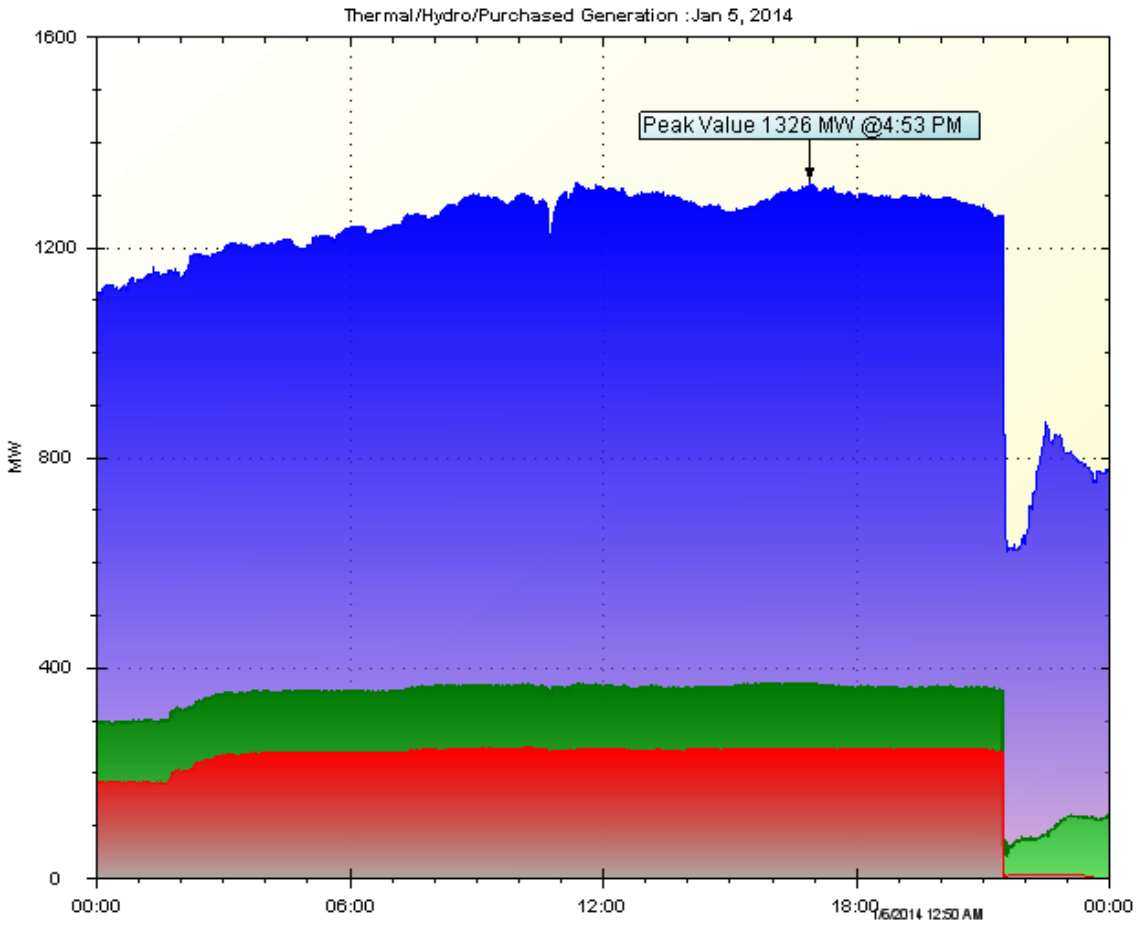
<u>230 KV Transmission Restoration</u>

TL242 – 21:35 (HRD 230 KV re-energized)*
TL217 – 04:51 (January 6)
TL218 – 05:53 (January 6)

*To restore Holyrood station service

Hydro Supplied Load

January 5, 2014



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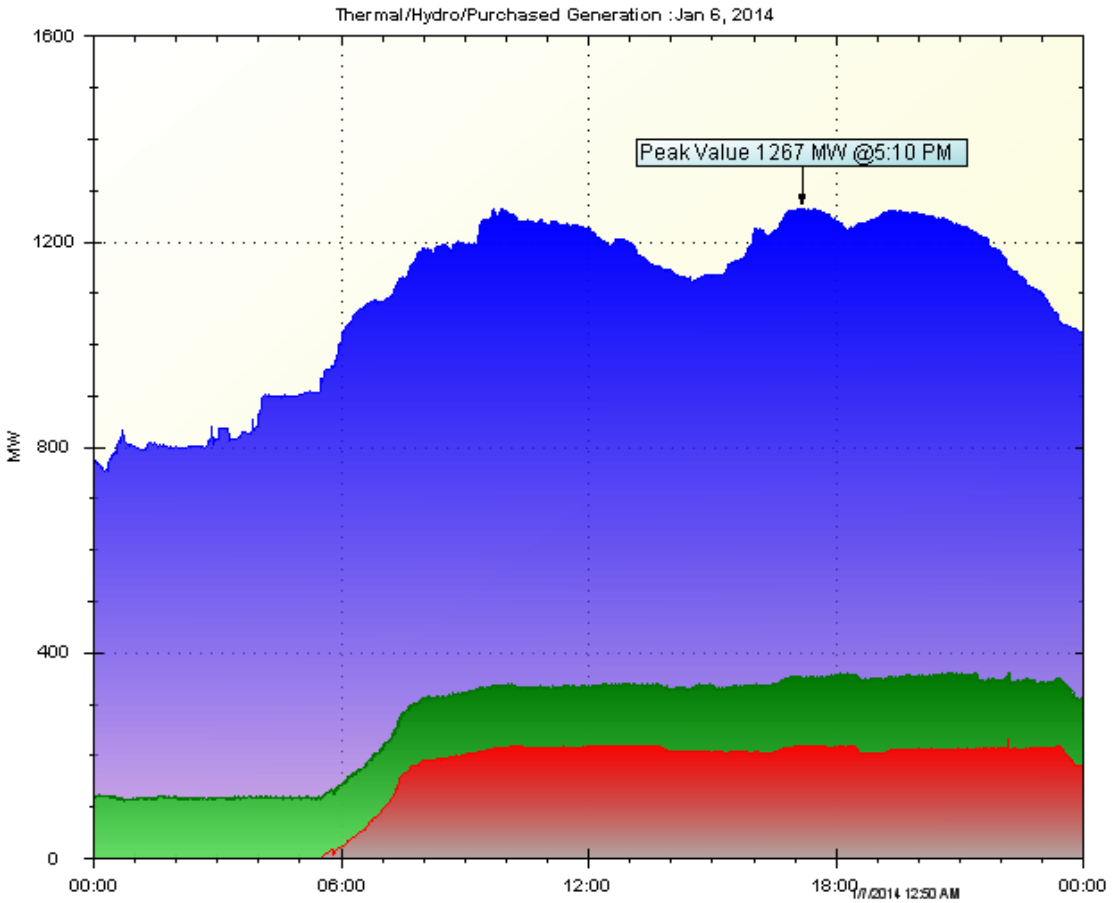
Hydro Supplied Load

January 6, 2014



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January 4 and 5 Disturbances – Post–event Analysis (to-date)

In all cases, through both events and restoration efforts, safe work practices were followed and **no safety incidents** occurred.

Sunnyside T1 Fault

- The 125 MVA transformer was lightly loaded at the time of the incident (55 MW)
- A fire resulted and continued to smolder – resulting in contamination of the 138 KV bus B2; cause under investigation
- The fire was extinguished at 0245 hours on January 7

Sunnyside 230 KV Bus Lockout

- Occurred during the restoration of T4 transformer at the Sunnyside terminal station following the T1 transformer fault earlier in the day
- The investigation into the trip is continuing

January 4 and 5 Disturbances – Post–event Analysis (to-date) cont'd

Holyrood Switchyard Fault and B1L17 Breaker Failure

- Occurred during the run-up of Holyrood Unit 1 immediately after closing the Unit disconnect switch B1T1 in the switchyard
- Transmission line restoration delayed due to problems with breaker air systems at Holyrood and Western Avalon
- Inspection of the 230 KV equipment associated with Unit 1 has not revealed any cause of the fault to date
- There is an air leak on A phase of breaker B1L17

Note: There were intermittent issues with the NP gas turbines at Greenhill and Wesleyville during these generation shortage events. Further investigation into the times and causes is required.

January 4 and 5 Disturbances – Post–event Analysis (to-date) cont'd

- Holyrood Generating Station
  - All units safely shutdown with some emergency shutdown impacts
  - Some repair work was required on unit 2 on first restart
  - Unit 1 experienced some vibration issues on initial restart. These have been resolved through careful start-up processes under the guidance of turbine contractor
  - Unit 1 has been tested and brought up to speed several times following this event – showing a smooth operation.
- Hydroelectric Stations
  - Shutdown safely with some emergency shutdown impacts
  - Workers on site provided quick response

Present System Status
January 8, 2014

- Transmission System
  - Sunnyside Transformer T1, 138 KV bus B2 and transmission line TL212 currently out of service. Burin Peninsula customers supplied via TL219.

Current Generation Status (January 8 - 1200 Hours)

GENERATION	STATUS
Holyrood Unit 1 (170 MW)	Completing final checks on switchyard equipment in order to restore to service; return to service today
Holyrood Unit 2 (170 MW)	Operating with minor de-rating to 165 MW
Holyrood Unit 3 (150 MW)	Operating at 50 MW. FD Fan motor being reassembled. Scheduled plant delivery early week of January 13
Hardwoods GT (50 MW)	Placed in service as synchronous condenser on January 7. Going through testing during remainder of week of January 6 for release to service as a generator at full capacity.
Stephenville GT (50 MW)	Cooling issue resolved. Both ends (25 MW each) going through testing to verify safe operation at 50 MW. Cooling air intake line problem being investigated to enable full output.
Exploits (nominally 63 MW)	Going through ongoing process of removing impact of severe ice around the Grand Falls plant. Capacity restored to 50 MW as of January 7.

Coordination with Customers

- Newfoundland Power
  - Advising on their hydro generation in a manner that ensures availability to meet system peak demands.
  - Advising when to start and stop their standby generation as the system load changes.
  - Requesting to interrupt their curtailable customers to help manage the system peak.
  - Consulting with them on delivery point voltage reduction strategies in order to reduce the system demand.
  - Coordinating the conservation effort and associated customer messages in order to help reduce system demand.

Coordination with Customers

- Newfoundland Power
  - Sharing our load forecasting information to help both utilities plan for future load demanded by customers.
  - Coordinating the restoration of the power system following a disturbance event.
  - Advising on power system limitations, when to begin load shedding and location and amounts of load to shed.
  - Providing regular updates on the status of power system equipment.
  - Using their resources to expedite operational requirements.

Coordination with Customers

- Corner Brook Pulp & Paper
  - Maximizing on their hydro generation to assist in meeting system peak demands.
  - Assistance through load curtailment, making Deer Lake Power generation available to the system under the short-term capacity agreement.
  - Open to discussions, willing to assist
- Rural customers
  - Rationing of power included Hydro's rural customers as well as Newfoundland Power customers

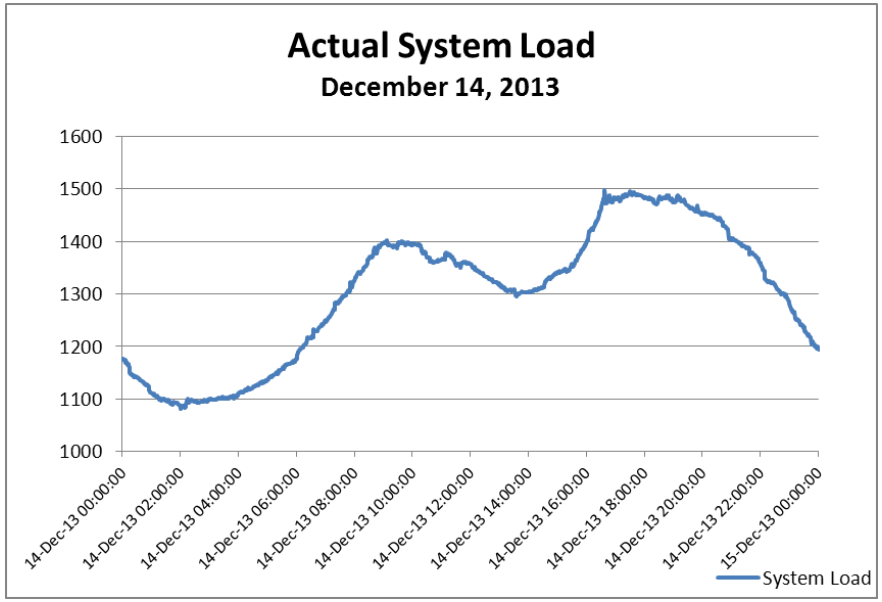
2014 Winter Season

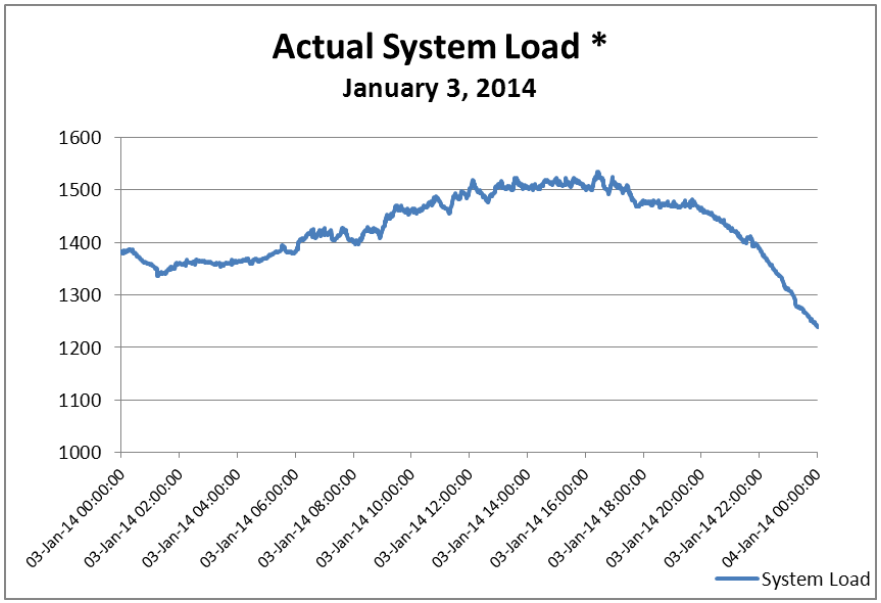
- Focus on restoring all generation (1,686MW)
  - Holyrood – Units 1 and 3
  - Hardwoods Gas Turbine
  - Stephenville Gas Turbine
- Supplemental generation
  - Project underway for blackstart to provide additional 16 MW generation (late February)

System Peak Load Forecasts and High Demands Experienced to Date

Load Forecasts going into 2013/2014 Winter Period

December 2013	-	1376 MW
January 2014	-	1454 MW
February 2014	-	1404 MW
March 2014	-	1298 MW





* The load on this day was lessened from what it otherwise would have been due to conservation, voltage reduction, use of Newfoundland Power standby generation and rotating outages

Public & Customer Communications

- Customer communication for conservation request:
  - Communications started 2:00 pm Thursday, January 2 and have been ongoing since then.
  - Updates through various mediums ongoing since Thursday. Updates provided through regular radio/ television and print interviews, media advisories, website updates and social media posts: Twitter and Facebook.
  - Coordination of conservation request with Newfoundland Power.
  - Advertising campaign with the Government of Newfoundland and Labrador and Newfoundland Power with radio, print and online conservation request and tips.
  - Call centres open with extended hours

Public & Customer Communications

- Communication activities during the system events and outages (January 3-7):
  - Regular updates and ongoing social media engagement: providing update on incidents, rotating outages, answering questions (Twitter and Facebook)
  - Public advisories (media and Hydro website)
  - Takeover of home page on Hydro website
  - Regular media interviews
  - Daily media briefings
  - Energy conservation advertising campaign (started January 6)
  - Communication with emergency services and essential service providers
  - Large municipalities contacted by Newfoundland Power

Public & Customer Communications

- Media briefings conducted to provide system and outage updates (Government of Newfoundland and Labrador, Nalcor/Hydro and Newfoundland Power):
  - 2:00 pm Friday, January 3
  - 2:00 pm Saturday, January 4
  - 6:00 pm Saturday, January 4
  - 12:30 pm Sunday, January 5
  - 1:30 pm Monday, January 6
  - 1:00 pm Tuesday, January 7

Conclusions

- Well prepared response with staff dispatched in preparation
- With restoration of all generation all projected demand for remainder of winter season will be met with appropriate reserves.
- Newfoundland and Labrador Hydro, the Government of Newfoundland and Labrador and Newfoundland Power will work to restore public confidence in the electricity system.

Conclusions

- Full and complete analysis/report of all events related to these incidents including:
  - Overall system response and restoration efforts
  - Planning criteria and assumptions
  - Equipment performance and availability
  - Critical systems and critical spares
  - Independent analysis and review as required
- Full report will be made available to public

Next Steps

- Focus on restoring all generation (Holyrood Units 1 and 3, Hardwoods GT and Stephenville GT)
- Continue to monitor weather and load forecasts to predict high demand and request public conservation if necessary
- Provide ongoing communications to customers regarding usage during peak demand

Next Steps

- Complete investigations of Holyrood switchyard and Sunnyside Terminal Station T1 incident
- Continue to apply learnings from January 11, 2013 and recent incidents