

## **Hydro Unit Relay Testing and Interconnection Study Status – May 1, 2010**

**Docket 09-091 – Order 25,060** dated December 31, 2009

**Re: PUC Staff Testimony Recommendation**

In Docket No. 09-091, which included the review of unit outages that occurred at PSNH's generating facilities during 2008, Mr. Cannata recommended that PSNH perform interconnection analyses for all combustion turbines and hydro units connected to the lower voltage PSNH system based on Mr. Cannata's observation that many outages involve apparent mis-coordination between PSNH lower voltage generating units and the distribution system. In connection with this recommendation PSNH should establish an appropriate relay test program for all combustion turbine and hydro units.

**PSNH Update:**

In response to Mr. Cannata's and the PUC's recommendation,

- 1.) PSNH initiated an under voltage protection study across the entire hydro fleet.

This study was a coordinated effort between with Distribution Protection and Control Engineering (D-P&CE) and the Generation Hydro group. The purpose of the study was to review generator voltage protection, relay settings and to evaluate coordination during a simulated fault condition.

PSNH completed the under voltage study in 2009 which checked local generator voltage (27) relaying coordination versus distribution 34.5 kV feeder coordination. The results of this study showed that except for Canaan Hydro, all other sites met coordination margins when the under voltage relays are set to factory published settings. Canaan Hydro's worst case coordination margin was slightly less than our desired target margin (more sensitive) but was still deemed as acceptable for this unit at this location.

- 2.) PSNH D-P&CE issued setting letters to the PSNH Hydro Generation, and the necessary settings changes were completed in 2009 during the stations annual inspection.

- 3.) In addition to the under voltage study PSNH Generation completed relay coordination studies at the Jackman and Ayers Island Hydro stations.

The Jackman study was initiated as part of the upgrade of certain features of that facility to modern utility standards. Included in the upgrade was the replacement of the failed delta-delta Generator Step-Up Transformer (GSU) with a Grounded Wye (34.5 kV) - Delta (2.4 kV) GSU, the addition of a dedicated circuit breaker on the 34.5 kV side of the GSU, and the addition of associated protection equipment. The scope of the Jackman study also required that relay settings be developed for the new protection elements. New settings were established to assure the system is capable of clearing a

fault in the minimum amount of time possible, while minimizing the impact to the power system.

As part of the Jackman study a general review of the existing protection coordination in the immediate vicinity of Jackman S/S including those protection elements at Jackman Hydro designed to coordinate with elements in the Distribution System. This analysis was intended to identify any setting or equipment modifications which might be required due to the new protection equipment or changes in fault current distribution resulting from the revised GSU configuration.

The Ayers Island coordination study was conducted by an outside contractor as part of the TB-19 breaker replacement/upgrade and reviewed by D-PC&E. The objective of the study was to provide detailed information of the Ayers Island station relay protection scheme and incoming switchyard protection. The relay protection includes descriptions of the 34.5 kV feeder protection at the interconnection point to transmission system, 2.4 kV protection and generator protection. Because of the enhanced capabilities of the upgraded circuit breaker relay setting changes were made to specific relays to better coordinate with the Distribution System

4.) Going forward, PSNH will continue this effort by prioritizing and completing coordination studies at the remaining Hydro facilities considering identified potential discrepancies, equipment upgrades, and other site specific conditions. The Hydro projects listed below have been identified as likely to require a coordination study. This list is consistent with Hydro's 10 year Capital budget plan, though subject to change.

- 1) Amoskeag breaker 354 & 355 replacement scheduled for 2011
- 2) Hooksett generator breaker replacement scheduled in 2011, Transformer replacement scheduled for 2013
- 3) Gorham Transformer replacement scheduled for 2011
- 4) Canaan Transformer replacement scheduled for 2013

5.) The Generation Hydro group implemented a regimented relay test plan not only for the Northeast Power Coordinating Council (NPCC) applicable devices, but also for all critical relay protection.

The NPCC applicable devices located at Smith (Distribution owned device), Ayers Island, Eastman Falls and Garvins Falls are subject to the NPCC Under Frequency Load Shedding Program (UF relays) and required to meet NPCC Directory III standards. These devices are tested in accordance with applicable NPCC requirements, and test reports are readily available. PSNH has created a Generation Protection System Maintenance and Testing operating procedure (GEN-8114) and the UF relays are included in this procedure.

Relays that are not considered NPCC applicable are not included in the Generation Protection System Maintenance and Testing operating procedure but are tested in accordance with the PSNH Hydro, Protective Relay Test Procedure. Testing is typically completed during the station's annual inspection. Test results are kept on file in both hard copy and software database at Amoskeag Hydro. A copy of the test results are also sent to the facility with the annual inspection after-service report for the unit.

6.) In addition to the Hydro fleet critical relays associated with the combustion turbines located at Schiller Station and Merrimack Station were evaluated and are now subject to NPCC requirements. Previously the combustion turbines were not considered bulk power assets, but in an effort to promote consistency among the North American Electric Reliability Council (NERC) regions, NERC/ NPCC requirements changed in May of 2009. Due to the changes these Schiller and Merrimack combustion turbines are now considered bulk power system assets and required to meet the standards stipulated in NPCC, Directory III. PSNH has identified the critical relays and implemented a comprehensive test program to comply with these standards. NPCC subject devices are included in (GEN-8114)

References available upon request –

- 1) Generation Protection System Maintenance and Testing (GEN-8114)
- 2) PSNH Hydro, Protective Relay Test Procedure

Attachment/

## Attachment/

| Hydro Progress Assessment Matrix - April 30, 2010 |  |                |          |              |        |               |               |        |          |         |       |  |
|---|--|----------------|----------|--------------|--------|---------------|---------------|--------|----------|---------|-------|--|
|   | Combustion Turbines  |                |          | Hydro Units  |        |               |               |        |          |         |       |  |
|   | White Lake CT  | Lost Nation CT | Amoskeag | Ayers Island | Canaan | Eastman Falls | Garvins Falls | Gorham | Hooksett | Jackman | Smith |  |
| 1   | NPCC Test Program In-place   |                |          | X            |        | X             | X             |        |          |         | X     |  |
| 2   | Under Voltage Study Complete   |                |          | X            |        | X             | X             | X      | X        | X       | X     |  |
| 3   | Setting Letters Issued   |                |          | X            |        | X             | X             | X      | X        | X       | X     |  |
| 4   | Field Verification Settings, necessary changes made per D-P&CE Setting Letters |                |          | X            | X      | X             |               | X      | X        | X       | X     |  |
| 5   | NPCC Testing Complete  |                |          | X            | X      | X             | X             | X      | X        | X       | X     |  |
| 6   | Critical Relay Testing Complete  |                |          | X            | X      | X             | X             | X      | X        | X       | X     |  |
| 7   | Comprehensive Test Program Inplace   |                |          | X            | X      | X             | X             | X      | X        | X       | X     |  |
| 8   | Coordination Study Complete  |                |          |              |        |               |               |        |          | X       |       |  |