Q. **System Protection**

Describe Hydro's programs and procedures for its 6-year protective relay testing program and state whether any changes will be necessary when Hydro's system is interconnected with the Muskrat Falls Project. In the response confirm that Hydro does not have any relays in its distribution substations.

A. Prior to 2014, Hydro's programs and procedures for its six-year protective relay testing incorporated the testing of all relays using a Doble Relay Software called Protest, and the function testing of protection to operate trip devices such as lockout devices. However, due to the risk in tripping customers off during this testing the output contacts were normally blocked from the tripping devices and the circuit breaker tripping was not typically tested during maintenance. Since the events of January 2014, Hydro has updated its six-year protective relay testing procedure, which can be seen in PUB-NLH-326 Attachment 1 and have also modified its preventative maintenance (PM) on circuit breakers, to ensure breakers are tripped from all associated tripping devices, which can be seen in PUB-NLH-326 Attachment 2.

Plans for the testing and maintenance of relays associated with the Muskrat Falls project will be assessed during the final design, construction, and commissioning of the facilities. Hydro will also be reviewing its protection and control testing and maintenance requirements as part of its ongoing assessment of the adoption of NERC reliability standards. It is predicted that some new programs will have to be created and existing programs modified as a result of the diverse nature of the new equipment which will be added to the Hydro system.

Hydro does not typically use circuit breakers and discrete protective relays on distribution systems. Rather, Hydro uses the more typical fused disconnects (cutouts) and circuit reclosers, which have the necessary protection functions built in.

PROTECTIVE RELAY MAINTENANCE PROCEDURE

6 YEAR PM INSPECTION

Protection outage required.

PROTECTIVE RELAY FUNCTION TESTING

1 Function test each protective relay one at a time.

2 For each relay:

a. Contact ECC to:
- notify of any protection that will be tested and its blocking requirements
- notify of any Metering that will be affected by any CT jumpers
- obtain permission to proceed with work

b. Block Protection by:
- using appropriate drawings
- identifying locations to block protection circuits

Note: If testing Digital/Static relays, continue to step 3.
If testing Electro-Mechanical/pullout type relays, go to Section "TESTING ELECTRO-MECHANICAL RELAYS – PULLOUT TYPE".

c. Jumper all CT circuits being used by Relay(s).

Note: May cause loss of metering in Station and/or ECC.

d. Remove covers off Test Switches, if installed in circuits.

Note: Always be aware contact 13-14 will OPEN, on cover removal.

e. Install Test Plugs, if being used.

Note: All wired circuits will be OPENED by doing this.
In order to maintain continuity for some circuits (such as power supplies, etc.), jumpers may have to be installed.

3. Relay(s) should now be ready to TEST.

a. Connect the relay test equipment to the relay.

b. Configure the relay test equipment settings to those required for the relay.

c. Function test each in-service function of the relay, using the relay test equipment.

d. Troubleshoot the relay, if it fails any function tests.

e. Record and save the results in the relay testing software.

PROTECTIVE RELAY MAINTENANCE PROCEDURE

4. Return to Service

Note: The reverse order must be followed. (Remember to ask ECC if any alarms are present / remaining once restored).

Notes:

- When Testing Relays with multiple Setting Groups (ex. SEL's), COPY in-service settings to alternate Group and use this Group for setting changes required for running individual Test.
- Once complete, ensure the Relay is set back to its original Group of in-service Settings.
- Check these with the Latest Revised Setting Letter in Station to ensure accuracy.

TESTING ELECTRO-MECHANICAL RELAYS – PULLOUT TYPE

1. Remove glass and clean inside and out. (Be sure to dry thoroughly).

2. Pull biscuit(s) and check for oxidation (tarnished). Clean with a white eraser.

Note: Be sure not to touch metal contacts with fingers, as natural skin oils and dirt can speed up future oxidation.

3 Unlock relay and gently pull out of case.

Caution: Some relays are heavier than they appear.

4. Check for:
   - Iron filings on operating disc, if equipped.
   - General cleanliness of relay.

Note: Iron (magnetic) filings/particles have been found in the past gathered on the magnet, impeding disk operation and/or resetting. A good check is to ramp up the disk manually and then check the air gap between disk and each pole of the magnet to see if there is any debris. If any is found, gently blowing it out will work sometimes. Alternatively, a piece of masking tape folded over itself and pulled through air gap works best.

5. Clean contact surfaces with a burnishing tool.

Note: Most contacts are very small and silver plated or tinned. The burnishing tool has a very fine surface that is just enough to clean contacts and not wear thin the plating/tinning.

6. Manually move disc to look for smooth operation and to ensure it resets properly.

   Caution: Operating disk, along with their resetting springs, etc. are fragile components and should be treated as such. The axis spins in a very small jewel bearing that is known to pit or even break.

7. Run test as per set-up/macro.

8. When installing relay:

   - Check to see if contacts have reset.
   - Install cleaned biscuit.

   Caution: When re-installing glass cover, ensure the resetting arm/lever does not hook anywhere and that it is resetting properly once installed. Good idea to leave flags dropped and reset until after glass is installed.

9. Restore Protection.

PROTECTION CIRCUIT FUNCTION TESTING

1. Function test each protection circuit individually.

2. For each protection circuit:

   a. Identify the locations where the protection circuit will be blocked. (Use appropriate drawings).

   b. Block the protection circuit.

   c. Operate the relay (or jumper out the relay contacts, if the relay has already been function tested).

   d. Verify the function of the circuit.

   e. Troubleshoot the protection circuit, if it fails any function tests.

   f. Un-block the protection circuit.

PROTECTIVE RELAY MAINTENANCE PROCEDURE

PROTECTIVE RELAY CARDS

1. Verify Protective Relay Cards are located in proper location on the panel. (Check all panels in Terminal Station).
2. Verify relay cards depict and match the installed relays on each panel.
3. Create corrective work order to have the relay card updated.

BREAKER FUNCTION TESTING MAINTENANCE PROCEDURE

BREAKER FUNCTION TESTING (4 YEAR PM FOR AIR BLAST CIRCUIT BREAKERS) (6 YEAR PM FOR OTHER TYPES OF BREAKERS)

This procedure presents guidelines for operating breakers from protection circuits. It applies to breakers associated with line protection, bus protection, common line and bus protection, and transformer protection. For breaker schemes providing redundancy (i.e. ring bus), trip commands to other breakers must be blocked during function testing. This will eliminate undesired operation of breakers (other than the one being tested) and prevent unplanned customer outages. For breakers on radial circuits where no redundancy exists, function testing shall be coordinated during planned customer outages (if possible).

PREPARATION FOR WORK

Prior to breaker function testing, contact ECC regarding the scope of work and obtain permission to proceed.

Note: Careful preparation is required for breaker function testing in terminal stations adjacent to generation (i.e. BDE, CAT, GFC, etc.) and at terminal stations connected to heavily loaded lines (i.e. TL202 & TL206).

BREAKER FUNCTION TESTING ON RADIAL CIRCUITS WHERE NO REDUNDANCY EXISTS

1. Coordinate breaker function testing during a planned customer outage, if possible.

2. Perform a three phase trip to trip coil(s), from protection circuits. (TC 1 & TC 2, if applicable).

3. Perform single phase tripping and reclosing on all three phases and/or three phase tripping and reclosing, as applicable.

4. Verify breaker functions properly through tripping/reclosing performed. If any function testing fails, troubleshoot and identify problem(s) for appropriate corrective action.

5. Record test procedure on “Breaker Function Testing Form”.

BREAKER FUNCTION TESTING MAINTENANCE PROCEDURE

BREAKER FUNCTION TESTING WHERE REDUNDANCY EXISTS

1. Each breaker shall be function tested individually.

2. Identify the locations where the protection circuit will be blocked, to avoid tripping additional breakers (other than the one being tested). Use appropriate drawings to block the other breakers and record information on “Protection Blocking Record Form”.

3. Perform a three phase trip to trip coil(s), from protection circuits. (TC 1 & TC 2, if applicable).

4. Perform single phase tripping and reclosing on all three phases and/or three phase tripping and reclosing, as applicable.

5. Verify breaker functions properly through tripping/reclosing performed. If any function testing fails, troubleshoot and identify problem(s) for appropriate corrective action.

6. Record test procedure on “Breaker Function Testing Form”.

7. Restore protection circuits which were blocked in Step 2, using “Protection Blocking Record Form”.

8. If another breaker requires testing, repeat this procedure.