

Appalachian Power Company Policy / Procedure No. 25:
Working on Lines Where the Primary Neutral is Missing

1) Statement of policy:

When working on a primary conductor where the primary neutral is missing or when working to replace missing primary neutral, special precautions must be taken to assure that unintended exposure to potential differences as a result of the system's condition do not occur.

Working to repair downed primary (de-energized, tested and grounded):

A protective ground can only be placed where the neutral is known to be continuous back to the source. It is likely that the protective grounds will be placed well away from the work area and with the primary neutral absent, an equipotential zone cannot be established, therefore, all workers aloft or on the ground who handle conductors shall wear a minimum of class 2 rubber gloves and insulating rubber overshoes.

Replacing the primary neutral:

When making connections on the pole or when handling conductors near a pole, the following precautions shall be taken:

- Assess the jobsite for any hazards noting especially:
 - Regulator, Capacitor and Step-down installations
 - Any metallic structures or equipment attached to the secondary neutral system
 - Terrain and other hazards to pulling the new conductor
- Pull out the new conductor along the entire length of the job taking care to avoid contact and putting in place measures to assure that contact is avoided between the new conductor and any conductive object connected to the secondary neutral system
- Bypass any voltage regulators within the work zone, take any capacitors within the work zone out of service, and de-energize any step-down transformers within that zone.
- Connect the new neutral to the intact system neutral before any other connections are made by first attaching a temporary bonding jumper between the new neutral and the system neutral using hot line tools then making permanent connections using the normally required IPE and cover up.
- Work from the source end to pull up and connect the new primary neutral using the most appropriate of the following techniques:
 - Connect a temporary bonding jumper between the new neutral and any conductive object (attach to guy wires not to guy anchors) attached to the secondary neutral system using hot line tools.
 - Complete sagging and permanent connections to the secondary neutral system before removing the temporary jumper
 - Sag and tie in the new neutral on clean poles (no transformer, secondary, pole ground or grounded attachments)

- To avoid any inadvertent bridging of the secondary neutral to true ground current path, all workers handling conductors must wear rubber overshoes while performing this work.

SPECIAL PRECAUTION:

Where the primary neutral is missing, anyone working on the meter or any equipment bonded to the secondary neutral must use PIPE and take extra care as a potentially hazardous voltage is likely to exist between that equipment and a well grounded area (such as a puddle of water, a propane tank or a well casing).

2) Discussion:

Electric System Issues:

1. The neutral serves as the path fault currents take to ground and for the return currents on single phase or two phase lines or those resulting from load imbalances. If the neutral is stolen, the fault and neutral currents will travel by whatever path is available including pole grounds, guy wires, telecommunications cables and other metallic paths bonded to pole ground wires or in contact with the earth.
2. When a primary neutral is missing, precautions need to be taken to assure that unintended hazards are not present affecting those performing work in these circumstances:
 1. It is difficult to apply protective grounds that provide an adequate measure of protection to those working on primary conductors when the primary neutral is missing. Protective grounds can only be effectively applied to a neutral conductor that is still intact.
 2. Replacement of the neutral conductor in this circumstance with the primary conductor(s) energized will result in a hazardous voltage between the replacement neutral conductor and pole grounds and other grounded attachments. The following are the hazards to an employee replacing the primary neutral:
 - a. There will be a voltage of unknown magnitude between the new neutral and pole grounds, communications cables, service drops, metering equipment, guy wires and other conductive objects attached to any secondary neutral in the area where the primary neutral is missing.
 - b. This voltage is likely to be relatively low, but it can be high enough to pose a significant hazard and can reach the primary line to ground voltage.
 - c. These voltages tend to be worse near line to ground connected devices such as regulators, capacitors and step down transformers.
 3. The primary hazard faced by the Line Mechanic doing the work is getting in series with a path between any secondary neutral or a conductive attachment to that neutral and true ground such as:
 - a. From lines or equipment attached to this energized system and moist ground
 - b. From any unprotected body part in contact with the new primary neutral and another body part in contact with any conductor or equipment connected to a secondary neutral in the work area.

4. Attaching a temporary bonding jumper between the new neutral and any conductor or equipment bonded to the secondary neutral system can mitigate this hazard.

3) Definitions:

Secondary neutral system – The secondary neutral of a transformer, any secondary or service neutral, the pole ground and anything that is bonded to any of these conductors.

Temporary bonding jumper – A jumper of adequate length and of sufficient capacity to carry the neutral current that was flowing in the primary neutral prior to its removal.

4) Attachments:

5) OSHA / Safety Manual References

Safety Manual:

E 2.29 While entering a station be aware of the potential hazards associated with copper theft and vandalism... Personal Insulating Protective Equipment (PIPE) and/or live-line tools shall be used when repairing an open distribution system neutral or station ground wire.

Procedure # 22: Working on De-Energized and Grounded Lines

6) Date Adopted: September 10, 2008