Protective Grounding
Without exception, the work practice philosophy adopted by IPL is:

If it’s not grounded, it’s not “dead”

and

“Live Line Work Procedures” must be followed!

31.1 Grounding General Principles
.01 When un-insulated contact with lines or equipment is necessary, the following conditions must be met:

a. All sources of supply shall be physically isolated from the line as described in applicable Hold Card Rules.

b. A Hold Card (and a corresponding Hold Tag) shall be placed for every source of electrical power. The Hold Card shall be established with documented orders to not close "held" equipment from all designated employees listed on the Hold Card for that equipment. The “Hold Card” is maintained in the appropriate Dispatch Office. The “Hold Tag” is placed in the field at the equipment being held.

c. The line shall be tested isolated using an approved nominal voltage A/V tester.

d. Protective grounds shall be installed.

e. Contact is permitted only after Hold Cards, Hold Tags, and protective grounds have been properly installed.

.02 Only 2 basic types of work procedures are acceptable and permissible: “Live Line” or “Dead Line”.

a. Live Line Work Procedures

(1) These procedures require the use of applicable protective equipment appropriately rated for the work being done such as: Class 2 rubber gloves, hot sticks, insulated aerial device platforms and buckets, etc.

(2) All lines and associated apparatus shall be considered energized and worked as energized using Live Line Work Procedures, unless properly identified, held, checked de-energized, and properly grounded.

(3) De-energized, but not grounded shall be considered energized and requires following Live Line Work Procedures.

(4) Class 2 rubber gloves shall be worn when performing any hot stick work including voltage testing, and placing or removing protective grounds.

b. Dead Line Work Procedures.

(1) Unless and until lines and/or apparatus have been properly identified, held, checked de-energized, and properly grounded, Live Line Work Procedures shall be followed. The fact that “I can see my clearances, does NOT mean that I don’t need protective grounds”.

(2) Dead Line Procedures: Establishing Clearances/Grounding.

• The clearing and holding of electrical circuits shall be governed by current, accepted practices, Service Dispatch Office Hold Card Rules, Load Dispatch Office Hold Card Rules, and any other pertinent rules the dispatcher may specify. These rules are included in Appendix A and B.

• A completed hold tag shall be placed at the “point”.

• If work is unfinished and the job site is vacated, the Hold Tag shall remain.
(3) Work On or Near Electrical Equipment
  • All lines and associated apparatuses shall be considered energized unless properly identified, held, checked de-energized, and properly grounded.
  • De-energized, but not grounded is considered energized.

31.2 Grounding Applications
.01 Employee work will normally be performed under EPZ (Equipotential Grounding) conditions. See Section 31.5 for known exceptions.
.02 Visible, protective grounds must be properly in place before any electrical lines or equipment can be considered safely de-energized and safe to work on using dead line work procedures. The applicable Dispatch Office shall be informed when protective grounds are attached.
.03 For normal fault-duty applications, protective grounds shall be 2/0 AWG copper wire size or larger and in good mechanical and electrical condition.

Annually tested grounds will be color coded with marking tape as follows and color-coding will be repeated every 3 years.
  • 2009 Red
  • 2010 Green
  • 2011 Blue
  • 2012 Red
  • 2013 Green
  • 2014 Blue

Exception: For protective grounding of single-phase pad-mount transformers, a minimum 1/0 AWG copper wire size is acceptable.

.04 Grounding applications for circuits that have “higher than normal” fault duty require that protective grounding sets be doubled or tripled for adequate protection. The circuits and applications are shown in the following chart.

<table>
<thead>
<tr>
<th>Location</th>
<th>Protective Grounding Applications / Cable Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guion 138kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>Hanna 138kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>Sanitation Belmont 138kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>Southeast 138kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>Southwest 138kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>Petersburg 345kV</td>
<td>2/0 doubled or 4/0</td>
</tr>
<tr>
<td>138kV applications at Stout Plant</td>
<td>2/0 tripled or 4/0 doubled</td>
</tr>
</tbody>
</table>

.05 If an employee must work closer than the approved safe working clearances for energized equipment, (see Section 13.3), the equipment shall be isolated, tested de-energized and protective grounds placed on all source sides of the equipment.
.06 Network and Non-network Circuits:
   a. Work on network feeders operated at 13.2kV shall be performed between protective grounds by
      placing adjacent transformers in the ground position ahead and behind the work being performed.
      This work is to be performed while working closely with a Transmission Operations Dispatcher
      (LDO).
   b. Where possible, non-network feeders operated at 13.2kV and 4kV shall be tested de-energized and
      grounded at SF6 switches and substation locations.

.07 Insulated Static Wires; 345kV and 138kV Transmission Lines:
   a. Insulated static wires on 345kV and 138kV transmission lines shall be considered energized. Must
      be grounded, permanently or temporarily using appropriate, IPL-issued protective grounding
      cables, before being worked on.

   CAUTION: These insulated static wires cannot be safely worked with
   only Class 2 rubber gloves and sleeves

.08 Power Transformers
   a. Large power transformers shall have their windings and tank grounded during oil filling to avoid
      static discharges hazards.

.09 Pad-Mounted Transformers and Switchgear
   a. Work requiring a connected primary circuit to be de-energized or work on a circuit/cable in
      proximity to a connected primary circuit shall not be performed until all circuits have been:
      (1) properly identified,
      (2) cleared (isolated from the source),
      (3) checked de-energized with an approved nominal voltage indicator,
      (4) "held" through the Service Dispatch Office or through Transmission Operations as applicable,
      (5) field hold tags placed,
      (6) properly grounded in adjacent switching points, and
      (7) "Spiked" using a spiking jack before cutting the cable in a trench, or
      (8) If near an elbow termination,
          • Is set in a feed through,
          • Is tested isolated using a test probe and an approved nominal voltage tester,
          • the test probe is removed, and
          • an elbow ground is placed prior to cutting

.10 Live-Front Transformers
   a. Work performed in a primary cable compartment area, both primary cables shall be isolated,
      checked de-energized with an approved nominal voltage indicator and properly grounded at the
      transformer adjacent to the work or cleared, held, checked de-energized and properly grounded.

.11 Underground Primary Circuit
   a. When working on a primary circuit under construction that has been terminated, a hold card and
      hold tag shall be placed through the Service Dispatch Office and the cable shall be properly
      isolated and grounded. Once any cable in a project has been energized, all cables will be
      considered energized.

.12 High Voltage Testing

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IPL Power Delivery
Contractor Health & Safety General Terms and Conditions
Appendix H - Grounding for the Protection of Employees
Final 1-1-2011
a. The high voltage lead from a high potential test set shall not be disconnect from a cable until the grounding devices have been closed long enough to drain all charge.

.13 Capacitors
a. Before employees work on capacitors or power circuit breakers with surge capacitors, the capacitors shall be disconnected from energized sources, and after a wait of at least 5 minutes from the time of disconnection, short-circuited to ground potential.

b. Before being handled, each unit of a capacitor “bank” shall be short-circuited to earth potential before it is handled. If the cases are in ungrounded substation racks, the racks shall be bonded to ground.

.14 Mobile Equipment
   (1) When using uninsulated mobile cranes or high-reach equipment inside energized substations, the chassis must be solidly grounded to the substation ground grid with the protective grounding cable provided on each vehicle
   (2) When un-insulated buckets or platforms are used in a grounded work environment they shall always be connected to the grounded network by bonding the basket to the grounded network to create an equipotential work zone.

b. Test Truck - Testing Equipment
   (1) The chassis of the vehicle must be grounded prior to energizing test equipment. This rule includes portable test sets that are being operated from the vehicle.

.15 Trailers and Other Mobile Support Equipment
a. When any “major” equipment is being used in any manner which might result in contact with an energized conductor, the equipment shall be considered energized at line potential. The equipment shall be:
   (1) Grounded in an equipotential zone
   (2) The area of equipotential must be barricaded to guard against step and touch potentials.
   (3) Access to the equipment will only be permitted from an equipotential grounding mat.
   (4) Access to the grounding mat must be through one designated area and from a rubber insulating mat.
   (5) During wire pulling, NO access to or from the equipotential zone will be permitted once the wire pull has begun.
   (6) The person in charge shall account for all step, touch potentials, and assign one or more employees to keep other persons at a safe distance.
   (7) Materials and tools shall not be passed between employees in the grounded work zone to employees outside the grounded work zone unless both employees are wearing Class 2 rubber gloves and the employee on the ground is insulated by an IPL-issued rubber mat.
   (8) The trailer or other mobile equipment shall be detached from the truck when performing work. If detaching is not possible, the preceding rules also apply to the truck.

.16 Equipment Grounds
a. While performing work of any nature on or near a distribution transformer, street light regulator or capacitor, the cases of such equipment shall be grounded or the equipment shall be worked as energized.

.17 Line Isolated but not Grounded
a. If a line is isolated, but is not properly grounded, Live Line Work Procedures shall be followed until proper clearance, hold card, hold tags, grounding plan JSA (Job Safety Analysis) and PJB (Pre-Job Briefing) determine an exception in 31.5 can be used.
   (1) Conductors and apparatuses that can become energized to 7620 volts (phase to ground) shall be worked from an insulated aerial device bucket or platform or by using hot sticks. Required PPE shall be worn and necessary line cover installed on conductors and apparatuses.
   (2) Conductors and apparatuses that can become energized to 2400 volts (phase to ground) may be worked from the pole. Required PPE shall be worn and necessary line cover installed on conductors and apparatuses.

.18 Live Line Work – Underground Residential Distribution (URD) Circuits
   a. Work requiring the isolation of a connected URD primary circuit or work on a circuit or a cable in proximity to a connected primary circuit shall not be performed until all circuits and adjacent circuits in proximity have been:
      (1) properly identified,
      (2) cleared (isolated from the source),
      (3) checked de-energized,
      (4) held with a service dispatcher,
      (5) properly grounded, and
      (6) “spiked” using a spiking jack before cutting the cable.
   b. Class 2 rubber gloves shall be worn when:
      (1) using a hot stick or other similar devices
      (2) using a spiking tool, and
      (3) when placing protective grounds.

.19 Protective grounds cannot be installed for a “Dropped Line” Restriction.

.20 An employee or crew shall not depend upon protective grounds placed by an employee of another crew without first making arrangements with the person in charge of the work for the protective grounds to be left connected until they are no longer required by either crew.

31.3 Grounding Installation
   .01 The equipment that is to have protective grounds placed on it shall first be cleared from all sources of voltage, “held” with the "Proper Authority" tested and verified de-energized. Field hold tags shall be placed as required and conductor or equipment will be properly bonded and grounded before contact is permitted.
      a. The equipment shall first be proven isolated by visual inspection and then tested with an approved nominal voltage tester before any grounding or bonding jumpers are placed.
      b. Fuzzing is unreliable and is only permitted if a nominal voltage tester is not available and cannot be obtained.

.02 Any qualified employee has the right to request protective grounding installed at any point where they deem it necessary. Any such request shall be given full consideration.

.03 Installing Protective Grounds
   a. The equipment, which is to have protective grounds placed on it, shall first be cleared with the "Proper Authority" from all sources of voltage.
   b. Hold cards and hold tags shall be completed and placed as required.
   c. The equipment shall be proven de-energized by the following mandatory method before the protective grounds are attached:
(1) By visual inspection, clearly see that all sources of voltage have been properly cleared. In some cases, it is impossible to verify visually that all sources are properly cleared. In such cases, work with the proper authority to verbally understand the clearances at the remote site or sites.

(2) Perform nominal voltage test with an approved nominal voltage tester attached to the end of the hot stick to prove that the equipment is de-energized.
   - Proper operation of the tester shall be verified by testing it on energized equipment immediately before and after use or by using the manufacturers approved testing sequence.
   - Nominal voltage testing shall be completed by moving the tester along an insulator starting at the ground end first. Note: Working from the ground makes it safer to verify the tester is working both before and after the test. A telescopic stick can be used for this purpose if needed.
   - Class 2 Rubber gloves are required for this operation.
   - If there is a question concerning the electrostatic voltage test, a phasing transformer shall be used to prove the equipment isolated.
   - Each protective ground shall be visually inspected immediately prior to installation and found to be inspected within the last 12 months, in proper working order, and free from defects.
   - The "ground" ends of the protective-grounding jumpers shall be connected first to an effective system ground and must be arranged such that they provide an area of equipotential for all work. E.g., if working in a substation, the substation ground grid would be the preferred effective ground. If working overhead lines, the system neutral would be the preferred effective ground.
   - A properly insulated hot stick of appropriate length necessary to maintain minimum safe-working approach distances shall then be used to attach the other end to the line or equipment to be grounded.

31.4 Grounding Removal
   .01 Using an insulated hot stick and rubber gloves remove the protective-grounding cable end from the line or equipment first while maintaining safe electrical clearances. Maintain safe electrical clearances from the line or equipment after removing the ground.
   .02 While maintaining clearances, remove the end of the protective grounding cable connected to the system neutral or ground grid last.
   .03 The Hold Tag shall not be removed and the "Hold Card" shall not be released from any "held" electrical equipment until all "shorts" and protective grounds have been removed and the equipment is ready for service. If "shorts" and protective grounds cannot be removed, the dispatcher must be informed of the reason.

31.5 Grounding Exceptions
   .01 There are a few circumstances where working without or not working between protective grounds may be necessary. When work is to be done under such conditions Live Line Work Procedures (including maintaining minimum live-line, safe-working clearances applicable for the situation) or the following procedures shall be strictly followed.
   .02 If work on any de-energized and "held" electrical equipment can not be performed while inside a grounded equipotential zone and bracket grounds must be used, the following conditions shall be met before work begins:
a. A written grounding plan must be completed (green grounding sheet) by the Person in Charge of the work and will include:
   (1) The reasons EP grounding could not be used
   (2) Extra clearances and precautions taken that will ensure there is no possibility of re-energization.

b. The equipment has been verified properly disconnected,

c. the equipment has been proven de-energized with an approved nominal voltage indicator, and

d. Class 2 rubber gloves shall be used as a insulation barrier between any possible differences in potential (Bracket Plus grounding).

.03 There shall be a valid reason for not using protective grounds.

.04 The "held" equipment shall be in no danger of accidental contact with any energized conductors due to falling or swinging conductors, insulator "flashover", improper switching, etc.

.05 There shall be no lightning storms in the immediate area.

.06 Precautions shall be taken to avoid accidental shock from capacitive charges left on capacitors, cables, etc.

.07 Approved Situations for Not Working Between Protective Grounds.

.08 The following list represents the only approved variations of not working between protective grounds for equipment rated over 277 volts (phase to ground).

a. Network Protector Testing:
   (1) Network protector testing and maintenance can be worked without protective grounds but this work shall be performed as though energized. Therefore, rubber gloves shall be used during the clearance procedure for the network protector. In addition, rubber blankets and other rubber insulating material will be placed for isolation from ungrounded bus and terminations.

b. Testing Equipment and Cable:
   (1) Electrical testing of equipment or cable may require working on ungrounded equipment only:
      • after the equipment has been proven properly disconnected,
      • after the equipment has been proven de-energized by approved testing methods,
      • and after the equipment has been contacted by approved protective grounding cables.
      • If leads are to be removed from the equipment for testing, protective grounds shall be placed on the leads prior to removal.

c. Radial and Tie Circuits:
   (1) Employees working on "held" unit transformers or switchgear that have radial and tie circuits may find it difficult to install protective grounds on the distribution voltage side. In this case, ground the high voltage side and work with Class 2 rubber gloves until protective grounds can be installed on the distribution voltage side of the transformer.

d. "Secondary" work on network transformers may only commence after the following conditions have been met:
   (1) The primary oil switch shall be placed in the OPEN position.
   (2) The secondary leads will be removed from the bus and proven de-energized using a voltmeter (while wearing Class 0 gloves).
      Note: Voltmeter operation shall be verified both before and after use.

e. Disconnected Electrical Equipment:
(1) Disconnected electrical equipment (meaning no leads are connected to the equipment), e.g., breakers or transformers in storage, or distribution breakers racked out into the aisle, do not require installed protective grounds in order for the equipment to be worked on. As an example, when working with transformers, installation of protective grounds would still be required on a transformer if oil were being moved through the transformer.

f. Disconnect Switches, Substations:
   (1) The clearance provided by an open disconnect switch is considered safe electrical clearance when the jaw and the blade of the disconnect switch are both physically secured in place in the open position and a Hold Card placed with the Proper Authority and a hold tag is installed.
   (2) Employees shall never violate safe, minimum, electrical, working clearance to work one side of an open disconnect switch while the other side is energized.

g. Non truck accessible substation riser lead removal or restoration
   (1) The breaker must be racked from the bus and held in accordance with appendix B of this Manual.

h. Other Exceptions:
   (1) If another exception to the above rule does occur, the responsible person in charge of the work or their designated replacement must approve it on a per job basis before work commences.