ELECTRIC LEARNING INSIGHTS | FIELD CHECKLIST

Grounding-System Objectionable Current Investigation Checklist

How to diagnose noise, stray readings, and ground-loop symptoms — without dismantling the fault return path under load.

Facility grounding systems carry three things: legitimate bonding current, circulating currents from impedance imbalances, and — when insulation fails — active fault current returning to the source. The failure pattern documented in *The Hidden Fault* RCA happens when crews cannot tell these three apart, and default to "isolate by disconnection" on a live grounding grid. This checklist walks you through the correct diagnostic sequence.

STOP — Read before you start: Never lift a grounding conductor, bonding jumper, or neutral until you have clamp-meter verified it carries no current. Any non-zero reading means the conductor is part of an active circuit and must be treated as energized until the source is identified and cleared. Severing a live ground path places you in series with the fault.

PHASE 1 Pre-Work & Hazard Classification

- [ ] **Classify the work as energized electrical work.**
  Any investigation of objectionable current on an energized distribution system is energized work per NFPA 70E 130 / CSA Z462. Issue an energized work permit before starting.
- [ ] **Complete a grounding-specific JHA.**
  Generic electrical JHAs do not capture the "live ground" hazard. The JHA must explicitly address (a) fault current on the EGC, (b) the voltage that will appear across any opened conductor, (c) contact with multiple surfaces simultaneously.
- [ ] **Verify PPE matches the task — not the assumption.**
  Minimum: Class 00 or Class 0 rubber insulating gloves with leather protectors, rated ≥ 500 V for 480Y/277V systems. Arc-rated clothing per the incident energy analysis for the MCC. Leather gloves alone are not sufficient.
- [ ] **Confirm fitness for duty.**
  Do not begin energized grounding work after 10+ hours on shift, at end-of-shift on Friday, or when the technician reports fatigue. Reschedule.
- [ ] **Verify test instruments.**
  Required: AC/DC clamp meter with low-current sensitivity (≤ 10 mA resolution), true-RMS DMM, non-contact voltage tester, proving unit, insulation resistance tester (≥ 1000 V range).
- [ ] **Identify a qualified second person on site.**
  No solo energized work. Second person must be trained in emergency response and know how to de-energize the upstream supply.

PHASE 2 Diagnostic — Identify What the Current Actually Is

- [ ] **Clamp every EGC and bonding jumper at the target MCC.**
  Record current on each. Work methodically — do not touch or disconnect anything yet. Objectionable current above a few mA indicates a parallel return path or active fault.
- [ ] **Clamp the MCC main grounding electrode conductor.**
  Current on the GEC indicates either a neutral-to-ground bond downstream of the service (NEC 250.24(A)(5) / CEC 10-204 violation) or active fault current leaving the building.

- [ ] **Measure neutral-to-ground voltage at the MCC.**
  On a healthy system, N-G voltage at an MCC should be < 2 V (ideally < 1 V). Higher readings indicate either high neutral loading, an improper N-G bond, or a phase-to-ground fault sourcing current into the grounding system.

- [ ] **Interpret readings against the threshold table (below).**
  Use the table to distinguish circulating current (nuisance) from active fault return (lethal).

EGC Clamp Reading	Most Likely Cause	Action
< 50 mA	Capacitive coupling, VFD leakage, normal circulating current	Document baseline. Investigate only if trending upward. Safe to proceed with planned grounding work after standard verification.
50 mA – 1 A	Improper N-G bond downstream; circulating loop via parallel metallic paths	Do not disconnect. Trace with clamp meter to identify the parallel path. Engineering correction required — do not lift the EGC to "test" the loop.
1 A – 10 A	Partial insulation breakdown; high-impedance phase-to-ground fault	**STOP.** Isolate and test downstream equipment (IR test per IEEE 43). The EGC is carrying active fault current. Do not touch.
> 10 A	Hard phase-to-ground fault; GFPE failed or absent	**STOP IMMEDIATELY.** De-energize the upstream feeder. Treat every grounding conductor in the system as energized at phase voltage. Do not approach the MCC.

Thresholds are general guidance. Adjust to your facility's documented baseline. A rising trend at any level is more diagnostic than a single reading.

PHASE 3 Source Isolation — Find the Fault Without Breaking the Path

> **⚠ DO NOT lift the EGC to trace current.**
> If current is present, lifting the conductor transfers the full phase-to-ground voltage across the opened gap — and through anything that bridges it, including the technician's body. Use clamp-based tracing on the intact circuit.

- [ ] **Perform clamp-based current signature tracing.**
  Starting at the source side of the suspect current, walk the conductor downstream. At every branch, clamp each path. Current will follow the faulted path. This narrows to the specific feeder or branch without any disconnection.

- [ ] **At the suspect equipment, measure phase-to-frame voltage.**
  Use a DMM from an energized phase to the equipment frame (through proper PPE and approach boundaries). A phase-to-frame reading approaching phase-to-ground voltage confirms the equipment as the fault source.

- [ ] **De-energize the faulted branch at the upstream breaker.**
  Apply LOTO per facility procedure. Verify zero voltage at the load with test-before-touch on a known-good proving unit.

- [ ] **Re-clamp all EGCs at the MCC.**
  With the faulted branch de-energized, objectionable current on the grounding system should drop to baseline. If it does not, a second fault exists. Continue tracing.

- [ ] **Only now, if required, proceed with physical inspection of the grounding grid.**
  With fault current confirmed gone, routine grounding work can proceed. Continue to clamp-verify before lifting any conductor.

PHASE 4 Root Cause & Corrective Action

- [ ] **IR test the faulted equipment.**
  Insulation resistance and polarization index per IEEE 43. Document readings. Do not return to service below 100 MΩ at rated test voltage (adjust to facility standard).

- [ ] **Verify GFPE is installed and coordinated.**
  Per NEC 230.95 / CEC 14-102, solidly grounded wye services ≥ 1000 A at more than 150 V to ground must have GFPE on the main disconnect. If your facility lacks this, open an engineering work order. This is the backstop that would have cleared the fault that drove this investigation.
- [ ] **Consider permanent ground-current monitoring.**
  Install residual ground-current CTs on main feeders with SCADA alarms. Turns a multi-week latent fault into a maintenance ticket on day one.
- [ ] **Add IR testing to PdM program for the affected equipment class.**
  Trend insulation over time. Set action thresholds tied to work orders before failure.
- [ ] **Update facility grounding SOP.**
  Mandatory clamp verification before any EGC, bonding jumper, or neutral is disconnected. Supervisor sign-off on grounding work orders. Share learnings across sites.

Investigation Record

FACILITY / AREA _____ **MCC / PANEL ID** _____ **DATE** _____

INVESTIGATOR _____ **QUALIFIED SECOND PERSON** _____

INITIAL SYMPTOM(S)

_____

_____

MAX EGC CURRENT MEASURED _____ **SOURCE IDENTIFIED (EQUIPMENT)** _____ **FAULT CLEARED (TIME)** _____

ROOT CAUSE

_____

_____

CORRECTIVE ACTIONS & WORK ORDERS RAISED

_____

_____

_____

Sign-Off

INVESTIGATOR SIGNATURE _____ **SUPERVISOR SIGNATURE** _____

Referenced Codes & Standards: NEC 230.95 & 250.4(A)(5) (ground-fault protection of equipment; effective fault current path) • CEC Rule 14-102 & Rule 10-500 (Canadian equivalents) • IEEE 142 (Green Book — grounding of industrial and commercial power systems) • IEEE 43 (insulation resistance testing) • NFPA 70E Article 130 & CSA Z462 Clause 4.3 (energized work requirements) • OSHA 1910.333 (selection and use of work practices).

Disclaimer: This checklist is a field aid, not a substitute for qualified engineering judgment, facility-specific procedures, or applicable codes and standards. Always follow your site's safety procedures and local regulatory requirements.