

**BUREAU OF RECLAMATION**  
**FACILITIES INSTRUCTIONS, STANDARDS, & TECHNIQUES**

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**GENERAL GUIDE FOR CHECKOUT OF  
NEW ELECTRICAL FACILITIES**

# General Guide for Checkout of New Electrical Facilities

The following list is to be used as a general guide for O&M checkout of new facilities, and should be followed to the extent practical prior to placing the facilities in commercial operation.

1. Schematic diagrams are to be checked for errors. Special consideration must be given to schematic diagrams for differential relaying current circuits and for ground relay polarizing circuits since errors are most frequently found in these circuits.
2. All detail wiring diagrams should be checked against the schematic wiring diagrams.
3. Check control wiring against the detail wiring diagrams. A complete detailed O&M check of all control board wiring is not required if such a check was made by the construction inspectors. However, in all cases a complete detailed O&M check of all alternating current protective relaying and metering current and potential circuit wiring is required regardless of checks by others.
4. Check the polarity of all current transformers, and check the ratio where practicable. The polarity of ground relay polarizing current transformers in the tertiary windings of autotransformers should be checked using the method presented in the copy of an article at the end of this section from the February 8, 1965, issue of Electrical World magazine.
5. Test and adjust all revenue and non-revenue metering equipment and all kilowatt-hour telemetering facilities.
6. Test and set all protective relays, and test all switchboard instruments.
7. Check and calibrate all analog and digital telemetering.
8. Test and adjust all supervisory control and associated selective telemetering equipment.
9. Test and adjust all communications circuits regardless of type and use.
10. Double test all power transformers, circuit breakers, instrument transformers, lightning arresters, coupling capacitors, bushings, etc. These initial test results will be used as reference points for evaluation of future tests.
11. Make physical oil and dissolved gas-in-oil tests (where applicable) for oil filled equipment. These test results will also be used as references for judging results of future tests.
12. Check all gages and alarms for proper operation.
13. If a factory erecting engineer was employed during installation of a circuit breaker and records are available, no O&M check of the breaker is required. If no erection engineer was employed, a complete O&M check of breaker adjustments, timing tests and contact resistance tests should be made. Timing tests must be made after installation of a circuit breaker in any event.
14. Check all high voltage switches for proper operation and adjustment
15. Make complete functional tests of all controls and equipment. Tests should be made to determine that each element of each relay and other protective devices trip the proper circuit breakers; all manual controls, including supervisory, function properly; all reclosing, transfer trip, and blocking schemes operate properly, etc.
16. After energizing, test and adjust capacitor potential devices.
17. Check phasing and phase rotation and check synchronizing circuits.
18. Take current, voltage and phase angle readings in directional overcurrent, distance, and differential relay circuits. In overcurrent-type bus differential relaying schemes where the current through the relay is zero under normal conditions,

one set of current transformers should be shorted, the external leads disconnected, and measurements made for proper unbalanced current in the relay coils. This test should be made with loads on all circuits connected to the bus to verify that all current transformers are connected properly and none left shorted.

19. Inspect all nameplates for control board panels, meters, instruments, relays, control switches, high-voltage switches, fuses, etc., to be certain that they are correct and in accordance with the latest standards. If any nameplates are missing or are incorrect, adequate temporary labels must be provided before the equipment is released for operation. Any temporary or special operating in-

structions shall be furnished by the use of the "special condition" procedure outlined in FIST Volume 1-1, Power System Clearance Procedure, or by permanent instruction plates, whichever procedure is appropriate.

20. Conduct staged fault tests. Such tests will be made on the transmission lines terminating in a station. Staged faults are not required inside station differential zones, but oscillograph elements should be connected in the appropriate differential current circuits to check for balance and current transformer saturation for through faults. Normally, one phase-to-ground fault and a phase-to-phase fault on the other two phases should be made on each line.

## Lv Dc Checks Current-Polarized Directional Grd Relays

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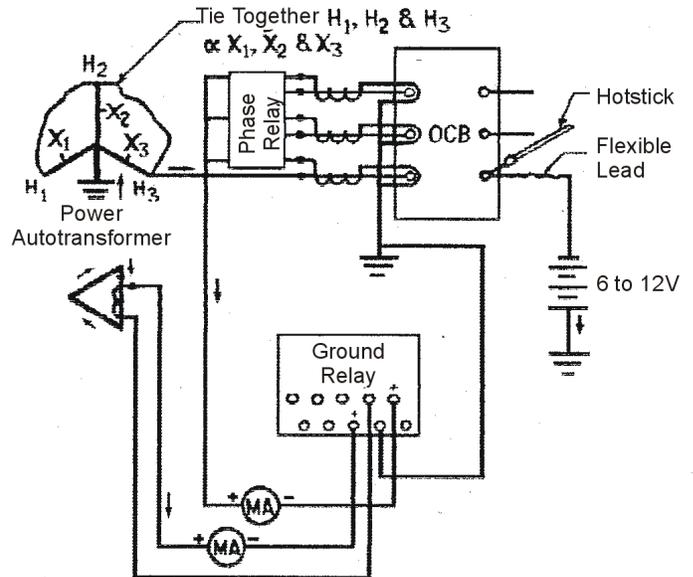
Connections required in the test are shown in the illustration. From the manufacturer's instruction book and prior testing, the relative polarity of the relay coil terminals will be known. With the milliammeters connected as shown with respect to the known polarity of the relays, closing of the circuit will cause both milliammeters to deflect in the same direction; when the circuit is opened they will deflect in the opposite direction. In the case of relays protecting large transformers, several seconds must be allowed for the iron to magnetize before the circuit is opened to get a deflection.

In most cases three terminals of the wye-connected winding must be tied together to get sufficient meter deflection. Use of a hot stick, rather than a knife switch or similar low-voltage device, is recommended to make anti break the circuit because considerable voltage and a rather long arc are generated when the circuit is broken. With careful attention to making the correct connections, it is possible also to check the line and polarizing circuits separately if the circuit from the transformer to the OCB, as shown, cannot be completed conveniently.

Correctness of connections for current polarized directional ground relays may be checked easily with a low-voltage, dc-test method devised at Kansas Gas & Electric Co. It replaces the procedure of carefully tracing wires and connecting the relay, then hoping for the best.

The new method also is simpler than the elaborate and clumsy approach, sometimes used for circulating primary current of proper magnitude to operate the relays. The method does not, however, eliminate the need for care in connecting the relays; rather, it offers a satisfactory method of proving out the connections to these relays.

The method requires several No 6 dry cells or an automobile battery of 6 or 12 v, a means of opening and closing the circuit and one or two dc milliammeters. One or more of the millimeter scales on the common multi-meter (volt-ohm-milliammeter) test instrument are ideal for the latter.



**SIMPLE METHOD** requires one or two dc milliammeters, plus a dc supply source to prove connections to relays