Protection Relay Testing Training Course: Scripted Routines, Test Evidence and Commissioning Control

4 – 8 January 2027
Rome

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Programme Summary

Protection relay testing, from scripted test routines to test evidence and commissioning control, is the subject of this one-week training course for protection, substation and electrical asset engineering leaders, ending in a testing and commissioning control plan for one substation. Protection that has been set but not tested well can fail to clear a fault, and gaps in test records usually appear only after an outage. The programme moves from test strategy to injection methods, automation, digital substation checks and records, using prepared relay and test data. Mars Training Centre UK delivers this programme on protection relay testing to mixed-organisation cohorts.

The Business Case

Utilities, industrial plants and transport operators depend on protection that acts correctly on the day a fault occurs. Leaders who can judge what a test proves, which tests can be scripted and how evidence is kept are better placed to approve energisation and to set sensible test intervals without relying on a single technician's judgement.

- Protection Misoperation Risk: Falls when tests are tied to the function each relay performs and results are checked against acceptance limits.
- Commissioning Delay: Decreases when test plans, scripts and handover records are prepared before site work begins.
- Audit Exposure: Reduces when settings, results and approvals are kept in one traceable record.

Principles and Evidence Base

- IEC 61850: The international standard for communication in substation automation, applied in Session 4 to plan checks of digital messaging and its testing.
- Secondary Injection Testing: A method of applying test signals at relay terminals, applied in Session 2 to prove protection functions.
- End-to-End Testing: A check of the whole protection scheme across both line ends and communication links, applied in Session 3 to confirm scheme behaviour.
- Acceptance Criteria Method: A way of fixing pass and fail limits before testing, applied in Session 1 to define evidence.

Intended Participants

- Protection engineering managers who set test strategy and approve test plans.
- Substation project leaders who control commissioning and energisation.
- Asset managers who decide test intervals and maintenance spend on protection.
- Quality and compliance leaders who review test records and settings control.
- Operations managers who accept protection systems into service.

Typical settings include power utilities, industrial plants, oil and gas facilities and rail or transit power systems.

Learning Outcomes

1. Participants will be able to construct a test strategy with acceptance criteria for a protection scheme.
2. Participants will be able to compare secondary injection routines for overcurrent, distance and differential protection.
3. Participants will be able to evaluate which test steps suit automation and which need manual judgement.
4. Participants will be able to diagnose faults in digital messaging and scheme coordination from test results.
5. Participants will be able to justify a settings verification and test record routine to an assurance reviewer.

Programme Structure

Day 1: Protection Relay Testing Strategy

What must a test prove, and what counts as a pass?

- Protection Function Register
- Test Purpose Matrix
- Acceptance Limit Table
- Risk-Ranked Test Scope
- Test Plan Template

Day 2: Injection Methods and Relay Functions

How are protection functions proved at the relay terminals?

- Secondary Injection Set-Up Sheet
- Overcurrent Test Routine
- Distance Zone Test Routine
- Differential Slope Test Routine
- Test Result Reading Guide

Day 3: Scheme and End-to-End Testing

Does the whole scheme work across both ends of the line?

- End-to-End Test Plan
- Time Synchronisation Check
- Teleprotection Signalling Check
- Breaker Trip Chain Test
- Scheme Fault Log Review

Day 4: Automation and Digital Substation Checks

Which test steps can be scripted, and how is digital messaging checked?

- Scripted Test Routine Library
- Automated Report Template
- GOOSE Messaging Check
- Sampled Value Check
- Automation Suitability Screen

Day 5: Testing and Commissioning Control Plan for One Substation

Do the findings join into a plan that an assurance reviewer can approve?

- Applying the Session 1 Acceptance Limit Table
- Selecting Session 2 Routines for Each Function
- Adding the Session 3 End-to-End Plan
- Fitting the Session 4 Automation Suitability Screen
- Completing the Testing and Commissioning Control Plan

Methodology

The programme is a structured exercise built on prepared relay settings, test results and one-line diagrams for two substations, one in a utility network and one in an industrial plant. Participants plan tests, read results, choose what to automate and defend their plan to peers acting as an assurance panel.

- Suggested activity: Setting pass and fail limits for a distance relay test.
- Suggested activity: Reading a differential test record to find a settings error.
- Suggested activity: Deciding which steps of a commissioning test to script and which to keep manual.

Capstone Output

Each participant completes a testing and commissioning control plan for one substation. It holds a protection function register, acceptance limits, a routine selection, an end-to-end plan, an automation screen and a records schema. At work it goes to the assurance reviewer and becomes the template for later commissioning and periodic tests.

Frequently Asked Questions

Is protection relay testing suitable for leaders who are not relay technicians?

Yes. Protection relay testing is taught through prepared relay data and templates. You need responsibility for protection, substations or electrical assets, but no earlier hands-on test experience.

Which standards and methods does protection relay testing rest on in this training?

Protection relay testing here rests on IEC 61850, secondary injection testing, end-to-end testing and an acceptance criteria method, applied to prepared relay and scheme data.

How is the plan from protection relay testing training used at work?

You present the control plan to your assurance reviewer, use its routines and limits for commissioning, and keep its records schema as the template for periodic tests.

How does protection relay testing differ from a programme on power system fault analysis?

Protection relay testing concentrates on proving that relays and schemes operate as set, while a programme on power system fault analysis concentrates on calculating faults and coordinating settings.