# Numerical Protection Relay Training Course: Settings, Logic and IEC 61850

5 – 9 September 2027
Cairo

# Numerical Protection Relay Training Course: Settings, Logic and IEC 61850

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## Programme Summary

Numerical protection relay configuration is the subject of this one-week training course for protection engineers, substation engineering managers and utility asset leaders, taught at managerial level and ending in a relay settings control pack for one substation. Modern relays hold hundreds of settings, logic equations and communication files, yet records often fail to show who changed what and why. The programme moves from relay functions to settings records, logic, communication files and acceptance, using prepared records from a utility and an industrial plant. Mars Training Centre UK delivers this programme on numerical protection relay settings to mixed-organisation cohorts.

## The Business Case

Leaders who keep calculated settings, logic and engineering files under version control can show that every relay in service matches its design basis. Where settings live on laptops and in memory, unrecorded edits, mismatched files and untraceable changes remain unseen until a relay misoperates or an audit asks for evidence. Commissioning without a clear acceptance record also leaves faults to surface later in service. The programme works on the measures below.

- Unplanned Protection Operations: Fall when settings and logic are reviewed against a recorded design basis.
- Settings Traceability: Improves when every change carries a request, a reason and a version.
- Commissioning Rework: Reduces when acceptance criteria are agreed before energisation.

## Principles and Evidence Base

- IEC 61850: The international standard for communication networks and systems in power utility automation, applied in Session 4 to read data models and engineering files.
- IEC 60255: The international series on measuring relays and protection equipment, applied in Sessions 1 and 3 to set performance and functional requirements.
- ISO 55001: The asset management system standard, applied in Session 5 to link relay records to asset control.

## Intended Participants

- Protection engineers who calculate, apply and verify relay settings.
- Substation engineering managers who approve protection schemes and changes.
- Utility asset leaders who answer for protection performance across a fleet.
- Commissioning leads who sign off protection before energisation.

Typical settings include electricity utilities, oil and gas facilities, heavy industry and rail power networks.

## Learning Outcomes

1. Participants will be able to construct a function selection matrix for a bay protection scheme.
2. Participants will be able to evaluate a setting calculation record against its design basis.
3. Participants will be able to diagnose logic errors and operating events from disturbance and event records.
4. Participants will be able to prioritise engineering file and signal list mismatches by risk.
5. Participants will be able to justify a version control process for relay settings across a fleet.

## Programme Structure

## Day 1: Numerical Protection Relay Architecture and Function Selection

What does a numerical relay do internally, and which functions should each bay carry?

- Relay Hardware and Signal Chain Diagram
- Function Library Selection Matrix
- Digital Input and Output Allocation Sheet
- IEC 60255 Performance Requirements Review
- Bay Protection Scheme Specification

## Day 2: Settings Groups and Setting Calculation Records

How are settings calculated, recorded and traced to a design basis?

- Setting Group Structure Plan
- Setting Calculation Record Template
- Pickup and Time Delay Rationale Sheet
- Settings Change Request Form
- Cross-Check Against Coordination Study

## Day 3: Protection Logic and Disturbance Records

How is logic built so it operates as intended and is proved by records?

- Logic Diagram Review
- Programmable Logic Equation Table
- Trip and Blocking Scheme Check
- Disturbance Record Reading Method
- Event Log Interpretation Sheet

## Day 4: IEC 61850 Communication and Engineering Files

How do engineering files and messages tie relays to the station system?

- IEC 61850 Data Model Walkthrough
- Engineering File Exchange Procedure
- Fast Peer Message Mapping Table
- Station Bus Signal List
- Configuration Mismatch Log

## Day 5: Settings Control and Commissioning Acceptance

Do the earlier records join into a controlled settings file ready for acceptance?

- Applying the Session 2 Calculation Record
- Testing the Session 3 Logic Review
- Checking the Session 4 Signal List
- ISO 55001 Asset Records Link
- Completing the Relay Settings Control Pack

## Methodology

The programme is a field-style audit built on prepared records from a utility and an industrial plant: single-line diagrams, setting sheets, logic diagrams, disturbance records and engineering files. Participants audit a bay file set, trace a setting to its basis, read a record to find a fault in logic and defend their findings to peers acting as a protection review board.

- Suggested activity: Tracing three settings from a relay file back to the study that justifies them.
- Suggested activity: Reading a disturbance record to decide whether a trip was correct.
- Suggested activity: Comparing two engineering files to find a signal mismatch.

## Capstone Output

Each participant completes a relay settings control pack for one substation. It holds a function matrix, a calculation record index, a logic review, a signal list check and an acceptance checklist. At work it goes to the protection review board for approval and becomes the standard for every later settings change.

## Frequently Asked Questions

### Is numerical protection relay training suitable for engineers new to relay configuration?

Yes. Numerical protection relay configuration is taught from prepared records and templates. You need basic knowledge of power system protection, but no experience with a particular relay make.

## Which standards does numerical protection relay training rest on?

Numerical protection relay practice here rests on IEC 61850 for communication and engineering files, IEC 60255 for relay requirements and ISO 55001 for asset records.

## How is the control pack from numerical protection relay training used at work?

You take the settings control pack to your protection review board, apply its change form to each edit and use its acceptance checklist at every commissioning.

## How does numerical protection relay configuration differ from relay testing?

Numerical protection relay configuration covers choosing functions, calculating and recording settings and managing files, while relay testing proves that a configured relay behaves as set.