
Substation Network Design for Protection and Control Training Course for Utility Engineering Leaders

15 – 19 August 2027
Manama





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Programme Summary

Substation network design for protection and control is the subject of this one-week training course for utility and industrial engineering leaders and protection and automation engineers, ending in a network review pack for one substation. Protection relays now depend on a communications network for messages and timing, yet that network is often designed by a different team from the one that owns protection. The programme moves from requirements to messaging, timing, redundancy, cyber resilience, testing and change control, using cases from utility and industrial substations. Mars Training Centre UK delivers this programme on substation network design for protection and control to mixed-organisation cohorts.

The Business Case

When protection and control signals share a network, a poor design can delay a trip, lose a message or leave devices out of step with one another. Separate records make faults slower to place and changes riskier. A shared review method gives leaders a basis to specify networks, judge resilience and approve changes to running substations.

- Protection Reliability: Improves as message paths and timing are specified and tested.
- Outage Duration: Falls as failure modes and recovery paths are planned in advance.
- Change Risk: Falls as configuration baselines and rollback plans are kept under control.

Principles and Evidence Base

- IEC 61850: The international communication standard for substation automation, used to frame station bus and process bus messaging in Sessions 1 and 2.
- Time Synchronisation Principles: Set how devices share a common clock, applied in Session 2.
- Network Redundancy Principles: Frame how a link or switch failure is tolerated, applied in Session 3.
- Cyber Resilience Principles: Guide segmentation and access control, applied in Sessions 3 and 4.

Intended Participants

- Engineering leaders who specify and approve substation protection and control networks.
- Protection engineers who depend on network messaging and timing for relay performance.
- Automation engineers who configure devices, switches and gateways in the substation.
- Operational technology and security leads who define segmentation and access for control networks.

Typical functions include power utilities, oil and gas facilities and large industrial plants.



Learning Outcomes

1. Participants will be able to construct a protection signal inventory and the latency budget it implies.
2. Participants will be able to evaluate message flows and configuration files for station bus and process bus communication.
3. Participants will be able to diagnose timing weaknesses in a time source hierarchy.
4. Participants will be able to compare redundancy methods against the failure modes of a substation network.
5. Participants will be able to prioritise cyber controls for segmentation, access and monitoring.
6. Participants will be able to justify a network change, with its tests and rollback plan, to an engineering review board.

Programme Structure

Day 1: Substation Network Design Foundations

What must the communications layer carry, and with what timing?

- Protection Signal Inventory
- Substation Network Topology Diagram
- Station Bus and Process Bus Map
- Latency Budget Sheet
- Network Requirement Specification

Day 2: Protection Messaging and Time Synchronisation

How do protection messages and timing reach devices reliably?

- IEC 61850 Message Flow Diagram
- Time Source Hierarchy Sheet
- Message Priority and Segmentation Table
- Configuration File Review
- Timing Accuracy Check Record

Day 3: Redundancy and Cyber Resilience

How does the network keep protection working when a link, switch or clock fails or is attacked?

- Redundancy Method Comparison
- Failure Mode Table
- Network Segmentation Plan
- Access Control Matrix
- Resilience Test Scenario



Day 4: Testing, Commissioning and Change Control

How is the network tested before service and changed safely afterwards?

- Network Acceptance Test Plan
- Message Capture Review
- Configuration Baseline Register
- Change Request and Rollback Form
- Maintenance Isolation Procedure

Day 5: Network Review Pack for One Substation

Do the requirements, timing, resilience and change records support one network decision?

- Applying the Session 1 Latency Budget Sheet
- Testing the Session 2 Timing Accuracy Check Record
- Reviewing the Session 3 Failure Mode Table
- Checking the Session 4 Configuration Baseline Register
- Completing the Network Review Pack

Methodology

The programme uses a structured exercise method built on a shared case of a substation with feeder relays, a transformer protection scheme and a redundant station network. Participants build each artefact on prepared network data, then adapt it to their own substation.

- Suggested activity: Building a latency budget for a trip signal from relay to breaker.
- Suggested activity: Tracing the effect of a lost time source across a set of devices.
- Suggested activity: Presenting a change request with a rollback plan to a mock review board.

Capstone Output

Each participant completes a network review pack for one substation. It holds a protection signal inventory, a latency budget, a timing hierarchy, a failure mode table and a configuration baseline with a change plan. The pack is used at work to brief protection, automation and security teams and to scope the next upgrade or audit.



Frequently Asked Questions

Is substation network design training suitable for leaders who are not communications specialists?

Yes. Substation network design for protection and control is taught through cases and templates, assuming engineering experience in protection, automation or utility operations but no network engineering background.

Which standard does substation network design for protection and control training rest on?

Substation network design training rests on IEC 61850, the international communication standard for substation automation, together with time synchronisation, network redundancy and cyber resilience principles.

How is the pack from substation network design training used at work?

You use the network review pack to brief protection, automation and security teams, scope the next upgrade or audit and support change requests.

How does substation network design differ from protection relay setting training?

Substation network design centres on messaging, timing, redundancy and change control across the communications layer, while protection relay setting training covers fault calculation, relay curves and coordination.