JUPITER PRIME

Consulting • Training • Advisory

جوبيتر برايم للاستشارات والتدريب

COURSE BROCHURE

Teleprotection and IEC 61850 Communication Training Course

jupiterprime.uk

info@jupiterprime.uk

Registered in the United Kingdom and Saudi Arabia

Teleprotection and IEC 61850 Communication Training Course

Teleprotection and IEC 61850 Communication is a 2-week advanced training course for protection, SCADA and telecom engineers in utilities who carry trip signals between line ends and messages across substation networks, and it ends with a protection communication test dossier. Digital substations, ageing copper pilot circuits and stricter fault-clearance expectations now make the signal path as critical as the relay itself. Jupiter Prime Training runs this course for engineers who share that signal path.

Why Teleprotection and IEC 61850 Communication Matters Now

Three pressures meet in the relay room. Utilities are replacing hard-wired interlocks and copper pilots with Ethernet process buses, telecom carriers are retiring the legacy circuits that older teleprotection relied on, and grid operators expect faults cleared within tighter windows as renewable infeed weakens system strength. A utility that engineers latency, redundancy and time accuracy properly keeps its protection dependable and secure; one that does not risks unwanted trips or failures to trip. The course rests on the International Electrotechnical Commission IEC standard IEC 61850 for communication networks and systems in substations.

Who Gains Most from Teleprotection and IEC 61850 Communication

- Engineers responsible for line protection schemes that depend on end-to-end signalling
- Engineers responsible for substation automation, SCADA gateways and station bus design
- Engineers responsible for utility telecom links, fibre routes and multiplexers carrying protection
- Engineers responsible for commissioning and testing digital substation bays
- Engineers responsible for clock distribution and event timestamp accuracy

A mixed group of protection, automation and telecom engineers from one utility gains most when they attend together, because faults in this field sit at the boundary between their disciplines.

Teleprotection and IEC 61850 Communication Capabilities

Participants move from the logic of permissive and blocking schemes to engineering and proving the networks that carry them.

- Design permissive, blocking and direct transfer trip schemes with matching channel requirements — line protection philosophy
- Specify fibre, power line carrier and multiplexed channels against latency and availability targets — telecom investment choices
- Build IEC 61850 GOOSE and sampled value configurations from substation configuration files — bay engineering sign-off
- Apply network redundancy and time synchronisation methods to process and station buses — automation architecture decisions
- Test end-to-end signal paths with injection, capture and timing tools — commissioning acceptance
- Communicate failure modes and test evidence across protection and telecom groups — asset owners and operations

Key Teleprotection and IEC 61850 Communication Terms

- Teleprotection — equipment and signalling that carry protection commands between line ends so both breakers clear a fault together.
- GOOSE — a fast multicast IEC 61850 message used to send trips, interlocks and status between intelligent electronic devices.
- Sampled values — digitised current and voltage measurements streamed from merging units to protection devices over the process bus.
- Merging unit — a device beside the instrument transformers that converts analogue signals into time-stamped sampled value streams.
- Substation configuration language — the IEC 61850 file format describing devices, data models and communication settings of a substation.
- Channel asymmetry — a difference between send and receive delay that distorts timing for current differential protection.

Teleprotection and IEC 61850 Communication Day by Day

Day 1: Protection Signalling Principles

- Permissive Underreach and Overreach Schemes — Speed Versus Security Choices
- Blocking and Unblocking Schemes — Behaviour on Channel Loss
- Direct Transfer Trip — Breaker Failure and Remote Clearance
- Dependability and Security Metrics — Setting Channel Performance Targets
- Fault Clearance Time Budgets — Allocating Delay Across the Chain

Day 2: Current Differential Over Communication Links

- Line Differential Principles — Channel Dependence of Phase Comparison
- Propagation Delay and Asymmetry Compensation — Avoiding False Differential Current
- Route Switching Effects — Ring and Path Change Risks
- Dual Channel Arrangements — Main and Backup Path Allocation
- Channel Monitoring Alarms — Detecting Degraded Links Early

Day 3: Physical Media for Protection Channels

- Dedicated Fibre and Optical Ground Wire — Route Diversity Planning
- Power Line Carrier Coupling and Line Traps — Noise and Attenuation Limits
- Microwave and Leased Circuits — Availability Trade-Offs
- Optical Power Budget Calculation — Margin for Splices and Ageing
- Legacy Copper Pilot Migration — Replacement Sequencing Choices

Day 4: Multiplexed and Packet Telecom Networks

- Time-Division Multiplexers for Protection — Deterministic Channel Delivery
- Packet-Switched Transport and Pseudowires — Jitter and Latency Control
- Quality of Service Classes — Prioritising Protection Traffic
- Network Path Protection Timings — Restoration Within Protection Windows
- Telecom Service Level Agreements — Defining Protection Channel Duties

Day 5: IEC 61850 Data Model and Engineering

- Logical Nodes and Data Objects — Mapping Protection Functions
- Substation Configuration Language Files — Specification to Configured IED Flow
- System and IED Configurator Tools — Vendor Interoperability Checks
- Client-Server Reporting — SCADA Gateway and HMI Integration
- Naming and Versioning Conventions — Controlling Configuration Changes

Day 6: GOOSE Messaging for Protection and Interlocking

- GOOSE Publishing and Subscribing — Replacing Hard-Wired Signals
- Retransmission Timing and Quality Flags — Detecting Lost Messages
- VLAN Tagging and Priority — Segregating Bay Traffic
- Breaker Failure and Busbar Interlocks via GOOSE — Station-Wide Trip Logic
- Routable GOOSE Between Substations — Wide-Area Signalling Options

Day 7: Process Bus and Sampled Values

- Merging Unit Placement — Yard Versus Relay Room Choices
- Sampled Value Stream Rates and Load — Process Bus Bandwidth Sizing
- Non-Conventional Instrument Transformers — Accuracy and Saturation Behaviour
- Test Mode and Simulation Flags — Isolating Live Bays Safely
- Loss of Stream Handling — Protection Blocking Behaviour

Day 8: Time Synchronisation and Network Redundancy

- Precision Time Protocol Grandmaster Design — Microsecond Accuracy for Sampled Values
- Satellite Clock Holdover and Spoofing — Timing Resilience Choices
- Parallel and Ring Redundancy Protocols — Zero Recovery Time Networks
- Station and Process Bus Topologies — Single Points of Failure
- Network Switch Hardening — Cyber Protection for Protection Traffic

Day 9: Testing and Commissioning Signal Paths

- End-to-End Teleprotection Testing — Synchronised Injection at Both Line Ends
- Network Analysers and Packet Capture — Proving GOOSE Timing
- Sampled Value Subscription Tests — Verifying Merging Unit Accuracy
- Factory and Site Acceptance Test Scripts — Recording Evidence for Handover
- Fault Recorder Timestamp Correlation — Post-Event Sequence Reconstruction

Day 10: Practising the Protection Communication Test Dossier

- Scheme Selection Exercise — Applying Permissive, Blocking and Differential Logic
- Channel Delay Budget Drill — Applying Media, Multiplexer and Asymmetry Limits
- Digital Bay Configuration Review — Applying GOOSE, Sampled Values and Timing
- Failure Mode Walkthrough — Applying Redundancy and Loss-of-Signal Responses
- Protection Communication Test Dossier — Final Schemes, Budgets and Test Evidence

Applying Teleprotection and IEC 61850 Communication After the Course

- Measure the send and receive delay of one differential protection channel and compare it with the asymmetry limit of the relay.
- Capture GOOSE traffic in one bay during a planned outage test and document retransmission timing and quality flags.

Teleprotection and IEC 61850 Communication Questions FAQ

What is teleprotection and IEC 61850 communication and why does it matter now?

It is the engineering of the signal paths that let protection devices trip, block and share measurements. It matters now because utilities are moving to digital substations and packet networks, where delay, redundancy and timing errors can cause protection to operate wrongly.

Which roles gain most from teleprotection and IEC 61850 communication training?

Protection, automation, SCADA and telecom engineers gain most. Each owns one part of the signal chain, and the course gives them shared methods for channel budgets, GOOSE and sampled value configuration, time synchronisation and end-to-end testing.

How does a teleprotection and IEC 61850 communication course differ from a relay coordination course?

It focuses on the communication between devices rather than the relay settings. A relay coordination course grades overcurrent and distance characteristics, while this course engineers the channels, messages, clocks and networks those relays depend on.

What do you bring back from teleprotection and IEC 61850 communication training?

You bring back a test dossier for a protection communication system. It records chosen schemes, channel delay budgets, configuration checks, redundancy arrangements and test evidence, ready to guide commissioning or a refurbishment project.

Teleprotection and IEC 61850 Communication: The Way Forward

The protection communication test dossier first informs whether an existing channel or bay design can meet its fault-clearance budget. Protection, telecom and commissioning engineers use it to agree acceptance criteria and test steps. After its first use, revisit the timing assumptions, since network changes by the telecom group can alter delay and asymmetry without any change to the relays.