JUPITER PRIME

Consulting • Training • Advisory

جوبيتر برايم للاستشارات والتدريب

COURSE BROCHURE

# Transmission Substation Layout and Equipment Design Training Course

10 – 14 January 2027
Manama

**jupiterprime.uk**

info@jupiterprime.uk

Registered in the United Kingdom and Saudi Arabia

# Transmission Substation Layout and Equipment Design Training Course

**Ref:** 3012_114192 **Date:** 10 – 14 January 2027 **Location:** Manama **Fees:** 5500 GBP

Transmission Substation Layout and Equipment Design is a 1-week training course for electrical engineers who lay out, rate and specify high voltage substations, and who leave with a substation design review for a real or case scheme. Grid expansion for renewable connections and rising fault levels on older networks put pressure on every layout and rating decision. Jupiter Prime Training delivers this course for designers who must balance reliability, footprint and capital cost.

## Why Transmission Substation Layout and Equipment Design Matters Now

Three forces shape substation design today: new connection points for solar, wind and storage plants, fault levels that climb as generation is added close to load centres, and land and outage constraints at existing sites. A design that gets busbar arrangement, insulation clearances and earthing right gives decades of safe, maintainable operation. One that gets them wrong leaves operators with switching restrictions, step and touch hazards and costly retrofits. The course follows recognised international practice for insulation coordination, earthing safety and substation communication.

## Who Gains Most from Transmission Substation Layout and Equipment Design

- Primary design engineers who choose busbar schemes, bay layouts and equipment ratings
- Secondary design engineers who arrange protection, control and metering cubicles
- Civil and layout coordinators who integrate cable trenches, foundations and access roads
- Owner engineers who check contractor designs against utility specifications
- Planning engineers who set connection requirements and future extension space

Utilities and engineering contractors gain most when primary, secondary and owner engineers attend together, because layout and protection decisions constrain one another.

## Transmission Substation Layout and Equipment Design Capabilities

Participants practise turning a connection requirement into a coherent single-line diagram, bay layout and equipment schedule.

- Weigh single, double and breaker-and-a-half busbar schemes for security and cost — network planners
- Calculate short-circuit, continuous current and voltage ratings for primary plant — equipment buyers
- Apply insulation coordination and clearance rules to bay arrangements — layout designers
- Design an earthing grid that keeps step and touch voltages within safe limits — safety reviewers
- Specify protection, control and auxiliary supply arrangements for each bay — secondary engineers
- Assess a contractor substation design against reliability and maintainability criteria — owner engineers

## Key Transmission Substation Layout and Equipment Design Terms

- Busbar scheme — the arrangement of busbars, breakers and isolators that sets how circuits connect and how outages affect supply.
- Bay — one circuit position in a substation, holding the breaker, isolators, instrument transformers and associated equipment.
- Insulation coordination — selecting equipment insulation strength and surge protection to match the overvoltages expected on the network.
- Touch voltage — the voltage between a hand on earthed metalwork and the feet during an earth fault.
- Short-time withstand current — the fault current equipment carries for a stated short duration without damage.
- Auxiliary supply — the alternating and direct current systems that power protection, control, lighting and battery charging.

## Transmission Substation Layout and Equipment Design Day by Day

### Day 1: Substation Function and Single-Line Choices

- Connection Requirements and Network Studies — Defining Substation Duty
- Single, Double and Breaker-and-a-Half Busbar Schemes — Security Versus Cost
- Air-Insulated and Gas-Insulated Options — Footprint, Climate and Outage Trade-Offs
- Single-Line Diagram Development — Bays, Couplers and Future Extensions
- Staged Extension of Existing Sites — Outage Windows and Interim Arrangements

### Day 2: Primary Equipment Ratings

- Short-Circuit and Continuous Current Ratings — Breakers, Isolators and Busbars
- Power Transformer Interface Choices — Impedance, Vector Group and Neutral Earthing
- Current and Voltage Transformer Selection — Accuracy Classes and Burdens
- Surge Arrester Selection and Placement — Protective Margins for Plant
- Conductor and Busbar Sizing — Thermal Limits and Mechanical Forces

## Day 3: Insulation, Clearances and Earthing

- Insulation Coordination Studies — Lightning and Switching Overvoltage Levels
- Phase and Safety Clearances — Bay Spacing and Maintenance Access
- Earthing Grid Design Calculations — Soil Resistivity, Conductors and Rods
- Step and Touch Voltage Checks — Fence, Gate and Perimeter Treatment
- Lightning Shielding of the Switchyard — Masts, Wires and Coverage Zones

## Day 4: Protection, Control and Auxiliaries

- Protection Scheme Allocation per Bay — Main, Backup and Busbar Zones
- Control Building and Relay Room Layout — Cubicles, Cabling and Segregation
- Substation Automation Networks — Bay and Station Level Architecture
- Alternating Current Auxiliary Supplies — Station Transformers and Changeover
- Direct Current Batteries and Chargers — Autonomy and Duty Cycle Sizing

## Day 5: Practising the Substation Design Review

- Busbar Scheme Selection for a Case Renewable Connection — Applying Day 1 Choices
- Equipment Rating Schedule Check — Applying Day 2 Calculations
- Clearance and Earthing Verification — Applying Day 3 Methods
- Protection and Auxiliary Supply Layout Check — Applying Day 4 Arrangements
- Substation Design Review — Findings, Risks and Approval Recommendations

## Applying Transmission Substation Layout and Equipment Design After the Course

- Recheck the equipment rating schedule of one existing substation against current fault levels.
- Run a step and touch voltage check on a planned extension using measured soil resistivity.

## Transmission Substation Layout and Equipment Design Questions FAQ

### What is transmission substation layout and equipment design, and why does it matter now?

It is the engineering of busbar schemes, equipment ratings, clearances, earthing and secondary systems for high voltage substations. It matters now because new renewable connections and rising fault levels test every rating and layout choice.

### Which roles gain most from transmission substation layout and equipment design?

Primary and secondary design engineers, layout coordinators, owner engineers and planning engineers gain most. Each makes or checks decisions that fix the substation's safety, reliability and future extension options.

## How does transmission substation layout and equipment design differ from a substation maintenance course?

It works at the design stage, before equipment is bought or built. You choose schemes, ratings and earthing, whereas a maintenance course concentrates on inspection, testing and repair of plant already in service.

## What do you bring back from transmission substation layout and equipment design training?

You bring back a substation design review covering busbar scheme, rating schedule, clearance and earthing checks, and protection and auxiliary layout.

## Transmission Substation Layout and Equipment Design: The Way Forward

The substation design review first informs whether a new connection scheme or extension design is ready for approval. Owner engineers use it to challenge contractor submissions, and design teams to close gaps before procurement. After its first use, revisit the rating and earthing checks, since measured fault levels and soil data often differ from study assumptions.