Switchboard Design Training Course: LV and MV Ratings, Busbars and Arc Safety

19 – 30 July 2027
Tokyo

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Programme Summary

Switchboard design is the subject of this two-week training course for design and electrical engineering leads, ending in a switchboard design verification file for one low and medium voltage assembly. Switchboards fail when ratings, fault duty and arc safety are settled late or on assumption. The programme moves from the design basis and standards to ratings, busbars, internal arc, separation, protection, layout and specification review, using prepared duty data from an industrial plant and a utility substation. Mars Training Centre UK delivers this programme on switchboard design to mixed-organisation cohorts.

The Business Case

Leads who fix ratings from calculated fault duty, specify verification evidence and review vendor drawings against it avoid late redesign and unsafe assemblies. Where design rests on past practice, busbars are over or under sized, arc risk is found at commissioning and approvals have no record. The programme works on the measures below.

- Late Design Changes: Fall when ratings and fault duty are settled before vendor release.
- Arc Exposure at Operator Positions: Reduces when containment and separation are chosen from classified options.
- Specification Queries: Decline when verification evidence is written into the specification.

Principles and Evidence Base

- IEC 61439 Low Voltage Switchgear and Controlgear Assemblies: Applied in Sessions 1, 2 and 9 to set ratings and choose design verification by test, calculation or design rules.
- IEC 62271-200 AC Metal-Enclosed Switchgear: Applied in Sessions 5 and 6 to select internal arc classification, loss of service continuity and partition class.
- IEC TR 61641 Arcing Fault Testing: Applied in Session 5 to read test evidence for low voltage assemblies.
- IEC 60909 Short-Circuit Currents: Applied in Session 3 to calculate fault duty for equipment ratings.

Intended Participants

- Design leads who approve switchboard arrangements and ratings for plants and substations.
- Electrical engineering managers who review vendor drawings and test evidence.
- Specification engineers who write the technical requirements for assemblies.
- Project engineers who carry switchboard interfaces between disciplines.

Typical settings include power utilities, process industries, data centres and large buildings.

Learning Outcomes

1. Participants will be able to construct a design basis and ratings schedule for a low and medium voltage switchboard.
2. Participants will be able to evaluate fault duty against busbar and equipment withstand.
3. Participants will be able to prioritise internal arc risk controls for operator positions.
4. Participants will be able to select a form of separation and continuity class for a stated duty.
5. Participants will be able to construct a protection and layout arrangement for one assembly.
6. Participants will be able to justify a specification and design review decision from verification evidence.

Programme Structure

Day 1: Switchboard Design Basis and Standards

What must a switchboard design deliver, and which standards govern it?

- Design Basis Statement
- IEC 61439 Scope Map
- Load and Duty Schedule
- Service Conditions Sheet
- Single-Line Diagram Review

Day 2: Rated Values and Ratings

How are voltage, current and diversity set for each section?

- Rated Current and Diversity Calculation
- Rated Voltage and Insulation Table
- Temperature-Rise Limit Check
- Rated Short-Time Current Selection
- Rating Assignment Register

Day 3: Short-Circuit Duty

How is fault current calculated and carried into equipment ratings?

- IEC 60909 Fault Current Calculation
- Peak and Short-Time Current Table
- Source Data Sheet
- Withstand Margin Review
- Motor Fault Contribution Worksheet

Day 4: Busbar Sizing and Support

How are busbars sized for heating and fault forces?

- Busbar Sizing Calculation
- Electrodynamic Force Estimate
- Support Spacing Check
- Joint Heating Review
- Conductor Material Comparison

Day 5: Internal Arc Safety

How is arcing fault risk contained in low and medium voltage assemblies?

- Internal Arc Classification Table
- IEC TR 61641 Test Reading
- Pressure Relief and Exhaust Route Plan
- Arc Detection and Fast Tripping Options
- Operator Position Exposure Map

Day 6: Form of Separation and Continuity

How is an assembly divided to protect people and keep supply?

- Form of Separation Selection
- Loss of Service Continuity Class
- Partition Class Comparison
- Compartment Interlock Scheme
- Maintenance Isolation Outline

Day 7: Protection and Control Arrangement

How is protection coordinated inside the assembly?

- Incomer and Feeder Settings Table
- Discrimination Curve Overlay
- Control and Interlock Logic Diagram
- Auxiliary Supply Arrangement
- Metering Point List

Day 8: Layout, Heat and Access

How are enclosure layout, cable entry and ventilation arranged?

- General Arrangement Drawing
- Cable Entry and Termination Plan
- Enclosure Heat Dissipation Estimate
- Room Clearance and Access Sketch
- Shipping Section Plan

Day 9: Specification and Design Review

How is verification evidence specified and reviewed?

- Technical Specification Structure
- Verification Method Matrix
- Type Test Report Checklist
- Vendor Drawing Review Gate
- Deviation and Change Log

Day 10: Switchboard Design Verification File

Do the earlier results join into a file that a reviewer can rely on?

- Applying the Session 3 Fault Duty Table
- Testing the Session 4 Busbar Calculation
- Checking the Session 5 Arc Safety Plan
- Reconciling the Session 9 Verification Matrix
- Completing the Design Verification File

Methodology

The programme is a structured exercise built on prepared duty data from an industrial plant and a utility substation: load lists, single-line diagrams, fault levels, vendor drawings and test summaries. Participants calculate, select and defend each choice in turn before peers acting as a design review board.

- Suggested activity: Sizing a busbar system from a stated fault level.
- Suggested activity: Choosing a form of separation for two duties.
- Suggested activity: Reviewing a vendor drawing against a specification.

Capstone Output

Each participant completes a design verification file for one assembly. It holds a ratings schedule, a fault duty table, a busbar calculation, an arc safety plan and a verification matrix. At work it supports the next design review and becomes the template for other switchboards.

Frequently Asked Questions

Is switchboard design training suitable for leads who do not draw panels themselves?

Yes. Switchboard design is taught from prepared data and templates. You need responsibility for approving or reviewing assemblies, and basic electrical knowledge.

Which standards does switchboard design rest on in this training?

Switchboard design here rests on IEC 61439 for low voltage assemblies and IEC 62271-200 for medium voltage switchgear, with IEC 60909 for fault current.

How is the file from switchboard design training used at work?

You take the design verification file to your next design review, reuse its ratings schedule and busbar calculation, and use its matrix when assessing vendors.

How does switchboard design differ from switchgear maintenance?

Switchboard design settles ratings, separation and arc safety before build, whereas switchgear maintenance tests and renews equipment already in service.