CONCEPT

Industrial Power Distribution Systems: Design, Protection and Fault Analysis

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Introduction:

Industrial power distribution networks grow by piecemeal additions, and many plants run with unverified cable ratings, outdated fault levels and relay settings that no longer discriminate, so a single fault can trip a whole process unit. This Core Concept course equips plant electrical engineers to choose network configurations, estimate demand, size cables for voltage drop and fault duty, calculate short-circuit currents with the IEC 60909-0 method, select earthing arrangements, grade protection and trace faults to root cause. Participants build a Plant Distribution Study Workbook for a network from their own site.

Course Objectives:

- Compare radial, ring and secondary selective network configurations and select one that meets plant continuity and maintenance needs
- Estimate maximum demand from connected load lists using demand and diversity factors and size feeders, busbars and cables for current rating and voltage drop
- Calculate balanced and unbalanced short-circuit currents with the IEC 60909-0 method and check equipment withstand against the results
- Select system earthing and neutral earthing arrangements for low and medium voltage networks and explain their effect on earth fault current
- Set overcurrent and earth fault relays with IDMT curves and produce a time-current coordination study that keeps discrimination between upstream and downstream devices
- Investigate electrical faults and outages with structured root-cause analysis and record corrective actions against the single-line diagram

Target Audience:

- Plant electrical engineers who extend, modify and keep records of site distribution networks
- Facility and utilities engineers responsible for supply continuity to process units, buildings and critical loads
- Project electrical engineers who prepare load lists, cable schedules and single-line diagrams for new installations
- Protection and power system study engineers who calculate fault levels and set relays for industrial networks
- Electrical reliability engineers who investigate trips, outages and repeat faults on plant feeders

Course Outline:

Day 1: Plant Network Configurations and Single-Line Diagrams

- Industrial Supply Intake Arrangements and Voltage Level Selection
- Radial, Ring Main and Secondary Selective Network Configuration Trade-Offs
- Single-Line Diagram Conventions, Device Numbers and Drawing Revision Control
- Connected Load List Preparation with Demand and Diversity Factors
- Current-State Network Survey Checklist for an Existing Plant

Day 2: Cable Sizing, Voltage Drop and Short-Circuit Calculation

- Cable Current Rating with Installation Method, Grouping and Ambient Derating Factors
- Voltage Drop Calculation for Feeders and Motor Starting Conditions
- IEC 60909-0 Equivalent Voltage Source Method and Voltage Factor c
- Initial Symmetrical, Peak and Breaking Short-Circuit Current Calculation Sheets
- Cable and Busbar Thermal Withstand Check Against Fault Duration

Day 3: System Earthing and Protection Coordination Studies

- IEC 60364 TN-S, TN-C-S, TT and IT Earthing Arrangements for Low Voltage Plant
- Solid, Resistance and Reactance Neutral Earthing and Zigzag Earthing Transformers
- IDMT Relay Curves to IEC 60255-151 and IEEE C37.112 Characteristics
- Pickup, Time Multiplier and Grading Margin Selection for Feeder Relays
- Time-Current Coordination Plot Construction Across Fuses, Breakers and Relays

Day 4: Power Quality, Emergency Power and Fault Analysis

- Power Factor Correction Capacitor Bank Sizing and Detuning Overview
- Harmonic Sources, Distortion Indicators and Mitigation Options Overview
- Standby Generator Sizing, Automatic Transfer Schemes and UPS Topologies
- Electrical Fault Types: Symmetrical, Line-to-Earth, Line-to-Line and Double Line-to-Earth
- Root-Cause Analysis of Plant Trips Using Event Records and Fault Trees

Day 5: Plant Distribution Study Workbook Build

- Case Network Data Collection and Impedance Model Assembly
- Load Flow and Voltage Profile Check for Normal and Contingency Cases
- Fault Level Table and Equipment Duty Comparison for the Case Network
- Relay Setting Schedule and Discrimination Review for the Case Network
- Plant Distribution Study Workbook Peer Review and Improvement Actions

Skills You Will Gain:

- Network Configuration Selection
- Maximum Demand Estimation
- Cable Sizing Calculation
- Short-Circuit Current Calculation
- Earthing Arrangement Selection
- Relay Grading and Coordination
- Standby Power Planning
- Electrical Fault Root-Cause Analysis

Why Attend This Course:

- Return with a Plant Distribution Study Workbook holding the load list, cable checks, fault levels and relay settings for a network from your own site
- Spot undersized cables, overdutied equipment and non-discriminating relays before a fault exposes them
- Explain network changes to project teams and management with calculations they can review and reuse
- Compare distribution design practice with engineers from oil and gas, petrochemicals, manufacturing, water, mining and large facilities

Conclusion:

A plant distribution network stays dependable when its configuration, cables, fault levels, earthing and protection settings are checked as one system. The course moves from network configurations, single-line diagrams and load estimation, through cable sizing, voltage drop and IEC 60909-0 short-circuit calculation, to earthing arrangements and relay coordination, then to power quality, emergency power and fault root-cause analysis. The final day brings these together in a Plant Distribution Study Workbook ready for the next network modification or outage review.