CONCEPT

# Distribution System Planning: Load Forecasting, Reliability and Network Expansion

12 – 23 September 2027
Jeddah - Corniche four-star



# Distribution System Planning: Load Forecasting, Reliability and Network Expansion

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## Introduction:

Distribution system planning in many electricity utilities still reacts to overloaded feeders and connection requests one scheme at a time, so reinforcement arrives late, losses and interruptions climb and capital is spent where the loudest complaint is rather than where risk is highest. This Core Concept course gives utility planning engineers a structured method to forecast demand by customer class and zone, apply security and voltage criteria, study feeder and primary substation capacity, plan for reliability, distributed energy resources and EV charging, and rank investment. Participants build a 10-Year Distribution Expansion Plan for a service area.

## Course Objectives:

- Produce spatial and customer-class load forecasts with growth scenarios that a distribution planning team can defend to management
- Apply security, thermal and voltage planning criteria to select MV and LV network configurations for new and existing service areas
- Run load flow, voltage drop and technical loss studies to size feeder and primary substation reinforcement
- Assess reliability with IEEE 1366 indices and choose reliability-based investments for worst-performing feeders
- Evaluate hosting capacity for distributed energy resources and the network effect of EV charging, including non-wires alternatives
- Build a prioritised capital plan and planning study report that turns technical findings into an approved multi-year investment programme

## Target Audience:

- Distribution planning engineers responsible for load forecasts, network studies and reinforcement proposals
- Network development engineers responsible for new connections, feeder extensions and service area design
- Asset investment planners responsible for capital plans, scheme phasing and investment cases
- Reliability engineers responsible for outage performance, worst-feeder programmes and improvement schemes
- Grid modernisation specialists responsible for DER integration, EV readiness and distribution automation roadmaps

## Course Outline:

### Day 1: Distribution Planning Context, Horizons and Network Data

- Planning Horizons: Short-Term Reinforcement, Medium-Term Programme and Long-Term Strategic Plan
- Distribution Planning Process from Needs Identification to Approved Scheme
- Network Asset Registers, GIS Connectivity Models and Feeder Metering Data Quality
- Primary Distribution Voltages, Secondary 230/400 V Networks and Voltage Level Strategy
- Planning Study Brief Template: Area, Horizon, Drivers and Assumptions Log

### Day 2: Load Forecasting: Spatial and Customer-Class Methods

- Historical Peak Demand Normalisation for Weather and Abnormal Switching
- Customer-Class Forecasts: Residential, Commercial, Industrial and Public Service Load Shapes
- Spatial Load Forecasting with Land-Use Grids and Small-Area Saturation Curves
- Block Load Applications, Developer Requests and Coincidence Factor Treatment
- Forecast Scenarios: Base, High Growth and Accelerated Electrification Cases

### Day 3: Planning Criteria, Security Standards and Network Configurations

- Deterministic Security Criteria: N-1 Transfer Capability and Restoration Time Targets
- Planning Voltage Limits, Thermal Loading Limits and Emergency Ratings
- MV Configuration Choices: Radial Overhead, Open Ring Underground and Closed Meshed Networks
- LV Network Layouts, Distribution Transformer Placement and Service Cable Lengths
- Standard Design Library: Preferred Conductor, Cable and Transformer Sizes

### Day 4: Feeder and Primary Substation Capacity Planning Studies

- Feeder Capacity Headroom and Firm Capacity Assessment at Primary Substations
- Load Flow Study Set-Up: Source Impedance, Load Allocation and Feeder Models
- Voltage Drop Profiles, Regulator Placement and Capacitor Bank Siting on Long Feeders
- Technical Loss Estimation with Loss Load Factor and Feeder Reconfiguration Options
- Planning Software Workflow: Network Model Import, Study Cases and Result Export

### Day 5: Week-One Guided Case: Growth Area Reinforcement Study

- Guided Case: Service Area Load Forecast Built by Customer Class and Zone
- Guided Case: Constraint Identification Against Thermal and Voltage Criteria
- Guided Case: Reinforcement Options of New Feeder, Load Transfer or Primary Uprating
- Guided Case: Option Comparison Table with Load Flow Evidence
- Week-One Reinforcement Study Note and Assumptions Register

## Day 6: Distributed Energy Resources, EV Charging and Grid Modernisation

- Rooftop PV Hosting Capacity Assessment: Voltage Rise, Reverse Flow and Tap Changer Operation
- IEEE 1547 Interconnection Requirements and Smart Inverter Volt-VAR Functions
- EV Charging Load Profiles, Clustering Scenarios and Managed Charging Effects
- Battery Storage as a Non-Wires Alternative to Feeder Reinforcement
- Distribution Automation Overview: Fault Location, Isolation and Service Restoration with Volt-VAR Control

## Day 7: Reliability Indices and Reliability-Based Planning

- IEEE 1366 Reliability Indices: SAIDI, SAIFI, CAIDI and Major Event Day Treatment
- Outage Data Collection, Cause Coding and Worst-Performing Feeder Ranking
- Predictive Reliability Modelling with Component Failure Rates and Switching Times
- Reliability Improvement Options: Sectionalising, Tie Points, Undergrounding and Recloser Placement
- Customer Interruption Cost Valuation and Planning Standards Governance Review

## Day 8: Stakeholders, Connections and Communicating the Plan

- Coordination with Transmission Planners on Grid Supply Point Capacity
- Municipal Land-Use Plans, Wayleaves and Substation Site Acquisition Lead Times
- Large Customer and Developer Connection Offers and Contribution Rules
- Planning Study Report Structure: Findings, Options, Recommendation and Risks
- Presenting Network Development Proposals to Investment Committees

## Day 9: Capital Plan, Investment Prioritisation and Planning KPIs

- Capital Expenditure Plan Build: Unit Costs, Scheme Estimates and Phasing
- Multi-Criteria Investment Prioritisation: Risk, Reliability Benefit and Cost Scoring
- Net Present Value and Least-Cost Comparison of Reinforcement Alternatives
- Planning KPIs: Feeder Utilisation, Loss Ratio, Forecast Accuracy and Scheme Delivery Rate
- Post-Implementation Review and Benchmarking Against Peer Distribution Utilities

## Day 10: Capstone: 10-Year Distribution Expansion Plan

- Capstone Brief: Service Area Network Data, Forecast Inputs and Planning Criteria
- Capstone Analysis: Year-by-Year Constraint Map for Feeders and Primary Substations
- Capstone Build: Staged Reinforcement, DER and Automation Scheme Programme
- Capstone Build: Ten-Year Capital Plan with Reliability and Loss Outcomes
- 10-Year Distribution Expansion Plan Presentation and Peer Challenge

## Skills You Will Gain:

- Spatial Load Forecasting
- Planning Criteria Application
- Feeder Capacity Assessment
- Technical Loss Analysis
- Reliability-Based Planning
- DER Hosting Capacity Evaluation
- Capital Investment Prioritisation
- Planning Study Reporting

## Why Attend This Course:

- Return with a 10-Year Distribution Expansion Plan for a service area, staged year by year with its capital programme
- Spot feeders and primary substations that will breach thermal, voltage or security limits years before customers feel it
- Move in week two from capacity studies to DER and EV impacts, reliability-based planning, stakeholder engagement and investment ranking
- Compare distribution planning practice with engineers from electricity utilities, industrial estates, new city developers and public service providers

## Conclusion:

A distribution network keeps pace with demand when forecasts, criteria, studies and investment decisions are linked in one planning cycle. The first week covers planning horizons, network data, spatial and customer-class forecasting, security criteria, MV and LV configurations, capacity, load flow, voltage and loss studies, closing with a guided reinforcement case. The second week adds DER hosting capacity, EV charging, distribution automation, IEEE 1366 reliability planning, stakeholder coordination and capital prioritisation. The capstone turns both weeks into a 10-Year Distribution Expansion Plan ready for the next budget round.