Power and Electricity Industry Fundamentals: Generation, Grids, Tariffs and Transition

3 – 14 January 2027
Riyadh - KAFD district five-star



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Ref: 957_21779 **Date:** 3 – 14 January 2027 **Location:** Riyadh - KAFD district five-star **Fees:** 35100 SAR

Introduction:

Power and electricity industry fundamentals are often missing among new joiners, analysts, lawyers and finance staff who work on generation contracts, network tariffs or regulatory filings, so meetings with engineers and system operators stall on basic terms and decisions rest on misread figures. This Core Concept programme explains how electricity is produced, moved, controlled, priced and regulated, from volts and kilowatt-hours to plant economics, substations, frequency control, tariffs and renewable integration. Participants prepare a Power System and Sector Briefing for a case utility.

Course Objectives:

- Explain voltage, current, power, energy, three-phase supply and power factor when reading plant data, bills and network reports
- Compare thermal, combined cycle, nuclear, hydro, solar, wind and storage plants on role, capacity factor and levelised cost
- Describe how transmission lines, substations, switchgear, distribution feeders and protection deliver supply to customers
- Interpret how system operators balance demand, hold frequency, schedule reserves and restore supply after outages
- Assess utility business models, cost of supply, tariff structures and market arrangements that shape sector revenues
- Prepare a Power System and Sector Briefing that sets out fleet, network, tariff and energy transition issues for a case utility

Target Audience:

- Early-career staff in generation, transmission and distribution companies who support engineering, planning or commercial teams
- Analysts in regulatory bodies and energy ministries responsible for reviewing licences, tariffs and performance reports
- Finance, investment and audit staff responsible for budgets, project appraisals or lending in the power sector
- Legal and contracts staff who draft or administer power purchase, connection and supply agreements
- Commercial, customer service and human resources staff in energy companies who need a working picture of the power system

Course Outline:

Day 1: Electrical Quantities and the Electricity Value Chain

- Voltage, Current, Resistance and Ohm's Law with Everyday Load Examples
- Power in Kilowatts Versus Energy in Kilowatt-Hours on a Customer Bill
- Alternating Current, System Frequency and Three-Phase Supply Sketches
- Active, Reactive and Apparent Power with the Power Factor Triangle
- Electricity Value Chain Map: Generation, Transmission, Distribution and Retail Supply

Day 2: Generation Technologies and Power Plant Economics

- Steam Turbine and Open Cycle Gas Turbine Plants: Fuel, Heat Rate and Efficiency
- Combined Cycle and Cogeneration Plants: Heat Recovery Steam Generator Principle
- Nuclear Fission Plant Overview: Reactor, Fuel Cycle and Construction Lead Times
- Hydro, Pumped Storage, Solar Photovoltaic, Wind Turbine and Battery Output Profiles
- Capacity Factor, Levelised Cost of Electricity and Levelised Cost of Storage Comparison Sheet

Day 3: Transmission Networks, Substations and Switchgear

- Extra High, High, Medium and Low Voltage Levels and the Step-Up Rationale
- Overhead Lines, Underground Cables and Interconnectors: Losses and Corridor Issues
- Substation Anatomy: Busbars, Power Transformers, Circuit Breakers and Disconnectors
- Gas-Insulated Versus Air-Insulated Switchgear Layout Recognition
- Single-Line Diagram Walkthrough of a Grid Supply Substation

Day 4: Distribution Feeders, Protection Basics and Customer Metering

- Primary and Secondary Feeders, Ring Main Units and Pole-Mounted Transformers
- Fault Types and Protection Principles: Fuses, Relays and Reclosers at Overview Level
- Service Connection Path from Feeder Pillar to Customer Meter with Earthing
- Electromechanical, Electronic and Smart Meters: Registers and Readings
- Network Asset Registers and Outage Logs as Utility Data Sources

Day 5: Week-One Case: Tracing Power from Plant to Customer

- Case Pack: Mixed Thermal, Solar and Wind Fleet Serving a Growing Service Area
- Case Task: Energy Flow Diagram from Plant Busbar to Household Meter
- Case Task: Generation Mix Table with Capacity Factor and Cost Ranking
- Case Task: Voltage Level and Network Loss Map for the Service Area
- Week-One Physical System Briefing Note and Glossary Check

Day 6: System Operation, Frequency Control and Dispatch

- Control Centre Functions: SCADA Displays, Energy Management System and Operator Roles
- Daily Demand Curves, Load Forecast Inputs and Unit Commitment Schedule
- Frequency Response: Governor Action, Automatic Generation Control and System Inertia
- Operating Reserves: Spinning Reserve, Firm Capacity and the N-1 Security Principle
- Outage Scenarios: Cascading Failure, Load Shedding and Black Start Restoration Overview

Day 7: Reliability, Power Quality, Grid Codes and Electrical Safety

- Customer Reliability Indicators: Interruption Frequency and Duration Measures
- Power Quality Awareness: Voltage Sags, Swells, Flicker and Harmonic Distortion
- Grid Code Connection Requirements for Generators and Large Loads
- Electrical Hazards Around Substations: Shock, Arc Flash and Safe Clearance Distances
- Site Visit Safety Rules: Induction, Escorting and Restricted Area Signage

Day 8: Utility Business Models, Regulation and Tariffs

- Vertically Integrated, Unbundled and Single Buyer Utility Models
- Natural Monopoly Networks and Independent Economic Regulation Principles
- Revenue Requirement, Regulated Asset Base and Allowed Return Overview
- Cost of Supply Build-Up: Generation, Network, Retail and Losses per Kilowatt-Hour
- Tariff Structures: Flat Rate, Time-of-Use, Demand Charge and Lifeline Blocks

Day 9: Electricity Markets, Energy Transition and Sector Indicators

- Wholesale Arrangements at Overview: Pools, Bilateral Contracts and Power Purchase Agreements
- Independent Power Producer Model and Long-Term Offtake Contract Features
- Variable Renewable Integration: Curtailment, Output Forecasting, Storage and Demand Response
- Smart Grid Building Blocks: Advanced Metering Infrastructure and Distributed Energy Resources
- Sector Performance Dashboard: Reserve Margin, Loss Ratio, Emissions Intensity and Customer Minutes Lost

Day 10: Capstone: Power System and Sector Briefing for a Case Utility

- Capstone Brief: Case Utility Fleet, Network, Tariff and Regulatory Data Pack
- Capstone Analysis: Generation Mix and Cost of Supply Summary
- Capstone Analysis: Reliability and Renewable Integration Issues Log
- Capstone Build: Stakeholder Question Map for Regulators, Investors, Customers and Staff
- Power System and Sector Briefing Presentation and Peer Challenge

Skills You Will Gain:

- Electrical Quantity Literacy
- Generation Technology Comparison
- Levelised Cost Interpretation
- Grid and Substation Recognition
- System Operation Awareness
- Tariff and Cost of Supply Reading
- Utility Regulatory Model Analysis
- Energy Transition Issue Framing

Why Attend This Course:

- Leave with a Power System and Sector Briefing for a case utility, tested in a peer challenge session
- Follow engineering, system operation and regulatory discussions without losing the thread on units, voltage levels or reserve terms
- Move in week two from the physical grid to control centres, regulation, tariffs, markets and the energy transition
- Compare how the power sector works with peers from utilities, regulators, independent producers, lenders and law firms

Conclusion:

A power sector makes sense to non-specialists once the physics, the assets and the money are seen as one chain. Week one builds that chain from electrical quantities and generation technologies to transmission, substations, distribution feeders, protection and metering, closing with a guided plant-to-customer case. Week two adds control centre operation, frequency and reserves, reliability, power quality, grid codes, safety, utility models, tariffs, market arrangements and renewable integration. The capstone turns both weeks into a Power System and Sector Briefing for a case utility.