CONCEPT

Battery Energy Storage Systems (BESS): Grid-Scale Sizing, Revenue and Safety

Battery Energy Storage Systems (BESS): Grid-Scale Sizing, Revenue and Safety

Introduction:

Battery energy storage systems BESS are being tendered and dispatched faster than many owners can write a sound specification, and plants disappoint when MW ratings are confused with MWh, cell fade is left out of the cash-flow model or fire codes are read after the container layout is frozen. This Core Concept course gives electrical engineers, developers and asset owners a working method for choosing a battery chemistry, dimensioning the plant, stacking market revenue and controlling thermal runaway risk. Participants produce a BESS Technical Specification and Investment Workbook.

Course Objectives:

- Compare lithium-ion, vanadium flow, pumped hydro and thermal options and choose a chemistry against duration, cycling and location criteria
- Specify a BESS from cells and racks through the PCS, battery management system and EMS controller
- Dimension a battery plant in MW and MWh using C-rate, depth of discharge, round-trip efficiency, fade and augmentation assumptions
- Model stacked revenue across arbitrage, frequency response, resource adequacy payments and renewables firming against cycling limits
- Apply NFPA 855 and UL 9540A fire test evidence to container spacing, gas detection, deflagration venting and emergency planning
- Define procurement, commissioning and O&M requirements with warranty, availability and state-of-health KPIs for an operating BESS

Target Audience:

- Electrical engineers who design and specify battery plants connected to transmission, distribution or generation assets
- Developers who screen BESS locations, prepare cash-flow models and take schemes to investment committee
- Asset owners accountable for availability, warranty claims and lifetime value of operating battery fleets
- Network operations and utility planning staff who contract batteries for balancing, reserves and congestion relief
- Owner's engineers and technical advisers who review supplier offers, test reports and EPC submissions for battery plants

Course Outline:

Day 1: Battery Chemistry Choices and Long-Duration Alternatives

- Duration Classes: MW Rating, MWh Rating and Hours of Discharge
- LFP versus NMC Lithium-Ion Cells: Cycle Life, Thermal Stability and Cost per MWh
- Vanadium Redox Flow Batteries: Stack Rating Decoupled from Electrolyte Tank Volume
- Pumped Hydro, Compressed Air and Molten Salt Thermal Alternatives Compared
- Chemistry Selection Scorecard for a Candidate Battery Location

Day 2: BESS Architecture: Cells, Racks, PCS, BMS and EMS

- Cell, Module and Rack Hierarchy Inside Containerised Enclosures
- PCS Topologies: Bidirectional Inverters and Medium-Voltage Step-Up Transformers
- Battery Management System Functions: Cell Balancing, State of Charge and Protection Limits
- EMS Dispatch Logic, Operating Modes and SCADA Interfaces
- AC-Coupled versus DC-Coupled Hybrid Configurations with Solar PV Arrays

Day 3: Dimensioning, Fade and Revenue Stacking Models

- C-Rate and Usable Depth of Discharge in MW versus MWh Dimensioning
- Round-Trip Efficiency, Auxiliary HVAC Load and Point-of-Interconnection Losses
- Cycle and Calendar Fade Curves with an Augmentation Schedule
- Revenue Stack Workbook: Arbitrage, Frequency Response and Resource Adequacy Payments
- Renewables Firming, Curtailment Capture and Network Upgrade Deferral

Day 4: Thermal Runaway, Contracting and Operating Risk

- Thermal Runaway Propagation, Off-Gas Composition and Deflagration Venting
- NFPA 855 Installation Requirements with UL 9540 Listing and UL 9540A Test Data
- Supply-Only versus Full EPC Contracting, Performance Guarantees and LTSA Terms
- Factory Acceptance, Site Acceptance and MWh Verification Tests at Commissioning
- O&M KPIs: Availability, State of Health, Throughput Counters and Warranty Tracking

Day 5: Modelling Workshop: BESS Technical Specification and Investment Workbook

- Scenario Data Pack Review: Load Profile, Price Curves and Interconnection Limits
- Dimensioning Workbook: MW, MWh, Duration and Twenty-Year Fade Path
- Cash-Flow Workbook with Augmentation Capex and Sensitivity Runs
- Fire Strategy, Guarantee Schedule and Test Plan Drafting
- Investment Committee Pitch and Peer Technical Challenge

Skills You Will Gain:

- Battery Chemistry Selection
- BESS Architecture Specification
- MW and MWh Dimensioning
- Cell Fade Modelling
- Market Revenue Stacking
- Fire Code Application for Battery Plants
- EPC and LTSA Contract Structuring
- Battery Fleet Performance Monitoring

Why Attend This Course:

- Return with a BESS Technical Specification and Investment Workbook built on realistic price, load and fade data
- Challenge supplier offers that quote nameplate MWh without usable throughput, efficiency or end-of-life retention
- Link UL 9540A test evidence and NFPA 855 requirements to container layout before the plant design is frozen
- Compare battery plant experience with engineers, developers and network staff from utilities, independent producers and industry

Conclusion:

A battery plant earns its keep only when chemistry choice, MW and MWh ratings, revenue assumptions and fire design are settled together rather than in sequence. This course moves from chemistry selection and BESS architecture, through dimensioning, fade and revenue stacking workbooks, to thermal runaway under NFPA 855 and UL 9540A, contracting, commissioning and O&M KPIs. The final day applies that material in a modelling workshop that produces a BESS Technical Specification and Investment Workbook ready for internal engineering and investment review.