Utility-Scale Battery Storage Engineering Training Course

Professional Development Training Course Outline

Category	Renewable Energy	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Utility-scale Battery Energy Storage Systems (BESS) are becoming a critical pillar of the modern energy transition, enabling grid-scale energy storage, renewable energy integration, grid flexibility, peak shaving, frequency regulation, energy arbitrage, and grid resilience. Utility-Scale Battery Storage Engineering Training Course provides a practical engineering foundation for designing, specifying, integrating, commissioning, operating, and maintaining large-scale BESS projects. Participants explore the complete project lifecycle from battery chemistry and energy-storage technologies through system architecture, power conversion, thermal management, controls, protection, safety, grid interconnection, and performance optimization.

The course emphasizes bankable BESS engineering, advanced Battery Management Systems (BMS), Power Conversion Systems (PCS), Energy Management Systems (EMS), SCADA, cybersecurity, fire protection, lifecycle management, degradation modeling, and techno-economic optimization. Through engineering exercises and industry-focused case studies, learners develop the ability to evaluate real-world utility-scale storage projects, identify technical risks, optimize system performance, and support safe and reliable deployment of next-generation grid-scale energy storage assets.

Programme Curriculum

Utility-Scale Battery Storage Engineering Training Course

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Course Duration

5 days

Course Objectives

By the end of the course, participants will be able to:

1. Understand utility-scale BESS architecture, technologies, and market trends.
2. Evaluate lithium-ion, LFP, sodium-ion, flow battery, and emerging storage technologies.
3. Design BESS systems using energy, power, duration, degradation, and efficiency requirements.
4. Engineer Battery Management Systems (BMS) and battery monitoring strategies.
5. Configure Power Conversion Systems (PCS) and bidirectional inverter architectures.
6. Integrate Energy Management Systems (EMS), SCADA, controls, and digital monitoring.
7. Apply grid-forming, grid-following, frequency response, and ancillary-service strategies.
8. Perform thermal management, HVAC, cooling, and battery degradation assessments.
9. Apply BESS electrical protection, grounding, isolation, and grid-interconnection principles.
10. Develop battery safety, fire protection, emergency response, and hazard mitigation strategies.
11. Conduct BESS sizing, energy-yield, availability, efficiency, and performance analysis.
12. Evaluate CAPEX, OPEX, LCOS, revenue stacking, bankability, and lifecycle economics.
13. Support commissioning, operations, predictive maintenance, repowering, and end-of-life planning.

Target Audience

1. Utility and power-sector engineers
2. Renewable-energy and **energy-transition professionals**
3. Electrical, power-system, and control engineers
4. BESS project developers and asset managers
5. EPC, commissioning, and O&M professionals
6. Grid operators and utility planning teams
7. Energy consultants and technical due-diligence specialists
8. Engineering managers, investors, and clean-energy decision-makers

Course Modules

Module 1: Utility-Scale BESS Fundamentals & Market Landscape

- BESS architecture and grid-scale applications
- Battery chemistry and **next-generation energy-storage technologies**
- Energy density, power density, duration, efficiency, and degradation
- Renewable-energy integration and grid flexibility

- Industry trends, applications, and project lifecycle
- **Case Study:** Utility-scale solar-plus-storage project designed to reduce renewable-energy curtailment and improve evening peak supply.

Module 2: BESS System Architecture & Engineering Design

- Battery racks, modules, containers, and DC systems
- PCS/inverter architecture and AC/DC coupling
- Medium-voltage transformers and switchgear
- EMS, BMS, SCADA, and communications architecture
- System sizing and engineering design criteria
- **Case Study:** Conceptual design of a 100 MW / 400 MWh grid-scale BESS.

Module 3: Battery Technology, BMS & Performance Engineering

- LFP and other lithium-ion battery technologies
- State of Charge (SoC), State of Health (SoH), and State of Power (SoP)
- Cell balancing and battery monitoring
- Degradation, cycle life, calendar aging, and warranty considerations
- BMS architecture and fault detection
- **Case Study:** Investigation of declining usable capacity and development of a degradation-management strategy.

Module 4: PCS, Grid Integration & Advanced Controls

- Bidirectional power-conversion technologies
- Grid-following and **grid-forming inverter** concepts
- Frequency regulation and voltage support
- Black start, inertia emulation, and ancillary services
- Grid-code and interconnection considerations
- **Case Study:** BESS integration into a weak grid to provide frequency response and voltage-support services.

Module 5: Thermal Management, Safety & Fire Protection

- Battery thermal behavior and thermal runaway fundamentals
- HVAC and liquid-cooling architectures
- Fire detection, suppression, and emergency response
- Hazard identification and risk assessment
- Safety-by-design and emergency shutdown strategies
- **Case Study:** Safety engineering review of a containerized BESS following a simulated thermal-event scenario.

Module 6: Protection, SCADA, EMS & Cybersecurity

- Electrical protection and fault-management strategies
- Grounding, isolation, arc-flash, and switching considerations
- SCADA architecture and remote monitoring
- EMS optimization and dispatch control
- **OT cybersecurity and critical-infrastructure protection**
- **Case Study:** Development of a BESS control and monitoring architecture with cybersecurity safeguards.

Module 7: BESS Economics, Optimization & Project Development

- BESS CAPEX, OPEX, LCOS, and lifecycle economics
- Revenue stacking and energy arbitrage
- Capacity markets and ancillary-service opportunities
- Bankability, warranties, performance guarantees, and risk allocation
- Technical due diligence and project optimization
- **Case Study:** Economic comparison of a 4-hour BESS under multiple revenue-stacking scenarios.

Module 8: Commissioning, O&M, Performance & Lifecycle Management

- Factory and site acceptance testing
- Commissioning procedures and performance verification
- Availability, round-trip efficiency, and degradation monitoring
- Predictive maintenance and digital asset management
- Augmentation, repowering, recycling, and end-of-life strategies
- **Case Study:** Performance assessment of an operating BESS and development of an optimization and augmentation plan.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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