Advanced Energy Storage and Battery Management Systems Training Course



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Vienna

5800 € (Per Person)

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Course Introduction / Overview:

The global energy landscape is undergoing a profound transformation, driven by the urgent need for decarbonization and the integration of variable renewable energy sources. In this new paradigm, energy storage systems (ESS) have emerged as a cornerstone technology, essential for ensuring grid stability, reliability, and efficiency. This comprehensive training course provides a deep dive into the cutting-edge world of advanced energy storage technologies, with a specialized focus on battery management systems (BMS). Participants will explore the entire ecosystem, from fundamental electrochemical principles to the complex engineering of grid-scale installations. Drawing on insights from pioneers in the field like Professor Jeff Dahn and foundational texts such as "Battery Systems Engineering", the curriculum is designed to be both academically rigorous and intensely practical. BIG BEN Training Center has developed this program to equip professionals with the critical skills needed to design, deploy, and manage sophisticated energy storage solutions, thereby empowering them to lead in the rapidly expanding energy storage market and contribute effectively to a sustainable energy future. This course is your definitive guide to mastering the technologies that power the next generation of energy infrastructure.

Target Audience / This training course is suitable for:

- Electrical Engineers and Technicians.
- Chemical and Materials Engineers.
- Project Managers in the energy sector.
- Research and Development Scientists.
- System Integration Specialists.
- Energy Policy Analysts and Regulators.
- Investment Analysts and Financial Modelers focused on renewables.
- Operations and Maintenance Managers for power facilities.
- Automotive Engineers working on electric vehicles.
- Technical Consultants in the energy industry.

Target Sectors and Industries:

- Electric Utilities and Power Generation Companies.
- Renewable Energy Project Developers (Solar and Wind).
- Automotive and Electric Vehicle (EV) Manufacturing.
- Grid Operators and Transmission System Operators (TSOs).
- Industrial and Commercial Facility Management.
- Electronics and Battery Manufacturing.
- Aerospace and Defense.
- Governmental bodies, regulatory agencies, and energy ministries.
- Engineering, Procurement, and Construction (EPC) firms.
- Technology and Research Institutions.

Target Organizations Departments:

- Engineering and Design.
- Research and Development (R&D).
- Operations and Maintenance (O&M).
- Project Management.
- Strategic Planning and Business Development.
- Regulatory Compliance and Affairs.
- Grid Integration and Planning.
- Asset Management.
- Procurement and Supply Chain.
- Sustainability and Corporate Social Responsibility (CSR).

Course Offerings:

By the end of this course, the participants will have able to:

- Analyze the operational principles of various energy storage technologies.
- Compare the performance characteristics of different battery chemistries, including Li-ion and emerging alternatives.
- Understand the core architecture and critical functions of a Battery Management System (BMS).
- Implement algorithms for State of Charge (SoC) and State of Health (SoH) estimation.
- Design effective thermal management strategies to ensure battery safety and longevity.
- Evaluate the technical and economic feasibility of energy storage projects.
- Navigate key industry standards and safety regulations like UL 9540 and NFPA 855.
- Integrate energy storage systems with renewable energy sources and the utility grid.
- Develop strategies for battery lifecycle management, including second-life applications and recycling.
- Assess the impact of market trends and government policies on the energy storage sector.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to be immersive, interactive, and directly applicable to real-world challenges. This course moves beyond traditional lecture-based learning by incorporating a dynamic blend of expert-led presentations, in-depth case study analyses of successful grid-scale storage projects, and collaborative group workshops. Participants will engage in practical exercises simulating BMS algorithm development and battery pack design considerations. Interactive sessions will encourage debate and discussion on complex topics such as thermal runaway prevention and the economic valuation of ancillary grid services. A significant portion of the course is dedicated to teamwork, where participants will collaborate on solving complex system integration problems, mirroring the multidisciplinary nature of the energy storage industry. Continuous feedback from the instructor ensures that concepts are not just understood but can be confidently applied. This hands-on, problem-solving approach guarantees that participants leave with not only theoretical knowledge but also the practical skills and strategic insights necessary to excel in their professional roles.

Course Agenda (Course Units):

Unit One: Fundamentals of Energy Storage Systems

- Introduction to the role of energy storage in modern power grids.
- Overview of energy storage technologies: mechanical, thermal, and electrochemical.
- Key metrics and performance characteristics of energy storage systems.
- Applications of energy storage: grid services, renewable integration, and behind-the-meter.
- The physics and chemistry of electrochemical batteries.
- Understanding battery terminology: voltage, capacity, energy density, and C-rate.
- Market overview and global trends in the energy storage industry.

Unit Two: Advanced Battery Chemistries and Design

- Deep dive into Lithium-ion battery families (NMC, LFP, NCA).
- Exploring emerging battery technologies: solid-state, sodium-ion, and flow batteries.
- Battery cell construction, components, and manufacturing processes.
- Principles of battery module and pack design.
- Analysis of battery degradation mechanisms and aging factors.
- Battery modeling and simulation techniques.
- Safety considerations at the cell and pack level.

Unit Three: The Core of Battery Management Systems (BMS)

- The critical role and architecture of a modern BMS.
- Hardware components: sensors, microcontrollers, and communication interfaces.
- Core BMS functions: monitoring, protection, and control.
- State of Charge (SoC) and Depth of Discharge (DoD) estimation algorithms.
- State of Health (SoH) and State of Power (SoP) monitoring techniques.
- Cell balancing strategies: passive and active balancing.
- Software and firmware development for BMS.

Unit Four: System Integration, Safety, and Thermal Management

- Designing the Balance of Plant (BOP) for an Energy Storage System.
- Power Conversion Systems (PCS) and their role in grid integration.
- Communication protocols for ESS (Modbus, CAN bus, DNP3).
- Thermal management strategies: air cooling, liquid cooling, and phase change materials.
- Understanding and preventing thermal runaway.
- Key safety standards and codes: UL 9540, NFPA 855, and IEC 62619.
- Commissioning, testing, and validation of energy storage systems.

Unit Five: Economics, Policy, and Future of Energy Storage

- Economic analysis and financial modeling of energy storage projects.
- Identifying and stacking revenue streams for ESS.
- The impact of policy, regulations, and incentives on market growth.
- Battery lifecycle management: from manufacturing to end-of-life.
- The circular economy: second-life applications and battery recycling.
- The role of energy storage in electric vehicle (EV) infrastructure and V2G technology.
- Future outlook: innovations in materials, AI-driven BMS, and long-duration storage.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

As battery energy density increases, how can we proactively engineer solutions to mitigate the escalating risks of thermal runaway, moving beyond reactive safety measures?

What unique qualities does this course offer compared to other courses?

This course distinguishes itself by offering a holistic, systems-level perspective that bridges the gap between deep technical theory and practical, market-driven application. While many courses focus narrowly on either battery chemistry or high-level project management, this program integrates both. Participants will not only learn the intricacies of State of Charge algorithms and cell balancing but will also immediately connect that knowledge to its impact on project bankability, grid integration standards, and long-term asset management. We emphasize the "why" behind the "how," exploring real-world case studies of both successful deployments and notable failures to extract critical lessons in safety and design. The curriculum is uniquely structured to mirror the entire lifecycle of an energy storage project, from initial technology selection and BMS design to commissioning, operation, and end-of-life management. This comprehensive approach ensures that graduates are not just specialists in one area but are well-rounded professionals capable of leading multidisciplinary teams and making strategic decisions that balance technical performance, financial viability, and operational safety in the complex energy storage landscape.