COURSE OVERVIEW EE1104
BESS Integration Design and Testing

Course Title
BESS Integration Design and Testing

Course Date/Venue
Session 1: July 21-25, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: November 17-21, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
EE1104

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

This course is designed to provide participants with a detailed and up-to-date overview of BESS Integration Design and Testing. It covers the types and key components of BESS including the key performance indicators (KPIs) and typical applications in power systems; the BESS integration in power systems, battery chemistry and technology; the BESS power conversion systems (PCS) and system requirements for BESS integration; the standards and regulations for BESS, safety requirements for battery installations, emergency protocols for battery fires or failures; and the codes of practice for installation and testing.

Further, the course will also discuss the power flow and load flow analysis for BESS; the battery sizing and optimization, control strategies for BESS and design of battery management systems (BMS); the cost-benefit analysis of BESS integration, return on investment (ROI) and payback period; the test procedures for BESS integration, battery testing methods and testing power conversion systems (PCS); the safety and fault diagnosis testing and environmental testing; and comparing test results with design expectations including continuous monitoring and system adjustments post-installation.

During this interactive course, participants will learn the BESS for frequency regulation, peak shaving and energy arbitrage and grid support services; the role of BESS in virtual power plants (VPP); the advanced grid integration of BESS, demand response and BESS in smart grids and communication and control systems for BESS; the maintenance strategies for BESS and troubleshooting common BESS issues; upgrading and retrofitting existing BESS systems and decommissioning and recycling of BESS; the role of AI and machine learning in energy storage optimization; developing standards for ultra-large-scale BESS; and predicting the future of grid-scale energy storage.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an in-depth knowledge on battery energy storage systems (BESS) integration design and testing
- Identify the types and key components of BESS including its key performance indicators (KPIs) and typical applications in power systems
- Determine BESS integration in power systems, battery chemistry and technology, BESS power conversion systems (PCS) and system requirements for BESS integration
- Discuss standards and regulations for BESS, safety requirements for battery installations, emergency protocols for battery fires or failures and codes of practice for installation and testing
- Illustrate power flow and load flow analysis for BESS, battery sizing and optimization, control strategies for BESS and design of battery management systems (BMS)
- Carryout cost-benefit analysis of BESS integration and return on investment (ROI) and payback period
- Employ test procedures for BESS integration, battery testing methods, testing power conversion systems (PCS), safety and fault diagnosis testing and environmental testing
- Compare test results with design expectations, ensure BESS meets customer and regulatory requirements and apply continuous monitoring and system adjustments post-installation
- Apply BESS for frequency regulation and peak shaving and energy arbitrage and grid support services
- Define the role of BESS in virtual power plants (VPP), aggregate of multiple energy storage systems, integrate VPPs for grid services and communicate and control VPP operation
- Carryout advanced grid integration of BESS, demand response and BESS in smart grids and communication and control systems for BESS
- Implement maintenance strategies for BESS, troubleshooting common BESS issues, upgrades and retrofitting existing BESS systems and decommissioning and recycling of BESS
- Discuss the role of AI and machine learning in energy storage optimization, develop standards for ultra-large-scale BESS and predict the future of grid-scale energy storage

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of power generation and transmission for electrical engineers, mechanical engineers, energy engineers, power system engineers, project managers, technicians and maintenance personnel and other technical staff.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Grant Stead, is a **Senior Electromechanical Engineer** with over **30 years** of integrated industrial experience and academic experience as a **University Instructor**. His wide expertise includes **UPS & Battery** Operation & Maintenance, **UPS** Classification, Online & Off-line **UPS Operation**, **UPS Battery** Features, **Battery Charger**, **UPS System Application**, **UPS Parallel** Operation & Strategies, **UPS System** Performance Evaluation, **Control Loop Strategies**, **UPS Converters & Inverters**, **UPS & Battery Charger** Systems, **Battery Chargers** Construction & Troubleshooting, **Battery** Design & Operation, **Battery Charger & UPS** System Prevention Maintenance, **Circuit Breakers & Switchegears**, **Electricity & Electrical Codes**, **Electrical Installations**, **Electric Motors**, **Hydraulics & Fluid Mechanics**, Engineering Services, Electrotechnology, **Fitting & Machining**, **Airconditioning** Repair & Maintenance, Trenching Machines, **Compressors** and **Diesel Engines**. He is also well-versed in Occupational Safety, Coaching & Mentoring, Project Management, Human Resources Management, Procurement Skills, Finance & Infrastructure Maintenance, Health & Safety and Quality Control, Time Management, Leadership and Management Skills, Supervising & Treambuilding Skills, Seven Habits of Highly Effective People, MS Office, Performance Manager, Budgeting & Financial Control and Presentation Skills. Currently, he is the **Operations Manager** of Damelin College wherein he manages the accredited learnership courses as per the required standards by the Sector Education and Training Authority (SETA) ensuring the proper assessment and moderation of all assessments.

During his career life, Mr. Stead worked with several prestigious companies and institutions occupying numerous challenging management and technical positions such as being the **Chairman**, **Campus Manager**, **Marketing Central Manager**, **Senior Lecturer**, **Senior Technician**, **Senior Training Officer**, **Technician**, **Exam Coordinator**, **Contract Lecturer**, **Lecturer**, **Examiner**, **Facilitator**, **Mentor**, **Field Training Officer**, **EDTP Practitioner**, **Performance Consultant**, **Moderator** and **Courseware Developer** of Gateway City College, Thekwini Technical, Vocational Education & Training College, Production Management Institute of South Africa, Telkom SA Limited and Doon Heights Primary School Governing Body.

Mr. Stead has a **Bachelor's** degree in **Mechanical Engineering**. Further, he is a **Certified Instructor/Trainer**, a Registered in South African Council for Education (**SACE**) and a **Certified Assessor & Moderator** with the Education Training & Development Practices Sector Education & Training Authority (**ETDP SETA**). He has further delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Battery Energy Storage Systems (BESS)*** *Types of BESS: Lithium-Ion, Lead Acid, Flow Batteries • Key Components of BESS: Battery Modules, Inverters, Controllers • Key Performance Indicators (KPIs) of BESS • Typical Applications in Power Systems (Grid Balancing, Renewable Integration)*
0930 – 0945	*Break*
0945 – 1030	***BESS Integration in Power Systems*** *Challenges in Integrating Energy Storage into the Grid • Impact of Energy Storage on Power Grid Stability • BESS Integration into Renewable Energy Systems • Grid Code Compliance for BESS*
1030 – 1130	***Battery Chemistry & Technology*** *Understanding Lithium-Ion, Flow Batteries and Lead-Acid Chemistries • Energy Density, Cycle Life and Charge/Discharge Characteristics • Advantages and Limitations of Each Technology • Safety Considerations and Handling Procedures*
1130 – 1215	***BESS Power Conversion Systems (PCS)*** *The Role of Inverters in BESS • Types of Inverters Used for Energy Storage • DC to AC Conversion and Grid Synchronization • Power Factor Correction and Voltage Regulation*
1215 – 1230	*Break*
1230 – 1330	***System Requirements for BESS Integration*** *Voltage and Current Specifications • Sizing of BESS and Storage Capacity Requirements • Load Profiles and Integration Planning • Equipment Selection: Batteries, PCS, Protections*
1330 – 1420	***Regulatory & Safety Considerations*** *Standards and Regulations for BESS (IEC, UL, IEEE) • Safety Requirements for Battery Installations • Emergency Protocols for Battery Fires or Failures • Codes of Practice for Installation and Testing*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0830	***Power Flow & Load Flow Analysis for BESS*** *Basics of Power Flow in Energy Storage Systems • Integration of BESS in Distribution Networks • Impact on System Stability and Voltage Control • Tools for Power Flow Analysis (MATLAB, PSCAD)*
0830 – 0930	***Battery Sizing & Optimization*** *Estimating Energy Needs and Load Profiles • Design Principles for Determining Battery Capacity • Trade-Offs in Sizing BESS for Peak Shaving versus Load Leveling • Optimization Algorithms for Cost-Effective Sizing*

0930 – 0945	*Break*
0945 – 1100	***Control Strategies for BESS*** *Control Algorithms for Charging and Discharging • Maximizing Efficiency with Charge/Discharge Cycles • Predictive Control Strategies for Grid-Connected BESS • Frequency Regulation and Voltage Control With BESS*
1100 – 1215	***Design of Battery Management Systems (BMS)*** *The Role of BMS in Managing Individual Cells • Battery Balancing, Health Monitoring and Diagnostics • Communication Protocols and Data Logging • Fault Detection and Management In BMS*
1215 – 1230	*Break*
1230 – 1330	***Economic Considerations for BESS*** *Cost-Benefit Analysis of BESS Integration • Return on Investment (ROI) and Payback Period • Levelized Cost of Storage (LCOS) • Incentives, Subsidies and Financing Options for BESS*
1330 – 1420	***Energy Storage System Simulation Tools*** *Overview of Simulation Software (e.g., HOMER, MATLAB Simulink) • Simulating Bess Operation Under Different Scenarios • Model Validation with Real-World Data • Sensitivity Analysis for Battery Performance*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0830	***Test Procedures for BESS Integration*** *Pre-Installation Tests: Voltage Checks, Insulation Resistance • Load Tests: Capacity, Efficiency and Performance • Functional Testing: Response to Grid Disturbances and Faults • Post-Installation Testing and Commissioning*
0830 – 0930	***Battery Testing Methods*** *Discharge Testing: Constant Current, Constant Power • Charging Tests: Constant Voltage, Constant Current • Performance Degradation Testing (Cycle Life) • Thermal Testing to Assess Heat Generation*
0930 – 0945	*Break*
0945 – 1100	***Testing Power Conversion Systems (PCS)*** *Pcs Efficiency Testing Under Different Loads • Harmonics and Waveform Analysis • Stability Testing Under Grid Conditions • Control System Testing for Fault Conditions*
1100 – 1215	***Safety & Fault Diagnosis Testing*** *Testing Emergency Stop Systems and Fail-Safes • Fault Simulations: Short Circuit, Overcharging, Over-Discharging • Fire Safety Testing and Protocols • Ground Fault Testing and Mitigation*
1215 – 1230	*Break*

1230 – 1330	***Environmental Testing*** *Extreme Temperature and Humidity Testing • Vibration and Shock Testing for Mechanical Durability • Weathering and Long-Term Stability Tests • EMC (Electromagnetic Compatibility) Testing*
1330 – 1420	***Verification & Validation of Design*** *Comparing Test Results with Design Expectations • Field Validation versus Simulation Results • Ensuring BESS Meets Customer and Regulatory Requirements • Continuous Monitoring and System Adjustments Post-Installation*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

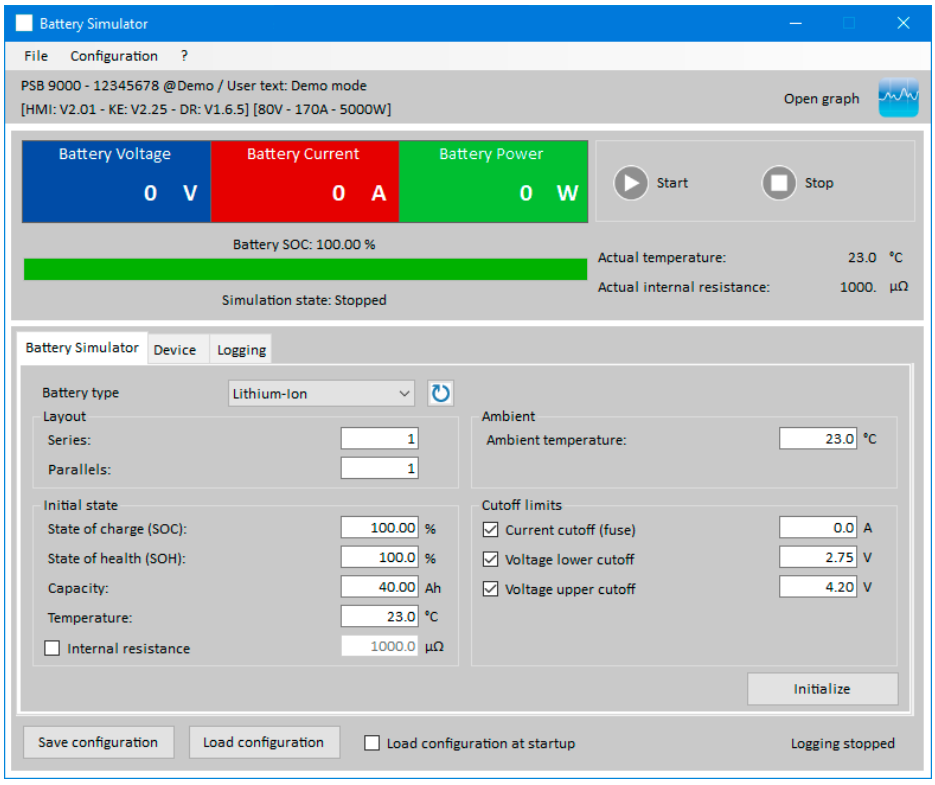
0730 – 0830	***BESS for Frequency Regulation & Peak Shaving*** *Mechanisms of Frequency Regulation in Grid Applications • How BESS Supports Peak Shaving and Load Leveling • Use Cases in Real-Time Energy Markets • Integration with Demand-Side Management Systems*
0830 – 0930	***Energy Arbitrage & Grid Support Services*** *Defining Energy Arbitrage with BESS • Economic Benefits of Arbitrage Strategies • Grid Services: Reactive Power Support, Black-Start Capability • Coordination with Renewable Energy Generation*
0930 – 0945	*Break*
0945 – 1100	***Virtual Power Plants (VPP) & BESS*** *Role of BESS in Virtual Power Plants • Aggregation of Multiple Energy Storage Systems • Market Integration of VPPs for Grid Services • Communication and Control for VPP Operation*
1100 – 1215	***Advanced Grid Integration of BESS*** *Integration Challenges with High-Penetration Renewable Systems • Dynamic Response of BESS to Grid Disturbances • Power Quality Improvements with BESS Integration • Long-Term Planning and Forecasting for BESS Integration*
1215 – 1230	*Break*
1230 – 1330	***Demand Response & BESS in Smart Grids*** *Demand Response Programs Utilizing BESS • Smart Grid Technologies for Managing BESS • Real-Time Data Analytics for Grid Optimization • Predictive Maintenance Using AI for BESS Systems*
1330 – 1420	***Communication & Control Systems for BESS*** *SCADA Integration for Remote Monitoring • Communication Standards and Protocols (IEC 61850, DNP3) • Cybersecurity Considerations for BESS Control Systems • Smart Metering Integration with BESS*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5

0730 – 0830	***Maintenance Strategies for BESS*** *Preventive and Predictive Maintenance Techniques • Routine Checks and Calibration for BESS Components • Remote Diagnostics and Monitoring Systems • Ensuring System Longevity and Reducing Downtime*
0830 – 0930	***Troubleshooting Common Bess Issues*** *Identifying Performance Degradation in Batteries • Troubleshooting PCS and BMS Faults • Troubleshooting Grid Synchronization Problems • Resolving Communication Failures and Software Bugs*
0930 – 0945	*Break*
0945 – 1100	***Upgrades & Retrofitting Existing BESS Systems*** *Identifying When to Upgrade A BESS System • Retrofitting Existing BESS with Newer Technologies • Compatibility Between Old and New Battery Chemistries • Re-Engineering PCS for Higher Performance*
1100 - 1230	***Decommissioning & Recycling of BESS*** *End-of-Life Considerations for Batteries and Storage Systems • Sustainable Recycling Practices for Battery Materials • Disposal of Hazardous Materials in Battery Systems • Regulatory Requirements for BESS Decommissioning*
1230 – 1245	*Break*
1245 – 1345	***Future Trends in BESS Technologies*** *Advances in Solid-State and Flow Batteries • The Role of AI and Machine Learning in Energy Storage Optimization• Developing Standards for Ultra-Large-Scale BESS • Predicting the Future of Grid-Scale Energy Storage*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulators (Hands-on Practical Sessions)

Practical session will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the simulator "Battery simulator".



Course Coordinator

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