Grid Stability and Renewable Integration 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

Introduction

Grid Stability and Renewable Integration Training Course provides a practical, industry-focused foundation for understanding how modern power systems maintain grid reliability, frequency stability, voltage stability, power quality, and system resilience while integrating rapidly growing levels of solar PV, wind power, battery energy storage, distributed energy resources (DERs), and smart-grid technologies. The course explores the transition from conventional centralized generation toward flexible, decentralized, and digitally enabled electricity networks. Participants examine renewable energy forecasting, grid flexibility, inverter-based resources (IBRs), grid-forming and grid-following inverters, ancillary services, demand response, energy storage, transmission constraints, congestion management, and real-time power-system operation. Through applied exercises and industry-oriented case studies, learners develop the technical insight needed to assess renewable integration challenges and implement effective grid modernization and decarbonization strategies.

The program emphasizes the emerging capabilities required for high-renewables power systems, including advanced power-system control, synthetic inertia, frequency response, voltage support, dynamic stability, microgrids, virtual power plants (VPPs), battery energy storage systems (BESS), digital substations, SCADA/EMS, wide-area monitoring, artificial intelligence (AI), machine learning, predictive analytics, and cybersecurity. Participants will investigate real-world scenarios involving renewable curtailment, low-inertia operation, frequency disturbances, transmission bottlenecks, and large-scale solar and wind integration. By combining technical concepts, operational practices, simulations, group activities, and case studies, the course enables energy professionals to make informed decisions that support secure, reliable, flexible, resilient, and net-zero-ready electricity grids.

Programme Curriculum

Grid Stability and Renewable Integration 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 power-system stability principles, including transient, dynamic, voltage, and frequency stability.
2. Evaluate the impact of variable renewable energy (VRE) on grid reliability and operational security.
3. Analyze low-inertia grid conditions and identify appropriate frequency-control solutions.
4. Assess the technical behavior and grid impacts of inverter-based resources (IBRs).
5. Explain the differences between grid-following and grid-forming inverter technologies.
6. Apply renewable energy forecasting and operational planning techniques to improve system flexibility.
7. Evaluate battery energy storage systems (BESS) for frequency regulation, voltage support, and energy shifting.
8. Develop strategies for ancillary services, demand response, and flexible generation.
9. Identify causes of voltage instability, frequency excursions, congestion, and renewable curtailment.
10. Explore microgrids, distributed energy resources (DERs), and virtual power plants (VPPs) as grid-flexibility solutions.
11. Apply SCADA, EMS, synchrophasor, AI, and predictive analytics concepts to modern grid operations.
12. Assess grid resilience, cybersecurity, and climate-related risks affecting renewable-rich power systems.
13. Develop practical renewable integration and grid-modernization strategies aligned with reliability, sustainability, and net-zero targets.

Target Audience

1. Power-system engineers and electrical engineers
2. Grid operators and control-room personnel
3. Renewable energy developers and project managers
4. Utility planners and transmission/distribution professionals
5. Energy storage and battery-system specialists
6. Government regulators and energy-policy professionals
7. Smart-grid, digitalization, and energy-technology professionals
8. Consultants, researchers, academics, and energy-sector decision-makers

Course Modules

Module 1: Power-System Stability Fundamentals

- Frequency, voltage, transient, and dynamic stability fundamentals
- Generator dynamics, inertia, damping, and system response
- N-1 security, contingency analysis, and reliability assessment
- Stability challenges associated with changing generation portfolios
- Case Study: System-frequency response following a major generator outage

Module 2: Renewable Energy Integration Challenges

- Technical characteristics of solar PV and wind generation
- Variability, uncertainty, ramp rates, and renewable forecasting
- Renewable curtailment and transmission congestion
- Grid-code requirements for large-scale renewable projects
- Case Study: Managing high solar penetration and midday overgeneration

Module 3: Inverter-Based Resources and Grid Stability

- Grid-following vs. grid-forming inverter architectures
- Synthetic inertia and fast-frequency response
- Fault ride-through and voltage-support capabilities
- Control interactions between multiple inverter-based resources
- Case Study: Stabilizing a low-inertia grid using grid-forming BESS

Module 4: Frequency and Voltage Control

- Primary, secondary, and tertiary frequency control
- Automatic generation control and balancing mechanisms
- Reactive power, voltage regulation, and dynamic voltage support
- Ancillary services for renewable-rich electricity systems
- Case Study: Coordinating batteries and flexible generation during a frequency event

Module 5: Battery Energy Storage and Grid Flexibility

- BESS technologies, operating characteristics, and applications
- Frequency regulation, peak shaving, energy shifting, and reserve provision
- State-of-charge management and battery degradation considerations
- Hybrid renewable-plus-storage systems
- Case Study: Using utility-scale batteries to reduce renewable curtailment

Module 6: Smart Grids, DERs, and Virtual Power Plants

- Distributed energy resources (DERs) and distributed flexibility
- Demand response and intelligent load management
- Microgrids and islanding strategies
- Virtual power plants (VPPs) and aggregated energy resources
- Case Study: Coordinating rooftop solar, batteries, and flexible loads through a VPP

Module 7: Advanced Grid Monitoring, Digitalization, and Cybersecurity

- SCADA, EMS, PMUs, synchrophasors, and wide-area monitoring
- Real-time grid visibility and situational awareness
- AI and machine learning for forecasting and anomaly detection
- Digital substations and data-driven grid operations
- Case Study: Using synchrophasor data and predictive analytics to identify emerging instability

Module 8: Grid Resilience, Planning, and Future Energy Systems

- Renewable integration planning and transmission expansion
- Climate resilience and extreme-weather risk management
- Grid modernization, flexibility markets, and emerging technologies
- Net-zero power systems and long-duration energy storage
- Case Study: Designing a resilient electricity system for high renewable penetration

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
21 Sep 2026	25 Sep 2026	Online	$1,000
21 Sep 2026	25 Sep 2026	Physical	$1,500
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0

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