Wind Power Grid 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

Wind Power Grid Integration Training Course provides a practical and strategic foundation for understanding how modern power systems can securely integrate increasing levels of variable renewable energy (VRE) from onshore and offshore wind farms. As wind generation expands, grid operators, utilities, developers, regulators, and engineers must address power-system flexibility, transmission constraints, frequency response, voltage stability, congestion management, forecasting, curtailment, ancillary services, and grid-code compliance. Current industry priorities increasingly include grid-forming inverters, battery energy storage systems (BESS), digitalisation, dynamic line rating, advanced power-flow control, demand flexibility, and grid-enhancing technologies. The IEA notes that rising wind and solar penetration is increasing the need for flexibility and that grid capacity is becoming a major bottleneck for renewable integration.

This course combines technical concepts, operational practices, planning techniques, regulatory considerations, and real-world case studies to help participants evaluate and manage wind-grid integration challenges. Particular attention is given to inverter-based resources, system strength, stability, renewable forecasting, transmission planning, energy storage, hybrid renewable plants, smart grids, power quality, and resilience. Participants will explore international examples and emerging approaches relevant to both mature and developing electricity markets, including the growing importance of flexibility, storage, ancillary services, and open-access grid frameworks in high-renewable systems. Kenya is also experiencing an advanced stage of VRE integration, with flexibility, storage, and ancillary services identified as important priorities for maintaining a secure and reliable electricity system.

Programme Curriculum

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Introduction

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Course Duration

5 days

Course Objectives

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

1. Understand wind power grid integration principles, architectures, challenges, and industry trends.
2. Evaluate variable renewable energy (VRE) impacts on power-system operation and reliability.
3. Analyse frequency stability, inertia, fast frequency response, and balancing requirements.
4. Apply voltage stability and reactive power management concepts to wind projects.
5. Interpret modern grid codes, interconnection requirements, and compliance-testing principles.
6. Assess inverter-based resources (IBRs) and their influence on system strength and stability.
7. Explain grid-forming and grid-following inverter technologies and emerging applications.
8. Apply wind power forecasting, dispatch, curtailment, and congestion-management strategies.
9. Evaluate battery energy storage systems (BESS) and other flexibility resources for renewable integration.
10. Understand transmission planning, hosting capacity, congestion management, and grid-enhancing technologies.
11. Assess the role of digital grids, SCADA, automation, advanced monitoring, and data analytics.
12. Develop strategies for resilient, flexible, reliable, and low-carbon power-system operation.
13. Translate technical findings into investment, planning, regulatory, and operational decisions.

Target Audience

1. Power-system engineers and electrical engineers
2. Grid and system operators
3. Renewable-energy developers and project managers
4. Wind-farm owners, operators, and O&M professionals
5. Transmission and distribution utility professionals

6. Energy regulators, policymakers, and government officials
7. Energy consultants, analysts, and technical advisors
8. Researchers, academics, and renewable-energy specialists

Course Modules

Module 1: Wind Power and Modern Power-System Integration

- Wind-turbine technologies, **variable generation**, and grid-integration fundamentals
- Onshore versus offshore wind-grid connection architectures
- Wind variability, uncertainty, ramp rates, and **system flexibility**
- Transmission and distribution integration challenges
- **Case Study:** High-VRE integration challenges and flexibility requirements in Kenya, drawing on the IEA's 2026 assessment.

Module 2: Grid Codes, Interconnection, and Power Quality

- **Grid-code compliance** and wind-farm interconnection requirements
- Active-power control, reactive-power capability, and voltage support
- Fault ride-through, protection coordination, and disturbance response
- Harmonics, flicker, power quality, and electromagnetic compatibility
- **Case Study:** Comparative assessment of wind-grid connection requirements across international electricity markets

Module 3: Frequency Stability, Inertia, and System Strength

- Frequency response and balancing in high-wind systems
- Reduced synchronous inertia and the rise of **inverter-based resources**
- Fast frequency response and synthetic-inertia concepts
- Short-circuit strength, weak grids, and stability challenges
- **Case Study:** Grid-forming inverter applications for strengthening renewable-rich power systems; the IEA identifies grid-forming inverters as an emerging tool for reinforcing system strength.

Module 4: Voltage Stability, Reactive Power, and Dynamic Performance

- Voltage regulation and reactive-power management
- STATCOMs, synchronous condensers, and advanced voltage-control solutions
- Dynamic voltage stability during faults and disturbances
- Power-flow analysis and contingency assessment
- **Case Study:** Voltage-management strategy for a large wind plant connected to a constrained transmission network

Module 5: Wind Forecasting, Dispatch, Curtailment, and Flexibility

- Short-term and day-ahead **wind-power forecasting**
- Forecast uncertainty and reserve requirements
- Renewable dispatch and economic operation
- Curtailment, congestion management, and negative-price conditions
- **Case Study:** Managing periods of high wind output and low electricity demand through storage, flexible demand, and operational controls.

Module 6: Energy Storage, Hybrid Plants, and Ancillary Services

- **Battery energy storage systems (BESS)** for wind integration
- Hybrid wind-plus-storage plant configurations
- Frequency regulation, reserves, ramp-rate control, and energy shifting
- Long-duration storage and emerging flexibility technologies
- **Case Study:** Utility-scale batteries supporting renewable integration, balancing, and grid services; global utility-scale battery additions reached a record level in 2024 according to the IEA.

Module 7: Transmission Planning, Grid-Enhancing Technologies, and Digital Grids

- Transmission expansion and **renewable hosting capacity**
- Congestion management and flexible/non-firm grid connections
- Dynamic line rating, advanced power-flow control, and topology optimisation
- SCADA, synchrophasors, digital substations, and real-time monitoring
- **Case Study:** Grid-enhancing technologies as tools for unlocking additional renewable connection capacity; the IEA estimates that selected technologies could unlock substantial capacity from advanced grid-connection queues.

Module 8: Advanced Wind-Grid Integration, Markets, and Future Power Systems

- **Grid-forming technology**, smart grids, and advanced inverter controls
- Demand response, distributed energy resources, and flexibility markets
- Ancillary services, open access, market design, and renewable participation
- Resilience, cyber-physical considerations, and future grid architectures
- **Case Study:** Demand flexibility and digitalisation examples demonstrating how flexible demand can support renewable integration and manage network constraints.

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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