Power System Protection for Renewables 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

Power System Protection for Renewables Training Course provides a practical, industry-focused foundation for engineers and technical professionals responsible for protecting modern electricity networks with increasing penetration of solar PV, wind power, battery energy storage systems (BESS), distributed energy resources (DERs), and inverter-based resources (IBRs). As renewable generation increasingly connects through power electronic interfaces, conventional protection assumptions particularly those based on high fault currents from synchronous generators can become less reliable. Current industry work emphasizes IBR fault response, short-circuit modeling, grid-following (GFL) and grid-forming (GFM) inverters, voltage/frequency ride-through, negative-sequence current, protection coordination, and system resilience. IEEE materials specifically identify the distinctive, controlled and current-limited fault behavior of IBRs as a major protection challenge.

The course combines power system protection fundamentals, renewable-grid integration, digital relaying, protection coordination, fault analysis, inverter behavior, adaptive protection, synchrophasor applications, and real-world case studies. Participants explore how protection strategies must evolve for high-IBR and low-inertia grids, including applications involving solar farms, wind plants, BESS, microgrids and transmission networks. The curriculum is aligned conceptually with contemporary industry themes surrounding IEEE 2800, grid-forming technologies, IBR interoperability, protection performance, and advanced short-circuit analysis.

Programme Curriculum

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Course Duration

5 days

Course Objectives

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

1. Understand modern power system protection principles for renewable and inverter-dominated grids.
2. Analyze IBR fault behavior and its impact on conventional protection schemes.
3. Evaluate short-circuit current characteristics of solar PV, wind and BESS installations.
4. Apply IBR-aware protection coordination for renewable generation networks.
5. Assess distance, overcurrent, differential and directional protection challenges in high-IBR systems.
6. Understand grid-following and grid-forming inverter behavior during grid disturbances.
7. Analyze fault ride-through (FRT) and voltage/frequency support requirements.
8. Develop approaches for adaptive protection in changing renewable-grid operating conditions.
9. Apply digital protection, numerical relays and synchrophasor-based protection concepts.
10. Evaluate islanding detection, anti-islanding and microgrid protection requirements.
11. Investigate BESS protection and renewable-storage integration challenges.
12. Interpret protection requirements associated with IEEE 2800, DER interconnection and grid reliability.
13. Design more resilient, reliable and future-ready protection strategies for renewable-rich power systems.

Target Audience

1. Power System Protection Engineers
2. Electrical and Power System Engineers
3. Renewable Energy Engineers
4. Utility Grid Planning and Operations Professionals
5. Substation and Relay Engineers
6. Solar PV and Wind Farm Engineers
7. BESS, Microgrid and DER Specialists
8. Engineering Managers, Consultants and Technical Leaders

Course Modules

Module 1: Renewable Energy Power System Protection Fundamentals

- Evolution from **synchronous-generator grids to inverter-dominated power systems**.
- Protection objectives.
- Protection architecture for **solar PV, wind farms, BESS and hybrid renewable plants**.
- Renewable-grid fault scenarios and protection operating principles.
- **Case Study:** Protection challenges created by increasing solar and wind penetration.

Module 2: Inverter-Based Resources and Fault Behavior

- Fundamentals of **Inverter-Based Resources (IBRs)** and power-electronic interfaces.
- **Grid-following vs. grid-forming inverter** characteristics.
- Current-limited and controlled IBR fault response.
- Positive-, negative- and zero-sequence behavior during disturbances.
- **Case Study:** Analysis of an IBR-dominated network where conventional fault-current assumptions become unsuitable. IEEE identifies low-magnitude, controlled IBR short-circuit behavior as a central protection challenge.

Module 3: Short-Circuit Analysis and Renewable Grid Modeling

- Renewable plant **short-circuit modeling** principles.
- Comparison of synchronous-machine and inverter-based fault models.
- Phasor-domain and time-domain approaches to **IBR fault analysis**.
- Influence of inverter controls on fault-current characteristics.
- **Case Study:** Modeling a solar/wind plant fault response for protection studies.

Module 4: Protection Schemes for Solar, Wind and BESS

- **Overcurrent, directional, distance and differential protection** applications.
- Collector-system and renewable-plant protection architecture.
- Transformer, feeder, busbar and interconnection protection.
- **BESS protection** considerations and renewable-storage interfaces.
- **Case Study:** Protection coordination for a utility-scale solar farm with battery storage.

Module 5: Protection Coordination and Adaptive Protection

- Protection coordination in **high-IBR and low-inertia networks**.
- Relay sensitivity, reach, selectivity and security considerations.
- Challenges caused by changing renewable dispatch and network topology.
- **Adaptive protection** concepts for dynamic grid conditions.
- **Case Study:** Adaptive relay settings for a renewable plant operating under multiple grid configurations.

Module 6: Digital Relays, Synchrophasors and Advanced Protection

- Numerical relay architecture and modern **digital protection**.
- **Phasor Measurement Units (PMUs)** and wide-area protection concepts.
- Communication-assisted protection and high-speed fault detection.
- Data-driven and **AI-enabled power system protection** concepts.
- **Case Study:** Using synchronized measurements to identify abnormal conditions in a renewable-rich transmission corridor.

Module 7: Grid Codes, IEEE 2800 and Renewable Interconnection

- Renewable interconnection requirements and **grid-code compliance**.
- Voltage and frequency ride-through requirements.
- Reactive power, active power and dynamic voltage-support considerations.
- **IEEE 2800**, IBR interoperability and system protection requirements.
- **Case Study:** Evaluating protection and performance requirements for a large IBR facility interconnected to a transmission system. IEEE 2800 covers capabilities including voltage/frequency ride-through, active/reactive power control, negative-sequence current injection and system protection.

Module 8: Advanced Protection, Resilience and Future Renewable Grids

- **Grid-forming inverter protection** and future protection architectures.
- Microgrid protection, intentional islanding and system restoration.
- **Wide-area protection, adaptive protection and real-time simulation**.
- Cyber-physical resilience and intelligent protection applications.
- **Case Study:** Developing a future-ready protection strategy for a high-renewable, battery-supported microgrid.

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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