Solar Microgrid Design and Operation 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

Solar Microgrid Design and Operation Training Course provides a practical and future-focused foundation for professionals working with solar photovoltaic (PV) systems, distributed energy resources (DERs), battery energy storage systems (BESS), smart grids, energy management systems (EMS), and resilient power infrastructure. Modern microgrids combine local generation, storage, controllable loads, and intelligent controls into coordinated energy systems that can operate in grid-connected or islanded modes. The course therefore emphasizes the complete project lifecycle from solar resource assessment, load profiling, system sizing, electrical architecture, inverter selection, battery integration, protection, controls, and grid interconnection through to commissioning, monitoring, maintenance, and operational optimization. Emerging areas such as grid-forming inverters, black start, digital energy management, virtual power plants, demand response, and AI-enabled optimization are also incorporated to reflect the rapidly evolving microgrid sector.

Through instructor-led learning, technical exercises, simulations, group problem-solving, and real-world case studies, participants will develop the knowledge required to evaluate, design, operate, and optimize solar microgrid projects for commercial facilities, industrial sites, campuses, healthcare facilities, remote communities, agricultural operations, and critical infrastructure. Particular attention is given to energy resilience, reliability, power quality, battery state-of-charge management, renewable intermittency, peak shaving, demand-side management, and lifecycle economics. Recent technical work also highlights advanced optimization of PV and storage, scenario-based reliability planning, and intelligent energy management as important directions for renewable-rich microgrids.

Programme Curriculum

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Course Duration

5 days

Course Objectives

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

1. Analyze solar microgrid architectures, DER integration, and distributed energy systems.
2. Design and size PV generation, BESS, inverters, distribution equipment, and critical loads.
3. Develop load profiles and perform solar resource, energy yield, and demand analysis.
4. Configure hybrid microgrids using PV, batteries, backup generation, and controllable loads.
5. Optimize energy management systems (EMS) for reliability, efficiency, and operating cost.
6. Apply grid-connected and islanded operation strategies, including seamless transition concepts.
7. Evaluate grid-forming and grid-following inverter technologies for renewable-rich systems.
8. Develop protection and control strategies for bidirectional power flows and inverter-based resources.
9. Apply battery energy storage optimization, state-of-charge management, and peak-shaving strategies.
10. Assess power quality, voltage, frequency, and system stability in solar microgrids.
11. Evaluate microgrid resilience, black-start, backup power, and critical-load strategies.
12. Analyze techno-economic performance, lifecycle costs, energy savings, and investment considerations.
13. Develop an operational roadmap incorporating smart-grid technologies, digital monitoring, demand response, and future AI-enabled energy management.

Target Audience

1. Electrical and Power Systems Engineers
2. Renewable Energy Engineers and Solar PV Professionals
3. Energy Managers and Facility Managers
4. Utility and Distribution Network Professionals

5. Microgrid Developers and Project Managers
6. Battery Energy Storage and Energy Management Specialists
7. Consultants, Regulators, and Energy Policy Professionals
8. Technical Managers, Researchers, and Sustainability Professionals

Course Modules

Module 1: Solar Microgrid Fundamentals and Architecture

- Microgrid concepts, architectures, operating modes, and **DER integration**.
- Solar PV, BESS, inverters, loads, meters, controllers, and protection components.
- Grid-connected, islanded, hybrid, and off-grid microgrid configurations.
- **Case Study:** Solar microgrid architecture for a remote community with critical loads.
- Develop a single-line diagram for a solar-battery microgrid.

Module 2: Solar PV Resource Assessment and Microgrid Sizing

- Solar irradiation, temperature, PV performance, energy yield, and degradation.
- Load forecasting, load profiles, critical-load identification, and demand analysis.
- PV capacity sizing and energy-balance calculations.
- **Case Study:** PV sizing for a commercial facility with daytime and evening demand.
- Compare alternative PV capacities against projected energy demand.

Module 3: Battery Energy Storage Systems and Hybrid Integration

- BESS architecture, battery technologies, power/energy ratings, and operating limits.
- **State of charge (SOC), depth of discharge, degradation**, and battery lifecycle considerations.
- Charge/discharge strategies, peak shaving, energy shifting, and backup operation.
- **Case Study:** BESS optimization for reducing peak grid demand in a commercial microgrid.
- Develop a daily PV-BESS dispatch strategy.

Module 4: Microgrid Control, EMS, and Intelligent Operation

- Microgrid controllers, **Energy Management Systems (EMS)**, supervisory control, and dispatch.
- Voltage and frequency regulation with inverter-based resources.
- Demand response, flexible loads, forecasting, and real-time energy optimization.
- Emerging **AI-driven energy management, digital twins, and intelligent dispatch** concepts.
- **Case Study:** AI-assisted coordination of PV, BESS, and variable loads during changing solar conditions.

Module 5: Grid Connection, Islanding, Protection, and Power Quality

- **IEEE 1547**, DER interconnection principles, and grid-support functions.
- Grid synchronization, anti-islanding, islanded operation, and reconnection.
- Protection coordination, fault detection, voltage regulation, and frequency management.
- Harmonics, power factor, voltage fluctuations, and inverter-related power-quality issues.
- **Case Study:** Protection and control strategy for a grid-connected solar microgrid transitioning to island mode.

Module 6: Microgrid Operations, Resilience, and Black Start

- Normal operation, abnormal conditions, outage management, and restoration.
- **Black start**, grid-forming inverters, critical-load prioritization, and load restoration.

- Renewable forecasting and operational planning under variable weather conditions.
- Resilience against grid outages and extreme-weather events.
- **Case Study:** Battery-supported black-start and restoration of a critical-facility microgrid.

Module 7: Monitoring, Maintenance, Performance Optimization, and Safety

- SCADA, smart meters, remote monitoring, alarms, data acquisition, and performance dashboards.
- PV, inverter, BESS, switchgear, protection, and communications maintenance.
- Battery performance monitoring, fault diagnosis, preventive maintenance, and asset management.
- Key performance indicators including availability, renewable utilization, efficiency, and energy-not-served.
- **Case Study:** Diagnosing declining solar microgrid performance using operational data and maintenance indicators.

Module 8: Techno-Economic Analysis, Project Development, and Future Microgrids

- CAPEX, OPEX, lifecycle cost, energy savings, payback, and project feasibility.
- Business cases for commercial, industrial, campus, rural, and critical-infrastructure microgrids.
- **Virtual Power Plants (VPPs), peer-to-peer energy trading, demand response**, and flexible DER aggregation.
- Future trends including **AI, digital twins, advanced BESS, grid-edge intelligence, and renewable-rich microgrids**.
- **Case Study:** Develop a preliminary business case for a resilient solar-BESS microgrid serving a campus or industrial facility.

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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