# Renewable Energy Reliability Engineering Training Course

Professional Development Training Course Outline

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|---|---|---|---|
| **Category** | Renewable Energy | **Duration** | 5 Days |
| **Base Fee** | $1,500 USD | **Delivery Mode** | Online / On-site Hybrid |

## Course Introduction

Renewable Energy Reliability Engineering Training Course is designed to equip professionals with advanced capabilities for improving the reliability, availability, resilience, safety, and lifecycle performance of renewable energy assets. The course covers solar PV, wind energy, hydropower, battery energy storage systems (BESS), smart grids, microgrids, and renewable-energy-integrated power systems, with strong emphasis on reliability-centered maintenance, condition monitoring, predictive maintenance, failure analysis, asset health management, and risk-based decision-making. Modern renewable assets increasingly depend on digital monitoring, AI-enabled analytics, and intelligent maintenance approaches to manage intermittency, equipment degradation, extreme weather, and complex grid interactions. Recent research highlights Digital Twins, AI/ML, predictive maintenance, physics-informed machine learning, IoT/SCADA, edge-cloud computing, and cyber-physical systems as important enablers of reliable renewable energy operations.

Participants will develop practical skills for building reliability strategies, maintenance optimization programs, failure prediction models, asset criticality frameworks, reliability KPIs, and resilience improvement plans. The course connects engineering theory with practical case studies, root-cause analysis, Weibull analysis, FMEA/FMECA, fault-tree analysis, RCM, remaining useful life (RUL), condition-based maintenance, and digital asset management. It also addresses the growing reliability challenges associated with high renewable penetration and grid flexibility; for example, Kenya Power has recently highlighted the impact of rapid wind and solar integration on grid stability and reliability. Participants will leave with a structured framework for converting operational data into actionable reliability intelligence, optimized maintenance decisions, reduced downtime, improved asset availability, and resilient energy-system performance.

## Programme Curriculum

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**Course Duration**

5 days

**Course Objectives**

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

1. Apply reliability engineering principles to renewable energy assets and power systems.
2. Develop asset criticality, risk, and reliability assessment frameworks.
3. Perform FMEA/FMECA, Fault Tree Analysis, Root Cause Analysis, and failure-mode assessment.
4. Apply Weibull analysis, reliability distributions, MTBF, MTTR, availability, and maintainability metrics.
5. Design Reliability-Centered Maintenance (RCM) and risk-based maintenance strategies.
6. Implement condition-based and predictive maintenance using operational and sensor data.
7. Understand AI/ML-enabled fault detection, anomaly detection, and Remaining Useful Life (RUL) estimation.
8. Apply Digital Twin technology for asset health monitoring and predictive maintenance.
9. Evaluate reliability risks across solar PV, wind turbines, hydropower, and BESS.
10. Improve grid reliability, resilience, flexibility, and renewable-energy integration.
11. Develop SCADA, IoT, edge analytics, and data-driven asset-monitoring strategies.
12. Establish reliability KPIs, dashboards, lifecycle-cost models, and maintenance-performance indicators.
13. Build integrated asset-management and reliability-improvement roadmaps for renewable energy projects.

**Target Audience**

1. Renewable Energy Engineers
2. Reliability and Maintenance Engineers
3. Electrical and Power Systems Engineers
4. Asset Management Professionals
5. Operations & Maintenance Managers
6. Solar PV and Wind Farm Professionals
7. Utility, Grid, and Energy-System Specialists
8. Engineering Consultants, Project Managers, and Technical Leaders

**Course Modules**

**Module 1: Fundamentals of Renewable Energy Reliability Engineering**

- Reliability, availability, maintainability, and resilience fundamentals.
- Failure mechanisms and reliability characteristics of renewable assets.
- Asset criticality and risk-based reliability prioritization.
- Reliability KPIs
- **Case Study:** Developing a reliability improvement strategy for a utility-scale renewable-energy portfolio.

**Module 2: Failure Analysis, FMEA/FMECA and Root Cause Engineering**

- Failure Mode and Effects Analysis (**FMEA**) and FMECA methodology.
- Fault Tree Analysis (**FTA**) and event-tree concepts.
- Root Cause Analysis (**RCA**) and structured problem-solving.
- Failure modes of PV modules, inverters, wind turbines, transformers, generators, and BESS.
- **Case Study:** Root-cause investigation of repeated inverter and balance-of-system failures.

**Module 3: Reliability-Centered and Risk-Based Maintenance**

- Principles of **Reliability-Centered Maintenance (RCM)**.
- Preventive, corrective, condition-based, and predictive maintenance.
- Criticality ranking and risk-based maintenance planning.
- Maintenance optimization and lifecycle cost analysis.
- **Case Study:** Converting a time-based maintenance program into an RCM-based strategy for a wind farm.

**Module 4: Solar PV Reliability and Predictive Asset Management**

- PV module degradation, hotspots, inverter reliability, and electrical faults.
- **SCADA analytics, I-V tracing, infrared thermography, UAV inspection, and condition monitoring**
- Performance degradation and reliability modeling.
- AI-assisted fault classification and predictive maintenance.
- **Case Study:** Early detection of PV performance degradation using multimodal inspection and analytics.

**Module 5: Wind Turbine Reliability and Intelligent O&M**

- Reliability of gearboxes, bearings, generators, blades, pitch, yaw, and control systems.
- Vibration, temperature, acoustic, oil, and SCADA-based condition monitoring.
- Predictive diagnostics and **Remaining Useful Life (RUL)** estimation.
- Digital Twins for wind-turbine operation and maintenance.
- **Case Study:** Digital-Twin-enabled predictive maintenance for wind-turbine components.

**Module 6: Hydropower, BESS and Energy Storage Reliability**

- Reliability challenges in hydro turbines, generators, governors, and auxiliary systems.
- Battery degradation, thermal management, power electronics, and BESS reliability.
- Health indicators, degradation modeling, and lifecycle assessment.
- Safety-oriented monitoring and failure-risk management.
- **Case Study:** Developing an asset-health model for a hybrid renewable-energy and battery-storage facility.

**Module 7: AI, Digital Twins, IoT and Predictive Reliability**

- **Artificial Intelligence, Machine Learning, Deep Learning, and anomaly detection**
- Digital Twin architectures for renewable-energy assets.
- IoT sensors, SCADA, edge computing, cloud analytics, and data pipelines.
- Physics-informed ML, federated learning, and intelligent predictive maintenance.
- **Case Study:** AI-enabled predictive maintenance using distributed sensor data for wind and solar assets.

**Module 8: Grid Reliability, Resilience and Reliability Improvement Planning**

- Renewable integration, grid stability, flexibility, and resilience.
- Reliability risks associated with variable renewable generation.
- Outage analysis, restoration, contingency planning, and resilience engineering.
- Reliability dashboards, KPIs, lifecycle economics, and improvement roadmaps.
- **Case Study:** Building a renewable-integrated grid resilience strategy using predictive analytics and digital monitoring.

## 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 |
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**Register Online Now**

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