Predictive Maintenance for Renewable Assets 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

Predictive Maintenance for Renewable Assets Training Course equips professionals with practical knowledge to transform conventional maintenance into AI-enabled, data-driven, condition-based asset management. As renewable portfolios expand across wind, solar PV, hydropower, and battery energy storage systems (BESS), operators increasingly need advanced capabilities for fault detection, anomaly detection, degradation forecasting, remaining useful life (RUL) estimation, reliability engineering, and intelligent maintenance planning. Recent research highlights the growing convergence of Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), SCADA analytics, and Digital Twins for predictive maintenance across renewable assets.

The course develops an end-to-end understanding of how operational data can support early-warning systems, asset health monitoring, predictive analytics, risk-based maintenance, lifecycle optimization, and prescriptive decision-making. Participants explore how physics-based, data-driven, and hybrid models can be integrated with Digital Twins, while addressing practical issues such as data quality, model validation, interoperability, cybersecurity, and deployment. These capabilities reflect current industry and research directions toward intelligent, resilient, scalable, and sustainable renewable-energy operations.

Programme Curriculum

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Course Duration

5 days

Course Objectives

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

1. Understand Predictive Maintenance (PdM) principles and their role in renewable-asset reliability.
2. Apply AI and Machine Learning concepts to renewable asset health monitoring.
3. Analyze SCADA, IoT, sensor, weather, and historical maintenance data.
4. Develop condition-monitoring and anomaly-detection strategies.
5. Identify early indicators of component degradation and impending failures.
6. Apply fault diagnosis and failure-mode analysis to renewable assets.
7. Understand Remaining Useful Life (RUL) estimation and prognostics.
8. Design Digital Twin-enabled predictive maintenance workflows.
9. Compare physics-based, data-driven, and hybrid AI models.
10. Integrate edge computing, cloud analytics, and real-time monitoring into maintenance architectures.
11. Evaluate maintenance risk, criticality, reliability, and lifecycle cost.
12. Develop prescriptive maintenance and decision-support strategies.
13. Address AI governance, cybersecurity, interoperability, explainable AI, and sustainable asset management.

Target Audience

1. Renewable energy asset managers
2. Operations & Maintenance (O&M) engineers
3. Wind turbine and solar PV engineers
4. Reliability and maintenance professionals
5. Energy data scientists and AI/ML engineers
6. Digital transformation and Digital Twin specialists
7. Power-system and energy-storage professionals
8. Technical managers, consultants, and renewable-energy project leaders

Course Modules

Module 1: Renewable Asset Reliability & Predictive Maintenance Fundamentals

- Reactive vs. preventive vs. predictive vs. prescriptive maintenance
- Asset criticality, failure modes, reliability, availability, and maintainability

- Condition-Based Maintenance (CBM) and asset-health concepts
- Maintenance KPIs-MTBF, MTTR, availability, downtime, OEE-style indicators
- Case Study: Transitioning a wind-farm maintenance program from calendar-based servicing toward condition-based maintenance

Module 2: Renewable Asset Data, SCADA & IoT Analytics

- Understanding SCADA, IoT sensors, telemetry, weather, vibration, thermal, and electrical data
- Data acquisition, cleansing, synchronization, labeling, and feature engineering
- Handling missing data, sensor drift, noise, and data-quality issues
- Building renewable-asset data pipelines and health-monitoring dashboards
- Case Study: Using wind-turbine SCADA signals to identify abnormal operating behavior before component failure

Module 3: AI, Machine Learning & Anomaly Detection

- Supervised, unsupervised, and semi-supervised learning for maintenance analytics
- Classification, regression, clustering, and anomaly-detection techniques
- Feature engineering and model-performance evaluation
- Explainable AI (XAI) and trustworthy predictive analytics
- Case Study: Developing an anomaly-detection model for early identification of abnormal solar-PV inverter behavior

Module 4: Fault Diagnosis & Failure Prediction

- Failure-mode identification using FMEA/FMECA and reliability engineering
- Fault signatures for turbines, PV systems, hydropower equipment, and BESS
- Deep Learning, time-series analytics, and multimodal diagnostics
- Root-cause analysis and fault classification
- Case Study: Combining electrical and thermal indicators to improve fault localization in a photovoltaic plant

Module 5: Remaining Useful Life & Prognostics

- Fundamentals of Prognostics and Health Management (PHM)
- Degradation modeling and Remaining Useful Life (RUL) estimation
- Time-series forecasting and survival/reliability approaches
- Uncertainty quantification and prediction confidence
- Case Study: Estimating degradation trajectories and maintenance windows for wind-turbine drivetrain components

Module 6: Digital Twins for Predictive Maintenance

- Digital Twin architecture and cyber-physical asset representation
- Integration of real-time data, simulation, AI, and asset models
- Physics-based, data-driven, and hybrid Digital Twins
- Diagnostic, prognostic, prescriptive, and increasingly autonomous maintenance workflows
- Case Study: Creating a Digital Twin concept for monitoring a wind turbine or solar PV asset throughout its operational lifecycle

Module 7: Predictive Maintenance Strategy, Optimization & Lifecycle Value

- Maintenance prioritization using risk, criticality, probability of failure, and consequence
- Spare-parts planning and maintenance-resource optimization
- Lifecycle cost, downtime reduction, energy-yield impact, and asset ROI
- From predictive analytics to prescriptive maintenance and decision intelligence
- Case Study: Optimizing maintenance intervals across a multi-asset renewable portfolio while balancing reliability and operating costs

Module 8: Deployment, Cybersecurity & Future of Intelligent Renewable O&M

- Edge AI, cloud analytics, IoT architectures, and real-time decision support
- Data interoperability, standardization, scalability, and system integration
- Cybersecurity and AI governance for connected renewable assets
- Model monitoring, retraining, validation, and operational deployment
- Case Study: Designing a secure AI-enabled predictive-maintenance architecture for a connected renewable-energy portfolio

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
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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