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COURSE BROCHURE

Machine Learning for Transformer and Substation Asset Health Course

22 – 26 August 2027
Manama

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Registered in the United Kingdom and Saudi Arabia

Machine Learning for Transformer and Substation Asset Health Course

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Machine Learning for Transformer and Substation Asset Health is a 1-week training course for utility asset engineers, protection specialists and network analysts who score the condition of power transformers, breakers and switchgear, and it produces a Transformer Health Index and Replacement Ranking. As fleets age and rooftop solar and new loads reshape feeder flows, utilities must decide which units to refurbish first. Jupiter Prime Training delivers this course on Machine Learning for Transformer and Substation Asset Health.

Why Machine Learning for Transformer and Substation Asset Health Matters Now

Many transformers run past their design life while vehicle charging and distributed solar push unfamiliar loading through them. At the same time, online monitors, smart meters and inspection drones produce far more condition signals than engineers can read by hand. Utilities that combine these signals into a defensible health score can defer spending safely and avoid unplanned outages; those that rely on age alone replace sound units and miss failing ones. The course draws on ISO/IEC 42001, the AI management system standard, and the NIST AI Risk Management Framework NIST AI RMF.

Who Gains Most from Machine Learning for Transformer and Substation Asset Health

- Engineers who interpret oil test, dissolved gas and thermal results for transformer fleets
- Specialists who maintain circuit breakers, switchgear and protection relays
- Analysts who forecast feeder and transformer loading from meter readings
- Planners who rank substation assets for refurbishment and capital replacement
- Data owners who manage condition monitoring and asset register records

Asset management departments that bring condition, planning and data roles into one cohort gain most from shared scoring rules.

Machine Learning for Transformer and Substation Asset Health Capabilities

Participants practise converting test results, loading histories and alarms into probability-of-failure estimates that engineers can explain.

- Assess dissolved gas trends with classification models alongside ratio methods — transformer specialists
- Calculate thermal ageing from forecast loading and ambient temperature — network planners
- Build a health index that weights oil, electrical and mechanical evidence — asset managers
- Test breaker anomaly alerts against maintenance findings — protection engineers
- Specify asset register and sensor data rules for model inputs — data owners

- Communicate risk-ranked replacement options to investment committees — capital approvals

Key Machine Learning for Transformer and Substation Asset Health Terms

- Dissolved gas analysis — measuring gases in transformer oil to detect overheating, arcing or partial discharge.
- Health index — a single score combining condition indicators to show how close an asset is to end of life.
- Hot-spot temperature — the hottest winding temperature, which drives insulation ageing in a transformer.
- Probability of failure — the estimated chance an asset fails within a chosen period, given its condition.
- Partial discharge — small electrical sparks within insulation that signal developing defects.
- Load profile — the pattern of demand over time on a feeder or transformer, often taken from meter data.

Machine Learning for Transformer and Substation Asset Health Day by Day

Day 1: Substation Fleet Risk and Data Sources

- Asset Register Audit — Finding Gaps in Nameplate and Age Records
- Condition Data Inventory — Oil Tests, Online Monitors and Inspections
- Failure Mode Mapping — Linking Defects to Measurable Signals
- ISO/IEC 42001 Scope Statement — Placing Asset Models Under Management Control
- NIST AI RMF Measure Function — Defining Evidence for Model Trust

Day 2: Load Forecasting and Thermal Ageing

- Smart Meter Aggregation — Building Transformer Load Profiles From Customer Data
- Gradient Boosting Load Forecast — Predicting Peak Loading by Season
- Solar Back-Feed Prediction — Estimating Reverse Flow From Distributed Generation
- Hot-Spot Temperature Model — Converting Forecast Loading Into Insulation Ageing
- Forecast Error Bands — Setting Margins Before Overload Decisions

Day 3: Condition Models for Transformers and Switchgear

- Dissolved Gas Classification — Comparing Learned Models With Ratio Methods
- Partial Discharge Pattern Recognition — Separating Noise From Insulation Defects
- Breaker Timing Anomaly Detection — Flagging Slow Trip and Close Operations
- Thermal Image Screening — Spotting Hot Joints in Switchgear Inspections
- Imbalanced Failure Data Handling — Learning From Rare Outage Records

Day 4: Health Index and Replacement Decisions

- Health Index Weighting — Combining Oil, Electrical and Mechanical Scores
- Probability of Failure Curves — Translating Scores Into Outage Risk
- Consequence of Failure Scoring — Weighing Customers, Safety and Repair Time
- Risk Matrix Prioritisation — Ordering Refurbish, Monitor or Replace Options
- Model Explanation Reports — Justifying Rankings to Investment Committees

Day 5: Practising the Transformer Health Index and Replacement Ranking

- Distribution Utility Case — Applying Load Forecasts to Ageing Transformers
- Industrial Plant Substation Case — Applying Gas Models to Process Supply
- Ranking Challenge Panel — Testing Risk Scores Against Field Engineers
- Data Stewardship Agreement — Assigning Owners for Condition Records
- Transformer Health Index and Replacement Ranking — Completing the Fleet Schedule

Applying Machine Learning for Transformer and Substation Asset Health After the Course

- Score twenty priority transformers with the health index weighting against current replacement plans.
- Build a transformer load profile from meter data for one feeder and check hot-spot ageing against forecasts.

Machine Learning for Transformer and Substation Asset Health Questions FAQ

What is machine learning for transformer and substation asset health and why does it matter now?

It is the use of predictive models on test, loading and monitoring data to estimate equipment condition. It matters now because ageing fleets face new loading from solar and electrification, and spending must target the riskiest units.

Which roles gain most from machine learning for transformer and substation asset health?

Transformer specialists, protection engineers, network analysts and asset planners gain most.

How does machine learning for transformer and substation asset health differ from a renewable integration course?

It centres on equipment condition and replacement ranking. A renewable integration course focuses on dispatch and flexibility, whereas here solar and load forecasts serve only to estimate stress on transformers.

What do you bring back from machine learning for transformer and substation asset health training?

You bring back a scored and ranked list of substation assets, with the rules and data owners behind each ranking.

Machine Learning for Transformer and Substation Asset Health: The Way Forward

The Transformer Health Index and Replacement Ranking first informs which units enter the next refurbishment or replacement budget. Asset planners, condition specialists and investment committees use it as a shared reference. After its first use, revisit the index weights against new oil tests and failures, to check the scores separate healthy units from failing ones.