Transmission System Modernization 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

Transmission System Modernization Training Course provides a practical, future-focused framework for professionals responsible for upgrading electrical transmission networks for grid resilience, digital transformation, energy transition, renewable integration, operational efficiency, and cybersecurity. Modern transmission systems increasingly depend on digital substations, intelligent electronic devices (IEDs), advanced protection and automation, high-speed communications, real-time monitoring, and interoperable standards. The IEC 61850 ecosystem has continued to evolve, with the 2026 edition covering an extensive set of power-utility automation standards, while current industry programs increasingly emphasize digital twins, inverter-based resources, machine learning, packet-based communications, and next-generation telecommunications.

The course equips participants to develop modernization strategies that balance legacy-system migration, smart substation architecture, wide-area communication, protection modernization, DER integration, asset management, AI-enabled analytics, and OT cybersecurity. It emphasizes practical decision-making through engineering scenarios and case studies, including modernization of aging substations, IEC 61850 migration, renewable-rich transmission corridors, digital protection, and cyber-resilient control environments. Current power-system guidance also highlights interoperability, secure communications, real-time monitoring, automation, and workforce capability as important elements of modernization.

Programme Curriculum

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Course Duration

5 days

Course Objectives

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

1. Develop transmission-system modernization strategies aligned with energy-transition objectives.
2. Assess legacy infrastructure and prioritize digital upgrade opportunities.
3. Design digital substation architectures using modern automation concepts.
4. Apply IEC 61850 interoperability principles to protection, control, and automation.
5. Evaluate SCADA, EMS, WAMS, PMU, and synchrophasor modernization requirements.
6. Plan reliable OT/ICS cybersecurity architectures for critical transmission infrastructure.
7. Integrate renewable energy, inverter-based resources, BESS, and DERs into transmission planning.
8. Apply AI, machine learning, predictive analytics, and digital-twin concepts to grid operations.
9. Modernize protection, automation, and teleprotection systems while maintaining reliability.
10. Evaluate fiber, packet-switched, deterministic networking, 5G, and advanced telecommunications options.
11. Develop asset-management and predictive-maintenance strategies using condition data and analytics.
12. Build phased migration, investment, risk-management, and business-continuity roadmaps.
13. Establish performance, resilience, interoperability, and cybersecurity KPIs for modernization programs.

Target Audience

1. Transmission system operators and grid operators
2. Electrical and power-system engineers
3. Substation, protection, and automation engineers
4. SCADA, EMS, WAMS, and control-center professionals
5. Asset-management and maintenance specialists
6. Telecommunications, OT, and cybersecurity professionals
7. Utility planners, project managers, and technical managers
8. Regulators, consultants, EPC professionals, and energy-sector decision-makers

Course Modules

Module 1: Transmission Modernization Strategy & Energy Transition

- Transmission-system transformation drivers and **grid modernization** trends.
- Assessing aging infrastructure, reliability gaps, and modernization priorities.
- Integrating **decarbonization, renewable generation, electrification, and grid resilience**.
- Developing modernization roadmaps, investment priorities, and implementation phases.
- **Case Study:** Strategic modernization roadmap for an aging transmission network experiencing rapid renewable-energy growth.

Module 2: Digital Substations & IEC 61850

- Digital-substation architecture, process bus, station bus, IEDs, and intelligent automation.
- **IEC 61850 data models, logical nodes, GOOSE, Sampled Values, and engineering concepts**
- Interoperability, configuration management, testing, and lifecycle considerations.
- Legacy-to-digital migration strategies and gateway integration.
- **Case Study:** Migration of a conventional substation toward an IEC 61850-based digital architecture.

Module 3: Advanced Protection, Automation & Control

- Modern **distance, differential, busbar, transformer, and adaptive protection** concepts.
- Protection automation, teleprotection, synchrophasors, and high-speed communications.
- Protection challenges associated with **inverter-based resources**.
- Hardware-in-the-loop, digital testing, simulation, and validation.
- **Case Study:** Protection modernization for a transmission corridor containing significant inverter-based renewable generation

Module 4: Grid Communications, SCADA, WAMS & Next-Generation Networks

- Modern SCADA, EMS, WAMS, PMU, and real-time data architectures.
- Fiber-optic, Ethernet, packet-switched, deterministic networking, and WAN engineering.
- Network redundancy, latency, synchronization, QoS, and reliability.
- Emerging **5G, IoT, and next-generation telecommunications** for grid applications.
- **Case Study:** Designing a resilient communication architecture for substation-to-control-center and wide-area protection applications.

Module 5: Renewable Integration, DERs & Grid Flexibility

- Transmission impacts of **solar PV, wind, BESS, EVs, and distributed energy resources**.
- Managing voltage, frequency, congestion, power quality, and system stability.
- Grid-support functions and inverter-based resource behavior.
- Interoperability and standardized information models for DER integration.
- **Case Study:** Managing a transmission region with rapidly increasing solar, wind, and battery penetration using modern grid-support capabilities.

Module 6: AI, Digital Twins & Predictive Grid Analytics

- **Artificial intelligence, machine learning, digital twins, and advanced analytics** for transmission.
- Predictive maintenance and condition-based asset management.
- Real-time anomaly detection, outage prediction, and situational awareness.
- Digital-twin applications for protection, automation, planning, and operational decision support.
- **Case Study:** Developing a digital-twin concept for a critical transmission substation to improve asset visibility, maintenance planning, and operational awareness.

Module 7: OT Cybersecurity, Resilience & Risk Management

- **OT/ICS cybersecurity** principles for substations and transmission control environments.
- Cyber-risk assessment, network segmentation, access management, monitoring, and incident response.
- IEC 62351 concepts and secure communications for power-system automation.
- Cyber-resilience, business continuity, recovery, and supply-chain considerations.
- **Case Study:** Building a cyber-resilience improvement program for a digitally automated transmission substation.

Module 8: Modernization Implementation, Asset Management & Future Grid

- Building phased **technology migration and modernization programs**.
- Total-cost-of-ownership, lifecycle management, procurement, and project governance.
- Performance measurement using **reliability, resilience, interoperability, cybersecurity, and operational KPIs**.
- Workforce transformation, competency development, commissioning, testing, and change management.
- **Case Study:** Creating a five-year modernization portfolio covering substations, protection, communications, asset analytics, cybersecurity, and renewable-integration requirements.

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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