MERCURY

Communications for Power System Protection and Automation Advanced Training

7 – 18 June 2027
Barcelona (Spain)



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Communications for Power System Protection and Automation Advanced Training

Ref: 15253_263406 **Date:** 7 – 18 June 2027 **Location:** Barcelona (Spain) **Fees:** 11100 Euro

Introduction:

This advanced power system protection, automation, and communication course is designed to provide a comprehensive understanding and overcome the challenges faced in communications for power system protection. It emphasizes automation and Smart Grid implementation. Participants will explore the standards and requirements of substation communication systems per the IEEE, NIST, and NERC guidelines.

This advanced power system protection, automation, and communication training is particularly relevant for those aspiring to become proficient power system protection engineers or advancing their knowledge in automated communication systems and tools.

Fundamentals of Power System Protection and Automation:

This advanced power system protection, automation, and communication course segment delves into what power system protection is and its importance in maintaining the stability and integrity of electrical grids. Participants will understand the principles behind safeguarding electrical systems and equipment from faults and abnormal conditions. Emphasis is placed on the fundamentals of power system protection, which ensures seamless operational performance and reliability.

In this modern era of technology, power system automation plays a critical role in efficiently managing electrical grids. The advanced power system protection, automation, and communication course will cover the pivotal aspects of power system automation and how it integrates with protection systems to achieve a seamless communication system. Real-world applications and case studies will be examined to illustrate advanced power system automation and protection concepts.

Targeted Groups:

- Substation Design and Operations Engineers.
- Technicians.
- Electric utility engineers.

Course Objectives:

At the end of this advanced power system protection, automation, and communication course, participants will be able to:

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- Set up a relay network leveraging advanced power system protection techniques.
- Read values from standard IEC 61850 data objects and utilize automated communication tools to display the data in an Excel spreadsheet.
- Implement relay-to-relay communications via IEC GOOSE and automated communication solutions.
- Capture and analyze network data packets.

Targeted Competencies:

By the end of this advanced power system protection, automation, and communication training, target competencies will be able to:

- Understand advanced power system protection principles.
- Implement automation in power systems.
- Understand proficiency in modern communication protocols for power systems.
- Analyze and diagnose protection system malfunctions.
- Design and integrating automation systems.
- Apply digital relays in protection schemes.
- Coordinate protection systems for reliability.
- Utilize SCADA systems for monitoring and control.
- Ensure cybersecurity in power system communication networks.
- Optimize power system performance through automation.
- Troubleshoot communication issues in power systems.
- Conduct advanced fault analysis and system restoration.

Course Content:

Unit 1: Analog Communications Fundamentals:

- AM, FM, PM.
- ASK, FSK, PSK, QAM.
- Generation and detection.
- Performance comparisons.

Unit 2: Digital Communications Fundamentals:

- Quantization.
- Encod.
- Fram multi-channels.
- Know the Synchronous optical network SONET.

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Unit 3: Fiber Optic Communication Theory and Application:

- Fiber optic basics.
- Explore Fiber types multi-mode, single-mode.
- Understand system components sources, detectors, connectors.
- Understand system design architecture, loss calculations.
- Utility applications.
- Learn about the new technology and standards WDM, PMD.

Unit 4: Fundamentals of Power Line Carrier:

- Basic System.
- System components.
- Coupling Systems.
- Modal analysis.
- Performance calculations.

Unit 5: Spread Spectrum Communications:

- Basic system.
- System components.
- Relay considerations.
- Control considerations.

Unit 6: WAN Ethernet Transport:

- MPLS.
- Carrier ethernet.
- Know comparisons and impact on power system-critical communications.

Unit 7: Special Communication Requirements of Protective Relaying:

- Dependability.
- Security.
- Channel delay effects.
- Modes of operation.
- Channel arrangements.
- Comments on audio tone protection.

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Unit 8: Serial Data Communication:

- Basic concepts.
- Data encoding formats.
- RS-232.
- RS-422.
- G-703.

Unit 9: Data Networks:

- Network concepts and devices.
- OSI seven-layer model.
- Substation LAN architectures.
- Network synchronization.

Unit 10: Ethernet:

- Physical connections.
- Data frames.
- Collision and retransmission mechanisms.
- Bridge.

Unit 11: Time Synchronization:

- Time synchronization sources GPS.
- IRIG-B.
- IEEE 1588.

Unit 12: Protocols and Standards:

- Architecture development concepts.
- Overview of Sequence of Events Standard.
- Overview of the IEEE Standard for Time Sequence Files.
- Review of the NERC Standard for Event, Fault, and Dynamic Recording.
- TCP/IP.
- ModBus.
- DNP.
- DDE and OPC.

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Unit 13: 61850 Network Communications Systems:

- Abstract service models.
- Logical node concept.
- Internet-based communication.
- The IEC 61850 security model.
- Peer-to-peer communications GOOSE.
- Substation Configuration Language-SCL.
- Integrate system examples.
- Routable GOOSE/SV sample values.
- Industry case studies.

Unit 14: DNP3 and Applications:

- DNP3 history, benefits, and capabilities.
- Overview of DNP3 object libraries.
- Discuss various DNP2 polling schemes.
- Demonstration of DNP3.
- Future enhancements.

Unit 15: Electronic Security of Remotely Accessible Control and Protection Equipment:

- Threats.
- Vulnerabilities.
- Attack scenarios.
- TCP/IP network scanner.
- SCADA protocol reconnaissance.
- Electronic attack barriers.
- NERC Critical Infrastructure Protection Standards CIPS.
- Requirements of IEEE 1686.
- Know substation IEDs' level of compliance.

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Unit 16: Implementing Multiprotocol Label Switching MPLS:

- Introduce MPLS and Label Distribution Protocol LDP.
- Transport Global IPv4 and IPv6 Traffic.
- Enable Multi-tenancy with MPLS Layer-3 VPNs.
- Build Complex MPLS Layer-3 VPNs.
- Extend Layer-2 Networks with Pseudowires.
- Scratch the Surface of MPLS Traffic Engineering TE.
- Verify MPLS LSPs Using OAM Tools.