Introduction:

The integration of renewable energy sources into modern power generation systems is critical to achieving sustainable development and aligning with environmental goals. As global investment in renewable energy continues to grow, so do the challenges of ensuring secure and reliable power system operations. The inherent variability of renewable energy sources, driven by weather conditions, presents unique challenges to energy delivery.

This course focuses on the computational methodologies essential for assessing the reliability and operational performance of power systems with significant renewable energy penetration.

Targeted Groups

This course is designed for:

- Electric power utility professionals, including system operators (ISOs, RTOs, TSOs).
- Regulation authority professionals.
- Engineers and managers involved in renewable energy projects.
- Power system consultants.

Course Objectives

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

1. Identify critical aspects of renewable energy plants requiring probabilistic modeling.
2. Understand computational methods for reliability and performance modeling.
3. Define and quantify essential indices for operational performance assessment.
4. Conduct practical evaluation studies of renewable energy systems.
5. Develop and propose strategies to enhance power generation systems.

Targeted Competencies

Participants will gain competencies in:

- Advanced computational analysis methods for reliability issues.
- Application of probabilistic modeling techniques to power systems.
- Understanding and calculating operational performance indices.
- Case study analysis of power systems with renewable energy sources.
- Strategic planning for sustainable energy system operations.

Renewable Energy and Sustainable Development

Renewable energy plays a pivotal role in fostering sustainable development. This course addresses how renewable energy contributes to energy security, environmental sustainability, and economic growth. Participants will explore the advantages of renewable energy, including emission reductions, energy diversification, and enhanced system resiliency.

Course Content

Unit 1: General Aspects

- Fundamentals of probabilistic modeling and reliability evaluation.
- Planning challenges for renewable and low-emission power systems.
- Features of traditional and renewable energy plants.
- The role of storage systems in renewable energy integration.
- Simulation techniques for operational performance modeling.

Unit 2: Conventional Power Plants

- Modeling generation characteristics of thermal, cogeneration, and hydroelectric plants.
- Reserve requirements and demand response integration.
- Operational reliability criteria for conventional systems.

Unit 3: Integration of Wind Generation

- Stochastic variability and modeling of wind generation.
- Developing equivalent daily curves for wind energy predictions.
- Correlation of wind generation with system demand.
- Indices for wind capacity credit and integration costs.
- High-penetration scenarios and future wind park development.

Unit 4: Integration of Other Renewable Energy Sources

- Stochastic modeling for solar and other renewable sources.
- Developing equivalent daily curves for solar generation.
- Reliability assessment of photovoltaic systems and interconnections.
- Exploring biomass and battery storage benefits.

Unit 5: Operational Assessment of Power Generation Systems

- Simulation of power system operations with renewable energy.
- Reliability and performance index calculations.
- Spinning reserve criteria and demand response programs.
- Assessment of interconnected and isolated power systems.

Conclusion

This course equips participants with the skills and knowledge to navigate the complexities of renewable energy integration into power systems. By focusing on solar, wind, and other renewable energy sources, participants will gain valuable insights into creating reliable, cost-effective, and environmentally sustainable energy infrastructures.