

Power Systems: Renewable Energy Integration

16 hour technical course



Course Introduction

This online course introduces the learner to renewable energy generation technologies and sets them into the context of modern power systems with conventional generators.

Modern power systems and the control and operation of synchronous generators are examined including the unconventional electrical generators and/or power electronics often employed by renewable energy technologies. The course looks at the effects of introducing these types of generation on dynamic performance of power systems.

The cost of energy of different technologies used at renewable energy sites and typical project costs are covered including tax credits and feed-in tariffs.

The course examines different designs of the electrical systems in these plants and presents an overview of the relevant S&C products.

Course topics

1. Overview of Renewable Generation Technologies

- Sources and technology associated with: wind energy, solar, hydro, tidal, wave, bioenergy and geothermal
- Renewable energy technologies and their definitions
- Differences between conventional plant and renewable energy sources

2. Fundamental Concepts of Power Systems

- Power systems: structure and typical components
- Synchronous generator: fundamental concepts
- Power quality of the electricity supply
- Induction generator: fundamental concepts

3. Characteristics of Renewables and Comparisons with Conventional Synchronous Generation

- Renewable energy technologies - how they are connected by the grid and major issues they face when doing so
- Grid integration issues such as grid code considerations, control systems, and connection issues

4. Economics of Renewables

- How to calculate the cost of energy
- Compare typical renewable energy project costs
- Governmental support mechanisms for renewable energy technology and projects

5. Power Electronics Equipment

- Types of power semiconductors such as diode, thyristor and transistor (IGBT)
- Voltage Source Converter (VSC) arrangements
- VSC-based applications in power systems:
 - FACTS and Custom Power Controllers
 - Integration of renewable energy technologies
 - HVDC transmission

6. Different Designs in the Renewable Site and S&C Solutions

- Equipment typically used in a renewable energy facility:
 - For protection
 - To meet grid codes
- Equipment examples for a wind farm

7. Influence of Wind Generation on Dynamic Performance

- Impacts of solar and wind power on power networks
- System-wide impacts of variable energy sources on power networks
- Grid codes and their impact on requirements for response times, switching frequencies, voltage rise impacts.

Expert multidisciplinary e-courses for engineers at all career stages

Course Units - Power Systems: Renewable Energy Integration

- Unit 1 Overview of Renewable Generation Technologies 1
- Unit 2 Overview of Renewable Generation Technologies 2
- Unit 3 Overview of Renewable Generation Technologies 3
- Unit 4 Power Systems and Main Components
- Unit 5 Induction Machines and Synchronous Generators
- Unit 6 Operation Modes and Power Quality Issues
- Unit 7 Renewable Control Systems and Local Controllers
- Unit 8 Operation and Control Systems
- Unit 9 Renewables and Conventional Synchronous Generation
- Unit 10 Power Electronics Equipment 1
- Unit 11 Power Electronics Equipment 2
- Unit 12 Influence of Wind Generation on Dynamic Performance
- Unit 13 Different Designs in the Renewables Site
- Unit 14 Economics of Renewables 1
- Unit 15 Economics of Renewables 2
- Final Assessment



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Who should take this course?

This course is aimed at graduates through to senior engineers with some knowledge of electrical power engineering who want to increase their understanding of the drivers and challenges of connecting renewable energy generation to electricity networks.

Other Engineering Courses

- Power Systems: Network Regulation and Economics
- Power Systems: Protection of Distribution Networks
- Mobile Communications (4G)

Further courses are being developed in BIM Management, Engineering Ethics, Entrepreneurship for Engineers, Professionalism, Railway Safety and Risk Management for Engineers.

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