



**GCC Electrical  
Testing Laboratory**

المفتبر الفليبي لفمص المصمات الكهريانية

## Integration of Non-Programmable Renewable Energy Sources in the Electric Power System

Renewable power generation, mainly photovoltaic or wind farms are not likely to be programmed and required a suitable network management to exploit all the source potential.



Addressed to:	Electric Network Operators
Duration:	5 Full Days
Location/Venue:	GCCIA HQ, Dammam
Course Fees:	

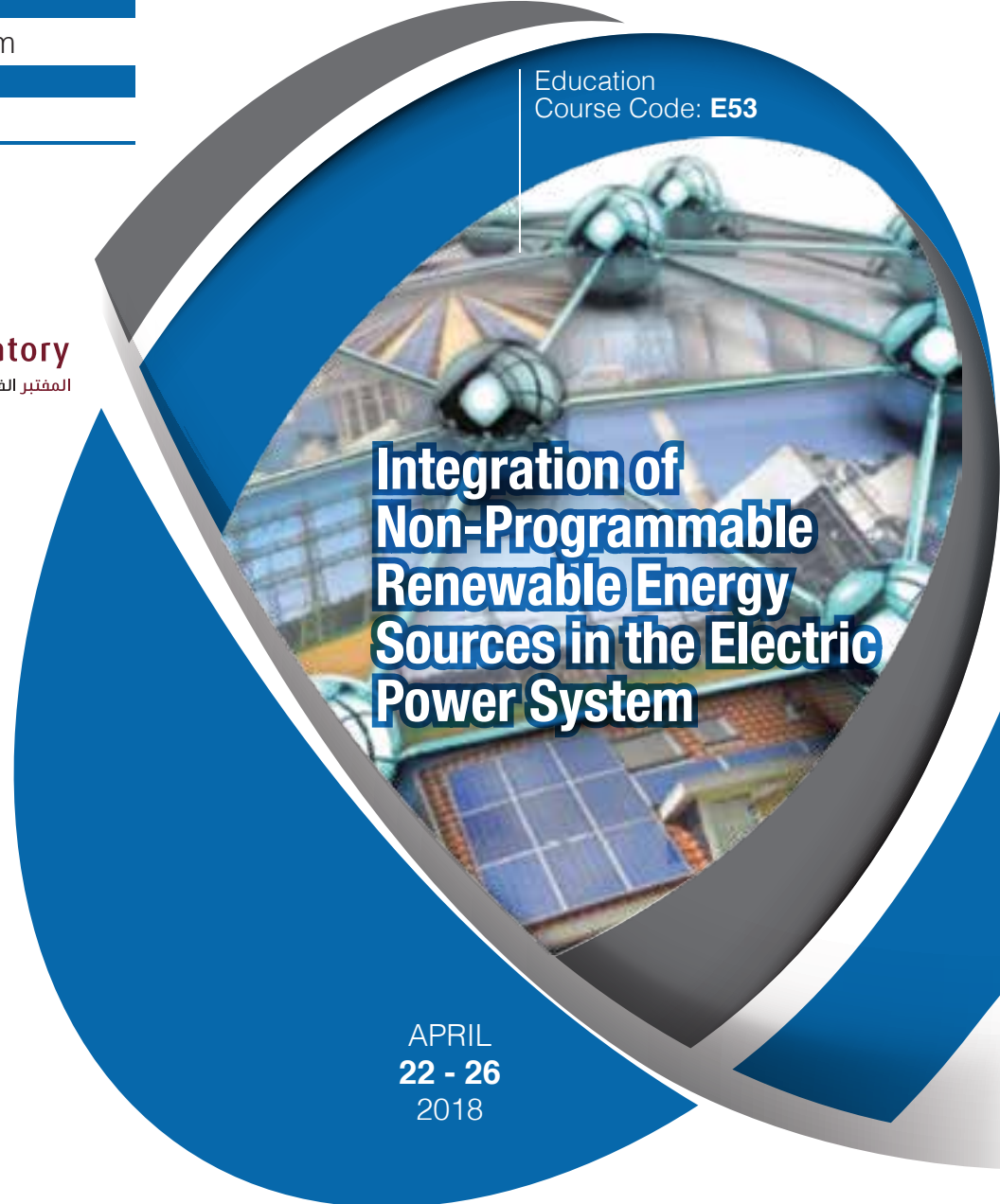
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Education  
Course Code: **E53**



## Integration of Non-Programmable Renewable Energy Sources in the Electric Power System

APRIL  
**22 - 26**  
2018



## Objectives

The course provides an exhaustive description of what happen in and established electric power system when a significant volume of non-programmable energy sources is connected to the electric power systems, to either the transmission network and the distribution one.

A set of power system performance analyses through simulation tools has to be carried out in order to assess the impact of RES. The basics for such kind of simulations are dealt with in another course, namely “Power system studies and performance checks”, but here the modeling of RES generation is explained. Furthermore, the typical provisions in order to compensate the unpredictable variations of such sources are shown.

The course makes use of well know commercial SW tools for power system analysis such as PSS-E by Siemens-PTI and Power Factory by DigSilent. For the power quality analysis, besides the above-mentioned tool, even tools for electromagnetic transient analysis, such as ATP, are applied



## PROGRAM

## Integration of Non-Programmable Renewable Energy Sources in the Electric Power System

The Course program contains the following training outline:

### DAY 1

#### Generals on the impact of non-programmable RES on the electric power system

- RES and their characteristics
  - Wind generation
  - Photovoltaic (PV) generation
- Outline of the impact of RES on power system performance
  - System wide impact
  - Network and local impacts
  - Market impact
  - Regulatory issues
  - Hints at environmental impacts
- Feasibility assessment of a RES deployment plan o Reserve criterion and balancing capability
  - Network connection
- Static performance analysis
  - System reliability analysis o Market analysis and cost assessment
  - Dynamic performance analysis

### DAY 2

#### Detailed assessment of RES impact on static and dynamic behavior of the electric power systems – part 1

- Maximum gradients in the variation of RES generation
- Risk associated to RES generation curtailments
- Network congestion caused by RES generation
- Risk of over-generation
- Impact on power market mechanisms
- Load following and reserve
- Optimal dispatch and multiple load-flows
- Selection of the set of Characteristics Days to be analyzed

### DAY 3

#### Detailed assessment of RES impact on static and dynamic behavior of the electric power systems – part 2

- Change in the inertia of the power system and consequent risk of large frequency deviations
- Risk in voltage profile and impact on reactive power management
- Risk of over-frequency and under-frequency
- Stability of RES power plants and network response to major fault events
- Fault through capability
- Provisions and mitigation measures facing the impact of RES
- Power system reliability with high RES penetration
- Monte Carlo approach

### DAY 4

#### Generals about Power Quality and relevant RES performance

- Harmonics
- Flicker and rapid voltage changes
- Voltage dips
- Unbalance
- Telephonic Interference
- Digital simulation for power quality impact assessment
- Field measurements and monitoring systems

### DAY 5

#### RES compliance to Grid Codes requirements

- Normal operating conditions
- Withstanding Voltage drops – Fault ride through capability
- Frequency regulation and active power control
- Voltage regulation and reactive power control
- Power Quality limits and requirements