# EXTreme

ENERZINX Training in Renewable Energy Modeling & Engineering

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# ENERZINX TRAINING IN RENEWABLE ENERGY MODELING & ENGINEERING

Having proven experience in end-to-end design, modeling, and grid integration studies of renewable energy plants across the globe, the company is excited to diversify its presence and start a technical training program EXTreme. Through this high-quality training program, we intend to create a human resource pool with a sound technical foundation. This would support the fast-paced developments in electric power grids and realize the renewable energy goals set forth by the government of India.

## Why EXTreme?

- Enerzinx has modelled over 75 GWs of renewable energy projects across 15 countries.
- Enerzinx has been recognized as TOP 10 RENEWABLE ENERGY SERVICE COMPANIES 2021 by Energy Tech Reviews, USA.
- Our DNA-Harnessing core expertise in cutting edge tools PSS®E, PSCAD, PSLF, ETAP, ASPEN, TSAT, TARA
- Extensive experience in working with ISOs- POSOCO/CTU, AEMO, PJM, CAISO, ERCOT, ISONE
- Highly qualified team of experts from premier institutions and having tens of GW renewable modeling and grid integration experience under their belt

## Who will benefit?

- Employees of Central and State utilities
- Power and Energy Industry Professionals
- Graduate/Post-graduate students in Electrical Engineering

## Training Modules

### Basic Level

***Module 0:*** Fundamentals of Power System Modeling
***Module 1:*** Renewable Energy System Design
***Module 2:*** Renewable Energy System Modelling and Simulation using PSS®E, ETAP and PSCAD

### Intermediate Level

***Module 3:*** Contingency Analysis in Electric power grids using PSS®E
***Module 4:*** Modeling and Dynamic Simulation of grid-scale Solar PV and BESS plants in PSS®E
***Module 5:*** Modeling and Simulation of grid-scale Solar PV and BESS plants in PSCAD/EMTDC

### Advanced Level

***Module 6:*** DC Injection, Voltage Flicker, and Harmonic Analysis for Renewable Energy Plants
***Module 7:*** Sub-synchronous Oscillation study for Renewabe plants using PSCAD
***Module 8:*** SVC modeling and simulation in PSCAD

600+ Projects

2.00 Million Miles of Transmission lines studied

Doing business in over 15 countries in 5 continents

**15 Countries | 75 GWs Modelled**

**100+ Clients | 1 Lac hours of modelling experience**

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# MODULE 0

## FUNDAMENTALS OF POWER SYSTEM MODELING

### Training Objectives:

The fundamental course of power system modeling is designed to expose participants to the development of models of major power system components such as synchronous generators, transformers, transmission lines, excitation systems, and speed governors. In addition to this, modeling of converter-based renewable energy sources, loads, and prime movers shall be introduced. An insight into the mathematical modeling of power system components is necessary to comprehend when goes behind when a power system is modeled in any power system modeling and analysis software.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Why is power system modeling required?
- Introduction to power system modeling
- Modeling of synchronous generator
- Modeling of power transformer, transmission lines, and loads
- Modeling of prime movers and excitation system
- Introduction to modeling of converter based renewable energy sources (Solar PV, Wind, and storage)
- Hands-on exercises using EMTDC/PSCAD and PSS®E simulation tools

**Pre-Requisite:** Basics of Power Systems and renewable energy systems

**Software:** EMTDC/PSCAD and Siemens Power System Simulator for Engineering (PSS®E)

**Delivery Mode:** In-Person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 20,000 (for professionals)
INR 10,000 (for students)

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# MODULE 1

## RENEWABLE ENERGY SYSTEM DESIGN (LAYOUT AND SINGLE LINE DIAGRAM – PV/BESS)

### Training Objectives:

The fundamental course is to expose participants to the development of layouts and single line diagrams of major power systems including renewable inverters, transformers, collector system, Gen-tie for PV, and BESS Renewable Energy systems. In addition to this, Individual equipment data and SLD modification based on the specific project requirement training will be conducted.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Basics of Layout design using Plant predict software
- Basics of Single Line diagram
- Inverter selection
- Equivalent collector system calculation.
- Switchgear and switchyard equipment (Preliminary consideration)
- Gen-tie calculation.

**Pre-Requisite:** Basics of Power Systems and renewable energy systems

**Software:** Plant predicts and Microsoft Vision

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 20,000 (for professionals)
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# MODULE 2

## RENEWABLE ENERGY SYSTEM MODELLING AND SIMULATION USING PSS®E, ETAP AND PSCAD

### Training Objectives:

The training objective is to introduce the modeling of a grid-scale Renewable plant (PV/BESS) with a 5-bus system using PSS®E, ETAP, and PSCAD. The focus shall be on building a power flow simulation of steady-state and verifying reactive power capability using different network components such as PV system, ISU transformer, Collector System Equivalent, Station transformer, Gen-Tie, and shunt devices.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Introduction to steady-state modeling of Renewable Energy (PV/BESS) with 5 bus system
- Building a power flow solution using
  - Grid-scale plant level PV/BESS system in PSS®E
  - Grid-scale plant level PV/BESS system in PSCAD
  - Grid-scale plant level PV/BESS system in ETAP
- Analysis and interpretation of power flow results
- Verifying reactive power capability and estimating the requirement of shunt devices
- Hands-on exercises on each sub-module

### Pre-Requisite:

- Basics of Power Systems
- Familiarity with PSS®E, PSCAD, and ETAP software environment
- Module 0 and Module 1 are desirable

**Software:** Siemens PTI PSS®E | PSCAD | ETAP

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 20,000 (for professionals)
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# MODULE 3

## CONTINGENCY ANALYSIS IN ELECTRIC POWER GRIDS USING PSS®E

### Training Objectives:

Contingency analysis covers a variety of analytical investigations performed by both system planners and operators. The course is designed to expose the participants to understand the contingency analysis, its importance, and how to perform it on the PSS®E platform. The focus shall be on building a generation/demand base case scenarios using different network components such as generator, load, lines, transformers, and shunt devices, Identify the tests (contingencies) to be performed for steady-state analysis and the system conditions that are acceptable or required before and during such contingencies.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Introduction to load flow analysis and contingency analysis
- Building generation/demand base case
- Large system case-solving techniques
- How to perform contingency using SUB, CON, and MON files in PSS/E
- Analysis and interpretation of contingency results
- Hands-on exercises on each sub-module

### Pre-Requisite:

- Basics of Power Systems
- Module 1

**Software:** Siemens PTI PSS®E

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 30,000 (for professionals)
INR 15,000 (for students)

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# MODULE 4

## MODELING AND DYNAMIC SIMULATION OF GRID-SCALE SOLAR PV AND BESS PLANTS IN PSS®E

### Training Objectives:

Understanding the real-time dynamic behavior of the Solar and BESS plants is important to address the technical challenges such as grid interconnections, protections, stability, and power quality issues. The course is designed to expose the participants to the dynamic behavior of the inverters, their associated controls in PSSE, and as well as its applications. The focus shall be on executing a simulation model using generic PSSE dynamic model representation for an inverter & power plant controller in an equivalent transmission level connected Solar/ BESS plant.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Introduction to PSSE dynamics
- Building a generic PSSE model representation
  - Modeling of generators
  - Modeling of the power plant controller
  - Modeling of load
- Dynamic Simulations for various disturbances
- Analysis and interpretation of dynamic behavior of the inverters
- Hands-on exercises on each sub-module

**Pre-Requisite:** Basics of Power Systems Module 0, 2

**Software:** Siemens PTI PSS®E

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 24 Hrs

**Course Fee:** INR 30,000 (for professionals)
INR 15,000 (for students)

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# MODULE 5

## MODELING AND SIMULATION OF GRID-SCALE SOLAR PV AND BESS PLANTS IN PSCAD/EMTDC

### Training Objectives:

Understanding the real-time transient/dynamic behavior of the Solar and BESS plants is important to address the technical challenges such as grid interconnections, protections, stability, and power quality issues. The course is designed to expose the participants to the modeling of inverters, develop a plant level model and perform grid interconnection studies. The focus shall be on building a plant-level simulation model using different components such as inverter, plant controller, infinite grid, load, transmission lines, transformers, and shunt devices.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- A brief overview of current/voltage source inverters
- Building a plant level simulation model
  - Modeling of inverter/plant controller
  - Modeling of transmission line
  - Modeling of transformers
  - Modeling of load
  - Modeling of fixed and switched shunts
  - Modeling of an infinite grid
- Perform grid interconnection studies such as LVRT/HVRT
- Hands-on exercises on each sub-module

**Pre-Requisite:** Basics of Power Systems Module 0, 2

**Software:** PSCAD/EMTDC software

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 24 Hrs

**Course Fee:** INR 30,000 (for professionals)
INR 15,000 (for students)

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# MODULE 6

## DC INJECTION, VOLTAGE FLICKER, AND HARMONIC ANALYSIS FOR RENEWABLE ENERGY PLANTS

### Training Objectives:

Renewable energy sources such as PV and Wind are evolving as a reliable sources of green energy and their contribution to the global energy supply is increasing exponentially. However, the integration of renewable energy sources into the grid poses power quality challenges due to the intermittent nature of these sources and the extensive use of power electronic converters. The course is designed to expose the participants to power quality requirements for the integration of Solar and Wind plants into the grid. The applicable standards pertaining to DC injection, voltage flicker, and harmonics shall be introduced. The assessment of DC injection, voltage flicker, and harmonics at the point of interconnection using a test system would be performed in PSCAD, PSSE and ETAP software.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Introduction to power quality
- Power quality requirements for Solar and Wind plants as per IEC/IEEE standards
  - DC injection
  - Voltage flicker (IEC 61000)
  - Harmonics (IEEE 519)
- Assessment of DC injection from Solar and Wind plant in PSCAD
- Assessment of Voltage Flicker from Solar and Wind plant in PSCAD
- Assessment of Harmonics from Solar and Wind plant in PSCAD, PSSE, and ETAP
- Hands-on exercises on each sub-module

### Pre-Requisite:

- Basics of Power Systems and Power Quality
- Familiarity with PSCAD and ETAP software environment Module 2

**Software:** PSCAD, PSSE and ETAP

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 24 Hrs

**Course Fee:** INR 30,000 (for professionals)
INR 15,000 (for students)

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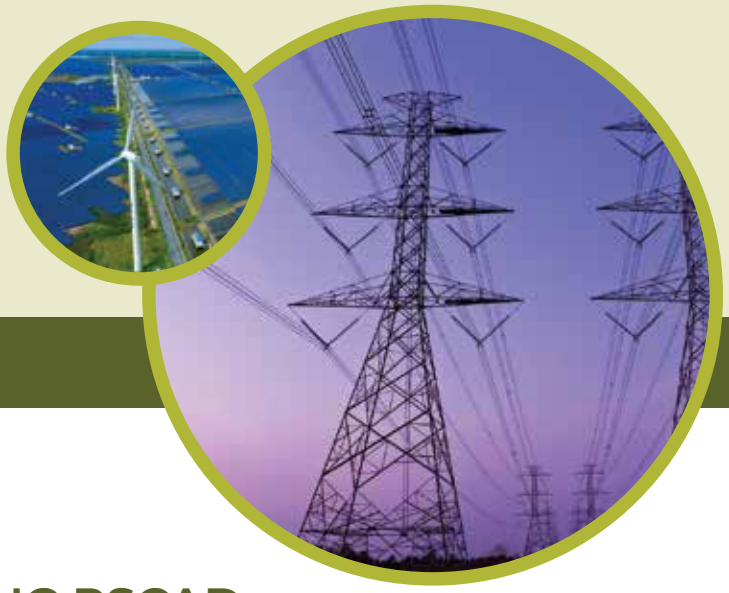

# MODULE 7

## SUB-SYNCHRONOUS OSCILLATION STUDY FOR RENEWABLE PLANTS USING PSCAD

### Training Objectives:

The course is entitled to impart knowledge on understanding Sub-Synchronous Oscillation (SSO) in power systems and its various types. The course emphasizes series compensation and its effect on SSO and possible mitigation methods. After successful completion of this module, the audience would gain an understanding of the SSO phenomenon and how to set up and analyze a test case for an SSO study in PSCAD.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Introduction to SSO
- Impact of series compensation on SSO
- Types of SSO
- Setting up of a test case for SSO study in PSCAD
- Analysis of impedance scanning results
- Mitigation methods

**Pre-Requisite:** Basics of Power Systems

**Software:** PSCAD/EMTDC Simulations

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 35,000 (for professionals)
INR 17,500 (for students)

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# MODULE 8

## SVC MODELING AND SIMULATION IN PSCAD

### Training Objectives:

The course is entitled to gain knowledge on understanding FACTS (Flexible AC Transmission) and about the benefits of the Transmission system enhancement using FACTS Technology. The course will also provide insight into the basic design of SVC (Static VAR Compensator), Industry-standard studies and its impact on the Utility grid, and milestones of project execution.

### Who Will Benefit?

- Employees of Central and State utilities
- Professionals working in the modeling, analysis, and system studies domain of the power & energy industry
- Graduate/Post-graduate students in Electrical/Electrical and Electronics Engineering willing to join the power system industry

### Course Content:

- Brief view of Understanding FACTS (Flexible AC Transmission) & Benefits
- Types of compensations & Configurations
- Simplified SLDs & Equipment Layout
- SVC Characteristics & Control philosophy of SVC (Static VAR Compensator)
- Design Considerations & Industrial Standard Studies
- General Industrial Procedure of Project stages/Milestones

**Pre-Requisite:** Basics of Power Systems

**Software:** PSCAD/EMTDC Simulations for SVC Model

**Delivery Mode:** In-person-Physical classroom setting

**Certification:** Yes

**Course Duration:** 12 Hrs

**Course Fee:** INR 20,000 (for professionals)
INR 10,000 (for students)

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