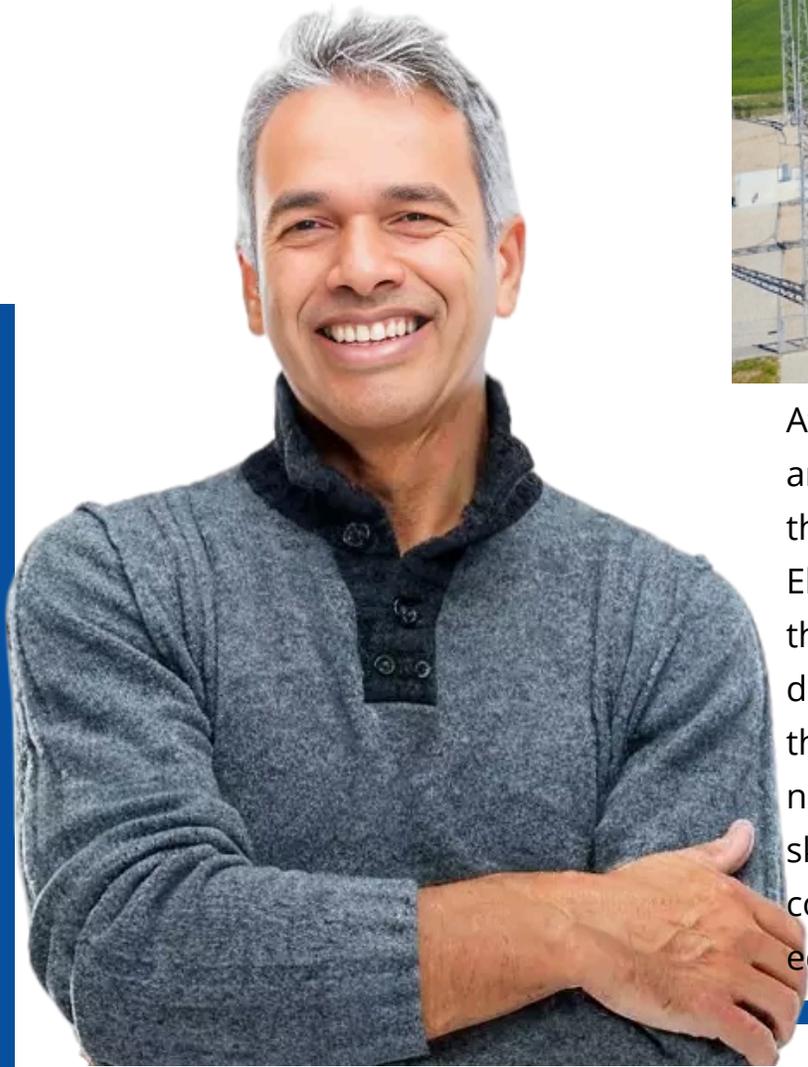


# ENGINEERS' CERTIFICATION PROGRAM

*Engineering Skills*



# Substation Design & Engineering for Renewable Energy Projects



At Electrical Learning Portal (ELP), we are dedicated to shaping the future of the electrical and MEP (Mechanical, Electrical, and Plumbing) industries through professional training and development. Our mission is to bridge the gap between the ever-evolving needs of employers and the dynamic skill set of engineers by providing comprehensive, industry-relevant education and training.

***Degree + Skills = Career Growth***

## CONTACT US

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# SUBSTATION DESIGN & ENGINEERING FOR RENEWABLE ENERGY PROJECTS

The rapid growth of solar, wind, and battery energy storage systems (BESS) has transformed the way substations are planned, designed, and integrated with the grid. Modern renewable projects demand engineers who not only understand conventional substation design, but also the unique technical, grid compliance, and project engineering challenges associated with inverter-based generation.

The Renewable Energy Substation Design & Grid Integration program is a practical, industry-oriented training designed to equip electrical engineers with end-to-end knowledge of substation design for renewable energy projects, from system planning and voltage level selection to equipment sizing, protection, automation, and commissioning.

This course focuses on real EPC and utility practices, covering:

- Renewable power evacuation philosophy
- Pooling and grid substations
- Impact of inverter-based resources on substation design
- Grid code requirements and voltage/reactive power control
- Electrical project engineering and execution challenges



Participants will learn how to develop Single Line Diagrams (SLDs), select and size major substation equipment (transformers, generators, UPS, batteries, cables), design earthing and lightning protection systems, understand protection and control schemes, and coordinate engineering activities across disciplines.

The program emphasizes practical design concepts, industry standards (IEC / IEEE / IS), and engineering judgement required to work on solar parks, wind farms, hybrid renewable plants, and utility-scale grid substations.

By the end of the course, participants will be capable of supporting real renewable substation projects, reviewing EPC designs, coordinating with utilities, and contributing effectively to grid integration and commissioning activities.



# TOPICS

## Part 01- POWER SYSTEM & LOAD ASSESSMENT

- *Power system overview and substation role*
- *Estimation of plant and substation loads*
- *Preparation of load schedules (AC & DC)*
- *Power supply requirements (Normal / Emergency / Backup)*
- *System frequency considerations*
- *Short circuit level basics*
- *Applicable IS / IEC / IEEE standards*

## Part 02 -VOLTAGE LEVEL SELECTION & SYSTEM PLANNING

- *Criteria for voltage level selection*
  - Power capacity*
  - Distance & losses*
  - Grid availability*
  - Reliability & future expansion*
- *Techno-economic comparison of voltage levels*
- *Typical voltage levels for conventional & renewable projects*
- *Impact of voltage selection on equipment cost and layout*

## Part 03 - SINGLE LINE DIAGRAM (SLD) DEVELOPMENT

- *Symbols and conventions used in SLDs*
- *Development of substation SLDs*
- *Metering & control philosophy in SLDs*
- *AC & DC auxiliary SLDs*
- *Renewable evacuation SLD examples*
- *Review of typical utility SLDs*

## Part 04 - ELECTRICAL EQUIPMENT SELECTION & SIZING

- *Power Transformer selection & rating*
- *Generator sizing fundamentals (kept as requested)*
- *Circuit breakers (HV / MV / LV)*
- *Switchgear and panel selection criteria*
- *CT & PT selection (metering vs protection)*
- *Busbar and busduct sizing*
- *Capacitor banks & reactive power equipment*
- *Battery & battery charger sizing*
- *UPS system selection & sizing*

## Part 05 - CABLE ENGINEERING & ROUTING

- *Types of cables used in substations*
- *Power cable sizing calculations*
- *Control & instrumentation cable selection*
- *Cable derating factors*
- *Cable segregation philosophy*
- *Cable tray sizing and layouts*
- *Cable routing best practices in substations*

## Part 06 - LIGHTING & AUXILIARY SYSTEMS

- *Importance of lighting in substations*
- *Types of indoor & outdoor lighting fixtures*
- *Basic lighting calculation methodology*
- *Typical lux levels for substation areas*
- *Emergency lighting philosophy*

## Part 07 - EARTHING & LIGHTNING PROTECTION DESIGN

### 1. **Earthing Design**

- Neutral grounding methods
- Earthed vs unearthed systems
- Soil resistivity & earthing calculations
- Step & touch potential concepts
- Substation earthing layouts

### 2. **Lightning Protection**

- Lightning protection philosophy for substations
- Earth wire and down conductor concepts
- Rolling Sphere Method
- Surge protection overview

## Part 08 - SUBSTATION DESIGN (AIS, GIS & RENEWABLES)

- Types of substations (AIS / GIS / Hybrid)
- Switchyard SLDs (33 / 66 / 132 / 220 / 400 / 765 kV)
- Substation layout philosophy & clearances
- Renewable energy evacuation systems
- Pooling substation concept
- Impact of inverter-based generation on substation design
- Transformer considerations for renewable integration
- Reactive power & voltage control
- Grid code requirements affecting design
- PLCC overview

## Part 09 - PROTECTION SYSTEM ENGINEERING

- Protection philosophy for substations
- Protection relays (numerical relays)
- Transformer protection schemes
- Line & feeder protection overview
- Busbar protection concept
- Protection coordination basics
- Redundancy & reliability concepts

## Part 10 - SUBSTATION AUTOMATION & CONTROL SYSTEMS)

- Substation control room philosophy
- Control & relay panels
- Substation Automation System (SAS)
- SCADA architecture overview
- Communication protocols (IEC 61850 – fundamentals)
- Interlocking philosophy

## Part 11 - ELECTRICAL PROJECT ENGINEERING)

- Project lifecycle (Concept to Commissioning)
- Engineering deliverables & document control
- Technical specifications & datasheets
- Interface engineering (OEM, Civil, Utility)
- Engineering during execution & site coordination
- Design reviews & approval process

## Part 12 - TESTING, COMMISSIONING & SAFETY

- *Factory Acceptance Tests (FAT)*
- *Site Acceptance Tests (SAT)*
- *Pre-commissioning & commissioning activities*
- *As-built documentation*
- *Electrical safety in substations*
- *Statutory inspections & approvals*

## Part 13- Power System study (ETAP)

- *Overview of Etap*
- *Input data for Etap study*
- *Load flow analysis*
- *short circuit analysis*
- *Relay coordination*

## Part 13 - AutoCAD (RECORDED)

- *Introduction*
- *Drawing commands*
- *Modifying commands*
- *Editing commands*
- *Dimension commands*
- *Block and layer commands*
- *Print commands*
- *Helping commands*

## Part 14 - Real-Time Project Discussion



## Tools

- o All Classes are Live via Google Meet or Zoom
- o MS PowerPoint slides
- o Transformers, CT/PT sizing Cables, Battery sizing, etc Calculation on Excel based.
- o Single Line diagram and Basic Layouts by AutoCAD
- o Power system study (LF/SC/RC) by ETAP tool

## Benefits of the program

1. *Job-ready programs*
2. *Updated course content*
3. *ISO-certified completion certificate*
4. *PDF notes provided*
5. *100% refund guarantee*

## Features of the program

1. *Live trainer interaction*
2. *Access to recorded sessions*
3. *Career counseling support*
4. *Weekly assignments*

## Contact:

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