



EE203: Transformers, RMU's Switchgears & Circuit Breakers



Training Description:

Power systems are comprised of transmission, distribution, and generation. In order to control the line losses and voltage drop percentages within these systems, power companies and industrial consumers normally design and install substations at different locations and at different voltage levels, which facilitate not only the monitoring and instrumentation of system parameters, but also they will help companies, utilities, and industrial loads to bring under control and improve their power factor, demand factor, load factor, tele-protection, overload, fault clearance times, critical and essential loads, and equipment ratings. The primary system component covers the installation, commissioning, testing, maintenance, operation and design of switchgears and switchyards, power transformers, service transformers, switching devices (circuit breakers, disconnect switches, earthing switches, etc.), gantry towers, cable trenches and cable ducts, and substation buildings.

The primary component also discusses clearance distances, cable and transformer sizing, lightning/switching impulse/power frequency protection (surge arresters and surge diverters), basic insulation level (BIL), instrument transformer types, substation geotech and feasibility studies, substation location, and load studies. In this training course, the participants will have the opportunity to discuss the pros and cons of different busbar configurations and build up single line diagrams and layout diagrams as the main tools for system analysis. The participants will also have the opportunity to determine the system voltage profile together with the technical specifications of switchgears, outdoor circuit breakers and busbars, power cables, etc. The secondary system component covers the installation, commissioning, testing, maintenance, operation and design of protection relays, fuses, circuit breakers, reclosers, sectionalizers/load break switches, fault recorders, and other protection, control, and instrumentation devices.

The secondary system component also discusses some popular protection and control logics, SCADA systems, COMMS protocols and applications, intertripping techniques, overload control, load shedding, automation and remote control, earthing systems, batteries and battery chargers, AC and DC auxiliary systems and panels, power factor compensation (PFC) techniques, power quality issues (such as harmonics, voltage flicker, sag, swell, etc.) and the impacts and applications of embedded generation. In this training, the participants will have the opportunity to calculate fault currents and system impedances by means of Per Unit system, and practice power system circuitry analysis, fault root cause analysis, propose appropriate protection schemes and choose suitable CT's, VT's, and relays for different scenarios through industry-based practical worked examples and mini projects to achieve an optimized and coordinated operation of control and protection devices in typical complex power systems.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Determine the location and busbar configuration of a typical substation
- ✓ Propose specifications for major substation equipment

Training Designed for:

This course is intended for Project Engineers/Managers, Electrical Engineers/Technicians, System Operators, Design Engineers, Asset Engineers/Managers, Planning Engineers/Managers, Protection,





Instrumentation, and Commissioning Engineers/Technicians. We encourage the staff involved in the operation, planning, design, and maintenance of power systems to attend this training course.

Training Program:

DAY ONE:

- ❖ Pre-Test
- ❖ **Role of Substations in Power Networks**
 - Power system principles & circuit analysis
 - Complex numbers and engineering math
 - Substation types
 - Substation drawings and diagrams (SLD, layout, schematics, auxiliary AC & DC)
 - Substation main components
 - Substation location
 - Soil parameters and calculations
 - Substation busbar configurations
 - Substation voltage selection
 - Environmental issues in the location of a switchyard and mitigation techniques

DAY TWO:

- ❖ **Major Equipment**
 - Circuit breaker types & applications
 - Switchgear types, components, and applications
 - Auto-reclosers
 - Sectionalizers
 - Disconnect switches
 - RMU's
 - Earthing switches
 - SF6 properties
 - GIS substations
 - HV cables types & calculations
 - Power & distribution transformers
 - Batteries & battery chargers
 - Power conditioner

DAY THREE:

- ❖ **Substation Studies & Calculations**
 - Power system studies
 - Power system planning
 - Substation load studies
 - Per Unit system
 - Fault calculations
 - Switchyard lightning protection
 - Instrument transformers (CT's & VT's)
 - Earthing systems





DAY FOUR:

❖ Protection & Control

- Power system studies
- Power system planning
- Protection zones, local & backup protection
- Sequence networks
- Fuse types, applications, selection, and coordination
- Protection relay types and functions
- Protection relaying technology
- Overcurrent protection
- Earth fault protection
- IDMT O/C & E/F protection
- Definite time (DT) protection
- High-set instantaneous protection
- Transient overreach
- Transformer O/C and E/F protection
- Transformer unit protection (REF and Diff)
- Buchholz & pressure relief
- Transformer differential protection complexities & solutions
- Interposing CT's
- Transformer-feeder protection schemes

DAY FIVE:

❖ Substation Safety Issues

- Ungrounded vs. grounded systems
- Touch & step voltages, mesh voltage
- Earth potential rise (EPR), transferred voltages
- Soil resistivity
- Verification of adequacy
- Lightning protection techniques (rolling spheres, cone of protection)
- Embedded generation
- Power factor compensation (PFC)
- Power quality (harmonics, voltage flicker)
- Clearance distances

❖ Course Conclusion

❖ Post-Test and Evaluation

Training Requirement:

“Hand’s on practical sessions, equipment and software will be applied during the course if required and as per the client’s request”.

Please note that the above topics can be amended as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.





Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

As per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

For training registrations or in-house enquiries, please contact:

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Training & Career Development Department

