



ELECTRICAL ENGINEERING

Practices for Facilities Engineers

Course Introduction:

This course is ideal for individuals who would like to gain an understanding of the principles of electrical engineering tools in a practical format. This course will cover all disciplines of electrical engineering including alternating current systems, direct current systems, magnetism, power equipment, switchgear, and protective equipment without relying on complex mathematics in addition to the use of electricity in Hazardous area along with the principle of area classifications especially in oil and gas fields also gives better understanding for non-electrical engineers (oil and gas fields engineers and technicians , operators ,.....etc.) the ways of dealing with electrical equipment's located in hazardous area.

The course will utilize illustrated case studies to demonstrate practical examples of applied electrical engineering. Participants will gain an understanding of the operation and maintenance of all essential electrical equipment including the various types electrical equipment's used in oil and gas fields such as power transformers, Ex-motors, uninterruptible power systems, generators, circuit breakers, and fuses.... Etc. In addition, this course will cover how electrical equipment operates, the latest advances in maintenance techniques, and it will provide the necessary guidelines and rules to ensure the successful operation of this equipment.

Participants will learn how electrical equipment operates, the latest maintenance techniques, and provides guidelines and rules to ensure the successful operation of this equipment. In addition to all the safety concepts associated with electrical equipment.

Course Objectives:

The course will cover all aspects of power systems engineering and it will provide non-electrical engineers with a sound knowledge to assist when working in an electrical engineering environment. It has been designed for those who want to learn more about electricity; in particular, how it is generated, transmitted, distributed and used by industrial, commercial and domestic users.

Delegates will gain a detailed appreciation of the following:

- What electricity is and ohms law;
- Power, energy, 3-phase power and power factor;
- Electricity generation; System operation;
- Transmission & distribution systems;
- Transformers, switchgear and protection systems;
- sources of electricity generation
- Electrical rotating induction machines
- Principles of Power Electronics components, Rectifiers, Inverters, Variable Speed Drives, Uninterruptible Power Systems, Industrial Batteries

- Electrical safety rules Compare the requirements for electricity at work and electricity regulations and understand where they each apply and on whom the responsibility to conform lies
- Use of electricity in hazardous area

Who Should Attend?

- Non-electrical engineers and other professionals working in an electrical power engineering environment especially those who works in oil and gas fields
- Graduate engineers with an electrical background
- Engineers who have changed jobs and are now working in a power systems environment
- Ex-industrial staff or technicians who are now undertaking engineering duties in a power systems environment

Course Outline:

DAY ONE:

Introduction to the course

- Terminology
- Brief description of presentations

Key parts of an electrical power system

- Generators
- Transmission networks
- Distribution networks
- Customer connections
- In-house or distributed generation
- Standby generation

What is electricity? - 1

- Water analogy
- Voltage, current & resistance
- Ohms law
- Power, energy and 3-phase power

What is electricity? - 2

- Impedance (resistance, capacitance & inductance)
- Power factor
- Horse drawn barge example

Harmonics

- What are harmonics
- How do they affect networks and equipment

DAY TWO

- Summary of Day 1 key learning points & brief discussion

Electricity generation

- Typical coal/oil-fired power station and main items of plant
- Other types of power station used in oil and gas fields e.g. CCGT, Diesel, etc.

Transformers

- Why transformers?
- How do they work?
- Rating, physical size & capacity
- Turns ratio
- Primary & secondary voltages and currents
- General Classification of Transformers: Transformer Construction, Core-Type, Shell-Type, Dry-type Transformers, Oil-filled Transformers, Cooling Techniques
- Parallel Operation of Transformers, Loadings of Transformers in Parallel, Paralleling Requirements, Polarity
- Typical Construction of power transformers
- General view points about Transformer Oil, Characteristics, Oil Oxidation, Breakdown Voltage, Water Content, Acidity, Oil Testing, Field Oil Testing, Dissolved Gas Analysis, Treatment and Filtering of Oil

DAY THREE

- Summary of Day 2 key learning points & brief discussion

Transmission networks

- Plant components – cables, switchgear, overhead lines, transformers, protection and enclosures
- National strategic issues
- Size & capacity
- Grouping
- Interconnection

Sub-transmission or higher voltage distribution networks

- Plant components
- Design philosophy
- Grouped or cellular networks
- Protection
- Distribution networks
- Plant components
- Radial network designs

- Circuit Breakers, circuit breaker rating, plain break type, magnetic blow-out type, oil circuit breakers, recent developments in Circuit Breakers, vacuum circuit breakers, sulphur Hexafluoride (SF₆) Circuit Breakers, maintenance and inspection of circuit breakers
- Fuses, Types of fuses, features of current limiting fuses, advantages of fuses over circuit breakers

ELECTRICAL ROTATING MACHINES – AC AND DC

- Rotating magnetic field, relationship between electrical frequency and the speed of magnetic field rotation, RMS voltage in a three-phase stator, induced torque in a three-phase machine, winding insulation in ac machines, ac machine power flow and losses
- Induction motor construction, rotor slip, electrical frequency of the rotor, losses and the power flow diagram, induction motor torque-speed characteristics, variation of the torque-speed characteristics, starting induction motors, induction motor starting circuits
- Speed control of induction motors, speed control by changing the line frequency, speed control by changing the line voltage, speed control by changing the rotor resistance, solid-state induction motor drives, motor protection, induction generator, induction generator operating alone, induction motor ratings
- Typical simple power and control circuits for motor
- General idea about trouble shooting for motor

DAY FOUR

Power Electronics components, Rectifiers, Inverters, Variable Speed Drives, Uninterruptible Power Systems, and Industrial Batteries

- Power Electronics components, rectifier circuits, filtering rectifier output, pulse circuits, voltage variation by ac phase control, inverters, pulse-width modulation (PWM) inverters
- Variable speed (frequency) drives, principles of ac variable speed drives, inverters, insulated gate bipolar transistors (IGBT's), pulse-width modulated inverters, input power converter (rectifier), output IGBT inverter, magnetic braking, regeneration, transients, harmonics, power factor and failures, common failure modes, thyristor failures and testing, IGBT switching transients, cabling details for ac drives, motor bearing currents, selection criteria for variable speed drives, maintenance, common failure modes, motor application guidelines
- Uninterruptible power systems (UPSs), UPS operation, standards, voltage regulation, harmonic distortion, advanced UPS design, efficiency, input power converter, inverter, battery system, remote UPS monitoring, testing of UPS, commissioning of UPS, UPS maintenance, battery maintenance, UPS sizing, battery selection, space vector modulation technology, electromagnetic and radio frequency interference

Electrical Safety Rules

- Health & safety legislation
- Electricity regulations

- Precautions to be Taken on Specific Items of Equipment

DAY FIVE

Use of electricity in hazardous area

The properties of flammable materials

- The properties of flammable materials
- Area classification
- Protection methods, apparatus grouping and temperature class
- Marking of equipment
- Flameproof equipment, Ex d
- Intrinsically safe equipment, Ex ia and Ex ib
- Increased safety equipment, Ex e
- Pressurised equipment, Ex p
- Type of protection 'n' for zone 2
- Cable and conduit entry
- Earthing in hazardous areas

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Fees:

To be advised as per course locations. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Requirement:

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

Course Timings:

Daily Course Timings:

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

