

# Certificate in CIRCUIT BREAKERS, SWITCHGEAR AND POWER TRANSFORMERS SAFE OPERATION AND MAINTENANCE

**LIVE,  
INTERACTIVE  
CLASSES OVER  
THE INTERNET**

**12 MODULES OVER 3 MONTHS**

Commencing on  
17 May 2010

## YOU WILL LEARN HOW TO:

- Describe the fundamentals of operating switchgear and circuit breakers
- Select appropriate type and rating of circuit breakers and switchgear
- Understand the operation of switchgear components (CTs, VTs, relays and cable terminations)
- Describe the principles of operation of power transformers
- Identify and apply the different transformer types
- Set up simple transformer protection schemes
- Detail power transformer testing procedures
- Manage power transformer breakdowns to minimise disruption
- Detail safe working procedures in switch rooms, indoor and outdoor substations
- Draw up simple operational policies for safety rules
- Detail practical maintenance strategies for switchgear and transformers

Presented by

**Jerry  
Walker**

(D.Tech)



INCLUDES  
**4 FREE REFERENCE MANUALS**  
VALUED AT OVER \$400  
OVER 1400 PAGES OF VALUABLE  
REFERENCE MATERIAL

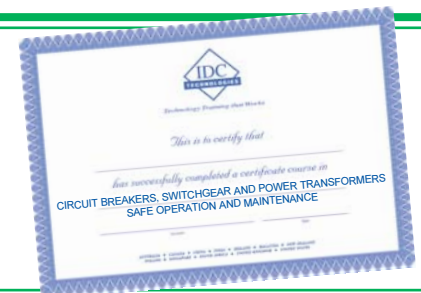


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## CERTIFICATION

Participants completing all the assignments, and achieving 60% or more for their final mark, will receive the IDC Certificate in Circuit Breakers, Switchgear and Power Transformers Safe Operation and Maintenance



**REGISTER TODAY**

# BENEFITS OF E-LEARNING

- Upgrade your skills and refresh your knowledge without having to take valuable time away from work
- Receive information and materials in small, easy to digest sections
- Learn while you travel - all you need is an Internet connection
- Have constant support from your course instructor and coordinator for the duration of the course
- Interact and network with participants from around the globe and gain valuable insight into international practice
- Receive a certificate of completion for CPD purposes

## PRESENTATION FORMAT

The certificate program is conducted by E-Learning, and features real-world applications using a multi-pronged approach involving self-study, interactive on-line webcasts and homework assignments with a mentor on call.

The course consists of 12 modules over a period of 3 months. All modules involve a practical component or group activity. For each module there will be an initial reading assignment along with course work or problems to be handed in. Participants will have ongoing support from their instructor via phone, fax and e-mail.

Course reading material will be delivered in electronic (PDF) format in advance of on-line presentations. Presentations and group discussions will be conducted using a live interactive software system. Assignments will be submitted via e-mail. You will receive 4 technical manuals in hard copy upon completion.

## LIVE WEBCASTS

During the program you will participate in 6 live interactive sessions with the instructor and other participants from around the world.

Each webcast will be scheduled at 2 varying times, so you can select one that is most convenient for you. All you need to participate is an adequate Internet connection and a headset with a microphone.

The software package and setup details will be sent to you prior to the course. Session times to be confirmed upon registration.

## PRESENTED BY JERRY WALKER (D.Tech)



Jerry is one of those engineers who has worked all the way up from "the tools" as an electrical Millwright to a doctorate in High Voltage Engineering with a focus on Diagnostics of Electrical Cable Insulation.

He commenced his career working on the Hot Strip Mill in a steel plant, on maintenance of protection systems and Variable Speed Drives, for 10 years. He then spent 9 years in the oil and gas industry where he was involved in the commissioning and maintenance of the complete spectrum of Power Electronic and Power Engineering equipment.

He has devoted the next fourteen years to a combination of research/consulting and lecturing, focusing on Power Distribution, Power Systems Protection and High Voltage Engineering. One of his major successes during that period has been the designing, equipping and commissioning of a complete high voltage laboratory for the engineering school of a prominent University of Technology. He is still involved on a part-time basis as a consulting professor in the Institute for High Voltage Studies. He is also a director of a consulting company focusing on high voltage testing and the supply of test equipment.

Jerry is a particularly entertaining instructor with a host of experiences in, and a tremendous passion for the topic of Circuit Breakers, Switchgear and Power Transformers.

## OVERVIEW

Switchgear (and circuit breakers) and transformers are critical components in electrical distribution systems and their operation significantly affects the overall performance of the system. This course will discuss the application, installation, maintenance and testing issues relating to medium and high voltage switchgear, circuit breakers and transformers.

Low voltage switchgear will also be covered and you will receive a thorough grounding in switchgear theory and standards. You will gain a solid understanding of the issues associated with the proper application, installation and maintenance of these critical items of equipment with an overriding emphasis on safety. The emphasis is on medium voltage (referred today as high voltage) switchgear which represents most of the switchgear installed on electrical distribution systems. The focus is on air blast, oil, SF6 and vacuum circuit breakers. Case studies covering the main manufacturers' equipment will illustrate the important practical principles. Other power system protection components will be discussed as well to ensure that switchgear is understood in the correct context.

Installation of high voltage distribution and transmission equipment has increased significantly over the years due to ongoing global demand for power. As a result, the need to ensure reliability of operation of power systems is paramount. Power transformers are among the most important and most expensive components of power systems. Their failure can impose extraordinarily high costs on plants, factories and utilities of all descriptions. It is critical that all personnel operating and working with such equipment have a sound knowledge of their operational requirements and maintenance. This practical course provides knowledge on both the theory and operation of Power Transformers. The course will develop and enhance an understanding of what is involved in the maintenance of these essential components of the power systems, through the tips and tricks learnt and developed by some of the world's pre-eminent electrical engineers.

### INCLUDES 4 REFERENCE MANUALS

VALUED AT OVER US\$400 (RECEIVED UPON COMPLETION)

- Safe Operation and Maintenance of Circuit Breakers and Switchgear
- Practical Power Transformers: Operation, Maintenance & Testing
- Practical Medium & High Voltage Testing of Electrical Equipment for Engineers and Technicians
- Earthing of Utility and Industrial Distribution Systems



## HARDWARE AND SOFTWARE REQUIREMENTS

All you need to participate is an adequate Internet connection, PC, speakers and a microphone. The software package and setup details will be sent to you on the commencement date of the course.

## ENTRANCE REQUIREMENTS

A working knowledge of basic electrical engineering principles is required. Experience in planning, installation and maintenance of electrical equipment and systems will enable the course to be placed in context. If you have no electrical background, you will struggle with this course. Contact us for bridging materials.

# COURSE OUTLINE

## MODULE 1: INTRODUCTION TO SWITCHGEAR AND TRANSFORMERS

- Single line diagrams
- Active and passive network components
- Circuit breaker utilisation
- Alternative forms of MV switchgear - ring main units and load breaking/fault making switches
- Fuse switches
- HV fuses in combination with, and as alternatives to circuit breakers
- Auto-reclosers and auto-reclose operation

*Practical Exercise*

## MODULE 2: APPLICATION OF SWITCHGEAR

- Principles of current interruption
- Plain break circuit breakers
- Bulk and small oil volume circuit breakers
- Turbulator (explosion pot)
- Operating mechanisms
- Transfer earth circuit breakers
- Air break and air blast switchgear
- SF6 and vacuum
- Switchgear in association with disconnectors
- Fixed and withdraw-able designs
- Switchgear standards
- Factors affecting switchgear selection

*Practical Exercise*

## MODULE 3: SPECIFICATION OF SWITCHGEAR

- Switchgear ratings - highest system and impulse withstand voltages, load and short circuit currents
- Simple and complex protection systems
- Switchgear ancillaries, measurement CTs, VTs and relays
- Cable terminations
- Indoor and outdoor operation
- Substation and switch room layouts and design

*Practical Exercise*

## SHORT CIRCUIT TESTING

- Symmetrical and asymmetrical breaking
- Make and break operations
- Understanding test oscillograms
- **Case study** - Specification for a 132 KV Switchboard

*Practical Exercise*

## MODULE 4: SAFETY POLICIES

- General safety precautions and the use of personal protective equipment
- Principles of safety rules
- Principles of personal authorisation
- Operative training for safe operation of switchgear
- Isolation in a circuit breaker context
- Safety documentation
- Operational and safety locking, caution and danger notices
- Work safety in a substation environment
- Safety interlocks
- Substation alarms
- Individual study tasks and presentation - safety policies in my company and how they might be improved

*Practical Exercise*

## MODULE 5: OPERATION OF MODERN SWITCHGEAR

- **Case Studies**
  - Sprecher and Schuh
  - Schneider
  - ABB
  - Siemens

*Practical Exercise*

## ASSETS MANAGEMENT IN A SWITCHGEAR CONTEXT

- Principles of time and condition based asset management
- Asset registers
- Asset management systems

*Practical Exercise*

## MODULE 6: DIAGNOSTICS, TESTING AND MAINTENANCE

- Switchgear inspection methodologies
- Partial discharge measurement and survey
- Timing tests
- Thermovision
- Mechanisms of deterioration
- Principles of circuit breaker maintenance
- Maintaining oil circuit breakers
- Contact maintenance and contact wipe
- Oil testing
- Maintaining vacuum circuit breakers
- Maintaining SF6 circuit breakers
- SOPs and DINs
- Switchgear defects and defect control Systems

*Practical Exercise*

## MODULE 7: TRANSFORMERS' MAIN FUNCTIONS AND CLASSIFICATION

- Construction (shell type and core type)
- Classification and type in relation to insulation, windings, core, cooling systems, voltage level, sizing, tank and breathing action
- Transformer parts

*Practical Exercise*

## POWER TRANSFORMERS AND SAFETY

- How to install, operate and work with high voltage power transformers safely
- Earthing of HV transformers

*Practical Exercise*

## MODULE 8: TRANSFORMER THEORY

- Electrical values and their definition in a power transformer - voltage, current, number of turns, impedance and their interrelation

*Practical Exercise*

## OPERATION OF POWER TRANSFORMERS IN A POWER SYSTEM

- Thermal performance, loading, paralleling, tap-changing, connections and vector groups

*Practical Exercise*

## MODULE 9: POWER TRANSFORMER PROTECTION

- Surge protection
- Protective relaying (differential, over-current and earth fault)
- Buchholz relay and pressure relief relay

- Thermal devices and instruments (oil temperature alarm and trip, winding temperature alarm and trip)

*Practical Exercise*

## MODULE 10: AUTO-TRANSFORMERS

- Design criteria
- Specifications

*Practical Exercise*

## GENERATOR TRANSFORMERS

- Design criteria
- Specifications

*Practical Exercise*

## UNIT TRANSFORMERS

- Design criteria
- Specifications

*Practical Exercise*

## STATION TRANSFORMERS

- Design criteria
- Specifications

*Practical Exercise*

## MODULE 11: OIL QUALITY

- Oil contents: water, acidity and dissolved gas
- Oil tests: dielectric breakdown, moisture, resistivity, interfacial tension, specific gravity, power factor and furan analysis
- Recovery voltage measurement test

*Practical Exercise*

## MODULE 12: POWER TRANSFORMER ELECTRICAL TESTS

- AC Tests:
  - Power factor tests (insulation, oil, and bushings); Single phase excitation current test; Transformer turns ratio test
- DC Tests:
  - Insulation resistance test; Dielectric absorption test; Polarisation index test; Step voltage test; Hi-pot test

*Practical Exercise*

## PREVENTATIVE MAINTENANCE ON POWER TRANSFORMERS

- Techniques to improve life expectancy

*Practical Exercise*

# 12 MODULES OVER 3 MONTHS

## ON-SITE TRAINING

All IDC Technologies Training Workshops are available on an on-site basis, presented at the venue of your choice, saving delegates travel time and expenses, thus providing your company with even greater savings.

For more information or a **FREE detailed proposal** contact **Kevin Baker** via e-mail: [training@idc-online.com](mailto:training@idc-online.com)

