ABB University Switzerland
Course Program 2014
Part 9
High Voltage Products
Transformers
ABB University Switzerland

Zurich/Oerlikon
1 LC High Voltage Products

Geneve
1 LC Transformers

Baden
1 LC Business Processes and Personal Development
   LC Communication Networks
   LC Substation Automation and Protection
   LC Power Generation
   LC Information Systems Applications
2 LC Management and Leadership Development
3 LC Robotics

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# ABB University Switzerland

## Course Schedule 2014

### High Voltage Products

<table>
<thead>
<tr>
<th>No.</th>
<th>days</th>
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<tbody>
<tr>
<td>1</td>
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<td>2</td>
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### Product Courses

<table>
<thead>
<tr>
<th>No.</th>
<th>days</th>
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### Transistors

<table>
<thead>
<tr>
<th>No.</th>
<th>days</th>
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<tbody>
<tr>
<td>1</td>
<td>Mon-Wed</td>
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<tr>
<td>2</td>
<td>Th-Fri</td>
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</tbody>
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**Legend:**
- E = English
- G = German
- F = French
- = public holiday

**Organising Learning Centre (LC):**
- ~ LC High Voltage Products, Zurich
- ~ LC Transformers, Genève

**The latest version of our course schedule can be found on internet:**
[www.abb.ch/abbuniversity](http://www.abb.ch/abbuniversity)
“Take the right train”
Course Selection Table – Basic Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title</th>
<th>Duration</th>
<th>Prerequisite Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHS100</td>
<td>Power System Technology – Fundamentals</td>
<td>5 days</td>
<td></td>
</tr>
<tr>
<td>CHS222</td>
<td>Gas Insulated Switchgear – Introduction</td>
<td>2 days</td>
<td></td>
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<tr>
<td>CHS222a</td>
<td>Gas Insulated Switchgear – E-Learning</td>
<td></td>
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<tr>
<td>CHS232a</td>
<td>HMB Drive Operation &amp; Maintenance – E-Learning</td>
<td></td>
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</tr>
<tr>
<td>CHS239</td>
<td>SF₆ – Gas Handling &amp; Measuring Instruments</td>
<td>1 day</td>
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<tr>
<td>CHS243a</td>
<td>SF₆ – Gas Basic – E-Learning</td>
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<tr>
<td>CHS223</td>
<td>Gas Insulated Switchgear – Operation &amp; Maintenance (Basic)</td>
<td>5 days</td>
<td>CHS234</td>
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<tr>
<td>CHS224</td>
<td>Gas Insulated Switchgear – Operation &amp; Maintenance (Advanced)</td>
<td>10 days</td>
<td>CHS235</td>
</tr>
<tr>
<td>CHS289</td>
<td>Gas Insulated Switchgear – Service Life Cycle Management</td>
<td>4 days</td>
<td>CHS236</td>
</tr>
<tr>
<td>CHS201</td>
<td>Generator Circuit Breaker – Introduction</td>
<td>1 day</td>
<td></td>
</tr>
<tr>
<td>CHS201a</td>
<td>Generator Circuit Breaker – E-Learning</td>
<td></td>
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</tr>
<tr>
<td>CHS249</td>
<td>Fiber Optic Current Sensors – Introduction</td>
<td>1 day</td>
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</tbody>
</table>

The participants acquire fundamental knowledge on general philosophies and today’s technologies.

The participants acquire in-depth knowledge in order to maintain and operate customer specific equipment.

Typical Target Group Clients:
Executives, Operators, Maintenance Personnel, Consultants and Others

Typical Target Group ABB Personnel:
Managers, Sales, Project Managers

Typical Target Group Clients:
Planning Personnel, Operation and Maintenance Personnel, Substation Managers

Typical Target Group ABB Personnel:
Engineering Personnel, Testing Personnel, Commissioning Personnel, Service Personnel

Typical Target Group Clients:
Executives, Operators, Maintenance Personnel, Consultants and Others

Typical Target Group ABB Personnel:
Managers, Sales, Project Managers

Typical Target Group Clients:
Planning Personnel, Operation and Maintenance Personnel, Substation Managers

Typical Target Group ABB Personnel:
Engineering Personnel, Testing Personnel, Commissioning Personnel, Service Personnel

The course selection table shows: course number, title, duration, prerequisite courses and the page of the course description.

For the course details please consider the course description or go to our webpage:
http://www.abb.ch/abbuniversity –> setting “Your preferences” to: Switzerland / English –> High Voltage Products

Page ## = Page number of the course description
“Take the right train”
Course Selection Table – Certification Courses

The course selection table shows: course number, title, duration, prerequisite courses and the page of the course description. As well, the general course dependency over the three different skill levels in the different field areas. According to your job function and your experience in the subject area, you should select the needed course modules under the consideration of the course dependency and prerequisites.

For the course details please consider the course description or go to our webpage: http://www.abb.ch/abbuiversity (setting "Your preferences" to: Switzerland / English) –> High Voltage Products

Field areas High Voltage Products

Typical Target Group Clients / ABB: Site Installation and Erection Personnel, Consultants and Others

Installation

Gas Insulated Switchgear

CHS225 Page 12 20 days
Gas Insulated Switchgear – Installation

Commissioning

CHS225 Page 12 10 days
Gas Insulated Switchgear – Commissioning

CHS251 Page 15 5 days
Gas Insulated Switchgear – Control & Protection

Repair & Overhaul

CHS250a Page 14 15 days
Gas Insulated Switchgear – Components Exchange & Troubleshooting

CHS250b Page 15 15 days
Gas Insulated Switchgear – Repair & Overhaul

CHS251 Page 15 5 days
Gas Insulated Switchgear – Control & Protection

CHS262 Page 16 5 days
AHMA Drive – Repairs, Maintenance and Troubleshooting

CHS263 Page 17 5 days
HMB Drive – Repairs, Maintenance and Troubleshooting

Typical Target Group Clients / ABB: Commissioning Personnel

CHS225

Typical Target Group Clients / ABB: Service Personnel

CHS262

The participants acquire knowledge on assembly and pre-commissioning of equipment and respective site procedures and instructions.

The participants acquire knowledge on commissioning of equipment and respective site procedures and instructions.

The participants acquire knowledge on maintenance, troubleshooting, components exchange, repair and overhaul of equipment.

CHS100 = Previous course or equivalent experience is recommended
CHS100 = Previous course or equivalent experience is required!

Page ## = Page number of the course description
ABB University Switzerland
Enrolment form

To
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Administration
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Tel:  +41 58 585 67 34
E-mail: university@ch.abb.com

Personal details
Title / Job function
First name
Surname
Phone / Mobile
E-mail

Course details
Course number From To Comments
1.
2.
3.
4.
5.
6.
7.

Do you need a letter of invitation for a visa application? ❑ Yes* ❑ No
Do you need any assistance with the booking of accommodation? ❑ Yes* ❑ No
* We will contact you for further information.

Company details
Company address
Invoicing address
(leave empty if same as company address)

Company name
Street / Number
Postal code / Town
Country
Phone (main)
Fax (main)

For ABB companies only
(CIT (eg, CHPAU) BU (eg, 2875)
( Please check with your financial department)

By returning this completed form you accept the general terms and conditions on page 8/9 in part 1 of our course program, ie, in case of cancelations or deferrals a cancelation fee may be charged. Completed enrolment forms are treated like an official purchase order and are binding.

Place and date
Signature

* We will contact you for further information.
High Voltage Products

CHS100
Power System Technology – Fundamentals

Course goal
The participants become familiar with the electrical power system and all its components and features. This familiarization is the basis for all engineering and operating activities in power systems. They are introduced to the fundamentals of today’s technologies in substations (switchgear), substation automation including protection, communication and power system management.

Learning objectives
– Get an overview of the power system structure and behavior
– Explain the different configurations of substations and their components
– List the functions of the automation and protection system
– Explain typical substation automation system structures
– Understand most common protection schemes
– Explain how the primary system (switchgear) is interfaced with the substation automation system
– Get an overview of the communication in power systems
– Understand the basics of network management

Participants
Consultants and employees from the electricity supply industry. Personnel from ABB companies.
Note: The course is designed for newcomers in the area of power system technology.

Prerequisites
College qualification or equivalent.

Topics
– Power system description
  Voltage levels, substations as power grid nodes
  Transmission vs. distribution power systems
  Power system faults and disturbances
  Network equations and state estimation, network stability,
  Generation, active and reactive power, P-f relationship, Q-V relationship, Power quality
  Principles of power system management
  Idea and concept of Smart-grids
– Substations and their components
  Fundamentals of substation design and their components
  High voltage switchgear installations with air (AIS) and SF6 gas insulation (GIS), innovative switchgear solutions
  Single line configurations for transmission (HV) and distribution (MV)
– Substation automation and protection
  Monitoring, control and automation principles for power systems
  Protection principles for power systems
  Substation automation including also protection functions
  Substation automation structures and architectures
  Protection of generators, transformers, lines and busbars
  Communication for substation automation and protection
– Power system management and related communication
  Functions and management levels (network control)
  Communication in power systems (utility communication)

Methods
Lectures, demonstrations, audio-visuals.

Duration
5 days (until Friday noon)

CHS004
Planning & Realization of HV-Substations – Application Solution & System Design

Course goal
The participants become acquainted with the basis for planning of transmission networks and their primary HV-Substations (switchgears) as well they receive an overview of implemented solutions.

Learning objectives
– Reflect an overview of the different network concepts in the transmission and sub-transmission
– Describe the requirement of HV-Substations
– Developing of future network concepts for transmission and sub-transmission
– Explain the operation of HV-Substations
– Execute the planning and dimensioning of HV-Substations
– Explain the different configurations of substations and their components
– Explain how the primary system (switchgear) is interfaced with the automation system
– Developing of future network concepts for the transmission of electrical energy

Participants
Engineers, consultants as well as employees from the electrical energy industry, Technical personnel of ABB companies.

Prerequisites
Engineering degree, technical college qualifications or equivalent.
Required course or equivalent experience:
CHS001 Understanding the Electrical Power System
CHS100 Power System Technology

Topics
– Characteristics of transmission networks
  In-plant generation, alternating load behavior, voltage levels, high short-circuit power/current, etc.
– Planning criteria coming from transmission networks
  Reliability, availability, energy storage, design of the switchgears with different configurations, etc.
– Substation insulation coordination
– Lightning-, switching overvoltage etc.
– Substations and their components
  In-plant generation, alternating load behavior, voltage levels, high short-circuit power/current, etc.
  Fundamentals of substation design and configurations for transmission and sub-transmission switchgear installations with air (AIS) and SF6 gas insulation (GIS), Innovative switchgear solutions

8 ABB University Switzerland | Course Program 2014
High Voltage Products

Circuit breaker
Power transformer basics
Principles of instrument transformers
Surge arresters
Auxiliary power supply systems of substations
Earthing of substations and lightning protection
– Civil design in substations
– Challenges in substation planning
– Operating substations automated
– Considerations needed for switching
– Overview on ‘special purpose’ substations
– Operation and maintenance, servicing substations.

Methods
Lectures, demonstrations, audio-visuals, dimensioning exercises and selected examples. Please bring your Notebook with you.

Duration
5 days (until Friday noon)

CHS201
Generator Circuit-Breaker Introduction

Course goal
The course introduces the participant to Generator Circuit-Breakers and their application within power plants

Learning objective
The participant
- understands what a Generator Circuit-Breaker is
- understands the function of different main components
- knows the application and the benefits
- is aware of the ABB GCB product portfolio range
- knows the ABB maintenance and service concept

Participants
ABB employees, customers

Prerequisites
None

Topics
- What is a Generator Circuit-Breaker
- Active and passive components and their functions
- Interrupting principle of arcing chamber
- Advantages and benefits
- Function of the main hydraulic drive HMB-4/8
- Examples of GCB applications
- Product portfolio (history, trends)
- Maintenance and service concept
- Insulating medium

Methods
Presentations and practical demonstrations

Duration
1 day

CHS201e
Generator Circuit-Breaker E-Learning

Course goal
The participants understand the application and basic functions of the Generator Circuit-Breaker

Learning objective
The participant
- has an overview of the design and function
- is able to locate the operating mechanisms and gas filling connection
- knows what is displayed on the control cubicle
- can identify different alarm sources and distinguish between remote/local mode
- has an overview of the HMB drive
- is informed about the ABB maintenance plan

Participants
ABB employees, customers

Prerequisites
None

Topics
- Product description and design
- Operating modes and alarms
- Operating Mechanism
- Maintenance concept

Methods
E-Learning with quiz

Duration
20 – 40 minutes

CHS202
Generator Circuit-Breaker Customer Training (Project-specific)

Course goal
The primary course aim is to ensure safe, cost-efficient and risk-free operation of customers' Generator Circuit-Breakers system according to the instructions contained in the corresponding operation & maintenance manuals.

Learning objectives
The participant
- understands the operation and maintenance philosophy
- knows the overhaul criteria
- is able to set up a maintenance plan for the project-specific Generator Circuit-Breaker system
- can apply tools for maintenance
- knows relevant technical documentations
- knows characteristics of SF6-gas,
- is aware of health and safety aspects

Participants
ABB employees, customers

Prerequisites
None

Topics
- Product description and design
- Operating modes and alarms
- Operating Mechanism
- Maintenance concept

Methods
E-Learning with quiz

Duration
20 – 40 minutes
High Voltage Products

Participants
Design and planning personnel, engineering and application personnel, operation and maintenance personnel, consultants from electricity supply industry, technical personnel from ABB companies, EPC (engineering, procurement and construction)

Prerequisites
Basic knowledge on electrical or mechanical engineering

Topics
- Product description and design
  - Components
  - Function of arcing chamber
  - Operating modes, controls and alarms
  - Customer protection (interlocking)
- Operating hydraulic mechanism
  - Components
  - Function
  - Preventive maintenance
- SF6-Gas handling
  - Characteristics
  - Health and safety aspects
- Maintenance concept
  - Maintenance plan
  - Overhaul criteria
  - Preventive maintenance
  - Periodic checks
  - Maintenance tools
- Identification and documentation
  - Dimension drawing
  - Nameplate information
  - Schematic diagram
  - Factory acceptance test report

Methods
Presentations, hands-on practical demonstrations, exercises, factory tour (if applicable)

Duration
2 or 3 days

CHS222
Gas Insulated Switchgear Introduction

Course goal
The course introduces the participant to Gas Insulated Switchgear systems

Learning objectives
The participant
- understands what a Gas Insulated Switchgear is
- can name the main components
- knows the application and the benefits
- is aware of the ABB product portfolio range
- knows the ABB maintenance and service concept

Participants
ABB employees, customers

Prerequisites
None

Topics
- What is a Gas Insulated Switchgear
- Active and passive components and their functions
- Interrupting principle of circuit-breaker
- Advantages and benefits
- Example of GIS applications
- Product portfolio (history, trends)
- Maintenance and service concept
- Insulating medium

Method
Presentations and practical demonstrations

Duration
2 days
# Course Program 2014

## CHS223

### Gas Insulated Switchgear Basic

**Course goal**
The course conveys knowledge on the ABB Gas Insulated Switchgear product portfolio, its function, operation and maintenance philosophy.

**Learning objectives**
The participant:
- understands the function and design of a Gas Insulated Switchgear
- can describe the function of the components and their working principle
- knows typical single line diagrams and arrangements of gas zones
- knows the ABB product portfolio range and Gas Insulated Switchgear specific applications and benefits
- understands the operation and maintenance philosophy

**Participants**
Design and planning personnel, engineering and application personnel, operation and maintenance personnel, consultants from electricity supply industry, technical personnel from ABB companies

**Prerequisites**
Basic knowledge on electrical switchgear

**Topics**
**Introduction**
- Overview on typical single line diagrams for GIS and associated physical layout architecture
- Rules for subdivision of GIS to gas zones

**Function and design of components**
- Design features
- Working principle and technical data of switching components like circuit-breakers, disconnectors, grounding switches
- Spring hydraulic drive mechanism
- Statical components like voltage- and current transformers
- Connecting elements, SF6-gas -to-air bushings, cable and transformer interfaces
- Gas supervision apparatus (level switches, on-line gas monitoring)

**SF6-gas handling**
- Properties of SF6-gas environmental aspects
- Application of dewpoint-, decomposition products-, SF6-gas -%, -measuring devices
- Pressure gauges for GIS
- Leak detection

**Maintenance concept**
- Overview on operation and maintenance manual
- Service concept of GIS

**Method**
Presentations, practical demonstrations, exercises, factory tour

**Duration**
5 days

## CHS224

### Gas Insulated Switchgear Operation & Maintenance (Project-specific)

**Course goal**
The primary course aim is to ensure safe, cost-efficient and risk-free operation of customers’ Gas Insulated Switchgear system.

**Learning objectives**
The participant:
- understands the operation and maintenance philosophy
- knows the overhaul criteria
- is able to set up a maintenance plan for the project-specific Gas Insulated Switchgear system
- can apply tools for maintenance supervision
- knows relevant technical documentations
- SF6-gas, handling and measuring instruments

**Participants**
Design and planning personnel, engineering and application personnel, operation and maintenance personnel, consultants from electricity supply industry, technical personnel from ABB companies

**Prerequisites**
Basic knowledge on electrical or mechanical engineering, knowledge on Gas Insulated Switchgear system

**Topics**
**Product description and design**
- Circuit-breaker and breaker drive mechanism
- Disconnector, earthing switch, fast acting earthing switch
- Statical components like connecting elements, busbars, lateral dismantling elements, compensators
- SF6-to-air bushing
- Surge arrester

**GIS layout and gas schematic diagram**
- Gas schematic diagram and concept of segregation for selective access to components
- Layout concept and feeder architecture

**SF6-gas, handling and measuring instruments**
- Properties and environmental aspects when working with SF6-gas
- Handling equipment and practical application of reclamer (evacuating, filling, reclaiming)
- Measuring instruments incl. practical measurements (air content/humidity and density)

**Operation, maintenance and trouble shooting**
- Guide through switchgear manual about steps and rules for operation and maintenance
- Planning and checkpoints of maintenance tour
- Time-based and load-based maintenance and corresponding maintenance intervals
- Maintenance and operation procedures on apparatus
- Repair procedures for CB-chamber, CB-drive, replacing DS/ES drive, work with pressurized compartments and insulators
High Voltage Products

CHS225
Gas Insulated Switchgear Installation

Course goal
The course conveys profound knowledge on the assembly and pre-commissioning of Gas Insulated Switchgear systems

Participants
ABB installation personnel, technical personnel from ABB companies and customers

Prerequisites
Knowledge on electrical or mechanical engineering, knowledge on Gas Insulated Switchgear system operation and maintenance

Topics
- Product description and design
  - Circuit-breaker and breaker drive mechanism
  - Disconnector, earthing switch, fast acting earthing switch
  - Statical components like connecting elements, busbars, lateral dismantling elements, compensators
  - SF6-to-air bushing
  - Surge arrester
- Site assembly instructions
  - Civil work requirements and building conditions
  - Cleanliness on site
  - Admissible torques on flanges
  - Corrosion protection and flange greasing
  - Tools and instruments set
  - Handbook / guide for site supervisors
- Assembly unit handling
  - Overview and detailed drawings of assembly units
  - Packing list
  - Documents and protocols
- Assembly steps and procedures
  - Anchor drilling and positioning of circuit-breakers
  - Coupling and alignment of assembly units, busbars, compensators and exit bus
  - Coupling and adjustment of transmission shafts of disconnector, earthing switch, fast acting earthing switch
  - Installation of interfaces (bushings, cable- and transformer connections and isolating links for testing)
  - Structure and arrangement of gas zones
  - Safe working procedures on pressurized compartments
- Steel structures
  - Packing lists, positioning and assembly
- Earthing connections
  - Principle and fixing of earthing
  - Catalogue earthing and connection elements

Installation SF6 - gas density monitors
- Circuitry and alarms
- Allocation of monitors to gas compartments

Apparatus wiring and cabling
- Cabling and apparatus wiring list
- Installation of cable glands

Health and safety on site
- Health and safety plan and protocols
- Examples and video about health and safety

Gas schematic diagram and layout
- Structure and arrangement of gas zones
- Feeder arrangement and layout architecture
- Introduction to drawings for gas zones, layout, steel structures, earthing and site assembly drawings

SF6 - gas processes on site
- Rules and documents for handling SF6 - gas balance
- Functions and handling of SF6 - gas reclaimer (evacuation, filling, reclaiming)
- Measurements, values and protocols

Pre-commissioning
- Completeness- and adjustment checks on installed GIS
- Testing of gas monitors
- Resistance testing of primary conductors
- Protocols and documents

Method
Presentations, practical demonstrations (assembly, cabling and pre-commissioning of complete GIS feeder ELK-14/300), factory tour, visit at sub-supplier and installed GIS in Switzerland

Duration
20 days

CHS226
Gas Insulated Switchgear Commissioning

Course goal
The course conveys basic knowledge on the commissioning of Gas Insulated Switchgear systems

Participant profile
ABB installation personnel, technical personnel from ABB companies and customers

Prerequisites
Profound knowledge on electrical or mechanical engineering, knowledge on Gas Insulated Switchgear system operation and maintenance

Topics
- GIS commissioning basics
  - Why commissioning?
  - What needs to be tested?
GIS control functions
- Circuit-breaker
- Disconnector / earthing switch
- Interlockings
- Analogue circuits

GIS testing
- Primary components
- Secondary components / circuits
- Electrical / mechanical
- Factory testing
- Site testing

Electrical norms for current and voltage transformers Practical exercises
- Factory testing GIS
- Current transformer testing
- Voltage transformer testing
- Circuit-breaker timing test
- Troubleshooting

Methods
Presentations, practical demonstrations, factory tour

Duration
10 days

CHS239
SF6-Gas Handling and Measuring Instruments (Environmental-friendly Rules and Procedures)

Course goal
The course covers theoretical and practical training on environmental-friendly SF6-Gas handling rules and procedures

Learning objectives
The participant
- knows the properties of SF6-Gas
- understands the rules for environmental handling of SF6-Gas
- is able to handle SF6-Gas measuring instruments
- can apply SF6-Gas handling devices for filling and reclaiming procedures correctly
- can measure and analyze the SF6-Gas results

Participants
Project management and purchasing, operation and maintenance staff, electricity power board staff, contractor’s engineering and technical staff for HV-substations, sales engineers and technical personnel from ABB companies

Prerequisites
Basic knowledge about SF6-Gas

Topics
Introduction
- Properties of SF6-Gas, environmental aspects
- Rules for safe handling of SF6-Gas for operation, maintenance and overhaul
- Disposal of decomposed SF6-Gas and decomposition products

Gas filling and reclaiming procedures
- Correct use of SF6-Gas handling devices for filling and reclaiming procedures
- Practical work with DILO gas handling devices (gas filling trolley, reclamer, hose connections)

SF6-Gas measuring instruments
- Modern and environmental-friendly measuring devices for SF6-Gas
- Application of dewpoint-, decomposition products-, SF6-Gas %, leak detection, pressure gauges

Methods
Lectures, demonstrations, practical training with SF6-gas handling devices and instruments, discussion

Duration
2 days

CHS232e
HMB Drive Operation & Maintenance E-Learning

Course goal
The participants understand basic maintenance steps for circuit-breaker drive mechanism HMB

Learning objective
The participant
- has an overview on maintenance intervals
- is able to take HMB drive out of service
- knows how to perform visual checks
- knows how to check and replace carbon brushes
- knows how to change oil

Participants
ABB employees, customers

Prerequisites
None

Topics
- First maintenance operations
- Take HMB out of service
- Visual checks
- Check and replace carbon brushes
- Change oil

Methods
E-Learning with quiz

Duration
10 – 20 minutes
CHS243e
SF6-Gas Basic E-Learning

Course goal
The course conveys basic knowledge about SF6-Gas and its usage within Gas Insulated Switchgears

Learning objectives
The participant
- knows the properties of SF6-Gas and why it is used in Gas Insulated Switchgears
- understands the effects of SF6-Gas on the atmosphere (Greenhouse effect)
- knows the most important equipment and instruments used for SF6-Gas handling

Participants
Project management and purchasing, operation and maintenance staff, electricity power board staff, contractor’s engineering and technical staff for HV substations, sales engineers and technical personnel from ABB companies

Prerequisites
none

Topics
Introduction
- What is SF6-Gas?
- Where and how is SF6-Gas used?
- What are the advantages of SF6-Gas?
- Is SF6-Gas dangerous?
- Are there dangerous substances?
- Are there alternatives to SF6-Gas?

Greenhouse effect
- Comparison
- Explanation

Equipment and Instruments
- Reclaimer
- Analog Manometer
- Digital Manometer

Methods
E-Learning with quiz

Duration
10 - 20 minutes

CHS249
Fiber Optic Current Sensors
Introduction

Course goal
The course is focused on introduction of the FOCS technology, product and its application. The FOCS-LTB current sensor device is a technology enabler that may lead to a large impact on high voltage devices, substation design, and substation automation. This course aims to accelerate the development of new integration projects, substation designs and new substation automation products based on the new optical sensing technology.

Participants
ABB employees, customers

Prerequisites
None

Topics
- What is a Fiber Optic Current Sensor
- FOCS LTB420 – main components, integration concept, basic functionality
- Operating Principle and Response Characteristics of FOCS
- Advantages and Benefits of FOCS-Technology
- Instrument Current Transformers and their applications: protection, metering, other functions
- ABB position in conventional Instrument Transformers and in NCIT (product portfolio)
- Basic information about competitors

Methods
Presentations and practical demonstrations

Duration
1 day

CHS250a
Gas Insulated Switchgear Repair and Exchange of components

Course goal
The course conveys knowledge on repair and exchange of main components of Gas Insulated Switchgears

Learning objectives
The participant
- understands the operation and maintenance philosophy of Gas Insulated Switchgears
- is familiar with all relevant documents needed to repair and maintain GIS
- is familiar with all relevant tools and equipment to repair and maintain GIS
- learns relevant steps in troubleshooting Gas Insulated Switchgears
- gets to know common faults in Gas Insulated Switchgears and how to overcome these
- how to replace and exchange all main components of Gas Insulated Switchgears

Participants
ABB maintenance personnel

Prerequisites
All relevant prerequisites needed for level 3 certification. Certification on GIS installation level 3; or service technicians with sufficient GIS maintenance experience of at least 3-5 years.

Topics
- Service portfolio and maintenance philosophy
- Preconditions for working on Gas Insulated Switchgears
- Types of reference documents and schematics
- Refresher on GIS components and its functions
- Practical training on circuit breaker
- Practical training on disconnector and earthing switch
- Practical training on circuit breaker drives
- Re-commissioning of circuit breaker and circuit breaker drives

Methods
Presentations and hands-on training

Duration
15 days

CHS251
Gas Insulated Switchgear Control and Protection

Course goal
The course conveys basic knowledge about GIS control and protection

Learning objectives
The participant
- knows the rules and can apply safety aspects for working on GIS Local Control Cubicle (LCC)
- gains overall knowledge on different types of GIS controls
- knows the functions of LCC components
- understands basics of electrical diagrams of LCC
- can perform practical measurements on components
- is able to identify failures at LCC and troubleshoot

Participants
Mechanical or electrical background, commissioning personnel, field service engineers, operation and maintenance personnel

Prerequisites
none

Topics
- Preconditions for working on GIS controls
- Design of GIS controls and protection
- Types of reference documents and schematics
- Overview of control room, local and remote control
- Function of LCC components and control voltages
- GIS drives schematics and interlink to LCC
- Troubleshooting LCC and how to measure
- Examples of failures, tricks and hints
- Replacing LCC components

Methods
Presentations, hands-on training

Duration
5 days
CHS289
GIS Service Customer Training
(Become an expert in GIS lifecycle management)

Course goal
The course will guide you through the most essential parts of the different service strategies needed to give your gas-insulated switchgear a long and healthy life. It will put some perspective on technology developments achieved throughout the years and provide you with insights on how to modernize your existing equipment. Get familiar with the processes and advanced services used today and obtain an outlook of what is to be expected in the future. Overall, the course provides you with the basic know-how and contacts to experts that help you shape your maintenance strategy in the future.

Learning objectives
The participant
- understands the ABB service strategies in the field of Gas Insulated Switchgears
- knows processes and advanced services ABB offers
- is able to design a maintenance strategy with respect to the existing equipment

Participants
In general people with a basic knowledge about GIS that want some more detailed know-how on the maintenance possibilities and alternatives for GIS. And anyone interested in the performance, reliability and availability increase of this strategic asset. Typically this includes:
- Asset managers
- Maintenance managers
- Substation managers
- Operation & maintenance staff

Prerequisites
none

Topics
Latest GIS technology
- What is state-of-the-art today?
- What technology is currently under development?

GIS Service portfolio and maintenance philosophy
- How do you extend the lifetime of a GIS?
- What is the difference between time and condition based maintenance for GIS?
- Explanation

Case study on failure mitigation and risk management
- How do you best prepare for the worst case?
- How to mitigate failures through proper risk management?

Troubleshooting
- What if a failure occurs?
- What are suitable steps to take and which people to contact?

Condition monitoring and diagnosis of a GIS
- What are the parameters influencing the condition-based maintenance criteria?
- Monitoring of SF6-Gas and partial discharge

SF6-Gas handling
- Environmental background and properties of SF6-gas
- Rules for handling
- Measurement of SF6-gas quality (pressure, humidity) using state-of-the-art today analyzer

Circuit-breaker drive maintenance
- Understand drive design
- Maintenance checks / Intervals
- Hydraulic modules and their function

Field trip
- Visit a substation where service on GIS has helped to extend the lifetime and increase reliability

Methods
Classroom training, workshops and case studies, practical training in repair shop, field trip.

Duration
4 days

CHS262
AHMA Drives: Repairs, Maintenance and Troubleshooting

Course goal
The course conveys knowledge on AHMA drives for repairs, maintenance and troubleshooting

Learning objectives
The participant
- understands the function and working principle of the AHMA drive
- knows maintenance checks and intervals for AHMA drive
- knows how to solve failures and repair

Participants
Mechanical or electrical background, maintenance personnel, field service engineers

Prerequisites
Basic knowledge on GIS and switchgear drives

Topics
Design of AHMA drive
Main elements: Hydraulic elements, control and monitor elements

Function of hydraulic system
High Voltage Products

Why measurement is needed?
- Measuring equipment
- Speed-time
- Dynamic resistance measurement (DRM)

Maintenance checks and intervals

Examples of failures and how to repair

Methods
Presentations, hands-on training, GIS factory tour

Duration
5 days

CHS263
HMB Drives: Repairs, Maintenance and Troubleshooting

Course goal
The course conveys knowledge on HMB drives for repairs, maintenance and troubleshooting.

Learning objectives
The participant
- understands the function and working principle of the HMB drive
- knows maintenance checks and intervals for HMB drive
- knows how to solve failures and repair

Participants
Mechanical or electrical background, maintenance personnel, field service engineers

Prerequisites
Basic knowledge on GIS and switchgear drives

Topics
Design of HMB drive
Hydraulic modules: Storage, charging, control, monitor, working module
Function of hydraulic system

Why measurement is needed?
- Speed-time
- Dynamic resistance measurement (DRM)

Maintenance checks and intervals
Examples of failures, tricks and hints
- Oil handling
- Adjust change over valve

Methods
Presentations, hands-on training, GIS factory tour

Duration
5 days
Transformers

CHS501
Transformers I

Course goal
To study and to improve the knowledge on the specific characteristics, data and application of power transformers, protection and tests. To study the new methods of the power flow control and its operational and economic consequences. To know the interactions between the transformers and the environment.

Participants
Design and planning personnel, engineering and application personnel and consultants from the Electricity Supply Industry. Technical personnel from ABB companies.

Prerequisites
Electrical or mechanical engineering degree, technical college qualifications or equivalent. Basic knowledge about Power Transmission and Distribution.

Topics
- Network Transformer, Generator Transformer
  Design Parameters, Construction Rules,
  Basic Design, Operation Rules, Overloading, Cooling, Economic aspects for replacement, Tests etc.
- Optimization and Management of the Energy Flow
  Regulation of Active and Reactive Power Flow with Power Transformers, Economical Aspects.
- Future solutions
  New Trends and Developments, Dry Type Transformer,
  Gas Insulated Transformer,
  Supraconductive Transformer
- Power Transformer and Environment
  Water Protection, Noise Reduction, Fire Safety,
  Protection of Transformer
  Electromechanical Protection Devices, Buchholz relay, Tank Protection Overpressure Protection, Thermal Image etc.
- Overvoltage protection, Surge arresters
- Protection techniques
  Network types, installations and power devices, faults and disturbances, protection functions overview, basic technology etc., differential, thermal overload, restricted earthfault etc.

Methods
Lectures and practical examples

Duration
3 days

CHS501
Transformateurs I

Objectif du cours
Apprendre et améliorer la connaissance sur les caractéristiques spécifiques, les essai, la protection et l’application des transformateurs de puissance. Apprendre les nouvelles méthodes de contrôle de flux de puissance et ses conséquences opérationnelles et économiques. Connaître les interactions entre les transformateurs et l’environnement.

Participants
Personnel de conception et de planification. Conseillers de l’industrie d’approvisionnement en électricité. Personnel technique d’exploitants, de bureaux d’ingénieurs et de la société ABB.

Conditions
Diplôme d’ingénieur en électricité ou qualification technique équivalente.

Contenu
- Transformateur de réseau, Transformateur de machine
  Règles de construction, Conception de base, Règles d’utilisation, Surcharge, Refroidissement, Aspects économiques du remplacement, Essais, etc.
- Optimisation et gestion du flux de l’énergie
  Régulation du flux de puissance actif et réactif.
- Solutions futures
  Nouvelles tendances et nouveaux développements, Transformateurs de type sec, Transformateurs isolés au gaz,
  Transformateurs supraconducteurs
- Transformateurs de puissance et environnement
  Protection de l’eau, Réduction du bruit, Protection contre l’incendie, etc
- Protection du transformateur
  Dispositifs electromécaniques de protection, Relais Buchholz, Protéctions de cuves, Protéctions contre les surpressions, Image thermique, etc.
- Protection de surtension, Parafoudre (exposé en allemand ou en anglais).
  Possibilité et type de surtension dans les réseaux de transmissions d’énergie, propagation d’ondes, surtensions temporaires, normes.
- Technique de protection (exposé en allemand ou en anglais possible)
  Type de réseaux, d’installation et d’appareils, défauts et perturbations, principe des fonctions de protection, technologie de base, etc., protection différentielle, surcharge, protection différentielle de défauts de terre.

Méthodes
Conférences et exemples de la pratique.

Durée
3 jours.
Transformers

CHS501
Transformatoren I

Kursziel

Teilnehmende
Planungs- und Projektierungspersonal, Betreiber und Berater aus der elektrischen Energiewirtschaft. Technisches Personal von Ingenieurbüros sowie ABB Firmen.

Voraussetzungen
Abschluss als Elektro- oder Maschineningenieur, Absolvierung einer technischen Fachhochschule oder entsprechende Ausbildung.

Inhalte
– Netztransformatoren, Leistungstransformatoren.
  Auslegungskriterien, Bauformen
  Grundlagen, Aufbau, Funktionsweise, Überlastbarkeit,
  Kühlung, wirtschaftliche Aspekte betreffend Ersatz und Reparaturen, Prüfung, usw.
– Optimierung des Energieflusses
  Steuerung des Wirk- und Blindleistungsflosses mittels Leistungstransformatoren, Wirtschaftlichkeitsbetrachtungen
– Zukünftige Lösungen
  Trocken-Transformator, Gas-isolierter Transformator, Supraleiter-Transformator usw.
– Leistungstransformatoren und Umwelt
  Gewässerschutz, Geräuschminderung, Brandschutz,
– Schutz des Transformators
  Elektromechanische Schutzeinrichtungen, Buchholzschutz,
  Kesselschutz, Ueberdruckschutz, Thermisches Abbild, usw.
– Überspannungsschutz, Überspannungsableiter
– Schutztechnik
  Netztypen, Anlagen und Betriebsmittel, Fehler und Störungen, Übersicht der Schutzfunktionen, Basistechnologie etc.
  Differential, Überlast, Erdschluss Differential etc.

Methoden
Vorträge und Anwendungsübungen.

Dauer
3 Tage.
Transformers

CHS502
Transformers II

Course goal
To study and improve the knowledge about the modern techniques available in the field of life time prolongation of the equipment. To study the important operational and economic consequences of an unexpected shortage or of a major failure for aged units.

Participants
Design and planning personnel, engineering and application personnel and consultants from the Electricity Supply Industry. Technical personnel from ABB companies.

Prerequisites
Electrical or mechanical engineering degree, technical college qualifications or equivalent. Basic knowledge about Power Transmission and Distribution. Attendance of course CHS501 or relevant experience is recommended.

Topics
– Life Time Prolongation of Power Transformers
  Test method for oil analysis
  Interpretation of the results,
  Advanced diagnostic methods, etc
– Transformer accessories
  Oil cooler, Oil pump, fans
  Bushings, Current Transformer, etc.
– On-Line Monitoring
  Sensors, Data Acquisition,
  Economical justification, etc
– Maintenance and Repair
  Check-list, Periodicity of controls, On-site maintenance activity, Repair technology, Economical analysis of a transformer population, Economical justification, etc.
– Treatments on oil and windings
  Filtration technique for oil, winding drying with low-frequency heating, etc.

Methods
Lectures and applied exercises.

Duration
2 days

CHS502
Transformateurs II

Objectif du cours
Apprendre et améliorer la connaissance au sujet des techniques modernes disponibles dans le domaine de la prolongation de la durée de vie de l’équipement et de la gestion d’un parc d’appareils. Apprendre les conséquences opérationnelles et économiques importantes d’une défaillance inattendue ou d’un accident majeur sur des transformateurs en service depuis une longue durée.

Participants
Personnel de conception et de planification. Conseillers de l’industrie d’approvisionnement en électricité. Personnel technique d’exploitants, de bureaux d’ingénieurs et de la société ABB.

Conditions
Diplôme d’ingénieur en électricité ou qualification technique équivalente. Participation au cours CHS501 ou expérience équivalente recommandée.

Contenu
– Prolongation de la durée de vie d’un transformateur de puissance
  Méthodes de test pour analyses d’huile,
  Interprétation des résultats
  Méthodes et résultats de diagnostiques avancés, Solutions de surveillance continue, etc
– Accessoires de transformateurs
  Refroidisseurs d’huile, Pompes,
  Ventilateurs, Bornes, Transformateurs d’intensité, etc.
– On-Line Monitoring
  Capteurs, Acquisition de données,
  Justification économiques, etc
– Maintenance et réparation
  Check-liste, Périodicité des contrôles, Travaux sur site,
  Technique de réparation, Gestion d’un parc d’appareils,
  Justification économique, etc.
– Traitement sur l’huile et les enroulements
  Technique de filtration de l’huile, séchage des enroulements par chauffage basse-fréquence, etc.

Méthodes
Conférences et exemples de la pratique

Durée
2 jours.
Transformers

CHS502
Transformatoren II

Kursziel

Teilnehmende
Planungs- und Projektierungspersonal, Betreiber und Berater aus der elektrischen Energiewirtschaft, Technisches Personal von Ingenieurbüros sowie ABB Firmen.

Voraussetzungen

Inhalte
- Lebensdauerverlängerung von Transformatoren
  Methoden der Oelanalyse
  Interpretation der Resultate
  Messmethoden für die Diagnose, usw
- Zubehör von Transformatoren
  Kühler, Oelpumpen, Ventilatoren, Durchführungen,
  Stromwandler, usw.
- On-Line monitoring
  Monitoringlösungen und Sensoren,
  Wirtschaftlichkeits-Betrachtungen.
- Wartung und Reparaturen
  Check-List, Periodizität der Kontrolle, Reparatur vor-Ort bzw.
  im Werk, Ersatzplanung, Wirtschaftlichkeits-Analyse eines
  Trafoparks, usw.
- Behandlung des Oeles und des Aktivteils
  Oel-Filtrierung bzw. Trocknung, Trocknung des Aktivteils mit
  LFH, usw.

Methoden
Vorträge und Anwendungsübungen.

Dauer
2 Tage