

Lecture 01:

Introduction to switchgears

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SWITCHGEARS : Definition

Switchgear is a general term covering all equipment used for :

- ❖ *Switching,*
- ❖ *Protection,*
- ❖ *Control and*
- ❖ *Isolation* in a power system.

All equipment used for fault clearing is covered by the term switchgear. Switchgears are used in Generation, Transmission and Distribution Systems, whereas, Control Gears are used in Consumer Circuits.

Essential features Switchgears

- ❖ Complete reliability
 - ❖ Absolutely certain discrimination
 - ❖ Quick operation
 - ❖ Provision for manual control
 - ❖ Provision for instruments
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- Decorative geometric shapes in orange, teal, and blue at the bottom of the slide.

Necessity of Switchgears

Switchgears are necessary at every switching point in the power system because there are *several voltage levels* and *fault levels* which has to be *controlled* and *protected* by accessible switching devices and for isolation, if the need arises.



Types of switchgears

Following are the two types of switchgear:


Principal Switchgears are the main equipment concerned with the process of switching and isolating circuits in a power system.

Auxiliary Switchgears are secondary or subsidiary equipment which assist the main switchgear equipment in the control, measurement, protection and fault-clearing process.




Switchgear Equipment

SWITCHING DEVICES

- ❖ *Circuit Breakers*
 - ❖ *Isolators (Disconnect or Disconnecting Switch)*
 - ❖ *Earthing Switches*
 - ❖ *Air-Break Switches*
 - ❖ *Oil Switches*
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Switchgear Equipment Cont.

PROTECTION DEVICES

- ❖ *Protection Relays*
 - ❖ *Lightning Arresters*
 - ❖ *Feeder Pillars*
 - ❖ *Fuses.*
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Switchgears Equipment

SENSING DEVICES:

- ❖ *Voltage (Potential) Transformers*
- ❖ *Current Transformers*

CONTROL (COMPENSATION) DEVICES

- ❖ *Series Inductive Reactors*
- ❖ *Shunt Inductive Reactors*
- ❖ *Series Capacitive Reactors*
- ❖ *Shunt Capacitive Reactors*

AUXILIARY POWER SUPPLY DEVICES

- ❖ *Tripping Units (Battery Bank & Charger)*
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SWITCHGEAR : Gear for switching

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graph TD; A([SWITCHGEAR : Gear for switching]) --> B([Switching Devices]); A --> C([Control & Sensing Devices]); A --> D([Decision Making Devices]);
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Switching Devices

Circuit breakers
Isolators
Switches

Control & Sensing Devices

Current Transformers;
Voltage Transformers;
Reactors;
Tripping units.

Decision Making Devices

Protective Relays
Lightning Arresters
Fuses

Circuit Breakers

- ❖ Definition: *A Circuit Breaker is a device capable of making and breaking an electric circuit under normal and abnormal conditions such as short circuit.*
- ❖ Functions: *A Circuit Breaker is a switching and current interrupting device.*


Purposes of a Circuit Breaker

- ❖ Switching during normal operating conditions for the purpose of operation and maintenance.
- ❖ Switching during abnormal conditions such as short circuits and interrupting the fault current.




Classification of Circuit Breaker

C.Bs are classified according to the following categories:

- ❖ *Rated Voltage*
 - ❖ *Medium of arc extinction*
 - ❖ *Type of operating mechanism*
 - ❖ *Type of construction*
 - ❖ *Structural form*
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Arc Extinction Media Employed in C.B

- ❖ *Atmospheric Air*
 - ❖ *Compressed Air*
 - ❖ *Dielectric Oil (Transformer Oil)*
 - ❖ *Sulphur Hexafluoride (SF_6) Gas*
 - ❖ *Vacuum*
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Current Interruption Modes

- ❖ High Resistance Current Interruption Mode is employed in all HVDC CBs and in Air Blast CBs by the automatic insertion of high resistance in the CB circuit, milliseconds, prior to current-interruption, to divert and extinguished arcing.
- ❖ Zero-Point Current Interruption mode is employed in all ac C.Bs by extinguishing the arcing by the timing of the zero-value position of the current wave form with the rapid operation of the operating mechanism to achieve rapid build-up of dielectric strength of the contact space.

Fault-clearing Process of a C.B

If we consider a fault occurrence and clearing process of a circuit breaker, the following order or sequence of operation is observed.

FAULT OCCURS: As the fault occurs, the fault impedance being low, the currents increase and the relay gets actuated. The moving parts of the relay move because of the increase in the operating torque. The relay takes some time to close its contacts.

RELAY CONTACT CLOSES: The relay contacts close the trip-circuit of the circuit breaker and the trip-coil is energized from the control voltage supply from a battery bank of tripping unit.



Fault-clearing process of a C.B

OPERATING MECHANISM OPERATES: As the trip-coil is energized, appropriate plunger, toggles, latches or valves are operated, which enables the actuation of the operating mechanism for the opening operation to separate the circuit breaker contacts.

ARCING: Arc is drawn between the separating contacts, because the charged electrons surrounding the separating contacts tries to re-establish potential between the contacts.

CLEARANCE/ISOLATION: The arc is extinguished in the circuit breaker by appropriate suitable techniques at some natural currents zero of a.c. wave. The process of current interruption is completed when the arc is extinguished, current reaches final zero value and the arc does not restrike again. The fault is said to be cleared.

It the introductory lecture covering the main topics we will be discussing in coming classes for whole semester under Course Title:
Switchgear and Protective Devices.

Thank you !

For any query you can contact me through class group on Whatsapp or can call on my cell number from 10:00 AM to 04:00 PM.

