4.0 CIRCUIT BREAKER CUBICLE

Learning Objectives

The circuit breaker cubicle is the component of the switchgear that holds the circuit breaker, and the controls and cabling for the distribution system.

As a result of this lesson you will be able to:

1. Understand the components of the cubicle
2. Understand the function of the shutter assembly
3. Describe the positions of a breaker during the racking operation
4. Understand and explain the test position
5. Explain the function of the truck-actuated switch
6. Understand the operation of the mechanism operated Switch

4.1 WHY CIRCUIT BREAKERS ARE REMOVABLE

The circuit breaker is removed from the cubicle to allow for the complete isolation of loads from sources, for personnel safety during component maintenance, and for repair. Circuit breakers of the same rating are generally interchangeable; allowing an alternate circuit breaker to be installed while the original is maintained.

When a circuit breaker is removed for system repairs a ground truck may be installed in the compartment to connect the de-energized equipment to ground. The ground truck is a breaker frame with bushings only and a ground bus, the bus side is run to ground and with the truck in the breaker position there is no danger of energizing the circuit.

4.2 MEDIUM VOLTAGE BREAKER CELL COMPONENTS

The following components are common to most cubicles; this example is an ABB HK cubicle.

- Shutter: the fiberglass barrier that isolates the live bus connections to the cell (Figure 4-1).

- Primary Disconnects: the disconnects that connect the power to the breaker (Figure 4-3).
- Secondary Disconnects: the disconnects that connects the control power (Figure 4-2.)
- Guide rail: the rail that guides the breaker into the cell (Figure 4-5).
- Ground Bar: the ground connecting point to the breaker frame (Figure 4-2).
- CT's: current transformers located on the primary bus. Transform the current down to a manageable value for instrumentation (Figure 4-4).
- Instrumentation Relays: relays mounted in the door of the cell that monitor the voltage and current.
- Rejection Plate: prevent racking the wrong breaker into the cubicle (Figure 4-2).
- Breaker Positions: markings that show position of the breaker, such as, connected, disconnected and testing (Figure 4-5).

4.3 SWITCHGEAR AUXILIARY SWITCHES (figure 4-6)

A number of different types of auxiliary switches are used to indicate the position of the circuit breaker contacts and readiness of the circuit breaker for operation and also to provide additional electrical interlocks. These are mechanism operated and truck operated auxiliary switches.

4.3.1 Mechanism-Operated Control Auxiliary Switches (MOC switch)

MOC switches are operated directly from the breaker mechanism some switches are mounted on the circuit breaker but normally they are mounted in the switchboard enclosure and linked mechanically to the circuit breaker. Figure 4-6 shows a common MOC arrangement on a Westinghouse DHP cubicle.

4.3.2 Truck-Operated Contact Auxiliary Switches (TOC switch)

TOC auxiliary switches are mounted in the circuit breaker compartment and operate when the circuit breaker is moved to the operating position. TOC switches may be used for interlocking and remote position indication.

4.4 INTERNAL CONTROL WIRING

The circuit breaker control wiring originates at the secondary disconnects and terminates at meters, relays, and control circuits.

4.5 RACKING INTERLOCKS

All breakers have interlocks on the racking mechanism or in the switchboard to prevent the breaker being racked in or out when closed. These interlocks will trip the breaker if a close operation is attempted while racking the breaker in or out. The interlock will also prevent insertion of the racking tool until the breaker is tripped.

4.6 RACKING POSITIONS

A racking mechanism also called a levering device is the mechanism used to insert and remove the circuit breaker from the circuit breaker compartment. Most circuit breakers are racked in manually by a racking tool, which looks like a large speed wrench with a special end to fit on to the breaker-racking device (Figure 4-5). The general electric vertical lift Magne-Blast breakers are racked in by an electric racking motor but can also be inserted with a manual-racking handle.

The racking operation is potentially one of the most dangerous breaker evolutions; if the breaker safety interlocks fail the breaker can explode. Because of this danger many plants are starting to use remote racking systems to perform the breaker racking operation.

All circuit breakers have two main positions connect and disconnect, some breakers also have a test and a withdrawn position.

- Disconnect Position: In this position the breaker is completely off the bus and disconnected from the secondary disconnect. The breaker should be able to be removed from the cubicle but may need to have a latch holding it in this position.

- Connect Position: In this position the breaker primary and secondary disconnects are completely inserted and control power is available to the breaker.

- Test Position: The definition of the test position is the primary disconnects are disconnected from the cubicle bus, and the secondary disconnect is connected and control power is available to operate the breaker.

  In this position the breaker can be operated electrically to verify operation but since the bus is not connected the equipment will not be energized.

- Withdrawn Position: Circuit breakers with racking mechanism as part of the breaker may have a position beyond disconnect. In this position the racking mechanism interlocks the mechanism and puts the breaker in a locked out position where the close and trip latch is engaged.

4.7 RACKING SHUTTER

The racking shutter is a mechanism, which covers the cubicle side primary bus when the breaker is racked out and removed. The shutter prevents easy access to the live portion of the cubicle bus work when the breaker is removed from the switchboard.

As the breaker is racked into the cubicle a roller or shaft will engage the shutter-actuating arm and lift the shutter from the primary bus opening. When removing the breaker the shutter will re-close and cover the primary opening.

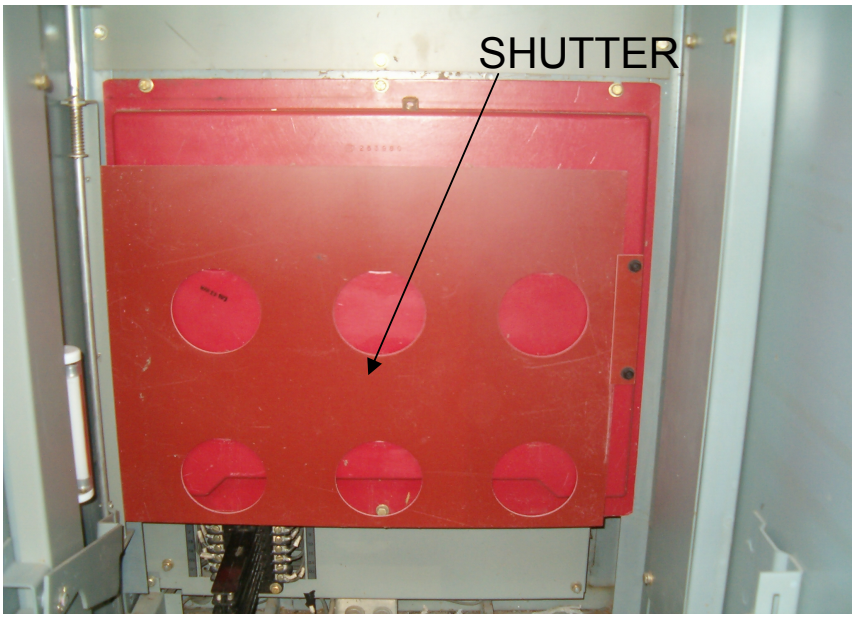

Figure 4-1 Shutter assembly

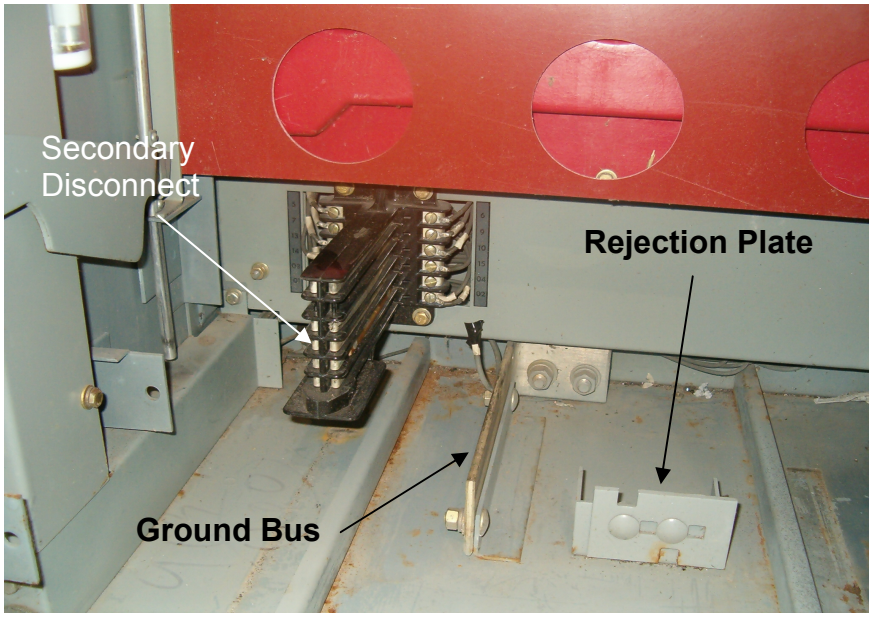

Figure 4-2 Stationary secondary disconnect

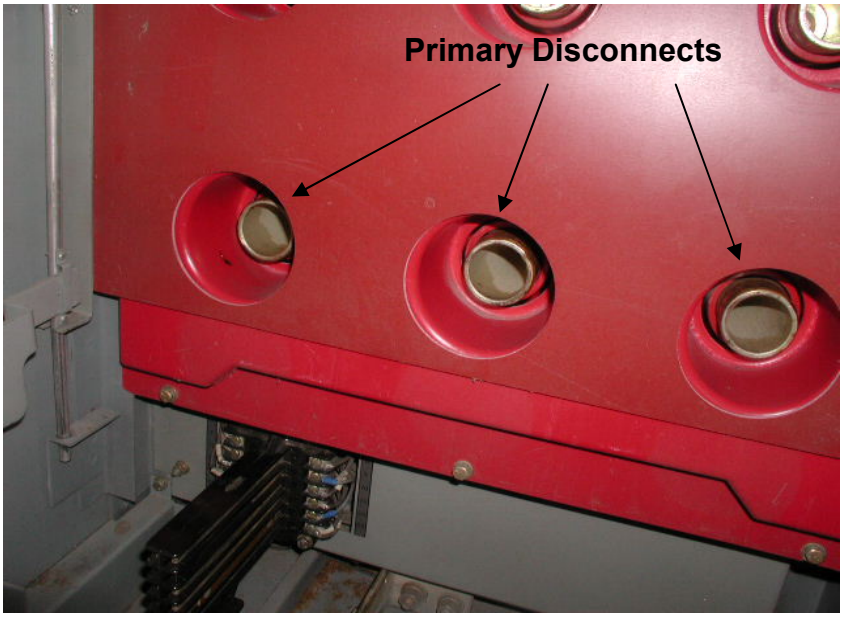

FIGURE 4-3 HK Primary disconnects

Figure 4-4 Instrumentation current transformers

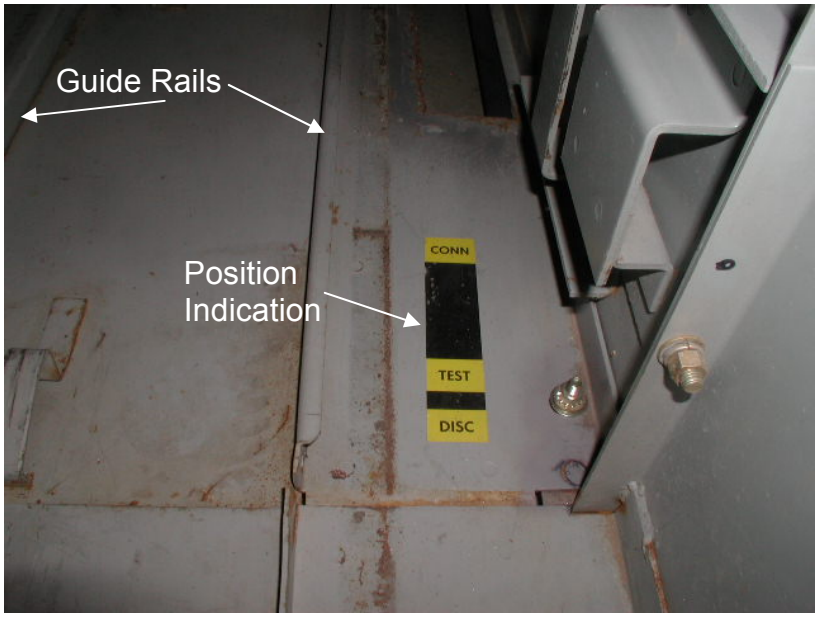

Figure 4-5 Position indication and guide rails

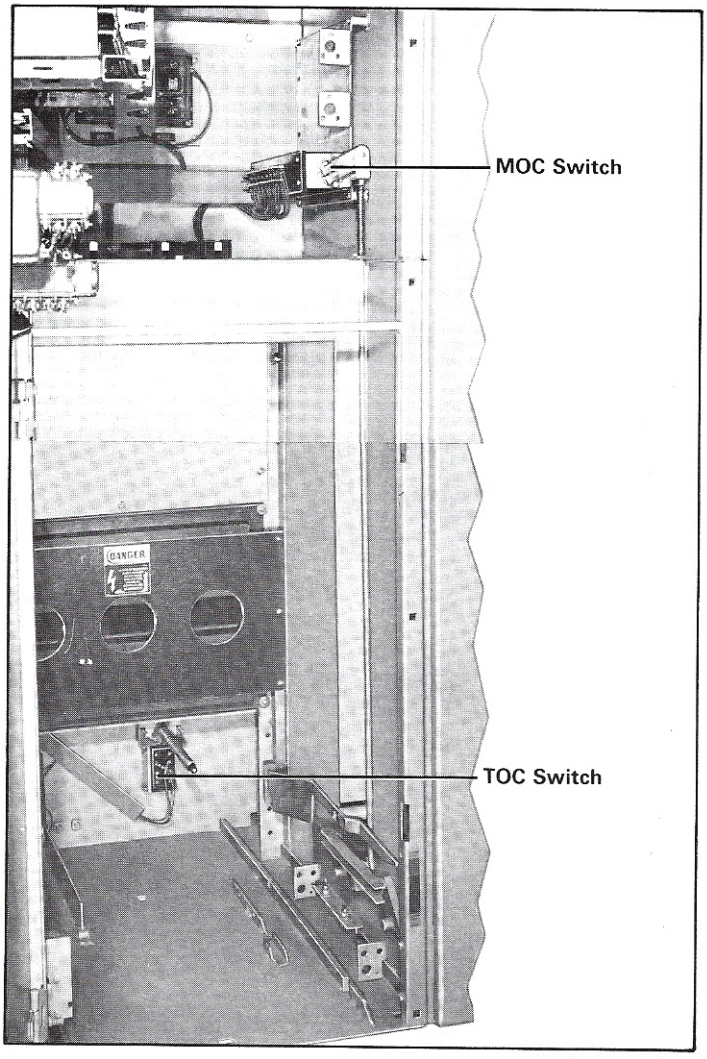

Figure 4-6 Westinghouse DHP - MOC and TOC Switches