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1. SCOPE

This document provides a guideline for the minimum maintenance requirements for MV and LV switchgear.

2. GENERAL REQUIREMENTS

The need for maintenance of switchgear is often not obvious as switchgear may remain idle, either open or closed, for long periods of time. Switchgear that remains idle for 6 months or more should be opened and closed several times in succession to verify proper operation and remove any accumulation of dust or foreign material on moving parts and contacts.

3. CIRCUIT BREAKERS

3.1 Moulded case circuit breakers

Moulded case circuit breakers are designed to require very little or no maintenance during their normal life cycle. Hence, the need for preventative maintenance will vary depending on operating conditions, as the accumulation of dust on the latch surface may affect operations of the circuit breaker.

3.2 Low-voltage circuit breakers

Low voltage circuit breakers should be inspected in accordance with their service and operating conditions. Conditions that influence the frequency of maintenance and inspection include:

- a. High humidity and high ambient temperatures.
- b. Dusty or dirty environment.
- c. Corrosive environment.
- d. Frequent switching operations.
- e. Frequent fault operations.
- f. Older equipment.

A circuit breaker should be inspected and replaced if necessary whenever it has interrupted current at or near its rated capacity.

3.3 Medium-voltage circuit breakers

Medium-voltage circuit breakers operating in the range of 0.4 kV 33 kV should be inspected and maintained annually or after every 2000 operations, whichever comes first. The above maintenance schedule is recommended by the applicable standards to achieve required performance from the breakers.

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3.3.1 Maintenance procedures for medium-voltage oil circuit breakers

The following suggestions are for use in conjunction with the manufacturer's instruction books for the maintenance of medium-voltage oil circuit breakers:

- a. Check the condition, alignment, and adjustment of the contacts.
- b. Thoroughly clean the tank and other parts which have been in contact with the oil.
- c. Test the dielectric strength of the oil and filter or replace the oil if the dielectric strength is less than 22 kV. The oil should be filtered or replaced whenever a visual inspection shows an excessive amount of carbon, even if the dielectric strength is satisfactory.
- d. Check breaker and operating mechanisms for loose hardware and missing or broken cotter pins, retaining rings, etc.
- e. Adjust breaker as indicated in instruction book.
- f. Clean and lubricate operating mechanism.
- g. Before replacing the tank, check to see there is no friction or binding that would hinder the breaker's operation. Also check the electrical operation. Avoid operating the breaker any more than necessary without oil in the tank as it is designed to operate in oil and mechanical damage can result from excessive operation without it.
- h. When replacing the tank and refilling it with oil, be sure the gaskets are undamaged and all nuts and valves are tightened properly to prevent leakage.

3.3.2 Maintenance procedures for medium-voltage vacuum circuit breakers

Direct inspection of the primary contacts is not possible as they are enclosed in vacuum containers. The operating mechanisms are similar to the breakers discussed earlier and may be maintained in the same manner. Consult the manufacturer's instruction book.

4. SAFETY

Maintenance procedures include the safety practices indicated in the preamble. Below are a number of points that require special attention:

- a) Ensure that the circuit breaker and its mechanism are disconnected from all electric power, both medium voltage and control voltage, before it is inspected or repaired.
- b) Exhaust the pressure from air receiver of any compressed air circuit breaker before it is inspected or repaired.

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- c) After the circuit breaker has been disconnected from the electrical power, attach the grounding leads properly before touching any of the circuit breaker parts.
- d) Do not lay tools down on the equipment while working on it as they may be forgotten when the equipment is placed back in service.
- e) All conductors and equipment shall be treated as energized until tested or otherwise determined to be de-energized and grounded.

4 RECLOSERS

Reclosers are generally designed for long service life and minimum maintenance. As reclosers are applied under varying operating and climatic conditions, maintenance intervals are best determined by the user based on actual operating experience. To operate properly, reclosers must be maintained when they have operated the equivalent of a duty cycle and before the dielectric strength has deteriorated below prescribed levels.

In the absence of specific operating experience and if a recloser has not completed an equivalent of duty cycle within three years, it is recommended that an external inspection, oil-level check and a check of the dielectric strength of the oil be made at that time.

5 SECTIONALIZERS

Frequency of maintenance is dependent on the local climate and the switching duty imposed on the sectionalizer. As sectionalizers do not interrupt fault currents, contact wear and oil contamination due to arcing will be minimal. Hence, maintenance efforts should be directed specifically towards keeping the unit in operating order and maintaining the dielectric strength of the insulating oil.

It is recommended that, initially a maintenance inspection be conducted after one year of service. The results of this initial maintenance check along with a study of maintenance records for similar equipment within a specific area can be used to establish realistic maintenance intervals.

Each periodic maintenance inspection is to include as a minimum, the following steps:

1. Bypassing, tripping and de-energizing the sectionalizer and removing it from service
2. External inspection
 - a) Check for broken or cracked bushing, paint scratches, or other mechanical damage.
 - b) Manually close and trip the sectionalizer several times to check mechanical operation. Leave the unit in the open position.

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3. Internal inspections are to be conducted in accordance with manufacturer's maintenance specifications.

6 SURGE ARRESTERS

Surge arresters require little operational maintenance. It is recommended that units found to be defective be replaced rather than repaired:

Surge arresters are almost always applied with one terminal connected to an electrically energized source and one terminal to ground. No work should be done, or contact made with surge arresters, when connected to the energized source.

Visual inspection should be made periodically to ensure that:

1. The line lead is securely fastened to the line conductor and the arrester.
2. The ground lead is securely fastened to the arrester terminal and ground.
3. The arrester is not located in such a manner as to be subject to:
 - a. Damaging fumes or vapours.
 - b. Excessive dirt or other current-conducting deposits.
 - c. Excessive humidity, moisture, dripping water, steam, or salt spray.
 - d. Abnormal vibrations or shocks.
4. Any external gaps are free from foreign objects and set at proper spacings.

7 RING MAIN UNIT

Maintenance guidelines for RMUs are given in Table 1 below.

Table 1: Maintenance guideline

Insulation medium	Routine inspection	Minor services	Major
Oil	3 monthly	None	3 monthly
Vacuum	3 monthly	none	6 -12 yearly
SF6	3 monthly	None	12 yearly

- a. Three monthly inspections are usual for visual inspections.
- b. Three yearly services on oil breaker include oil change, mechanical inspection, busbar pressure tests and MV contact resistance, where applicable.

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- c. Trip testing of breakers is to be done in accordance with local conditions.

8 METAL CLAD SWITCHGEAR

8.1 Safety

Before any covers are removed or any doors opened which permit access to the primary circuits, it is essential that the circuit(s) be de-energized and breakers be withdrawn to the test position and tagged.

8.2 Recommended annual maintenance

The switchgear structure and connections should be given the following overall maintenance at least annually. All maintenance work must be done with both the primary and control power circuits de-energized.

1. Thoroughly clean the equipment, preferably using a heavy duty vacuum cleaner to remove all dust and other accumulations.
2. Clean racking mechanism and lubricate jack screws and gears with lubricant.
3. Check primary disconnecting device contacts for signs of abnormal wear or overheating. Before replacing breaker, apply a thin coat of contact lubricant to breaker studs.
4. Check tightness and continuity of all control connections and wiring.
5. Adhere to maintenance recommendations from the equipment manufacturer's recommendations.

A permanent record of all maintenance work should be kept, the degree of detail depending on the operating conditions. The record should include reports of tests made, the condition of equipment and repairs and adjustments that were made.

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Annex A

(Informative)

Recommended inspection intervals for Circuit Breakers

The following are guidelines and recommended intervals for the various maintenance inspections to be carried out on circuit breakers

Item/Equipment	Intervals	Activity
moulded case circuit breakers	3 to 5 years	Routine trip testing
low-voltage circuit breakers	1 to 3 years	Carefully read and follow manufacturer's instructions
medium-voltage circuit breakers	Annually or every 2000 operations	Carefully read and follow manufacturer's instructions

