Section 6: Inspection and maintenance

6.1 Safety precautions

Refer to Section 1.6, "Safety precautions."

⚠ WARNING

WHEN INSPECTING, REPAIRING, AND PERFORMING MAINTENANCE ON SWITCHGEAR, THE FACT THAT DANGEROUS VOLTAGES MAY EXIST MUST BE KEPT IN MIND. PRECAUTIONS MUST BE TAKEN TO INSURE THAT PERSONNEL DO NOT COME IN CONTACT WITH ENERGIZED HIGH VOLTAGE PARTS. FAILURE TO DO SO MAY RESULT IN DEATH, PERSONAL INJURY, OR PROPERTY DAMAGE.

Some common general precautions for high voltage work are:

Connections

All connections should be considered energized until the personnel expecting to work on them is assured that the circuits are de-energized, and until every possible precaution has been taken to see that there is no chance of a circuit being energized while the crew is working.

Switches

Switches, which have been opened to de-energize a circuit to permit work on equipment, should be locked or blocked open and a suitable visible warning device placed on them.

Grounding

Do not work on parts normally carrying current at high voltage until these parts have been disconnected and grounded to the ground bus. The purchaser should make provisions for connecting adequate, flexible ground leads to every part of the switching equipment.

6.2 Access to switchgear parts

6.2.1 High voltage parts

VacClad-W switchgear is a metal-clad design. All major parts of the primary circuit are isolated by grounded metal barriers and enclosed within separate compartments. For example, the circuit breaker, main bus, and primary line and load terminations are isolated from each other and enclosed in separate compartments, which are made from grounded metal barriers and covers. Access to high voltage parts can be gained by removing the covers and barriers. The covers and barriers should not be removed unless the parts to be exposed are de-energized.

6.2.2 Main contacts

Stationary main disconnecting contacts are located behind the automatic safety shutters. Upper and/or lower stationary contacts can be exposed by manually opening the shutters (see Figures 12 and 13). Do not expose any contacts unless all upper and lower high voltage parts are de-energized.

⚠ WARNING

FAILURE TO DO SO MAY RESULT IN DEATH, PERSONAL INJURY, OR PROPERTY DAMAGE.

6.2.2.1 Manually opening the shutters

1. Insert the breaker maintenance tool (see Figure 22), such that the handle rests on the welded rail support while making contact with the hardware assembly on the manual shutter extension (Refer to Figure 21).

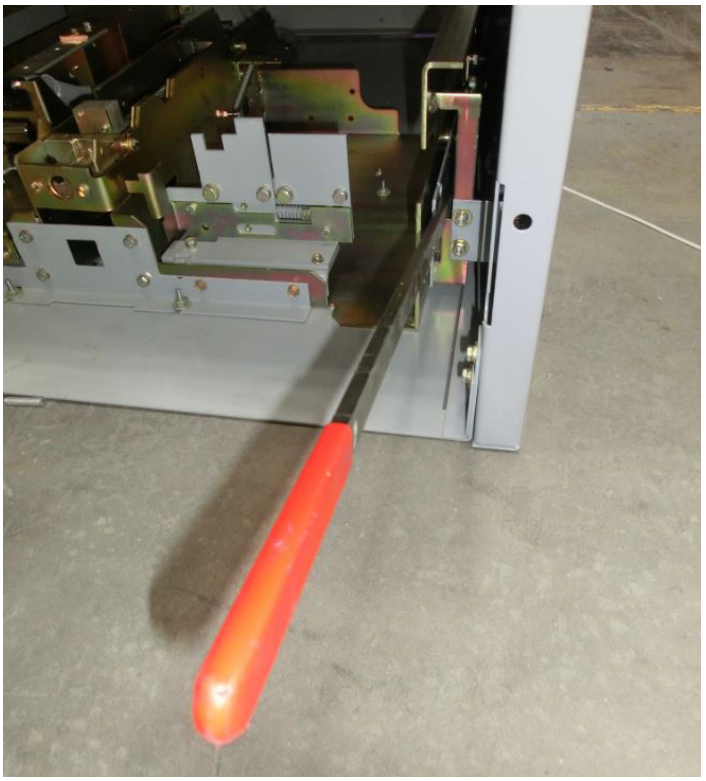

Figure 21. Insertion of Maintenance Tool into the Pan for Manually Opening the Shutters.

2. Push down on the maintenance to open the shutters (Refer to Figure 22).

Note: Shutters will close if pressure is removed from the maintenance tool. Shutters can be locked into place with the shutter lock kit or other manual means.

Figure 22. Hand Operation to Manually Open the Shutters

6.2.3 Current transformers

Window type current transformers are installed over the primary contact insulating tubes in the front of the unit (see Figures 12 and 13). All primary circuits must be de-energized prior to gaining access to any CTs.

6.2.4 VT and primary fuses

Disconnecting transformers and fuses:

Simply pulling out the drawer automatically disconnects and grounds the moving high voltage parts. Shutters automatically cover the primary disconnects (see Figure 23).

⚠ WARNING

DO NOT ATTEMPT TO REMOVE THE BACK COVERS OR TO OPEN OPTIONAL REAR DOORS, THE DISCONNECTING ASSEMBLIES, OR THE SHUTTERS UNLESS THE HIGH VOLTAGE CIRCUITS TO THE COMPARTMENT ARE DE-ENERGIZED AND PRECAUTIONS HAVE BEEN TAKEN TO PREVENT ENERGIZATION. FAILURE TO DE-ENERGIZE THE CIRCUIT MAY RESULT IN BODILY INJURY OR DEATH. WHEN ENERGIZED, THE CIRCUIT CARRIES LETHAL HIGH VOLTAGES.

Figure 23. Typical VT and CPT Drawer in the Upper Drawout Position.

6.2.5 Control equipment

With the exception of apparatus such as current transformers and rear-mounted heaters, control equipment and wiring is generally accessible without exposing high voltage parts.

6.3 Inspection and maintenance schedule

To assure high-quality service, a definite maintenance schedule, systematically followed, is essential. Plant, operating, and local conditions vary to such an extent that the schedule must be prepared to suit the conditions. However, the following general requirements should be helpful in setting up the program.

⚠ WARNING

BEFORE ATTEMPTING ANY INSPECTION OR MAINTENANCE, BE SURE THAT ALL PRIMARY AND CONTROL CIRCUITS HAVE BEEN DE-ENERGIZED AND GROUNDED AS REQUIRED AND THAT PROPER STEPS HAVE BEEN TAKEN TO BE SURE THAT THEY WILL REMAIN DE-ENERGIZED UNTIL ALL WORK IS COMPLETED. FAILURE TO DO SO MAY RESULT IN BODILY INJURY OR ELECTROCUTION. WHEN ENERGIZED, CIRCUIT CARRIES LETHAL HIGH VOLTAGE.

6.3.1 Individual devices

The maintenance schedule for individual devices, such as circuit breakers, relays, and so on, should be based upon recommendations contained in the individual instruction book for the device. These operations should be coordinated with the overall program to result in the least operating inconvenience and circuit shutdown.

6.3.2 Overall maintenance

The switchgear installation should be given a thorough overall maintenance check at the end of the first year in service because it provides an opportunity to evaluate conditions at an early point in the life of the equipment. Where conditions are abnormal, more frequent inspection and maintenance is necessary. Where conditions warrant, a longer period of time between maintenance periods may be used. The following require attention.

1. Buses and connections
   De-energize the primary circuits and remove the cover plates from the primary compartments. Before cleaning, take megohmmeter (megger) readings between phases and each phase to ground. Inspect for signs of overheating or weakened insulation. Remove dust from buses, connections, supports, and enclosure surfaces. A vacuum cleaner with a long nozzle will be of assistance. Wipe clean with distilled water and wipe dry.

   After buses have been dusted and wiped clean, take megger readings again between phases and each phase to ground. Keep a record of these readings for future reference in determining when trends occur that would indicate a lowering of the insulation resistance.
   Periodic high-potential tests are not required after initial start-up and are recommended only after repair of high voltage buses or installation, or when the trend of megger readings indicates it to be advisable. Refer to Table 1.

2. Primary disconnecting contacts and primary contact insulating tubes
   Remove each breaker from its compartment. De-energize the primary circuits and expose the primary contacts and their supports by manually opening automatic safety shutters. Wipe clean with a cloth moistened in a non-flammable solvent. Inspect for abnormal wear or overheating. Discoloration of the surfaces is not harmful unless corrosion due to atmospheric conditions is severe, resulting in deposits on the surface. Check each breaker while it is out of the housing for all items recommended in the instruction book applying to that particular type of breaker.

3. Other disconnecting contacts
   Inspect all secondary disconnecting contacts, such as those on auxiliary drawout assemblies, for abnormal wear, fatigue, or overheating. Replace if necessary. Otherwise treat the same as the main disconnecting contacts above.

4. Control contactors
   Contacts should be inspected and dressed or replaced when the surface becomes pitted. Unless repetitive duty has been experienced, little attention should be required.

5. Instruments, relays, and other panel mounted devices
   Individual devices should be maintained according to the specific instructions supplied for each device. Remove all relay covers and inspect the interiors for dust or dirt. Relay test personnel can easily perform this operation during periodic relay testing.

6. Secondary wiring
   Check all wiring connections for tightness, including those at the current and voltage transformers and at the terminal blocks where circuits leave the switchgear. Make sure that all secondary wiring connections are properly connected to the switchgear ground bus where so indicated.

7. Mechanical parts
   Visually check and manually operate mechanical moving parts such as the shutter, TOC and MOC switch assemblies, the position interlock, hinged doors, and the drawout features of the auxiliary drawout assemblies. Examine mechanical mating parts such as the breaker secondary contacts blocks, guide rails, and trippers. Grease the racking screw and the plunger/operating mechanism of the MOC switch, as called out in Section 4.3, items 4 and 9.

8. Ventilation
   Check all grillwork and air passages for obstructions and accumulations of dirt.

9. Battery and charging equipment (optional)
   The control battery is such an important item in switchgear operation that it must be given special periodic attention if it is to give reliable service for a long period of time. Periodic inspections and test are recommended in the battery supplier(s) instructions. At the same time the battery is checked, inspect the battery charger and remove accumulations of dust and dirt. On all chargers having a manual transfer switch for setting the charging rate, check carefully to be sure that the selector switch is returned to the value appropriate for a floating charge at the end of the periodic inspection. Serious damage to the control battery can occur if the charger is left on a high charging rate for an extended period of time.

10. Records
    The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between the regular maintenance periods. Megger tests are suggested for checking the insulation. A series of these tests will indicate any tendency toward a reduction in dielectric strength of the insulation. Megger readings should be taken before and after cleaning the equipment and, where possible, under similar conditions at successive periods. Records should include the megger reading, the temperature, and the humidity.
    The readings will vary with the extent and design of the bus structure. In contrast with a small installation, the longer switchgear assemblies will have a more extensive bus structure with a greater number of insulators and, thereby, a larger number of parallel insulation resistance paths to ground which will tend to decrease megger readings. This variation in insulation resistance between different switchgear assemblies emphasizes the value of a series of readings, which can be charted to establish a normal insulation level so that progressive weakening of the insulation can be recognized.

11. Abnormal conditions
    Local conditions such as high humidity, salt-laden atmosphere, corrosive gases, heavy dust, or severe circuit operating conditions, are considered to be abnormal. They will require more frequent inspections.
    It should be emphasized that a series of inspections should be made at quarterly intervals until the progressive facts of the local conditions can be analyzed to determine a schedule which will maintain the equipment in satisfactory condition.
    In some locations, conditions may be so harsh that the frequency of maintenance will interfere with operating and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear equipment in a relatively tight room and supplying a sufficient quantity of clean air to maintain a positive pressure in the room. Under such conditions, maintenance schedules may then be established on a more normal basis. Such an arrangement might also provide for cooling the air where the ambient temperature is relatively high, thus further improving operating conditions.

Section 7: Lubrication

VacClad-W Switchgear is designed so that lubrication in usual service is infrequently required under normal conditions. However, unusual service conditions such as high humidity, salt-laden atmosphere, corrosive gases, or severe circuit operating conditions may demand more frequent relubrication. All mechanical parts have been lubricated during assembly with molybdenum disulphide grease (Eaton Electrical Material No. 53701QB). The application of the lubricants should be held to a minimum to reduce the accumulation of dust and dirt.

7.1 Where to lubricate

1. MOC Switch (Refer to #9 in Figure 20b) – Grease (Eaton Electrical Material No. 53701QB) should be applied to the three locations where the rotary switch assemblies link to the Push Bar assembly (see Figure 24). This should be done at least every 3 years.

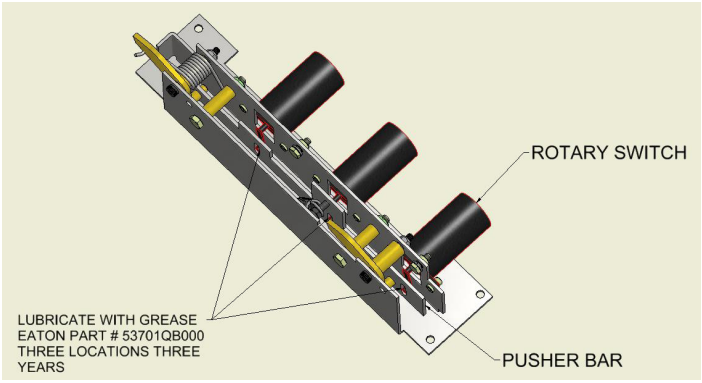

Figure 24. Lubrication Locations for the MOC Switch.

2. Racking Screw (Refer to #4 in Figure 20b) – With the breaker removed, apply grease (Eaton Electrical Material No. 53701QB) to the racking screw (see Figure 25). Grease should be applied with a brush using a motion perpendicular to the axis of the threaded shaft. It is important the grease is applied to the face of the threads. Apply to the length of the exposed threads and then move the nut from disconnect to connect to distribute the grease.

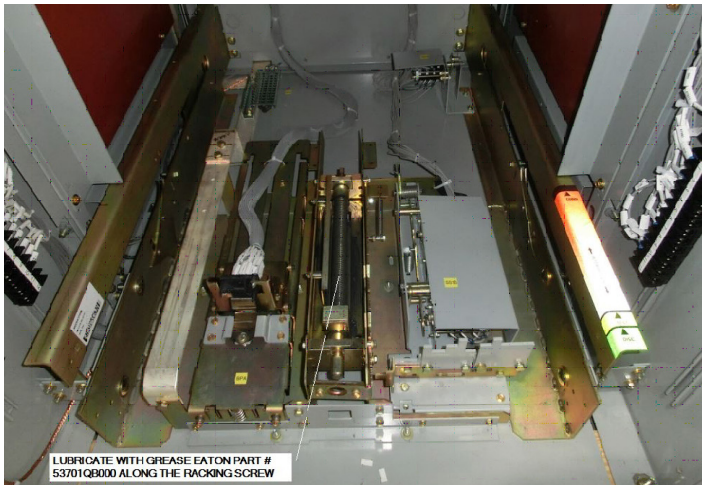

Figure 25. Lubrication Location for the Racking Screw.