Electrical Equipment - Course 230.2

SWITCHGEAR: PART 4

VACUUM CONTACTORS

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1. OBJECTIVE

The student must be able to:

1. *For vacuum contactors:*

   (a) state the purposes of each operational component.

   (b) describe the normal operation of:

      (i) preparation for service (de-isolating),
      (ii) closing,
      (iii) opening,
      (iv) taking out of service (isolating).

   (c) State the three ratings and the consequences of exceeding these ratings.

   (d) State the operator actions that should be taken in the event of abnormalities.

2. VACUUM CONTACTORS

2.1 Introduction

In Ontario Hydro, vacuum contactors are used at 2.4 kV at BHWP 'A'. At other locations, they are used in small numbers at 600 V.

The advantages of vacuum contactors *over air* circuit breakers are:

(a) they are small in size.

(b) they require no contact maintenance. The contacts are sealed for life.

(c) they can be operated many tens of thousands of times before replacement is required.

The disadvantages are:

(a) because vacuum contactors are a relatively new development, they are not fully accepted.

(b) loss of vacuum can be dangerous and is difficult to detect.

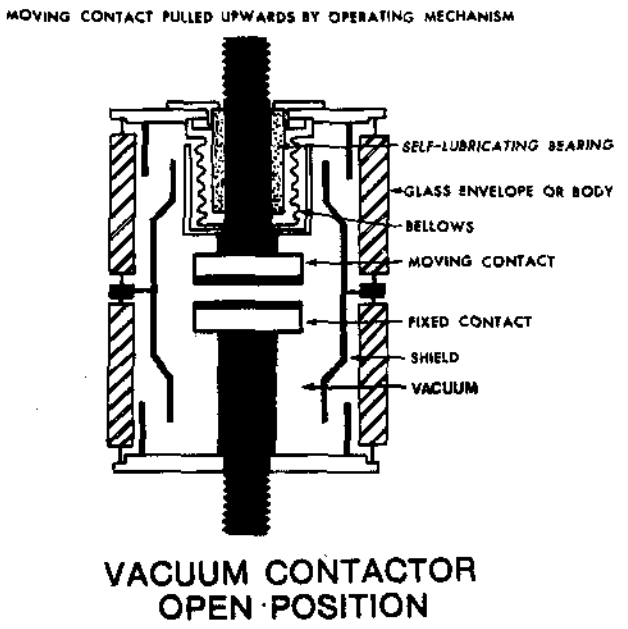
(c) no repairs can be done to the vacuum sealed contacts. Faulty units are discarded.

NOTE: In some descriptions, a vacuum contactor is called a vacuum breaker. It should be called a contactor when its operate coil has to be continuously energized to keep the contacts closed. It should be called a breaker when the contacts are held closed by a latching mechanism.

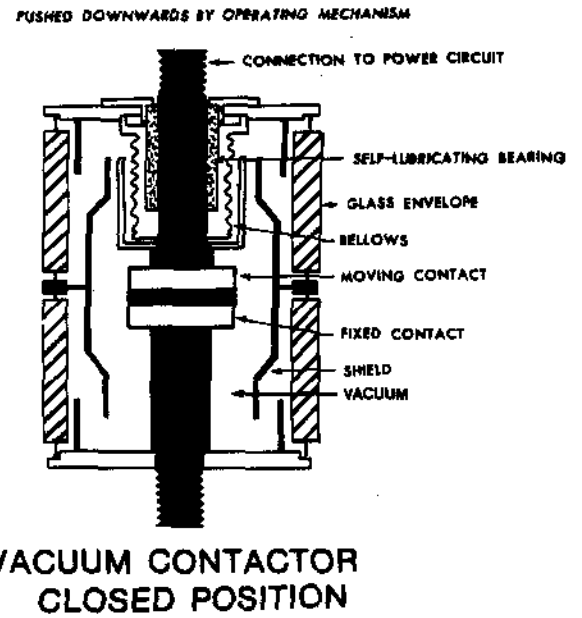
2.2 Principle of Operation and Construction Details

A three phase vacuum contactor consists of three separate sealed vacuum bottles (sometimes called vacuum interrupters) which contain the contacts, see Figures 1(a) and 1(b). On each bottle, metal bellows allow contact movement and ensure the vacuum seal. The moving contacts are moved downwards when the closing coil is energized. When the closing coil is de-energized, the contacts in the bottles are opened by spring action. This mechanism is similar to that on a regular electromechanical contactor. Because of the excellent insulating properties of a vacuum, contact separation is approximately 3 mm (.125 inch).

Minimal contact damage occurs because the arc is extinguished at the first current zero after the contacts part. Most of the metal vapour produced by the arc condenses back on the contacts and is ready for subsequent use. The remainder of the metal condenses on the shield, which prevents contamination of the glass insulating surfaces. The three vacuum bottles and three series fuses (for the purpose of interrupting short circuit currents) are mounted on a withdrawable chassis. This chassis can be racked in and out of the service position. The arrangement is similar to that used with air circuit breakers.



(a)



(b)

Figure 1: Vacuum Contactor Bottles.

2.3 Ratings

Vacuum contactors, like air circuit breakers, have the following ratings:

- voltage,
- current (continuous),
- current (interrupting).

If any of these ratings are exceeded, the vacuum contactor can be expected to fail. Equipment damage will occur and personnel injury may also be involved.

2.4 Action(s) to be taken in the Event of Abnormalities

Because the loss of vacuum is difficult if not impossible to detect, there is no way that an operator can know that a vacuum bottle will mal-function when called upon to operate. It has been found that vacuum contactors are less likely to fail if they are regularly operated. This is because traces of gases are "scavenged" at each operation.

Therefore, if there is any suspicion that a vacuum bottle is defective, the contactor must not be operated. If it is in the closed position before investigation is started, the contactor must first be de-energized from all sources of supply. This will ensure there will be no arcing and consequential explosion.

ASSIGNMENT

1. State the purpose(s) of the following vacuum contactor components:

   (a) bellows.
   (b) vacuum.
   (c) moving contact and fixed contact.
   (d) glass envelope.

   (Section 2.2)

2. Describe the normal operation of a vacuum contactor:

   (a) for the closing cycle.
   (b) for the opening cycle.

   (Section 2.2)

3. State:

   (a) the ratings of a vacuum contactor. (Section 2.3)

   (b) the consequences of exceeding these ratings. (Section 2.3)

   (c) the action(s) to be taken if it is suspected that a vacuum bottle has lost its vacuum whilst it is in-service. (Section 2.4)

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