NUCLEAR OPERATIONS TRAINING

BACKGROUND SYSTEMS

SB-9

ELECTRICAL BREAKERS

REVISION 1

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LIST OF ATTACHMENTS

ATTACHMENT	TITLE
I	480V Breaker Operation
II	7.2KV Breaker Operation
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OBJECTIVES

TERMINAL OBJECTIVE: The student shall be able to describe the ELECTRICAL BREAKERS as they apply to the operation of the V.C. Summer Station

ENABLING OBJECTIVES: The student shall be able to:

		AO	RO	SRO	SE
SB-9-01	**DESCRIBE** the operation of the following breaker type. INCLUDE both local and remote operation. 1. 7.2 KV Breaker 2. 480V Feeder Breaker 3. 480V Switchgear Breaker 4. 480V MCC Breaker 5. 120V AC Breakers	X	X	X	X
SB-9-02	**DESCRIBE** the construction of all types of 7.2 KV, 480V, and 120 VAC Breakers,	X	X	X	X
SB-9-03	**DESCRIBE** the component operation associated with each switch position of the following switches/controls: 1. 7.2 KV normal and alternate Feeder Breaker Controls 2. 7.2 KV Breaker Control Power 3. 480 volt Breaker Controls.	X	X	X	X
SB-9-04	**STATE** the reason for the following indicators available for the Service Power System. 1. 7.2 KV Breaker Position (local and remote) 2. 480V Breaker position (local and remote)	X	X	X	X

		AO	RO	SRO	SE
	3. Breaker Relay Flags.				
SB-9-05	**DISCUSS** the breaker trip indications, both local and remote, for 7.2KV, 480V, and 120V breakers.	X	X	X	X
SB-9-06	Give a basic **DESCRIPTION** of the local operation of 7.2KV and 480V during emergency plant procedures such as GOP-8 and the FEPs	X	X	X	X
SB-9-07	**DISCUSS** in detail all recommendations that pertain to operator training for the following: SOER 98-2, SOER 83-6, and SOER 82-16.		X	X	X
SB-9-08	**DESCRIBE** how the following operating experiences apply to your job and/or their significance to plant operations: SOER 98-2, SOER 83-6, and SOER 82-16.		X	X	X
SB-9-09	Using selected operating experiences related to this course, **DESCRIBE** their applicability to your job, their significance to plant operations, and which of the seven human performance tools could have been used to prevent or mitigate the events.	X	X	X	X
SB-9-10	**DETERMINE** which of the seven Human Performance tools could have been used to prevent or mitigate the events of SOER 98-2, SOER 83-6, and SOER 82-16.	X	X	X	X

LESSON TEXT

INTRODUCTION

The objective of the Virgil C. Summer Nuclear Station is to generate electrical power for consumer usage. Of the produced electrical power, a small portion is needed to operate reactor safety-related and nonsafety-related auxiliary and support equipment, which allows the reactor, and steam plants to operate as designed. This auxiliary and support equipment is called house loads. Power to many of these house loads is needed whether the station is generating power or is shut down. The distribution of electrical power to the site house loads and vital loads is accomplished by independent electrical distribution systems. These systems are the Service Power System and Safeguards Power System. The Service Power System distributes electrical power on-site to all auxiliary and support equipment that is not related to reactor safety. The Safeguards Power System distributes electrical power to only those site loads needed to place and maintain the reactor plant in a safe shutdown condition with or without electrical power from an offsite source. This chapter deals specifically with the breakers used to supply this electrical power.

Abnormal conditions in, and improper work on, electrical distribution systems have contributed to plant transients, fires, loss of power to important plant components, and damage to electrical components. Unsatisfactory conditions that have contributed to industry events related to ground faults include foreign objects, moisture and dirt accumulation, loose fittings, corrosion, and overheating of components. (RE: SOER 90-1)

GENERAL DESCRIPTION

The plant's power systems consists of three alternating current (AC) power networks, which distribute electrical power throughout the V. C. Summer site at their respective voltage. These networks are the 7200 volt (V), 480 volt, and 120 volt AC subsystems.

The networks are designed to supply reliable power while at the same time preventing equipment damage. Damage is prevented using feeder (supply) circuit breakers which automatically open for various electrical faults such as overcurrent, undervoltage, or grounded conditions.

The 7200 VAC network receives electrical power from power transformers. Power from the 7200 VAC subsystem is then distributed to the 480 VAC network and the large 7200 VAC site loads such as the reactor coolant pumps and the other large motors.

The 480 VAC network receives electrical power from the 7200 VAC network via voltage step down transformers. It, in turn, distributes 480 VAC power throughout the site to the 120 VAC subsystem and 480 VAC loads.

The third network, the nonvital and nonsafety-related vital 120 VAC network, is supplied electrical power directly from the 480 VAC network via voltage step-down transformers. Electrical power from this network is distributed to 120 VAC loads throughout the site.

DETAILED DESCRIPTION

Feeder Breakers

Typical feeder breakers from the transformers to the 7.2 KV buses are air-break circuit breakers located in the switchgear for their respective bus. Each of these breakers may be operated from the MCB or locally at the switchgear. From the MCB, a pistol-grip control switch, with red and green flag indicators, is used for operator control of the breakers. The control switches have TRIP and CLOSE positions and are spring-returned to the unmarked center position. The center position is called the NORMAL-AFTER-TRIP (CLOSE) position. A window in the center of the switch displays the position flags. A red flag in the switch window indicates that the breaker switch was last taken to the CLOSE position (demanding breaker closure). A green flag indicates that the breaker switch was last taken to the OPEN position (demanding breaker opening). Green, amber, and red indicator lights are located above each control switch. The green light indicates an open breaker, the red light a closed breaker, and the amber light indicates that the actual breaker position does not match the flag (demanded) position.

Protective relays that sense overcurrent conditions send signals to the 51BX relays when their set limits are exceeded. The 51BX series relays are used for contact multiplication and require positive manual action to reset. It is the 51BX relay that actually performs the overcurrent protective trips and lockout. There also may be undervoltage relays on some 7.2KV switchgear panels. These relays typically have flags to indicate when they are tripped so the operator/electrician will have an indication of what might have caused the breaker trip.

Control power for tripping and closing the breakers is obtained from the station batteries via 125 VDC distribution panels. If the control power supply breaker trips, annunciator "CNTRL PWR BKR TRIP" actuates on the MCB.

A manual trip can be initiated locally at the switchgear or from the MCB. The operator is alerted to a tripped 7.2 KV breaker (auto or local trip) by an annunciator.

All the circuit breakers that control power to and from the 7.2 KV buses are located in switchgear cubicles. The switchgear enclosures consist of a separate, metal-type, dead-front construction rated at 7500 volts. Each circuit breaker cubicle is isolated from the adjacent circuit breaker cubicle by metal barriers. There are no mechanical interlocks between the switchgear doors and the circuit breakers to prevent opening a door with the circuit breaker closed. (Figure SB9.8)

Control Board Indications

Two white lights on the MCB are associated with each normal and alternate feeder breaker. The lights are illuminated when power is available to the feeder breaker from the associated power supply.

7.2 KV Subsystem Loads

Each 7.2 KV bus supplies electrical power to loads. Those motor circuits which receive power from the 7.2 KV buses are equipped with an extra overcurrent setpoint. An alarm and amber light above the control switch are actuated in the control room when motor current exceeds normal full-load current but is still less than the overcurrent trip setpoint. This alarm allows the control room operator time to take corrective action before the trip occurs. An ammeter is located on the MCB for each of these motor circuits. Each component's breaker also trips if the ground overcurrent (50) relay detects a phase-to-ground short on that component.

Each 7.2 KV bus feeds 480 VAC switchgear units via 7.2 KV to 480 V, delta-wye step down transformers. The 7.2 KV power input to the 480 VAC step down transformers is controlled by input breakers located in the 7.2 KV switchgear. Most of the breakers can be operated remotely from the MCB or locally at the switchgear.

The 480 VAC transformer feeder breaker control switches are identical to the 7.2 KV service bus supply breaker control switches. They too have the pistol-grip handles and a center flag window for breaker position indication. These control switches also have the red, green, and amber breaker position lights. These feeder breakers can be shut only after meeting both of the following conditions:

- The associated 480 VAC transformer lockout relay is reset.

- Any previous overcurrent conditions on the respective 7.2 KV service bus have been cleared and reset.

When an electrical fault occurs in the 480 VAC step down transformer, its feeder breaker from the associated 7.2 KV bus trips open automatically due to the transformer protective lockout relay energizing. This lockout relay also trips the 480 VAC breaker at the output of the faulted step down transformer (discussed in the next section). The step down transformer feeder breaker trips when an overcurrent condition occurs in the individual 480 VAC switchgear unit or the supplying 7.2 KV bus.

Manual Breaker Operations

The 7.2 KV breakers are mechanically interlocked so that they cannot be inserted or withdrawn when the breaker is in the closed position. Each breaker also has a test position which separates the primary disconnects by a safe distance, but retains the grounding connection and permits the breaker to be closed or tripped using the control switch located on the front of the breaker cubicle door. A control power jumper cable must be used to connect the control power block with the breaker mounted block. A closing lever and a trip pushbutton on the front of the breaker can be used to operate the breaker locally during normal operation if remote control is not possible. (Figure SB9.9 & SB9.10)

There are no mechanical interlocks between the switchgear doors and the circuit breakers to prevent operating a door when the circuit breaker is closed. Care must be taken when switching operations call for insertion or withdrawal of 7.2 KV breakers. Mechanical interlocks which are designed to prevent racking out a closed breaker have been known to fail, and serious injury could occur. The correct breaker to be withdrawn must be verified open and the correct breaker again is verified just before withdrawal is attempted. As always, recommended safety gear (face shields, gloves) should be used when operating switchgear.

If a 7.2 KV breaker does not close remotely or locally because the closing spring is discharged (local indication), the closing spring can be manually charged as follows:

- A ratchet wrench with a 5/8-inch socket is placed on the hex head charging stud just to the right of the charging motor (under the front of the breaker).

- The ratchet wrench is turned to rotate the eccentric wheel until the charge-discharge device indicates charged.

Transformer Feeder Breakers

The supply feeder breakers from the 7.2 KV buses are 1200 amp, air-break circuit breakers located in the switchgear. Any of these seven breakers may be closed from the MCB or locally if no transformer faults (86) or overcurrent (51BX) relays are picked up. The breakers may also be tripped from the MCB or locally.

The transformer feeder breakers trip automatically if an overcurrent condition occurs to either the associated 7.2 KV bus or the associated 480 VAC service bus. Additionally, a transformer fault trips the breaker.

480 V Feeder Breakers (Figure SB9.1)

The supply breakers for the 480 VAC switchgear units can typically be operated from the MCB. All supply breakers can be operated locally. The feeder breaker control switches for the 480 VAC switchgear units are identical to the control switches previously discussed. These control switches allow the operator to control power to the associated buses.

Control power to the 480 VAC switchgear bus supply breakers is 125 VDC supplied by the station batteries. Should breaker control power be deenergized, an annunciator actuates to alert the operator.

480 V Crosstie Breakers

Also located on the MCB are five additional breaker control switches. These switches control crossties to provide, or receive, alternate power for 480 VAC unit substations.

The crosstie breaker control switches are identical to the control switches previously mentioned, with one exception: the pistol-grip handle can be pulled out or pushed in. When pushed in, the contacts of the switch allow for automatic operation of the crosstie breaker and inhibit manual operation. When pulled out, the associated crosstie breaker can be operated manually by the operator.

Feeder Breakers

Each of the 480 VAC feeder breakers has pushbuttons mounted on the breaker for operation in the test position and for manual operation of the breaker. Electrically (Remote) operated breakers have trip and close pushbuttons. Manually operated breakers have a trip pushbutton and a close lever (Figure SB9.6 & SB9.3). The three-position design of these breakers permits the front door to be closed with the breaker in the operating, test, or disconnected position. In the test position, the primary disconnects are separated by a safe distance to allow test operation. If an attempt is made to insert the breaker into the operating position with the breaker closed, or to withdraw the breaker from the operating position with the breaker closed, a mechanical interlock trips the breaker open. There is no interlock to prevent opening a feeder breaker door when the circuit breaker is closed. The breakers can be padlocked in the test or disconnected position.

The 480 V feeder breakers can be operated locally. To close a breaker manually, the manual closing lever is pulled outward (the closing springs must be charged). To trip a breaker manually, the TRIP pushbutton on the left is depressed. The closing springs can be charged by inserting a manual charging handle into the manual charge lever (located under the face of the breaker) and pumping. It takes approximately ten pumps to charge the closing spring. The closing spring indicates "SPRING CHARGED" when the closing spring has been pumped sufficiently.

<u>480 V Switchgear Breakers</u> (SB9.2, SB9.4 & SB9.6)

Electrically (Remote) operated breakers have two trip pushbuttons. The button on the left is the mechanical trip and the one on the right is the electrical trip that works only in the test position. There is also a close pushbutton. Manually operated breakers have a trip pushbutton and a close lever.

Local operation of the 480 V switchgear breakers varies with the type of breaker. If the breaker in question does not have the large closing handle on its front, it is a remotely operated breaker. To open a remotely operated breaker locally, control power to the breaker is first removed in order to disable breaker closing capability. This is accomplished by opening the closing control power breaker located in the rear of the breaker cubicle (SB9.5). Next, the Charging Motor Disconnect switch is opened. This switch is the toggle switch located on the front of the breaker and is positioned DOWN to the OFF position. Control power should always be removed when racking out a breaker or when breaker reclosure is not desired (due to fire or some other problem). The breaker is now tripped to the OPEN position by depressing the TRIP pushbutton located on the left hand side of the front of the breaker. It should be noted that on certain breakers, such as those associated with automatic transfer units, the closing springs are charged immediately after the breaker closes. If such a breaker is to be opened, removing the control power and placing the toggle switch to OFF is not enough to assure the breaker will not close, because the spring is still charged. Should the manual close lever be pulled up locally, the breaker will close.

To locally close a remotely operated breaker, the closing springs are first checked to see if they are charged. The indicator flag shows "charged" if the springs are charged. If necessary, the springs are charged according to the following guidelines:

- For 2000 amp and 3000 amp frame size breakers, the manual charging handle is inserted into its slot in the breaker front and pumped in and out until the breaker is charged. During this operation control power is turned off to prevent auto charging while manually charging.

- For the 600 amp and 1600 amp frame size breakers, the door on the breaker cubicle is opened and the manual charging handle is engaged with slots on the pawl carrier on the bottom of the breaker at the centerline. The same rule concerning control power being secured while manually charging the springs applies.

Once the charging springs are ready, close the breaker by pulling up on the manual close lever. The lever is between the black test CLOSE pushbutton and the left-hand red TRIP pushbutton. Make sure that the breaker closes and remains closed.

Sometimes problems occur with the breaker tripping back open. During emergency conditions such as fire in the control room or control room evacuation, disabling the remote tripping circuitry is the solution to this. When the trip circuitry is disabled, so are all the interlock trips, but the overcurrent trips still work. The trip circuitry is disabled by opening the panel on the back of the breaker in question and tripping the small breaker for the trip circuits. Should the breaker fail to remain closed, it means that an overload condition exists which should be investigated.

These breakers have a Trip Indicator that indicates the breaker has tripped on overcurrent only. It protrudes about ½” from the front plate when actuated and must be reset manually.

The Racking mechanism on these breakers is used to move the breaker between the ”connected”, “test”, and “disconnected” positions. The racking shutter cannot be opened if the breaker is closed or the locking hasp is out. SOP-313 provides detail on racking these breakers in and out.

SYSTEM OPERATION

Breakers operated from the MCB are typically operated as dictated by the applicable System Operating Procedure. When a breaker has to be operated locally, SOP-313, Local Switchgear Breaker Operation is used. This procedure includes both the steps for manipulating the breaker and electrical safety precautions.

Effects of Ground Faults

One type of serious electrical fault occurs when one phase of either a component or a bus is shorted to ground. The grounded component would be isolated by its ground overcurrent (50G) relay tripping its feeder breaker. A “selective tripping“ scheme trips the component’s feeder breaker at a lower current than the bus feeder breaker (ex: the 1C RCP breaker opens at 50 amps ground current, but the feeder from the Unit Auxiliary Transformer to bus 1C would not open until ground current reached 600 amps). If the 50G relay target is up on the component’s breaker, the status of the equipment should be determined by electrical maintenance (“megger“ test, etc.) before it is reenergized.

Another case is where a ground exists on the bus itself. The primary protection in this case is the neutral ground overcurrent sensed by the neutral grounding (51N) relay on the generator or transformer supplying the bus. For example, a phase-to-ground fault on bus 1C would trip and lockout the unit auxiliary transformer. The operator must be alert to the fact that if bus 1C is re-energized from the emergency auxiliary transformer (XTF-31), the ground overcurrent will return through XTF-31’s neutral ground transformer, resulting in a trip and lockout of XTF-31 as well. The presence of ground overcurrent (51NL) relay targets on both the Unit Auxiliary Transformer and the Emergency Auxiliary Transformer indicates that the ground is on the bus that was transferred between these sources. Note that the expected ground overcurrent in this case (about 600 amps) would not be high enough to cause a bus phase overcurrent lockout (51 relay at about 2,000 amps).

EMERGENCY OPERATIONS

During plant emergencies when the Control Room is not accessible, there is a need to operate many 7.2KV and 480V components locally that are normally operated from the Main Control Board. (RE: SOER 83-6) The procedures to operate these breakers locally are in Attachments for GOP-8 and the Fire Emergency Procedures (FEPS). Since they are all the same, Attachment X of GOP-8 is excerpted into this handout as Attachment I and Attachment II.

SUMMARY

The V.C. Summer electrical power system distributes electrical power throughout the site to safety and nonsafety-related electrical loads. The system consists of three voltage subsystems: the 7.2 KV, 480 V and 120 V subsystems. Each bus is supplied from a normal and an alternate power source. The 7.2 KV subsystem supplies power to large plant loads, such as reactor coolant pumps, and to step down transformers which transmit power to the 480 VAC power subsystem.

Electrical breakers are used to supply or remove power from these various subsystems. Most of the breakers can be operated from the MCB; however, a few must be operated locally. The 480 VAC subsystem is fed by the 7.2 KV subsystem via 7.2 KV to 480 V step down transformers. The 480 V switchgear units and MCCs also supply power to smaller 480 VAC power panels for further distribution and also to the 120 VAC subsystem.

After studying this text, the student should review the text's learning objectives and answer the self-assessment questions.

PRECAUTIONS, LIMITATIONS, AND SETPOINTS

Precautions

1. Opening a breaker does not provide an acceptable safety margin for electrical work. The breaker should be racked out and any associated air disconnects opened prior to commencing maintenance work.

2. At no time shall any of the evolutions described in SOP-313 be performed without the knowledge and consent of the Control Room Operators.

3. Failure to follow the instructions in SOP-313 could lead to serious injury or death.

4. Prior to performing any racking operation, manually trip open the breaker, if closed.

5. Protective equipment is required for all personnel involved in breaker racking operations as follows:

    a. 7.2 KV breakers require lineman gloves

    b. 480 V (2000 and 3000 amp) breakers require either lineman gloves or rubber gloves rated for at least 600 volts.

6. The following criteria shall be met prior to attempting a reclosure of a Reactor Trip Breaker that has tripped open or has failed to remain closed upon a closure attempt:

    a. The Shift Engineer shall conduct a short meeting with all involved personnel for the purpose of clearly defining an action plan for problem investigation or, if warranted, a breaker closure attempt. He shall further ensure a high level of communication is maintained between all involved personnel.

b. An investigation into the cause of the breaker response shall be conducted involving the following personnel:

1) Involved Electrical Maintenance personnel or, if required, the Electric Shop Supervisor

2) System Engineer, if possible

3) Other directly involved personnel.

c. The following shall be documented:

1) Directly involved personnel shall document, via notes, their specific actions, including the time of these actions and communications with other personnel.

2) All investigative and repair activities shall be documented at the time of occurrence.

d. The Shift Engineer shall be satisfied that a thorough investigation has been performed prior to attempting breaker closure.

7. When operating the racking motor for a 7.2 KV breaker, it is a good practice to stand to the right of the cubicle, to minimize injury in the event of a large arc.

REFERENCES

1. SOP-313, Local Switchgear Breaker Operations

2. SOER 90-1, Ground Faults on AC Electrical Distribution Systems

3. SER 1-90, Unplanned Plant Transient and Damage to Major Electrical Buses due to Ground Faults.

4. SER 37-87, Electrical Flash Resulting from Attempt to Rackout Closed 4.16 KV Bus Breaker.

5. SER 28-88, Ground Faults on 12 Kilovolt Systems

6. SOER 98-2, Circuit Breaker Reliability

7. SOER 82-16, Deenergized Breaker Spring Charging Motors

8. OE 18465, Fire on a Power Pole Outside of the Protected Area Results in an Unplanned Power Reduction on Two Units.

9. CER-00-1342, XSW1DA breaker 04, feed to XSW1EA, tripped due to short created while reterminating a relay after testing.

10. CER-02-0572, XFN0017A tripped due to short in motor.

11. CER-03-0777, Ground detector lights on both positive and negative legs are glowing dimly.

12. SOER 83-6, Unavailability of Emergency Power Caused by Diesel and Breaker Control Circuitry Design. (Recommendation 4)

TABLE SB-9-1

K/A CATALOG: COMPONENTS 191008 Breakers, Relays, and Disconnects (CFR 41.7)			
		IMPORTANCE	
K/A NO.	**KNOWLEDGE**	**RO**	**SRO**
K1.01	Purpose of racking out breakers (de-energize components and associated control and indication circuits)	2.6	2.8
K1.02	Local indication that breaker is open, closed or tripped	2.8	2.9
K1.03	Loss of power supply circuit breaker indicator lights and capability in remotely open and close	2.9	3.1
K1.04	Operation of various push buttons, switches and handles and the resulting action on breakers	2.9	3.0
K1.05	Function of thermal overload protection device	2.3	2.4
K1.06	Interpretation of symbols for breakers, relays and disconnects in a one-line diagram	2.3	2.6
K1.07	Safety procedures and precautions associated with breakers, including MCC bus breakers, high, medium and low voltage breakers, relays and disconnects	3.0	3.3
K1.08	Effects of closing breakers with current out of phase, different frequencies, high voltage differential, low current, or too much load	3.3	3.5
K1.09	Effect of racking out breakers on control and indicating circuits and removal of control power on breaker operation	2.8	3.1
K1.10	Function, control, and precautions associated with disconnects	2.7	3.1
K1.11	Control room indication of a breaker status	3.1	3.3
K1.12	Trip indicators for circuit breakers and protective relays	2.9	2.9

ATTACHMENT I

(EXCERPTED FROM: GOP-8, ATTACHMENT X, PAGES 3, 4, & 5, REV. 6)

PART II.

480V BREAKER OPERATION

1. Local opening of breakers is accomplished as follows:
   a. For electrically operated types, disable the breaker closing ability by opening the breaker Closing Control power breaker in the rear of the breaker cubicle.
   b. Depress the TRIP pushbutton
      (left pushbutton where two exist).
   c. Verify the breaker trips and remains open.
2. Local closing of manual type breakers (large closing handle) is accomplished as follows:
   a. Pull down the closing handle.
   b. Verify the breaker closes and remains closed.
   c. Investigate the cause if the breaker does not remain closed.
3. Local closing of electrically operated type breakers is accomplished as follows:
   a. Open the panel directly behind the breaker on back of the switchgear.
   b. Open both the CLOSE CP BRKR and the TRIP CP BRKR for the breaker to be operated.
   c. Verify the breaker closing springs are charged.
   d. If the breaker closing springs are discharged, perform Step 3.d 1) or 3.d 2) for the appropriate size breaker as follows:
      1) For 2000 or 3000 amp frame sizes, charge the springs as follows:
         a) Insert a manual spring charging handle into the slot in the breaker front.
         b) Pump the handle until the breaker indicates charged.

2) For 600 and 1600 amp frame sizes, charge the springs as follows:

a) Open the door on the breaker cubicle.

b) Engage a manual charging handle into the slots of the pawl carrier.

NOTE 3.d.2)c)

The pawl carrier is located on the breaker, on centerline, between the silver colored charging motor on the right and the black auxiliary switch assembly on the left. Occasionally, the charging motor will coast to a stop in such a position that the driving pawl does not engage the next tooth on the ratchet wheel. When the driving pawl is not engaged on the ratchet wheel, a screwdriver blade should be inserted along the right side of the pawl carrier against the roller on the charging motor output eccentric and the roller should be pushed to manually rotate it. Afterwards, the charging handle should be inserted.

c) Operate the handle until the breaker indicates charged.

e. Lift (or pull) the manual CLOSE lever.

f. Verify the breaker closes and remains closed.

ATTACHMENT II

(EXCERPTED FROM: GOP-8, ATTACHMENT X, PAGES 6, 7, & 8, REV. 6)

PART III.

7.2KV BREAKER OPERATION

1. Perform local opening of breakers as follows:
   a. Open the door to the appropriate switchgear cubicle.
   b. Open the Closing Power breaker RRP (located on the right hand side of cubicle).
   c. Depress the MANUAL TRIP lever on the breaker.
   d. Verify the breaker trips and remains open.
2. Perform local closing of breakers as follows:

CAUTION 2.a
If any relay flags are tripped, closing of breaker without protection could be a personnel hazard.

   a. Verify no relays have tripped on the associated breaker.
   b. Open the door to the appropriate switchgear cubicle.
   c. Verify the closing springs are charged.
   d. If the closing springs are not charged, perform the following:
      1) Open the Closing Power breaker RRP (located on the right hand side of cubicle)
      2) Use a ratchet and 5/8” socket to turn the charging motor until the breaker indicates charged.
   e. Depress the MANUAL CLOSE pushbutton on the breaker.
   f. Verify the breaker closes and remains closed.

g. If the breaker does not close, perform the following:

1) Disconnect and tape all leads at terminals 361, 363 and 364 on terminal board C.

2) Charge the springs per Step 2.d above.

3) Ensure the Trip Power breaker RRT is closed (located on the right hand side of cubicle).

4) Depress the MANUAL CLOSE pushbutton on the breaker.

5) Verify the breaker closes and remains closed.

h. If breaker does not remain closed, proceed as follows:

NOTE 2 h.1)

If trip circuitry is disabled, a valid circuit fault may cause excessive damage and may disable entire switchgear bus.

1) Inside door, on right, up high, are two circuit breakers. Open the one labeled RRT (on left) to disable trip circuitry for main breaker.

2) Repeat Step 2.

ATTACHMENT III

SELF-ASSESSMENT QUESTIONS

1. Which of the following best describes the required circuit breaker position to deenergize components and associated control and indication circuits?

   A. racked in and tagged in open position
   B. racked in and tagged in closed position
   C. racked out and tagged in racked-out position
   D. in test position and tagged in test

2. An advantage of racking out and pulling control power fuses for circuit breakers as opposed to tagging a control switch is

   A. that indication circuits remain energized for breaker position verification
   B. to maintain availability of the control switch and control power for testing
   C. that tagging a control switch would render the equipment inoperable and out of service
   D. that the equipment and its control and indication circuits would be deenergized

3. What should be done to completely deenergize a circuit breaker, including its control and indication power?

   A. Rack out the breaker and pull control power fuses
   B. Open the breaker and tag it out
   C. Lift the leads to ensure complete deenergization
   D. Tag the control switch and post a watch at the breaker

4. While locally investigating the condition of a large circuit breaker, an operator observes the following indications:

- OPEN/CLOSED mechanical flag indication indicates open
- OPEN/CLOSED indicating lights indicate open
- Overcurrent trip flags are actuated on all phases
- Load-side voltmeter indicates zero voltage
- Load-side ammeter indicates zero amperes

Based on these indications, the operator should report that the circuit breaker is

A. open, racked in, with an overload condition indicated
B. open, racked in, with no overload condition indicated
C. open, racked out, with an overload condition indicated
D. open, racked out, with no overload condition indicated

5. Which of the following available local circuit breaker indications would be a positive method for identifying whether a circuit breaker is closed or open?

A. overcurrent trip flags and load-side ammeter
B. OPEN/CLOSED mechanical flag indication and load-side voltage
C. OPEN/CLOSED indicating lights and overcurrent trip flags
D. load-side ammeter and OPEN/CLOSED indicating lights

6. Which of the following available local circuit breaker indications must be reset after operation to ensure reliable indication is being provided?

A. OPEN/CLOSED mechanical flag
B. OPEN/CLOSED indicating lights
C. overcurrent trip flags
D. spring CHARGE/DISCHARGE flag

7. Circuit breaker local overcurrent trip flag indicators

   A. indicate overcurrent conditions only during the actual overcurrent condition
   B. mean that the associated circuit breaker has failed to trip open, if actuated
   C. are normally disconnected; therefore, provide no useful function
   D. should be reported to the control room if found to be actuated

8. Loss of breaker control power on a large operating motor would

   A. trip the breaker
   B. leave the motor operating, but the breaker could be tripped remotely
   C. leave the motor operating, but the breaker could only be tripped locally at the breaker
   D. have no effect

9. Which of the following would cause a loss of ability to remotely trip a circuit breaker and a loss of position indication?

   A. loss of breaker control power
   B. failure of breaker control switch
   C. mechanical binding of breaker
   D. breaker in operate position

10. **DELETED**

11. Which of the following results from a loss of circuit breaker control power to a circuit breaker supplying a motor?

A. Motor ammeter indication would be zero regardless of actual breaker position
B. Breaker position would remotely indicate closed regardless of actual position
C. Breaker would trip open due to the actuation of its protective trip device
D. Close spring charging motor would not charge spring following local tripping of the breaker

12. A thermal overload protective device protects a motor by

A. adding series resistors to limit starting current
B. adding parallel resistors to limit starting current
C. shutting off the motor if current becomes excessive
D. slowing down the motor if current becomes excessive

13. For a motor, which condition would <u>not</u> require a thermal overload protective device to function?

A. running speed is too high
B. starting current is too high
C. ambient temperature is too hot
D. intermittent or sudden heavy loads

14. **DELETED**

15. In motors, the thermal overload protective device protects against the degrading effects of ABNORMALLY

A. reduced starting torque

B. high applied frequency

C. high line voltage

D. high winding currents

16. In a motor, potential damage due to intermittent or sudden heavy loads can best be prevented by which type of protective device?

A. thermal overload

B. reverse power

C. underfrequency

D. undervoltage

17. Refer to Figure 11:

With the K-3 relay energized, pushing the S-1 pushbutton ____ the K-3 relay when contacts #1 and #2 are ______.

A. tests, closed

B. deenergizers, open

C. defeats, closed

D. has no effect on, open

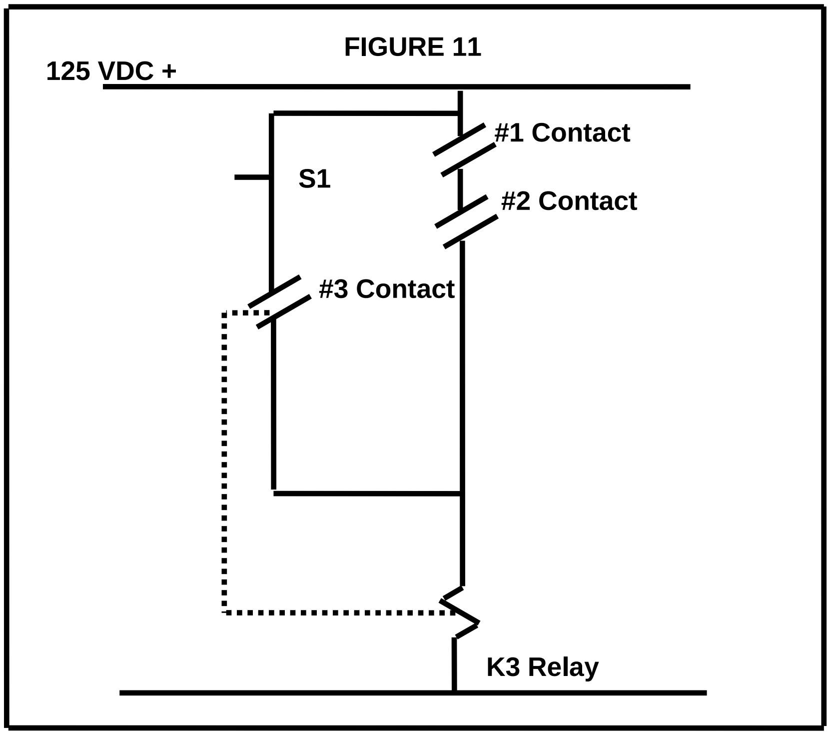
18. Which best describes the function of the #3 contact in Figure 11?

A. to keep the relay energized

B. to initially energize the relay

C. to reduce inadvertent relay chatter

D. to momentarily energize, then deenergize, the relay



Refer to Figure 11:

With the K3 relay energized, pushing the S-1 pushbutton ____ the K3 relay when contacts #1 and #2 are ______.

A. tests, closed
B. deenergizes, open
C. defeats, closed
D. has no effect on, open

20. Referring to Figure 11, select the correct statement regarding the operation of relay K3.

A. deenergized when the #1 and #2 contacts close
B. energized when pushbutton S1 is depressed
C. energized when the #1 or #2 contact closes

D. energized when the #1 <u>and</u> #2 contacts close

21. What best describes the arrangement of contacts in Figure 11?

A. 1 & 2 in series and in parallel with 3
B. 1 & 3 in series and in parallel with 2
C. 1 & 2 in parallel and in series with 3
D. 1 & 3 in parallel and in series with 2

22. Describe how to close a remotely operated 480 V switchgear breaker manually.