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STUDENT HANDOUT

REPAIR DUMMY LOAD ELECTRICAL SYSTEM

1. **Terminal Learning Objective:** Given a schematic of dummy load with a faulty electrical system and a description of the symptoms, with the aid of references, identify the probable cause of the malfunction in accordance with the appropriate equipment technical manual.
(1142.01.05)

2. **Enabling Learning Objectives:**

(1) Without the aid of references, given a list of Dummy Load instruments and a selection of instrument functions, identify the correct function for each instrument in accordance with the appropriate technical manual. (1142.01.05a)

(2) Without the aid of references, given the necessary equipment, tools and materials identify the proper function of a Dummy Load electrical circuit in accordance with the appropriate technical manual. (1142.01.05b)

BODY

1. **Electrical/Mechanical Controls and Componets.**

a. **Meters.**

(1) **M1, M2, M3, Voltmeters.** These meters provide continuous monitoring of phase voltages A, B, and C respectively. The meters are dual range instruments. The BLACK lower scale (0-150V) is read when the volt selector switch is in the 120/208V position. The RED upper scale (0-300V) is read when the voltage selector switch is in the 240/416V position.

(2) **M4, M5, M6, Ammeters.** The ammeters provide continuous monitoring of phase current for phases A, B, and C respectively. The meters are dual range instruments. The BLACK lower scale (0-300A) is read when the volt selector switch is in the 120/208V position. The RED upper scale (0-150A) is read when the voltage selector switch is in the 240/416V position.

(3) M7, M8, M9, Kilovolt Ampere Meters. The KVA meters provide continuous monitoring of the Dummy Load's apparent power. The meters have a full scale from zero to 40 KVA.

(4) M10, Frequency Meter. The Frequency meter monitors the line frequency continuously. This meter has a dual range from 56 to 64 Hertz or 375 to 425 Hertz, which is selectable by the S4 switch.

b. Lights.

(1) DS1, DS2, DS3, Phase Indication Lamps. These lamps indicated the presence of power available to the load elements. These lamps will not illuminate until the Dummy Load has been started.

(2) DS4, DS5, Phase Sequencing Lamps. These lamps provide indication on load power phasing. With correctly sequenced power connected to the Dummy Load, DS5 (ABC) will illuminate. With incorrectly sequenced power connected to the Dummy Load, DS4 (CBA) will illuminate. These lamps will illuminate prior to depressing the ON switch.

(3) DS8, DS9, Panel Lights. These lights provide illumination of the front panel, allowing for operation of the controls in the dark.

c. Switches.

(1) S1, On Switch. This is a pressable switch with two sets of momentary, normally open contacts.

(2) S2, Off Switch. This is a pressable type switch with one set of momentary, normally closed contacts.

(3) S3, Voltage Selector Switch. This switch is a 12 pole 3 position rotary switch, allowing for either 120/208VAC or 240/416VAC operation with a center OFF position. The Voltage Selector switch is used to set the metering, load bank and control circuits for the correct operating voltage and current.

(4) S4, Frequency Meter Selector Switch. This switch is a single pole single throw switch used to select between either 60 or 400 Hertz operation. Open is 60 Hz. and closed is 400 Hz.

(5) S5, External Power Selector Switch. This switch selects the power for the cooling fan and load bank contactor (K3) from within the Dummy Load of from an external power source through utility connector (J1).

(6) S6, Air Flow Switch. The Air Flow Switch monitors the cooling fan air flow. The switch has a momentary, normally open action. A loss of air flow opens S6 de-energizing the control contactors. Reduced air flow can be caused by closing one or both side doors, obstructing the air inlet or exhaust ports, or failure of the exhaust fan.

(7) S7, Thermal Switch. The Thermal Switch opens when the internal cabinet temperature reaches 210 degrees Fahrenheit. The switch action is to open on temperature rise and close on temperature fall.

(8) S9, Panel Light Switch. The Panel Light Switch is a single pole single throw switch used to illuminate the panel lights.

(9) Load Bank Switches. Load Bank Switches. S11-1, S11-2 and S11-3 connect the 1KW load for phase A, B and C respectively. Switches. S12-1, S12-2 and S12-3 connect one 2KW load to each phase, and S13 through S18 control the second 2KW load, the 4KW, and four 6KW loads respectively. The 0-1KW Switches. (S10-1, S10-2 and S10-3) connect variable transformers (Variacs) T-1, 2 and 3 with load resistors R100, R200 and 300, providing a variable load from zero to 1KW.

d. Relays and Modules.

(1) Phase Sequence Relay (PSR). The PSR provides a front panel indication of the phase status of the input lines. The PSR monitors the input lines L1, L2 and L3 and , if the input lines are correctly connected, DS5 (ABC) will light indicating that the phase is correct. If the input lines are incorrectly connected, DS4 (CBA) will light indicating a phase error.

(2) Meter overload module (MOM). The MOM provides protection of the ammeters due to current overload. The MOM monitors the input line current at the current transformers T5, T6 and T7. Each current transformer is a step down from 300A AC (pins 1-4) or 150A AC (pins 2-4) to 1A AC out. If the current increases above 1.5 A AC, the MOM will send an alarm signal (pins 7-8) to the SCM and de-energize the contactors. The MOM responds to a current overload in less than .25 seconds.

(3) Supervisory Control Module (SCM). The SCM provides protection for overvoltage, overcurrent, incorrect voltage switch settings and single phasing by removing power from the contactors. The SCM will allow up to a 125 percent overvoltage condition after 30 seconds, or 130 percent overvoltage condition instantly. The SCM will respond to a 150 percent overcurrent condition within less than .25 seconds.

2. Individual Dummy Load.

a. Neutral Potential (Purple).

(1) Neutral potential will begin it's journey from TB1 (Load Studs), terminal L0. neutral potential will then be placed on the SCM (Supervisory Control Module) terminal 5.

(2) The potential now branches off at a junction point and places a neutral potential on the coil of K2 terminal X, and then onto

the phase sequencing lights. This potential then continues on and places a neutral on each of KVA meters and the frequency meter. The voltmeters and the phase indicator lights will also receive a neutral potential. this neutral potential will also be placed on the variable load resistors.

(3) Coming back to the coil of K2 we follow the neutral and notice we are placing that potential on the coil of K3 terminal X. Neutral will also be present at terminal N of Jack 1 (External Power Jack) and the placing that neutral potential on DS8 and DS9 (Panel Lights). A neutral will also be felt on the fan motor.

(4) Neutral potential will now be felt on the normally open contacts of the K3, terminals A2, B2, and C2. Of course the potential will stop because of the open contacts.

(5) Neutral potential will now be placed on buss bar W5 of the resistive load coils.

(6) The ammeters will also have a neutral potential placed on terminal 1 by the earth ground which is electrically connected to L0.

b. Hot Phase Potencal(Red).

(1) Phase A will come from terminal L1 of the terminal board and be felt on the open contact A2 of the K3 relay. Phase B will come from terminal L2 of the terminal board and be felt on the open contact B2 of the K3 relay. Phase C will come from terminal L3 of the terminal board and be felt on the open contact C2 of the K3 relay.

(2) The three phases will now be felt on the SCM (Supervisory Control Module) through terminals 1,2, and 3. from here the potentials can be felt on the PSR (Phase Sequence Relay) through terminals 1,2, and 3.

c. Control Voltage(Light Blue).

This potential comes from phase C and is placed on terminal 54 of the S3 (Voltage Selector Switch). In the 120/208 position terminals 54 and 55 are connected together which will allow the potential to be felt on terminal 4 of the SCM (Supervisory Control Module). The potential continues on and now places that potential to the phase sequencing lights. At this point we can test these lights by pressing in on the lens cover.

d. 12 Volt dc To mom (Yellow)

The MOM (Meter Overload Module) receives a 12 vdc supply from the Supervisory Control Module between terminals 7 and 8 on both modules. As the load current detected through the MOM increases, the current supplied through terminals 7 and 8 also increases.

e. Potential To the Psr and s1 (Dark Blue)

(1) Under normal operating conditions the Supervisory Control Module turns on its normally off solid state switch between terminals 4 and 6. This not only provides potential to terminal 5 of the Phase Sequencing Relay but also to the lower contacts of the S1. Potential will not be felt through S6 (Air Flow Switch) since this is in a normally open position.

(2) With the phases properly sequenced the PSR will turn ON its normally off solid state switch between terminals 5 and 6. This will then supply the potential to the ABC light and illuminate this lamp. Should the phase sequence be connected improperly the PSR would turn ON its normally off solid state switch between terminals 4 and 5. This would supply potential to the CBA light and illuminate this lamp.

f. S1 Energized (Orange)

(1) Depressing S1 (On Switch) will momentarily close both sets of normally open contacts. Potential will then be felt through the lower contacts bypassing the Air Flow Switch, it will then be felt through the normally closed contacts of the S2 (Off Switch). Potential is now placed on the S3, terminal 64 and 65 from here the potential will be placed on 2 sets of normally open contacts belonging to the K1 and the K3 relay.

(2) Potential will also be felt across the top set of contacts on the S1 switch to the S3 terminals 61 and 68. The potential will now be felt through a set of normally closed contacts belonging to the K1 relay. This potential will continue on to terminal 11 of the K3 relay, since this is an open contact the potential will stop.

(3) Potential is placed on the coil of the K2 relay, terminal Y. Once this potential is felt on terminal Y the coil will energize. The contacts belonging to this relay will either open or close, depending on the normal position. The contacts between terminals 22 and 23 will open, the contacts between 11 and 12, A1 and A2, B1 and B2, C1 and C2 will all close.

g. Hot Phase After K2 Energized (Brown)

(1) The three phase potentials that were felt at the open contacts of K2 can now be felt through those contacts since they closed. The potential will now be placed on the buss bars W6, W7, and W8 of the resistive coils of the load bank.

(2) These potentials are now felt through three fuses onto the S3 switch. Potential is felt through the switch via terminals 41 and 48, 44 and 45, 51 and 58. This potential will be placed on the three variable transformers for resistive loading. As the phases branch off they place a potential on their respective voltage meters and phase indicator lights. Again the potential branches off to the S3 switch and is felt through terminals 24 and 25, 31 and 38, 34 and 35. As the potential is felt through it will now be felt on their respective KVA meters through terminals 4. The Frequency meter (M10) receives it input from the variable transformer T8.

(3) Lets look back at the S3 switch near the three fuses, F7, F8, and F9. As the potential continues on through the switch, it will be felt at the S5 (External Power Selector Switch). These potentials will now be rectified by a set of diodes and then onto the fan motor supplying the operating voltage for that component.

(4) After the phase "B" potential is felt through F11 it branches off to place this potential on the S9 (Panel Light Switch). With the panel light switch ON the potential can be varied by the dimmer switch, this will cause the panel lights to vary in brightness.

(5) After being felt through the F10, the phase "A" potential will be felt through the now closed set of K2 contacts 11 and 12. This potential will now be placed on the coil of K3, causing it to energize. As the coil energizes, its normally closed contacts (22 and 23) will open and the normally open contacts (11 and 12, A1 and A2, B1 and B2, C1 and C2) will all close.

h. Neutral After K3 Energized (Light Green)

As the contacts of K3 close the neutral potential that was sitting at the open contacts (A2, B2, C2) can now be felt through these contacts an onto the buss bars W9, W10, W11 of the resistive load coils.

i. Load Current To Mom (Dark Green)

Current transformers T5, T6, T7 monitor the three phases of the AC input. As the resistance of the banking resistors increases the amperage draw also increases. Since there is more current being pulled, the magnetic inductance within the current transformers also goes up increasing the output signal to the S3 switch terminals 11 and 18, 14 and 15, 21 and 28 and then into the MOM (Meter Overload Module).

j. Input To Ampmeter(Tan)

REFERENCES: TM 06870A-15
TM 4700-15/1