"PHASING-OUT" THREE-PHASE SOURCES AND LOADS

CONTENTS

1. GENERAL

1.1 Scope

1.11 This section describes the method of "phasing-out" three-phase ac source connections, load connections and two sources at a transfer switch.

1.2 Precautions

1.21 Phase sequence of all three-phase ac sources must be checked and the lines arranged in the required order before connecting any load to the source. This applies to commercial service as well as to emergency engine-alternator service.

1.22 Three-phase engine-alternator voltages must be "phased-out" with the three-phase commercial ac service voltage at all transfer switches.

1.23 Three-phase engine-alternators for parallel operation must have their output voltages "phased-out" with those of the other machines before any attempt is made to parallel them.

1.24 Refer to instructional material on any equipment that has compressors, such as air conditioning equipment and observe the starting routine and precautions listed. Extensive damage to compressors may occur if these rotate in the wrong direction.

1.3 Method of Procedure

1.31 As each three-phase source is connected to a load switch or fuse unit, test for phase sequence and "phase-out" the leads in accordance with Paragraph 3.

1.32 As each load is connected to the switch or fuse unit, perform the operations shown in Paragraph 4.

1.33 At each transfer switch, where a load can be switched from commercial service voltage to emergency engine-alternator voltage, "phase-out" both source voltages in accordance with Paragraph 5.

1.4 Description

1.41 The following definitions are pertinent to this section:

1.411 Phase Sequence: The order in which the phase voltages reach a positive maximum value.

1.412 Phase Rotation: A term sometimes used instead of phase sequence.

1.413 "Phasing-Out": The process of arranging three-phase source connections so that they have a particular phase sequence. Also, the process of arranging load connections in a particular order.

1.414 Positive Phase Sequence: A term sometimes applied to 1-2-3 phase sequence.

1.42 "Phasing-out" is covered in this section in more detail than the information previously included in Section 130 in this handbook. Section 130 covered comparison of commercial and engine-alternator voltages at transfer switches.

1.43 The leads or terminals of three-phase motors and alternators are marked by the supplier. This marking is usually an indication of phase sequence.

1.44 The direction of rotation of three-phase motors depends on the phase sequence of the source. The KS- motors will all have correct rotation when connected to a source with 1-2-3 phase sequence.

1.45 Motors on commercial equipment, such as air conditioners, air compressors, blowers, etc. may be marked T1, T2 and T3 but may require something other than 1-2-3 phase sequence for correct direction of rotation. Some equipment may be damaged by running backwards for more than a few seconds.

1.46 All KS- engine-alternators have their output leads marked for 1-2-3 phase sequence. Nonstandard engine-alternators may be marked for some other phase sequence.

1.47 New SCR-type rectifiers connected to three-phase ac sources require 1-2-3 phase sequence of the input leads or they will not operate. Examples of these rectifiers are: KS-19212 and KS-19215.

1.48 Other three-phase rectifiers require 1-2-3 phase sequence of the input or they will be unstable. Examples of these rectifiers are: KS-19210, KS-19211, KS-19356 and KS-19424.

2. TOOLS

Code	Description
R-3404	Phase Sequence Indicator

3. "PHASING-OUT" A THREE-PHASE SOURCE AT A SWITCH

3.1 If the switch terminals are marked in a particular order, use the marking as reference. For example, they might be marked L1, L3, L2 reading from left to right.

3.2 If the switch terminals are not marked, always consider them as 1,2,3 order, reading from left to right.

3.3 Check for phase sequence with the R-3404 Phase Sequence Indicator as follows:

3.31 Verify that the switch is open.

3.32 Install the fuses or close the breaker or switch that feeds the switch where phase sequence is to be checked.

3.33 Connect the clip terminal (No. 2) of the indicator to L2 of a marked switch or to the center terminal of an unmarked switch.

3.34 Touch the indicator No. 1 prod to L1 of a marked switch or to the left terminal of an unmarked switch.

3.35 Touch the main prod of the indicator (No.3) to L3 of a marked switch or to the right terminal of an unmarked switch.

3.36 With all three leads of the R-3404 connected, observe which bulb is lit. If the 1-2-3 bulb is lit, the three ac leads at the switch have the desired sequence. Disconnect the indicator and open the breaker or switch just checked or pull any fuses.

3.37 If the 3-2-1 bulb is lit on the indicator, the sequence is incorrect. Disconnect the indicator. Open the breaker or switch or pull any fuses feeding the switch just checked. Then interchange the outer two ac connections at the switch. Repeat Paragraphs 3.32 through 3.36.

3.4 Before connecting any load to the switch refer to Paragraph 4.

4. "PHASING-OUT" LOAD CONNECTIONS

4.1 Three-Phase Motors

4.11 Rotation of three-phase motors depends on the phase sequence of the source. Any KS- motors will have correct rotation when the marked leads are connected to a source having 1-2-3 phase sequence. With the source "phased-out" at the switch for 1-2-3 phase sequence (per Paragraph 3) the KS- motor leads can now be connected to the switch using the lead marking as a reference.

4.111 Connect motor leads T1, T2 and T3 to the 1,2 and 3 terminals, respectively on a marked switch.

4.112 Connect motor leads T1, T2 and T3 to an unmarked switch in 1-2-3 order. considering the switch terminals in 1-2-3 order, reading from left to right, facing the switch.

4.12 Motors on commercial equipment, such as air conditioners, compressors, etc. may be marked T1, T2 and T3 but may require something other than 1-2-3 phase sequence for correct direction of rotation.

4.121 When installing commercial or non-KS rotating equipment refer to instructional material with the equipment to determine what phase sequence is required, and the necessary CAUTIONS and PRECAUTIONS.

NOTE: The motor connections must be changed and not the ac input connections at the switch. One purpose of this section is to have three-phase ac voltages "phased-out" the same way at all switches.

4.2 Three-Phase Rectifiers

4.21 New SCR-type rectifiers operating from three-phase ac sources require 1-2-3 phase sequence of the input or they will not operate. Examples of these rectifiers are: KS-19212, KS-19215. The input ac terminal markings are used for reference.

4.22 Other three-phase rectifiers require 1-2-3 phase sequence of the input or they will be unstable. Examples of these rectifiers are: KS-19210, KS-19211, KS-19356, and KS-19424.

4.23 Phase sequence of the ac input leads are checked as follows, using the R-3404 Phase Sequence Indicator.

4.231 Verify that the rectifier ON/OFF or STOP/NOR switch is in the OFF or STOP position.

4.232 Install the service fuses in the AC Service Cabinet, if they are not already installed. Install the fuses in the bus duct switch for the rectifier. Close the bus duct switch.

4.233 Connect the 1, 2 and 3 leads of the indicator to input terminals L1, L2 and L3, respectively. In some cases, the terminals may be marked X, Y and Z, which correspond to 1,2 and 3, respectively.

4.234 If the 1-2-3 bulb on the indicator lights, the ac input leads are correctly "phased-out".

4.235 If the other bulb (3-2-1) lights, phase sequence is incorrect. In this case, open the bus duct switch and interchange two of the three-phase ac leads at the rectifier terminals. After switching leads again close the switch and check phase sequence.

4.236 When the phase sequence of the ac input is correct, open the bus duct switch and remove the service fuses in the AC Service Cabinet.

4.24 Where there are two or more three-phase rectifiers operating in parallel, the ac input leads should be connected the same way. That is, in addition to having the correct phase sequence at each rectifier, all terminal 1's on the rectifiers should be fed from the same line, all terminal 2's from the same line, etc.

5. "PHASING-OUT" TWO SOURCES AT A TRANSFER SWITCH

5.1 Phase sequence tests on commercial and emergency source voltages must be made at all load transfer switches when the Installer makes any connections to the switch.

5.2 The first power source connected to the transfer switch will be checked and "phased-out" in accordance with Paragraph 3.

5.3 The first power source connected to the transfer switch is used as a reference. Compare or "phase-out" the commercial power and emergency power sources across the transfer switch using the R-3404 Phase Sequence Indicator.

5.4 Start the emergency engine-alternator and connect it to the emergency bus which feeds the transfer switch being tested.

5.5 Connect the three leads of the indicator to the reference voltage side of the transfer switch. Note which lamp lights, either 1-2-3 or 3-2-1. Transfer the three leads to the other power source, observing the same relation of leads to switch terminals as on the reference voltage side of the switch. The same bulb should be lit on the other power source when the leads are transferred.

5.6 If phase sequence of the tested voltage is not the same as that of the reference voltage, remove the engine-alternator voltage from the emergency bus feeding the transfer switch. Interchange any two leads of the tested three-phase source. Repeat Paragraphs 5.4 and 5.5 as a check.

5.7 When the phase sequence of both sources at the transfer switch is identical, the engine-alternator may be removed from the emergency bus and shut down.

Superintendent, Installation Engineering