KOHLER®

TRANSFER SWITCHES

Contactor Automatic Transfer Switch

Sequence of Operation

Printed in U.S.A.

TP–5076 9/89

Contents

Introduction

The following pages illustrate the sequence of operation a basic contactor transfer switch, and a contactor switch with six common accessories goes through when normal power fails, and when normal power returns to a switch in the emergency position.

A "Definitions" section includes a list of the standard components as they are identified by symbol on transfer switch wiring diagrams, and a definition of what these symbols stand for. Each accessory available for contactor transfer switches is listed in one of four categories: Control Accessories, Test Accessories, Indicator Accessories, and Support Accessories. Along with the accessory number and description, all components for each accessory are identified as they are found on the wiring diagrams.

"Sequence of Operation" charts list the "Sequence" and the "Cause" for both of the switches, and for both power conditions. Each sequence and cause of that sequence is keyed with a blue number or letter on the corresponding wiring diagram(s). **The portion of the switch energized in each power condition is identified by heavy black lines for emergency power and medium blue lines for normal power. Gray lines illustrate the deenergized portion of the switch.**

This section has been designed to provide you with an understanding of how to read a transfer switch wiring diagram and should serve as a starting point in fault detection.

NOTE

Unless otherwise noted, all wiring diagrams supplied with transfer switches represent a switch in the neutral (deenergized) position.

If the wiring diagram supplied with the switch has been lost or misplaced, an additional print may be obtained from Kohler Co., Generator Service, Kohler, WI 53044. State Panel No. and Shop Order No. as found on transfer switch I.D. plate when ordering.

Definitions

General

Symbol	Description
N.O.	Normally Open (contacts open when coil is deenergized)
N.C.	Normally Closed (contacts closed when coil is deenergized)

Standard Components

Symbol	Description
VSR 1, (2, 3)	Normal Voltage Sensing Relay(s)
NR	Normal Relay
N	Normal
E	Emergency
NC	Normal Contactor - Main Contacts
EC	Emergency Contactor - Main Contacts
NS	Normal Source Auxiliary Contact (Not Shown)
ES	Emergency Source Auxiliary Contact (Not Shown)
TSS	Test Switch Maintained Contact
J	Jumper Wire

Control Accessories

Accessory No.	Description	Components
1A	Time Delay Normal to Emergency (adjustable 0-50 seconds)	TDNE-Time Delay Relay
2A	Time Delay Engine Start (adjustable 0-50 seconds)	TDES-Time Delay Relay
2E	Time Delay Engine Start (fixed at 2.5 seconds)	TDES-Time Delay Relay
3A	Time Delay Emergency to Normal (adjustable 0-60 seconds)	TDEN-Time Delay Relay
3C	Time Delay Emergency to Normal (adjustable 0.2-30 minutes)	TDEN-Time Delay Relay
4A	Time Delay Engine Cool Off (adjustable 1-30 minutes)	TDEC-Time Delay Relay
5B	Frequency Voltage Relay for Emergency Source	FR-Frequency Voltage Relay
26F	Solid State Field Adjustable Close Differential Voltage Sensing Relay	SSVSR-Voltage Sensing Relay

(continued)

Control Accessories (con't.)

Accessory No.	Description	Components
29B, D	Type of Operation (Push Button emergency to normal and normal to emergency)	NMPB-Manual Push Button EMPB-Manual Push Button
29C, E	Type of Operation (Push Button emergency to normal)	NMPB-Manual Push Button
29F, G	Type of Operation (Automatic/Manual two-position selector switch — includes option 29B)	NMPB-Manual Push Button (Emergency to Normal) EMPB-Manual Push Button (Normal to Emergency) SS1-Auto/Manual Selector Switch, Manual Both Ways
29H, J	Type of Operation (Automatic/Manual two-position selector switch — includes option 29C)	NMPB-Manual Push Button (Emergency to Normal) SS2-Auto/Manual Selector Switch (Emergency to Normal)
32A	Time Delay Neutral Position	TDNC-Time Delay Relay (Emergency to Normal) TDNE-Time Delay Relay (Normal to Emergency)

Test Accessories

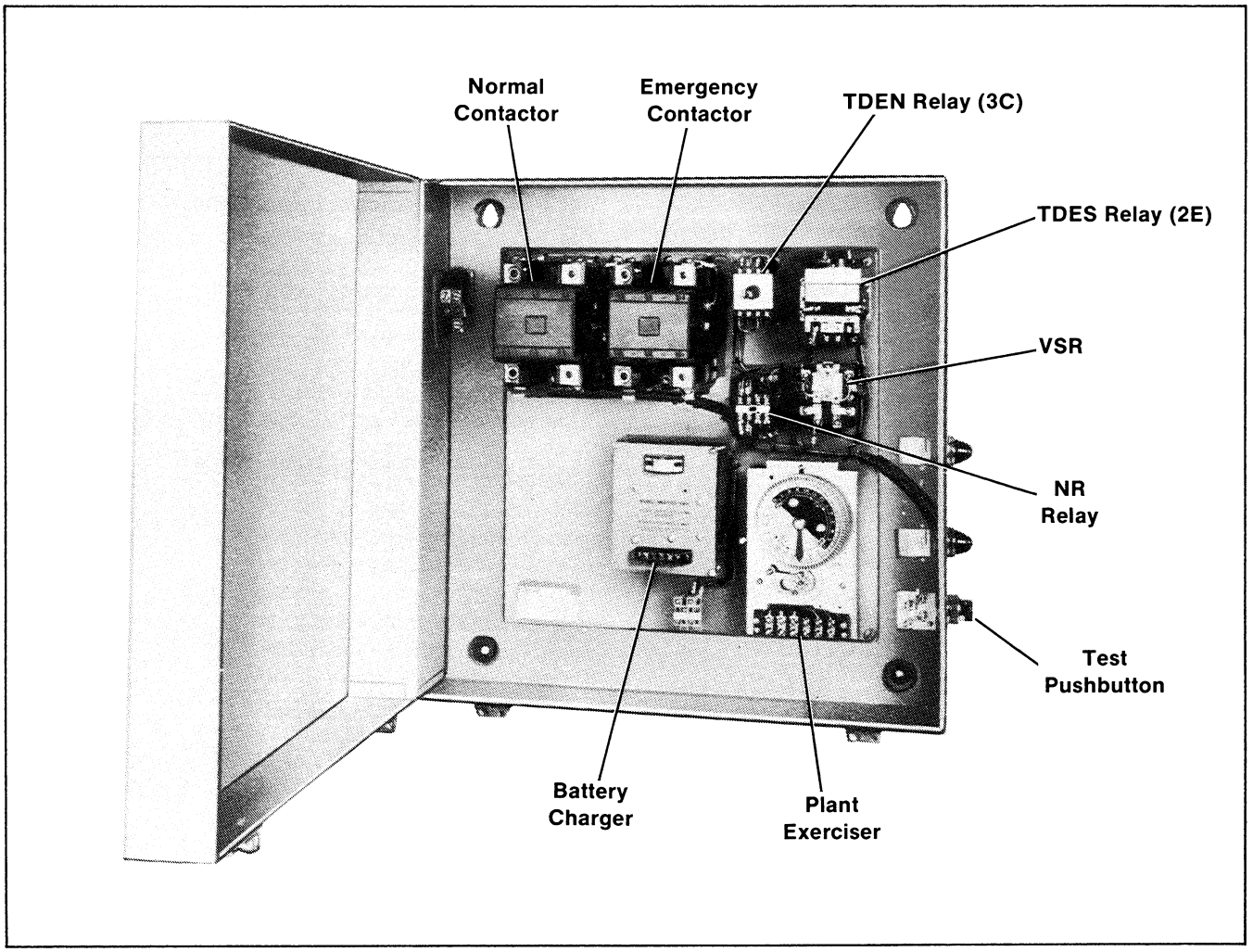
Accessory No.	Description	Components
6A, B	Test Push Button	TPB-Push Button
6C	Maintained Test Switch (for separate mounting)	TPB-Push Button
7C, D	Four Position Selector Switch	FPSS-Selector Switch
8A, C	Bypass Push Button (bypass time delay emergency to normal)	PBEN-Push Button
9C	Disconnect Plug (control circuit)	T11, T12, T13, T14, T15, T16, T17, T18 - Connectors
23C	Plant Exerciser (adjustable 0-168 hours without interrupting normal supply)	PE-Exerciser
23D	Plant Exerciser (adjustable 0-168 hours, simulates power failure)	PE-Exerciser
23G	Plant Exerciser with Selector Switch to Simulate or Not to Simulate Power Failure	PE-Exerciser TPSS-Selector Switch

Indicator Accessories

Accessory No.	Description	Components
12A, C	Pilot Light (normal supply, green) Indicates Switch Position	NL-Indicator Lamp, Green
12B, D	Pilot Light (emergency supply, red) Indicates Switch Position	EL-Indicator Lamp, Red
12E, G	Pilot Light (normal supply, white) Indicates Source Position	NL-Indicator Lamp, White
12F, H	Pilot Light (emergency supply, white) Indicates Source Position	EL-Indicator Lamp, White

Support Accessories

Accessory No.	Description	Components
14A	Relay Auxiliary Contacts (normal source one NO and one NC) Indicates Switch Position	NRA-Auxiliary Contacts on Normal Relay
14B	Relay Auxiliary Contacts (emergency one NO and one NC)	ERA-Auxiliary Contacts on Emergency Relay
14C	Relay Auxiliary Contacts (normal source two NO and two NC)	NRA-Two Sets of Auxiliary Contacts on Normal Relay
14D	Relay Auxiliary Contact (emergency source two NO and two NC)	ERA-Two Sets of Auxiliary Contacts on Emergency Relay
24C	Solid State Automatic Battery Charger, 12 Volt	BC-Battery Charger
24D	Solid State Automatic Battery Charger, 24 Volt	BC-Battery Charger



Typical Contactor Transfer Switch

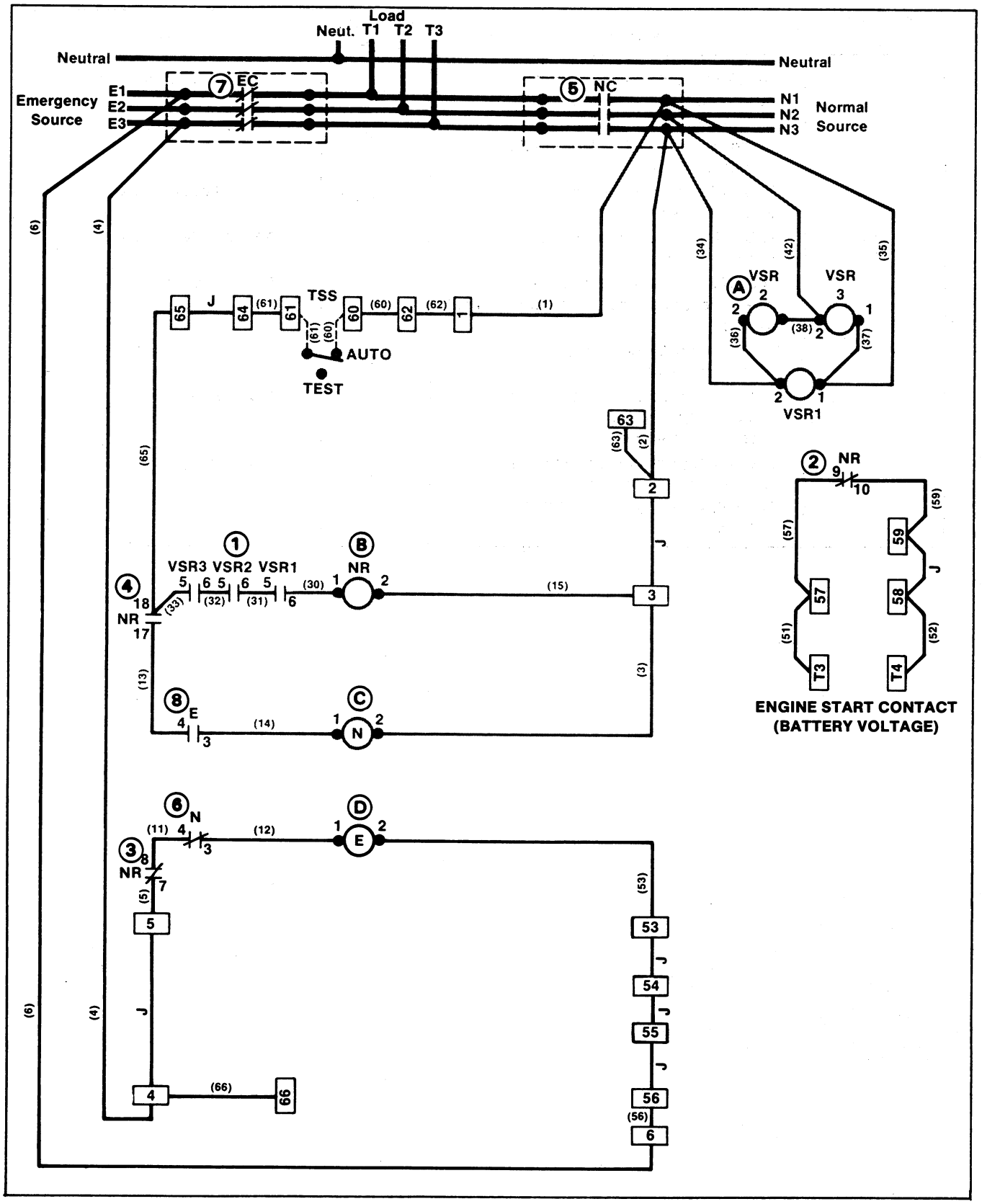
WARNING

HIGH VOLTAGE! Voltages present are dangerous to life. Disconnect all power sources from the panel before working on switch.

Basic Contactor Switch

Normal Power Fails

WIRING DIAGRAM



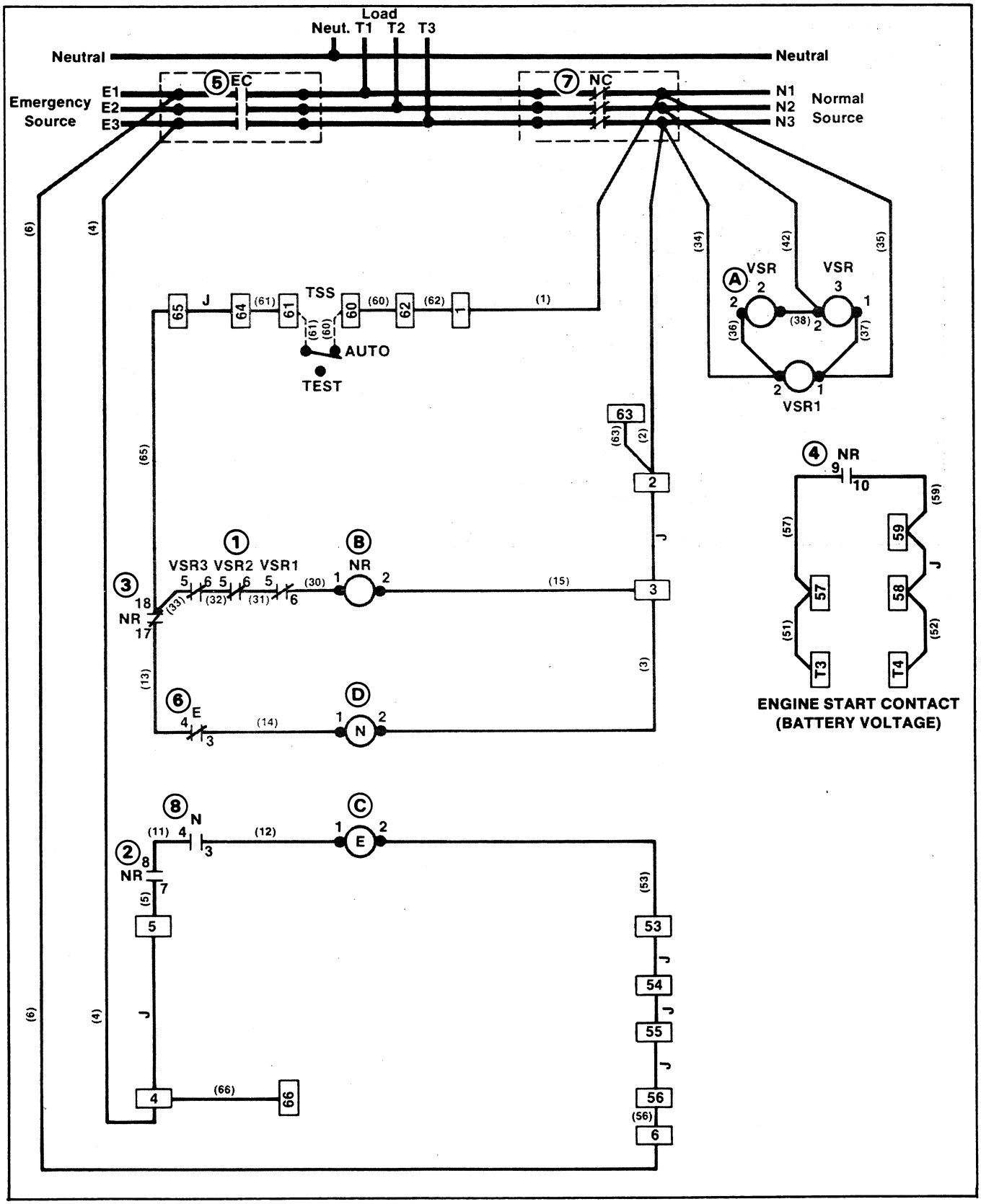
SEQUENCE OF OPERATION

Sequence No.	Sequence	Reference Letter	Cause
①	N.O. VSR contacts open interrupting current to NR	Ⓐ	VSR coil(s) deenergized
②	N.C. NR contacts in series with engine start circuit — close initiating engine start-up.	Ⓑ	NR coil deenergized
③	N.C. NR contacts in series with E coil — close	Ⓑ	NR coil deenergized
④	N.O. NR contacts in series with N coil — open	Ⓑ	NR coil deenergized
⑤	N.O. NC contacts (main contacts) open disconnecting load from normal source	Ⓒ	N coil deenergized
⑥	N.C. N interlock contacts in series with E coil — close	Ⓒ	N coil deenergized
⑦	N.O. EC contacts (main contacts) close connecting load with emergency source	Ⓓ	E coil energized
⑧	N.C. E interlock contacts in series with N coil — open to prevent N coil from energizing when normal power returns.	Ⓓ	E coil energized

Basic Contactor Switch

Normal Power Returns

WIRING DIAGRAM



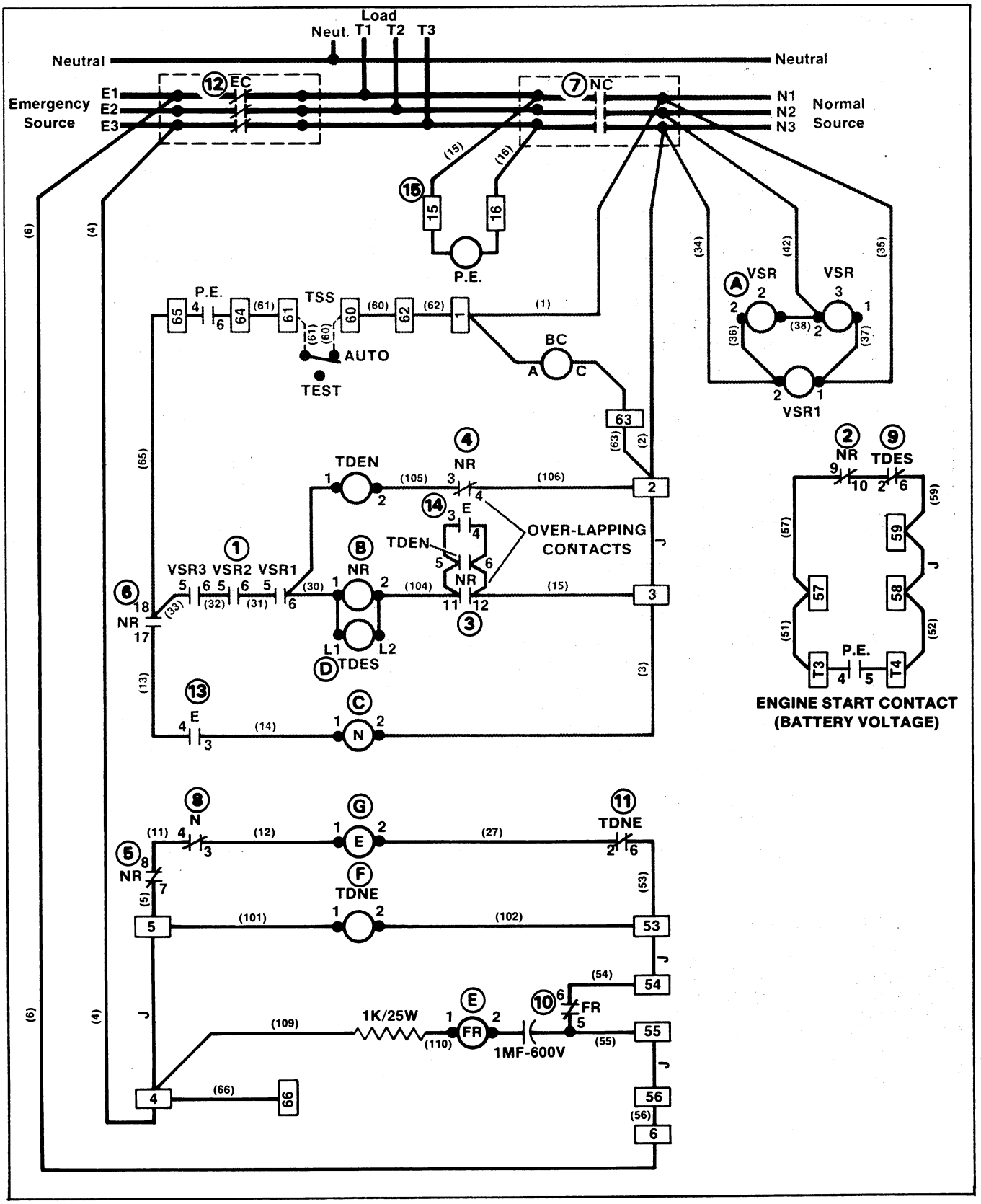
SEQUENCE OF OPERATION

Sequence No.	Sequence	Reference Letter	Cause
①	N.O. VSR contacts close	Ⓐ	VSR coil(s) energized
②	N.C. NR contacts in series with E coil — open to prevent E coil from energizing while connected to normal power	Ⓑ	NR coil energized
③	N.O. NR contacts in series with N coil — close	Ⓑ	NR coil energized
④	N.C. NR contacts in series with engine start circuit — open initiating engine shut-down	Ⓑ	NR coil energized
⑤	N.O. EC contacts (main contacts) open disconnecting load from emergency source	Ⓒ	E coil deenergized
⑥	N.C. E interlock contacts in series with N coil — close	Ⓒ	E coil deenergized
⑦	N.O. NC contacts (main contacts) close connecting load with normal source	Ⓓ	N coil energized
⑧	N.C. N interlock contacts in series with E coil — open to prevent E coil from energizing while connected to normal power	Ⓓ	N coil energized

Contactor Switch With Accessories

Normal Power Fails

WIRING DIAGRAM



SEQUENCE OF OPERATION

Sequence No.	Sequence	Reference Letter	Cause
①	N.O. VSR contacts open interrupting current to NR and TDES	Ⓐ	VSR coil(s) deenergized
②	N.C. NR contacts in series with engine start circuit — close	Ⓑ	NR coil deenergized
③	N.O. NR contacts in series with NR coil — open	Ⓑ	NR coil deenergized
④	N.C. NR contacts in series with TDEN — close	Ⓑ	NR coil deenergized
⑤	N.C. NR contacts in series with E coil — close	Ⓑ	NR coil deenergized
⑥	N.O. NR contacts in series with N coil — open	Ⓑ	NR coil deenergized
⑦	N.O. NC contacts (main contacts) open disconnecting load from normal source	Ⓒ	N coil deenergized
⑧	N.C. N interlock contacts in series with E coil — close	Ⓒ	N coil deenergized
⑨	When TDES "times out" N.C. TDES contacts close initiating engine start-up	Ⓓ	TDES coil deenergized (see sequence No. 1)
⑩	When generator reaches predetermined voltage and frequency, N.O. FR contacts in series with TDNE and E coil — close	Ⓔ	FR coil energized
⑪	When TDNE "times out" N.O. TDNE contacts in series with E coil — close	Ⓕ	TDNE coil energized
⑫	N.O. EC contacts (main contacts) close connecting load with emergency source	Ⓖ	E coil energized
⑬	N.C. E interlock contacts in series with N coil — open to prevent N coil from energizing when normal power returns	Ⓖ	E coil energized
⑭	N.C. E contacts in series with NR coil — open	Ⓖ	E coil energized
⑮	Emergency power is available to operate PE timer	—	No coil

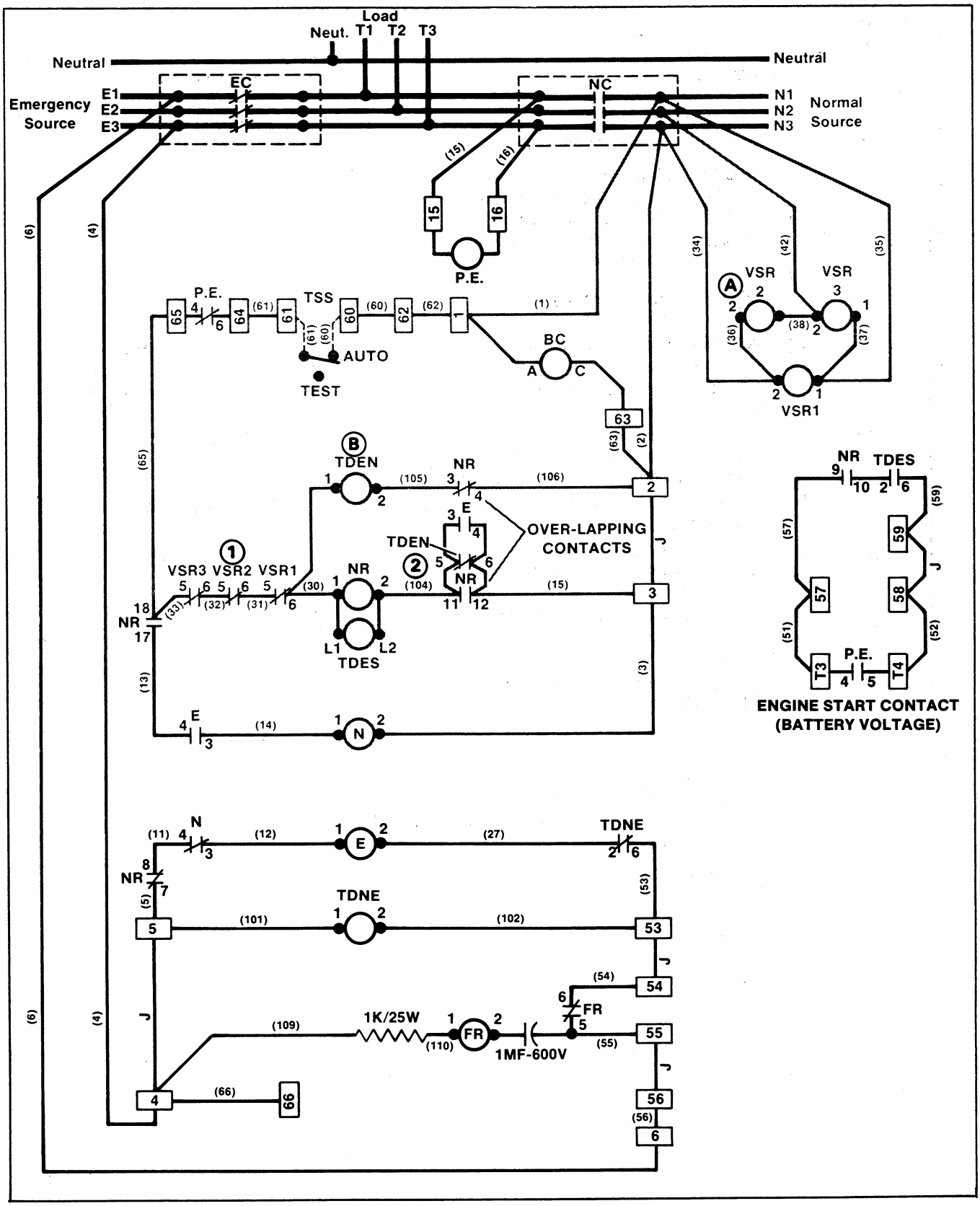
LIST OF ACCESSORIES

1A, TDNE
2E, TDES
3C, TDEN
23C,PE
24D, BC
5B, FR

Contactor Switch With Accessories

Normal Power Returns
(Switch in Emergency Position)

WIRING DIAGRAM



SEQUENCE OF OPERATION

Sequence No.	Sequence	Reference Letter	Cause
①	N.O. VSR contacts in series with TDEN coil — close	Ⓐ	VSR coil(s) energized
②	When TDEN "times out" N.O. TDEN contacts in series with NR coil — close **NOTE:** If emergency source fails while TDEN is timing, N.C. E contacts in series with NR coil will close permitting immediate transfer to normal, overriding time delay.	Ⓑ	TDEN coil energized
③	N.O. NR contacts in series with NR coil — close	Ⓒ	NR coil energized
④	N.C. NR contacts in series with TDEN coil — open	Ⓒ	NR coil energized
⑤	N.O. TDEN contacts in series with NR coil — open	Ⓑ	TDEN coil deenergized
⑥	N.C. NR interlock contacts in series with E coil — open to prevent E coil from energizing while connected to normal power	Ⓒ	NR coil energized
⑦	N.O. NR contacts in series with N coil — close	Ⓒ	NR coil energized
⑧	N.C. NR contacts in series with engine start circuit — open initiating engine shut-down	Ⓒ	NR coil energized
⑨	N.O. EC contacts (main contacts) open disconnecting load from emergency source	Ⓓ	E coil deenergized
⑩	N.C. E interlock contacts in series with N coil — close	Ⓓ	E coil deenergized
⑪	N.C. E contacts in series with NR coil — close	Ⓓ	E coil deenergized
⑫	N.O. NC contacts (main contacts) close connecting load with normal source	Ⓔ	N coil energized
⑬	N.C. N interlock contacts in series with E coil — open to prevent E coil from energizing while connected to normal power	Ⓔ	N coil energized
⑭	N.C. (slow acting) TDES contacts in series with engine start circuit — open	Ⓕ	TDES coil energized (see sequence No. 3)
⑮	Normal power is available to operate PE timer	—	No coil

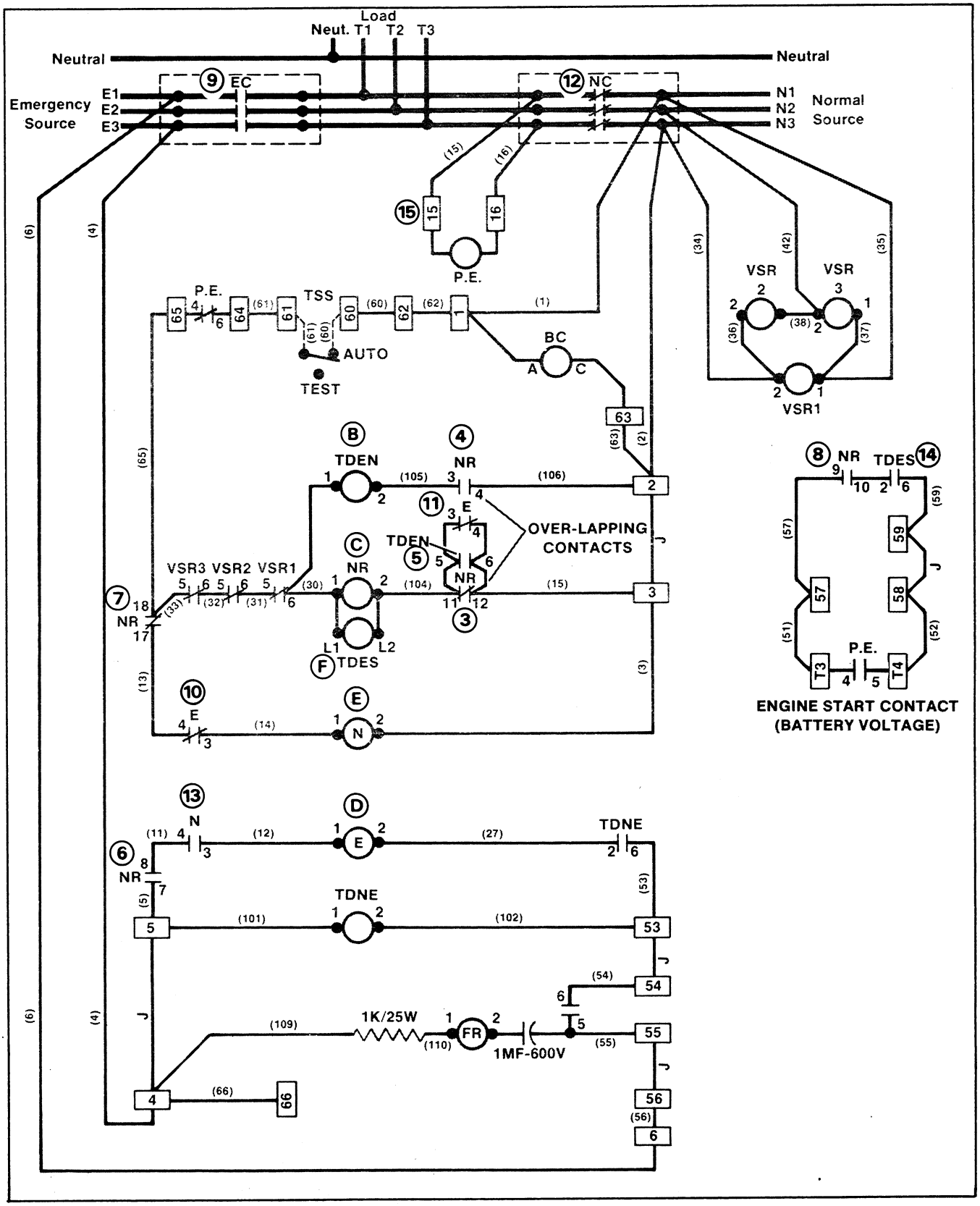
LIST OF ACCESSORIES

1A, TDNE	23C, PE
2E, TDES	24D, BC
3C,TDEN	5B, FR

Contactor Switch With Accessories

Normal Power Returns
(Load Transfers to Normal)

WIRING DIAGRAM



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