



Owner Manual

Transfer Switch

RA Series

100A (Spec A)

200A (Spec A)

400A (Spec A)

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1 Important Safety Instructions

Save these instructions. This manual contains important instructions that should be followed during installation and maintenance of the generator set.


Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

1.1 Warning, Caution, and Note Styles Used in This Manual

The following safety styles and symbols found throughout this manual indicate potentially hazardous conditions to the operator, service personnel, or equipment.

 DANGER
<i>Indicates a hazardous situation that, if not avoided, will result in death or serious injury.</i>

 WARNING
<i>Indicates a hazardous situation that, if not avoided, could result in death or serious injury.</i>

 CAUTION
<i>Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.</i>

NOTICE
Indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

1.2 General Information

This manual should form part of the documentation package supplied by Cummins Power Generation with specific generator sets. In the event that this manual has been supplied in isolation please contact your authorized distributor.

NOTICE
It is in the operator's interest to read and understand all warnings and cautions contained within the documentation relevant to the generator set, its operation and daily maintenance.

1.2.1 Safety Precautions

This manual includes the following symbols to indicate potentially dangerous conditions. Read the manual carefully and know when these conditions exist. Then, take the necessary steps to protect personnel and the equipment.

⚠ DANGER

This symbol warns of immediate hazards that will result in severe personal injury or death.

⚠ WARNING

This symbol refers to a hazard or unsafe practice that can result in severe personal injury or death.

⚠ CAUTION

This symbol refers to a hazard or unsafe practice that can result in personal injury or product or property damage.

1.2.2 General Precautions

Refer to NFPA 70E Standard for Electrical Safety in the Workplace to be sure the proper personal protective equipment (PPE) is worn around this product.

Follow these guidelines while working on or around electrical equipment.

- Place rubber insulated mats on dry wood platforms over metal or concrete floors when working on any electrical equipment.
- Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling any electrical equipment.
- Remove all jewelry when working on electrical equipment.
- Wear safety glasses whenever servicing the transfer switch.
- Do not smoke near the batteries.
- Do not work on this equipment when mentally or physically fatigued, or after consuming alcohol or any drug that makes the operation of equipment unsafe.

⚠ WARNING

Incorrect service or replacement of parts can result in death, severe personal injury, and/or equipment damage. Service personnel must be qualified to perform electrical and/or mechanical service.

1.3 Electrical Shock and Arc Flash Can Cause Severe Personal Injury or Death

High voltage in transfer switch components presents serious shock hazards that can result in severe personal injury or death. Read and follow these suggestions:

- The Operator **must** always keep the transfer switch cabinet closed and locked.
- Make sure only authorized personnel have the cabinet keys.
- All service and adjustments to the transfer switch **must** be performed only by an electrician or authorized service representative.

NOTICE

Whenever closed transition is used, approval to parallel with the local electric utility must be obtained.

1.3.1 AC Supply and Isolation

NOTICE

Local electrical codes and regulations (for example, *BS EN 12601:2010 Reciprocating internal combustion engine driven generating sets*) may require the installation of a disconnect means for the generator set, either on the generator set or where the generator set conductors enter a facility.

NOTICE

The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations. This equipment must be earthed (grounded).

It is the sole responsibility of the customer to provide AC power conductors for connection to load devices and the means to isolate the AC input to the terminal box; these must comply with local electrical codes and regulations. Refer to the wiring diagram supplied with the generator set.

The disconnecting device is not provided as part of the generator set, and Cummins Power Generation accepts no responsibility for providing the means of isolation.

1.3.2 Utility-To-Generator Set Applications

If the cabinet must be opened for any reason:

1. Move the operation selector switch on the generator set to STOP.
2. Disconnect the battery charger.
3. Disconnect the starting batteries of the generator set or sets (remove the ground [-] lead first).
4. Remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

WARNING

AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. With the breaker in the OFF position, the line side lugs are still energized.

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2 Introduction

2.1 Owner Manual

This manual covers models produced under the Cummins® Power Generation (CPG) brand names.

This manual provides information necessary for operation, installation, and service of RA Series transfer switches. This manual also includes parts information.

This is an open transition transfer switch which does not include an integral automatic transfer switch (ATS) control. With an open transition switch, there is never a time when both sources are supplying power to the load.

This manual includes information on the following types of RA Series transfer switch installations.

- *Non-Service Entrance*: The door panel must be removed to gain access to transfer switch components.
- *Service Entrance (One Circuit Breaker)*: Access to the circuit breaker can be obtained by removing the outer door panel. An internal panel must be removed to gain access to transfer switch components.

RA Series transfer switches are designed to only be installed with the Cummins generator models shown below. Installing these switches with any other generator model will void the warranty.

Cummins Generator Set Models Using RA100/RA200/RA400 Transfer Switches			
C30N6H	C36N6H	C40N6H	C45N6
C45N6H	C50N6H	C60N6H	C50N6
C22N6	C25N6	C30N6	C60N6
C36N6	C40N6	C20N6	C70N6
C10D6	C15D6	C20D6	C80N6
C25D6	C30D6	C35D6	C100N6
C40D6	C13N6H	C17N6H	C20N6H

Refer to the wiring diagrams at the end of this manual for specific information about switch configuration.

Use normal and necessary safety precautions before starting any service procedure. Identify all hazards by referring to the Important Safety Precautions section of this manual and by observing all warnings and cautions within the manual. Whenever you are troubleshooting, remember that the generator set, the transfer switch, and the utility power source are all interdependent.

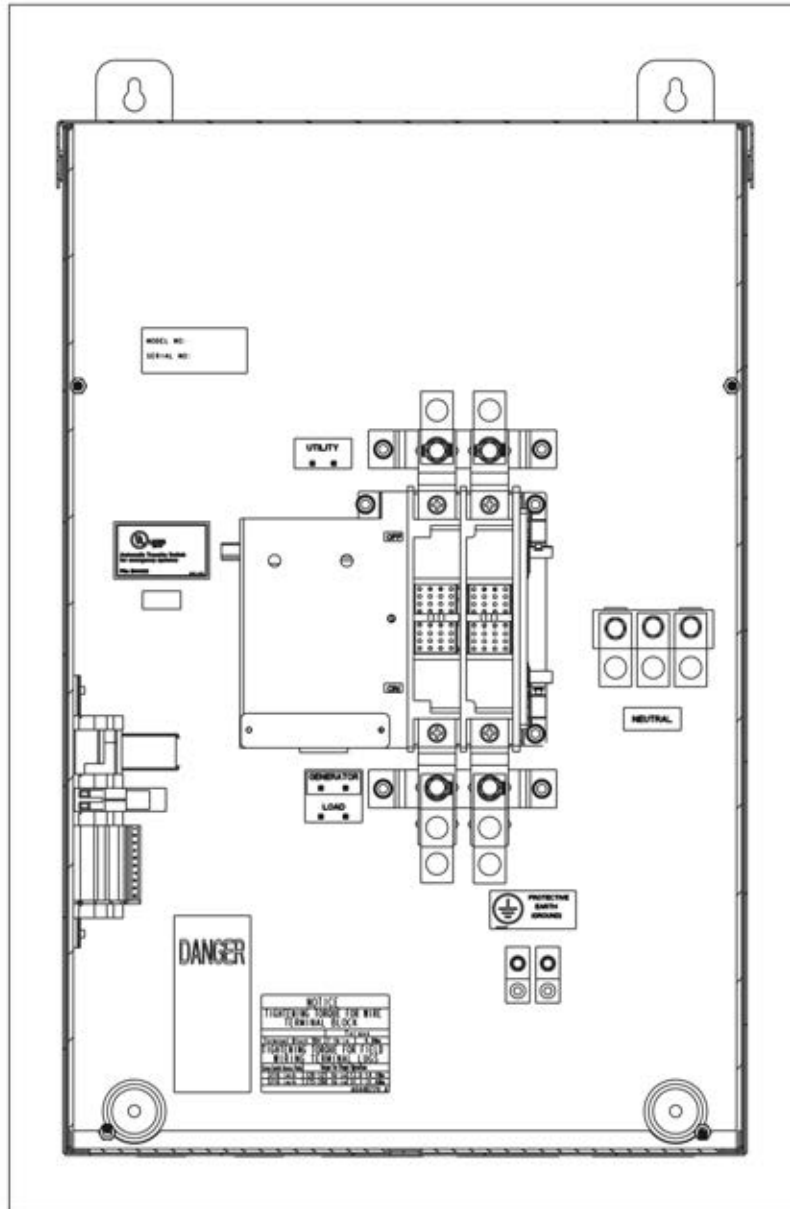


FIGURE 1. RA 100A AND RA 200A NON-SERVICE ENTRANCE TRANSFER SWITCH (WITH DOOR PANEL REMOVED)

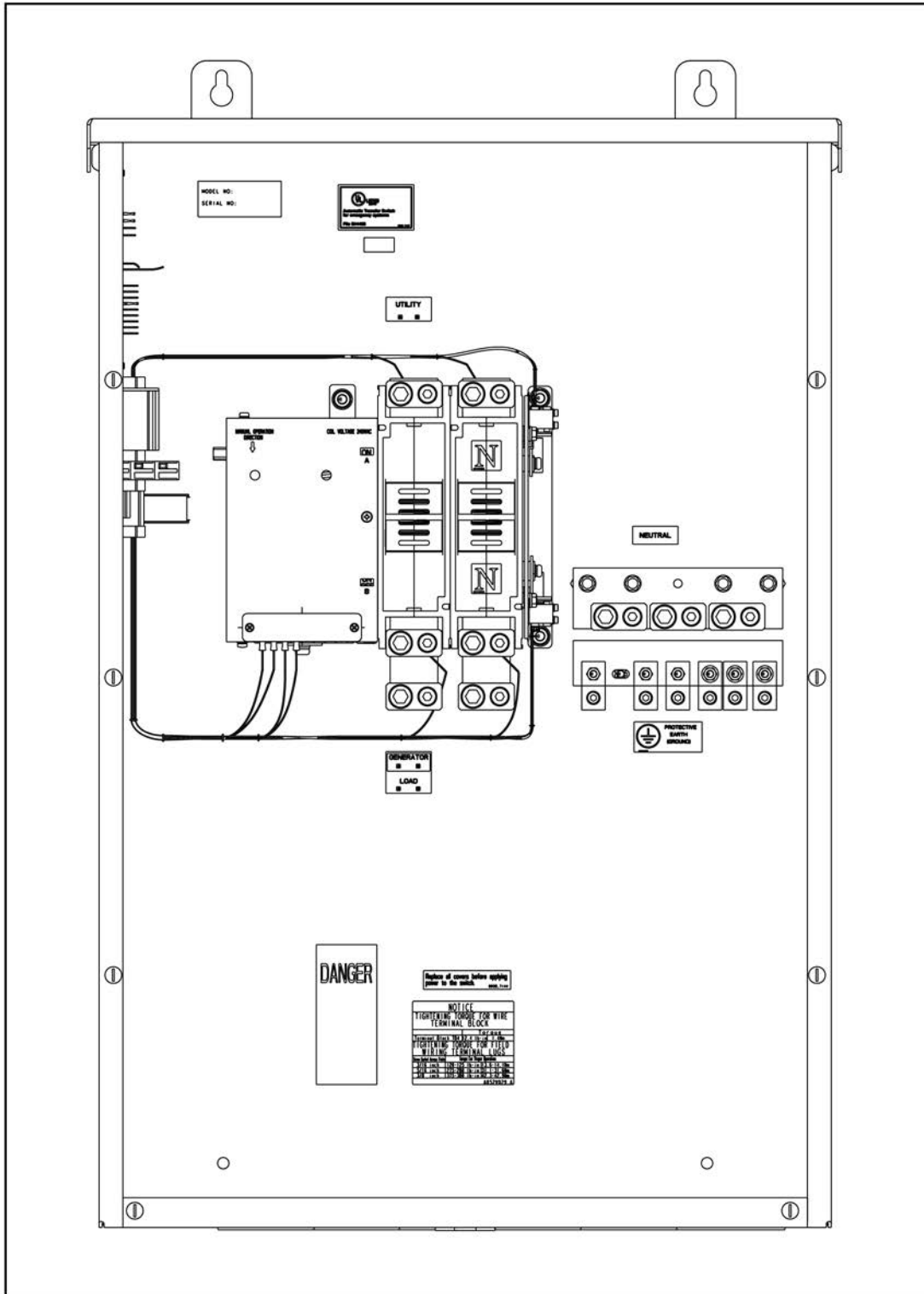


FIGURE 2. RA 400A NON-SERVICE ENTRANCE TRANSFER SWITCH (WITH DOOR PANEL REMOVED)

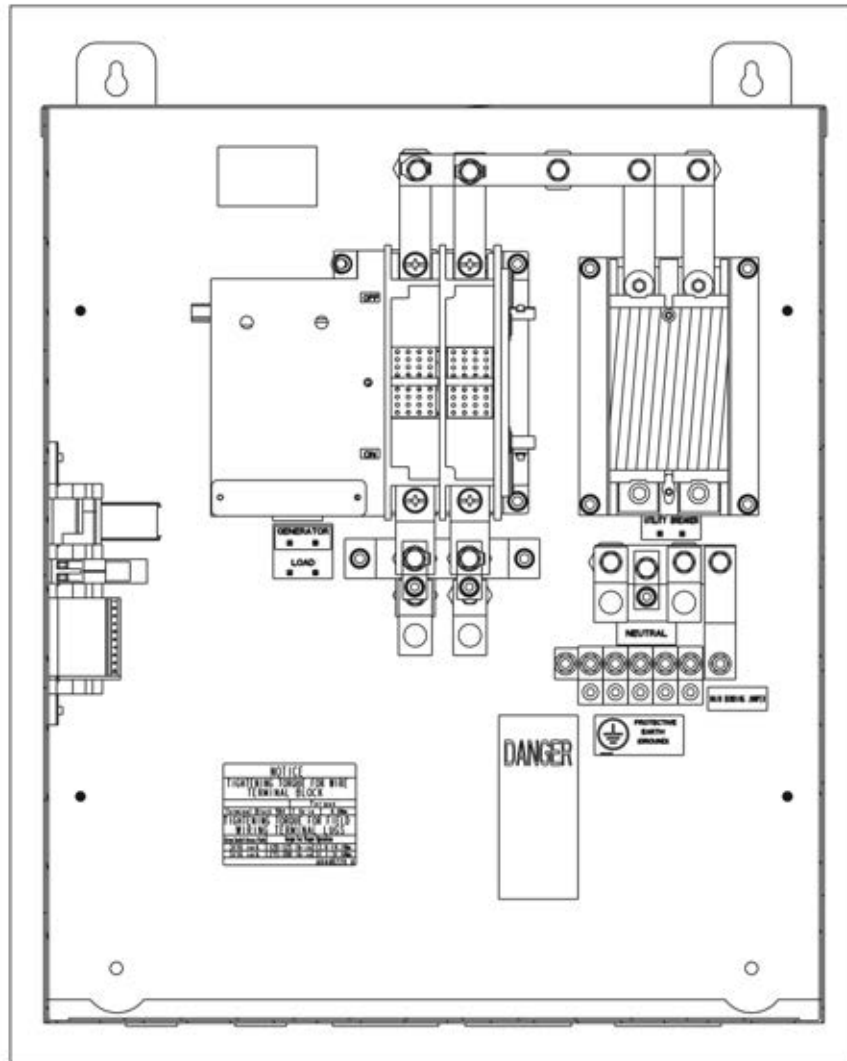


FIGURE 3. RA 100A AND RA 200A SERVICE ENTRANCE TRANSFER SWITCH (WITH DOOR PANEL REMOVED)

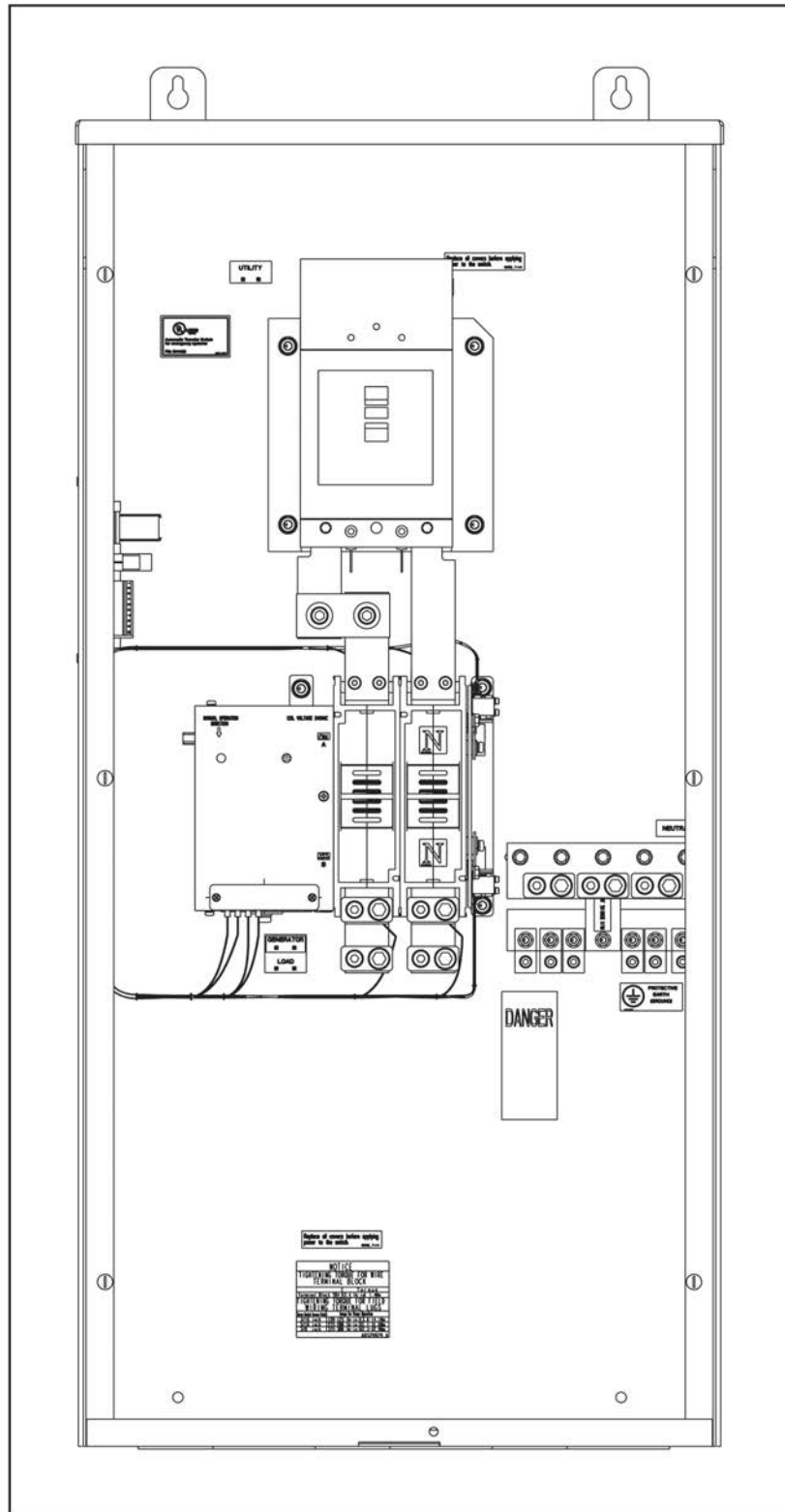


FIGURE 4. RA 400A SERVICE ENTRANCE TRANSFER SWITCH (WITH DOOR PANEL REMOVED)

2.2 Transfer Switch Application

Transfer switches are an essential part of a building's standby or emergency power system. The utility line (normal power), is backed up by a generator set (emergency power). The transfer switch switches the electrical load from one source to the other.

The load is connected to the common of the ATS (Figure 5). Under normal conditions, the load is supplied with power from the utility (as illustrated). If utility power is interrupted, the load is transferred to the generator set (genset). When utility power returns, the load is retransferred to the utility. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

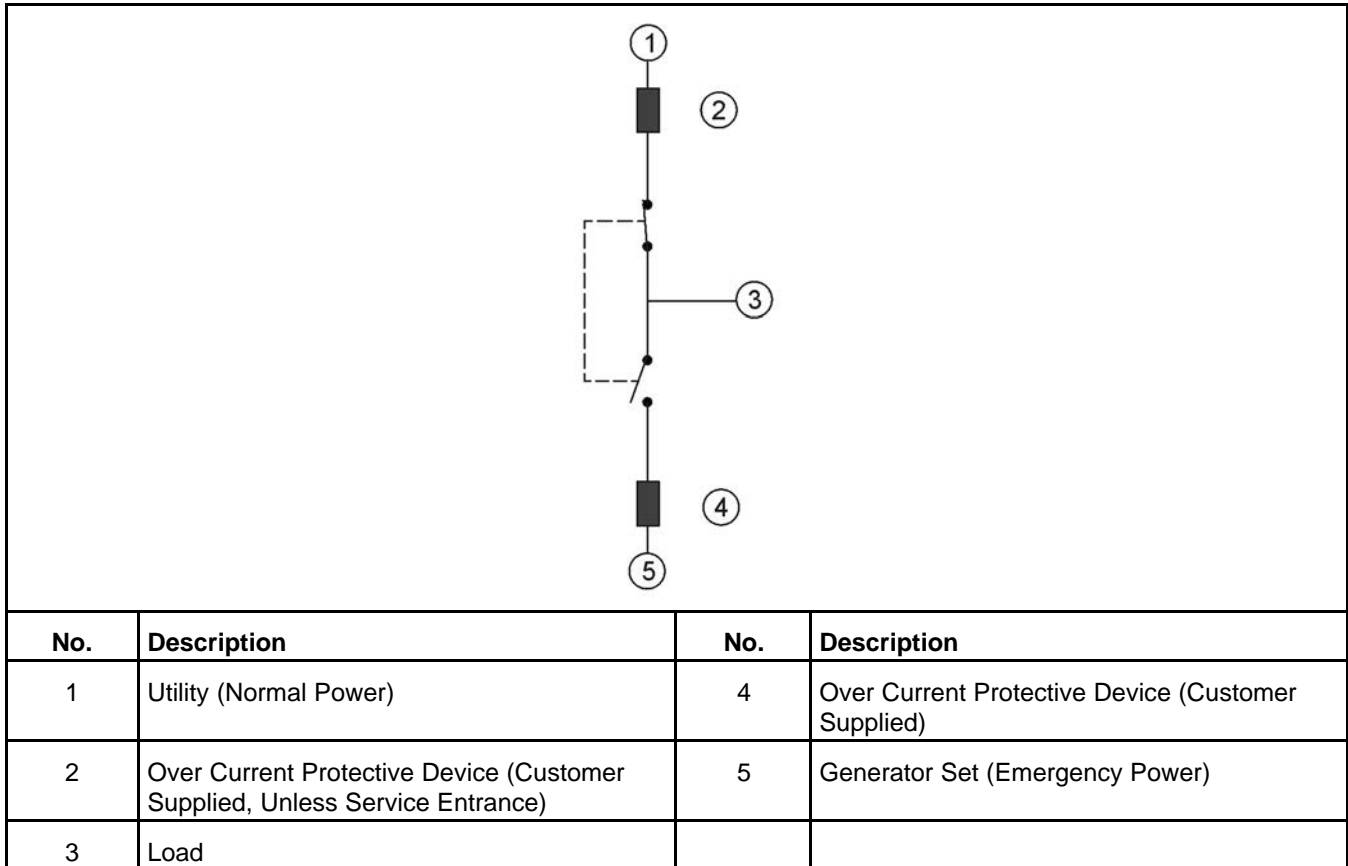


FIGURE 5. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

2.3 Transfer Switch Function

Automatic transfer switches, capable of automatic operation without operator intervention, perform the basic function of transferring the load to the available power source.

This automatic transfer switch, capable of automatic operation without operator intervention, is designed for utility-to-generator applications. In utility-to-generator applications, the transfer switch performs the following functions:

1. Senses the interruption of utility power
2. Sends a utility unavailable signal to the generator set
3. Receives transfer command from generator set control

4. Transfers the load to the generator set
5. Senses the return of utility power
6. Sends utility available signal to generator set
7. Receives retransfer command from generator set control
8. Retransfers the load to the utility

The transfer switch design is intended to signal when the utility voltage is not present and when it returns. The utility sense relay coil will energize or stay energized at voltages other than nominal. Therefore, the unit should not be expected to signal a failed utility to the generator set during undervoltage or overvoltage conditions.

2.4 Model Identification

Identify the model by referring to the Model and Specification number as shown on the nameplate. Electrical characteristics are also shown on the nameplate.

Refer to [Figure 6](#) for the key to the model character meanings.

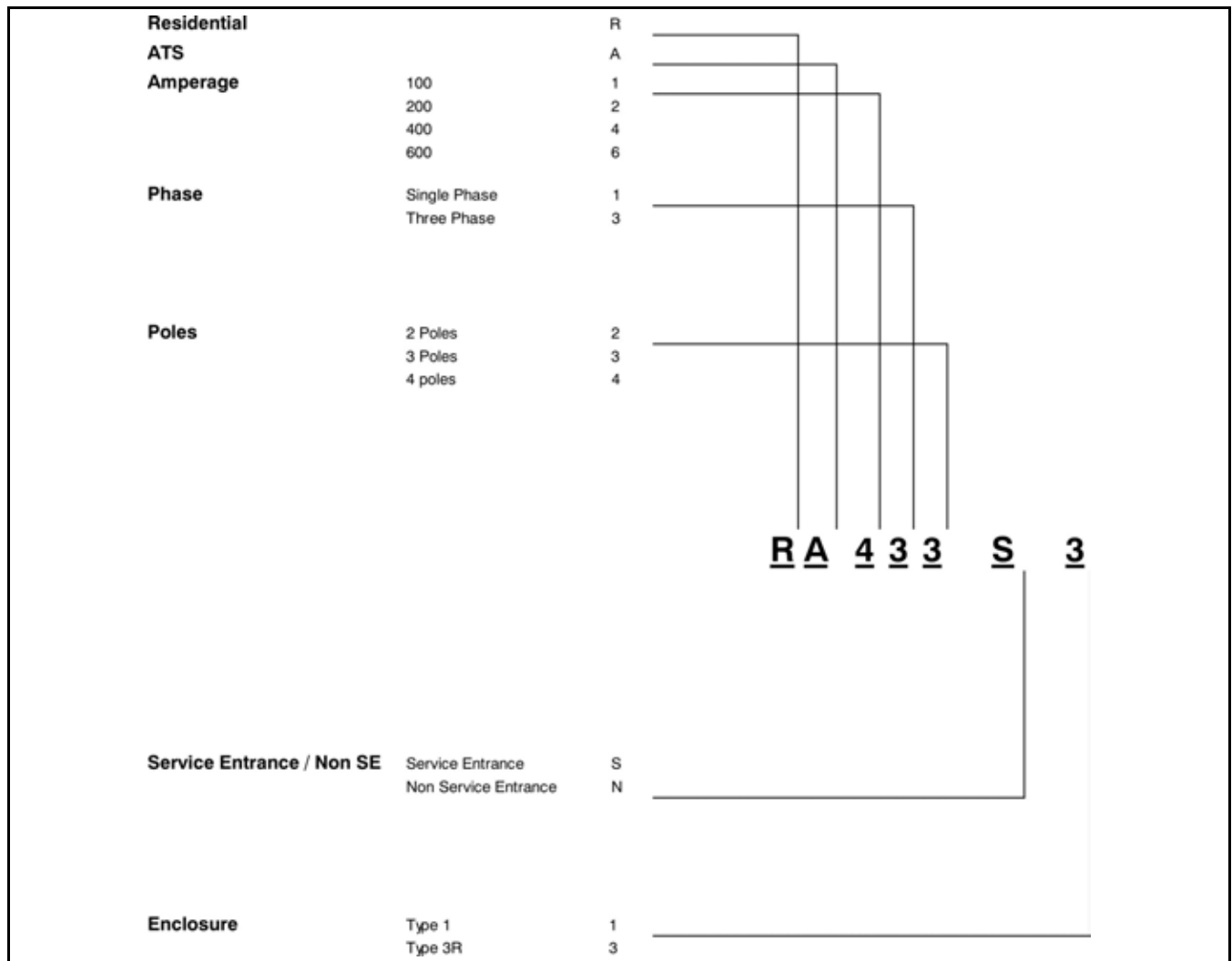


FIGURE 6. RA SERIES TRANSFER SWITCH MODEL CHARACTER KEY

The nameplates for the RA Series transfer switches are located inside the cabinet in the following locations:

- *RA 100A/200A transfer switches:* On the upper right side (see [Figure 7](#) and [Figure 9](#)).
- *RA 400A service entrance transfer switch:* On the upper right side (see [Figure 8](#))
- *RA 400A non-service entrance transfer switch:* On the lower right side (see [Figure 10](#))

If it is necessary to contact a distributor regarding the transfer switch, always give the complete Model and Specification number. This information is necessary to properly identify the unit among the many types manufactured.

CUMMINS POWER GENERATION	
Model No.	
Modele	
Serial No.	
Serie	
Current Rating:	
Voltage Rating:	240 VAC 1PH
Poles:	2
Frequency :	60Hz
Application :	Utility To Generator
Enclosure Rating:	Type 3R
Wiring Dagram :	A044B194
Interconnection	
Diagram :	A044R216
Outline Drawing :	A044R213
Use Copper Or Aluminum Wire For Power Connections	
Use 60°C Rated Wire #14 To #1 AWG	
Use 75°C Rated Wire 1/0 AWG And Larger	
Control circuit wiring must be installed in conduit. Do not install in conduit with AC power wiring.	

FIGURE 7. RA 100A/200A NON-SERVICE ENTRANCE NAMEPLATE

CUMMINS POWER GENERATION	
Model No.	
Modele	
Serial No.	
Serie	
Current Rating:	
Voltage Rating:	240 VAC 1PH
Poles:	2
Frequency :	60Hz
Application :	Utility To Generator
Enclosure Rating:	Type 3R
Wiring Dagram :	A049A203
Interconnection	
Diagram :	A049L206
Outline Drawing :	A049Z141
Use Copper Or Aluminum Wire For Power Connections	
Use 60°C Rated Wire #14 To #1 AWG	
Use 75°C Rated Wire 1/0 AWG And Larger	
Control circuit wiring must be installed in conduit. Do not install in conduit with AC power wiring.	

FIGURE 8. RA 400A NON-SERVICE ENTRANCE NAMEPLATE

CUMMINS POWER GENERATION	
Model No.	
Model	
Serial No.	
Series	
Current Rating:	
Voltage Rating:	240 VAC 1PH
Poles:	2
Frequency :	60Hz
Application :	Utility To Generator
Enclosure Rating:	Type 3R
Wiring Diagram :	A044B194
Interconnection Diagram :	A044R216
Outline Drawing :	A044R213
<p>Suitable for use as service equipment - UTILITY source only. An additional disconnect must be readily available for the alternate source, unless the alternate source is an accessible generator and can be readily shut down.</p>	
<p>Use Copper Or Aluminum Wire For Power Connections</p> <p>Use 60°C Rated Wire #14 To #1 AWG Use 75°C Rated Wire 1/0 AWG And Larger</p>	
<p>Control circuit wiring must be installed in conduit. Do not install in conduit with AC power wiring.</p>	
<p>This transfer switch is rated for use on a circuit capable of delivering not more than 10,000 rms symmetrical amperes, 240 volts maximum.</p>	
<p>Continuous load current not to exceed 80 percent of switch rating.</p>	

FIGURE 9. RA 100A AND RA 200A SERVICE ENTRANCE NAMEPLATE

CUMMINS POWER GENERATION	
Model No.	
Modele	
Serial No.	
Serie	
Current Rating:	
Voltage Rating:	240 VAC 1PH
Poles:	2
Frequency :	60Hz
Application :	Utility To Generator
Enclosure Rating:	Type 3R
Wiring Diagram :	A049A203
Interconnection Diagram :	A049L206
Outline Drawing :	A049Z141
<p>Suitable for use as service equipment NORMAL source only. An additional disconnect must be readily available for the alternate source, unless the alternate source is an accessible generator and can be readily shut down.</p>	
<p>Use Copper Or Aluminum Wire For Power Connections</p> <p>Use 60°C Rated Wire #14 To #1 AWG Use 75°C Rated Wire 1/0 AWG And Larger</p>	
<p>Control circuit wiring must be installed in conduit. Do not install in conduit with AC power wiring.</p>	
<p>This transfer switch is rated for use on a circuit capable of delivering not more than 35,000 rms symmetrical amperes, 240 volts maximum.</p>	
<p>Continuous load current not to exceed 80 percent of switch rating.</p>	

FIGURE 10. RA 400A SERVICE ENTRANCE NAMEPLATE

2.5 Manufacturing Facilities

NORTH AMERICA	EMEA, CIS	ASIA PACIFIC
Cummins Power Generation Limited 1400 73rd Ave. NE Minneapolis, MN 55432 USA	Cummins Power Generation Limited Columbus Avenue Manston Park Manston, Ramsgate Kent CT12 5BF United Kingdom	Cummins Power Generation Limited 10 Toh Guan Road #07-01 TT International TradePark Singapore 608838
Phone +1 763 574 5000 Toll Free +1 800 888 6626 Fax +1 763 574 5298	Phone +44 1843 255000 Fax +44 1843 255902	Phone +65 6417 2388 Fax +65 6417 2399
BRAZIL	CHINA	INDIA
Rua Jati, 310, Cumbica Guarulhos, SP 07180-900 Brazil	Cummins Power Generation 2 Rongchang East Street, Beijing Economic – Technological Development Area Beijing 100176, P.R.China	Cummins India Ltd, Power Generation Business Unit, Plot No B-2, SEZ Industrial Area, Village-Nandal & Surwadi, Taluka- Phaltan Dist- Satara, Maharashtra 415523 India
Phone +55 11 2186 4195 Fax +55 11 2186 4729	Phone 86 10 59023001 Fax +86 10 5902 3199	Phone +91 021 66305514
LATIN AMERICA	MEXICO	
3350 Southwest 148th Ave. Suite 205 Miramar, FL 33027 USA	Eje 122 No. 200 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico	
Phone +1 954 431 551 Fax +1 954 433 5797	Phone +52 444 870 6700 Fax +52 444 824 0082	

2.5.1 How to Obtain Service

When a product requires servicing, contact your nearest Cummins Power Generation distributor. To locate your local Cummins Power Generation distributor, refer to www.cumminspower.com and select Distributor Locator. When contacting your distributor, always supply the complete model, specification, and serial number as shown on the nameplate.

To contact your local Cummins Power Generation (CPG) distributor in the United States or Canada, call 1-800-888-6626 (this automated service utilizes touch-tone phones only). By selecting Option 1 (press 1), you will be automatically connected to the distributor nearest you.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

- Generators-Electric,

- Engines-Gasoline or Engines-Diesel,
- Recreational Vehicles-Equipment, or
- Parts and Service

If it is necessary to contact a distributor regarding the transfer switch, always give the complete Model and Serial number. This information is necessary to properly identify your unit among the many types manufactured.

⚠ WARNING

Removing the front door will expose the operator to hazardous voltage. Ensure that both sources are de-energized and locked out prior to removing the door.

- *Non-service entrance models:* A model and serial number label is located on the inner back of the enclosure on the upper left side (see [Figure 1](#) and [Figure 2](#)).
- *Service entrance models:* A model and serial number label is located on the inner panel. To view the label, remove the outer panel (see [Figure 12](#)) and [Figure 13](#).

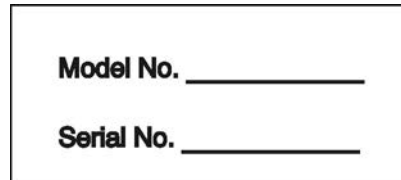


FIGURE 11. MODEL AND SERIAL NUMBER LABEL

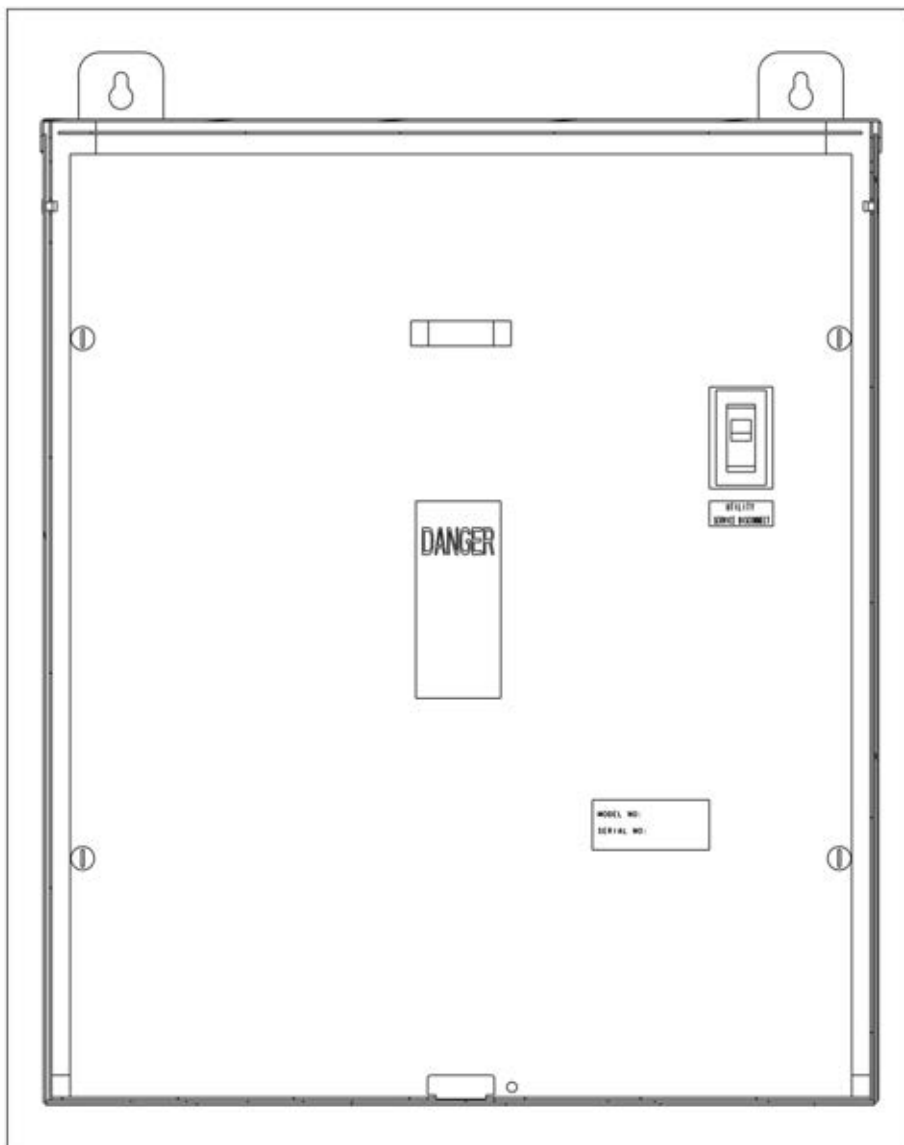


FIGURE 12. RA 100A AND RA 200A SERVICE ENTRANCE MODELS

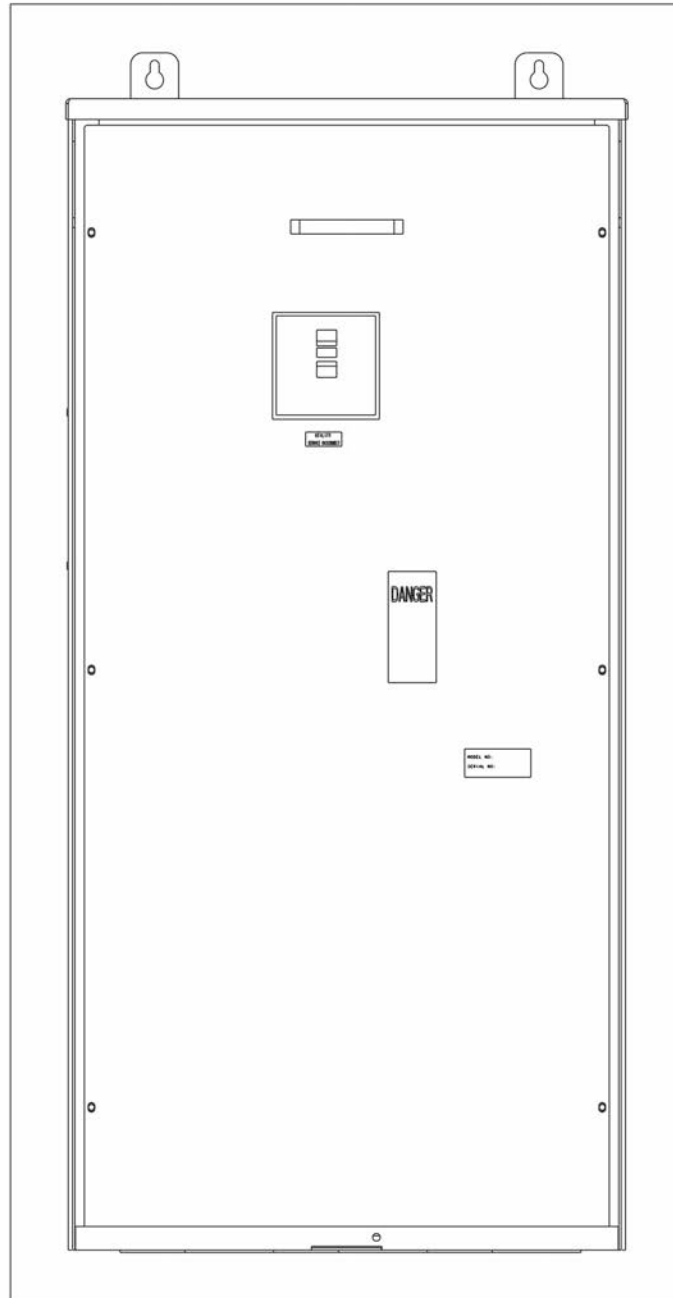


FIGURE 13. RA 400A SERVICE ENTRANCE MODEL

2.6 Installation Overview

These installation recommendations apply to typical installations. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact your nearest Cummins/Onan distributor for assistance.

2.6.1 Application and Installation

Installations must be carefully planned and correctly installed for proper operation. This involves two essential elements: application and installation.

Application refers to the design of the complete standby power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, cooling systems, exhaust systems, and fuel systems. Each component must be correctly designed so the complete system functions as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers are responsible for the design of the complete standby system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the standby power system. The installers set up and connect the various components of the system as specified in the system design plan. The complexity of the standby system normally requires the special skills of qualified electricians, plumbers, sheet metal workers, and etc. to complete the various segments of the installation. This is necessary so all components are assembled using standard methods and practices.

2.6.2 Safety Considerations

The transfer switch has been carefully designed to provide safe and efficient service when properly installed, maintained, and operated. However, the overall safety and reliability of the complete system depends on many factors outside the control of the manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the transfer switch exactly as specified in this manual. All systems external to the transfer switch must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

Verify that both power source voltages match the nameplate rating prior to installation.

3 Installation

3.1 Installation - Mounting

3.1.1 Introduction

Proper storage, installation, operation, and maintenance helps to increase the life of the transfer switch. **Installation is to be done only by licensed certified electricians.**

⚠ WARNING

AC power within the cabinet presents a shock hazard that can cause severe personal injury or death. Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. All corrective service procedures must be done only by technically trained and experienced personnel.

Each RA series transfer switch is factory wired and tested. Installation of the RA transfer switch includes the following.

- Mounting a transfer switch cabinet
- Connection of all Utility, Generator, and Load cables (covered in [Section 3.2](#))
- Connection of low voltage signal circuits (covered in [Section 3.2.2](#))

RA Series transfer switches are only designed to be installed with the generator models identified in [Section 2.1](#). Installing this switch with any other generator model will void the warranty.

3.1.2 Equipment Inspection and Storage

Once you have received the transfer switch, inspect it for any damage. Check for damage to the enclosure, the transfer switch, the control panel (if applicable), and the wiring harness.

Prior to installation, make sure the transfer switch is stored in a clean dry place, protected from dirt and water. Provide ample air circulation and heat, if necessary, to prevent condensation from gathering on the equipment. Be sure to adhere to the transfer switch storage and operating requirements listed below.

Transfer Switch	Storage Temperature	Operating Temperature (Ambient)	Humidity
RA 100A, RA 200A	-22 °F to +158 °F (-30 °C to +70 °C)	-4 to +140 °F (-20 to +60 °C)	5 to 95% (Non-Condensing)
RA 400A	-13 °F to +131 °F (-25 °C to +55 °C)	-4 to +122 °F (-20 to +50 °C)	Up to 90% at 68 °F (20 °C)

3.1.3 Location

The location of the transfer switch in the existing electrical circuit varies with the application and the type of entrance switch. **The location and wiring must comply with the contract drawings.**

There must be a service disconnect in the commercial power line ahead of the transfer switch.

Typical installations of a transfer switch are shown in [Figure 17](#) and [Figure 19](#).

Cabinet dimensions and weights are listed in [Table 1](#).

Choose a vibration-free mounting surface that supports the weight of the switch. Avoid locations that are near flammable liquids or gases, or are hot, moist, or dusty.

⚠ WARNING

An electrical arc occurs during transfer that can ignite a flammable atmosphere, resulting in severe personal injury or death. The switch must not be located near batteries, fuel tanks, solvents, or other sources of flammable liquids or gases, or in areas sharing ventilation with such sources.

3.1.4 Installing Transfer Switches in Applications that Include a Utility Panel

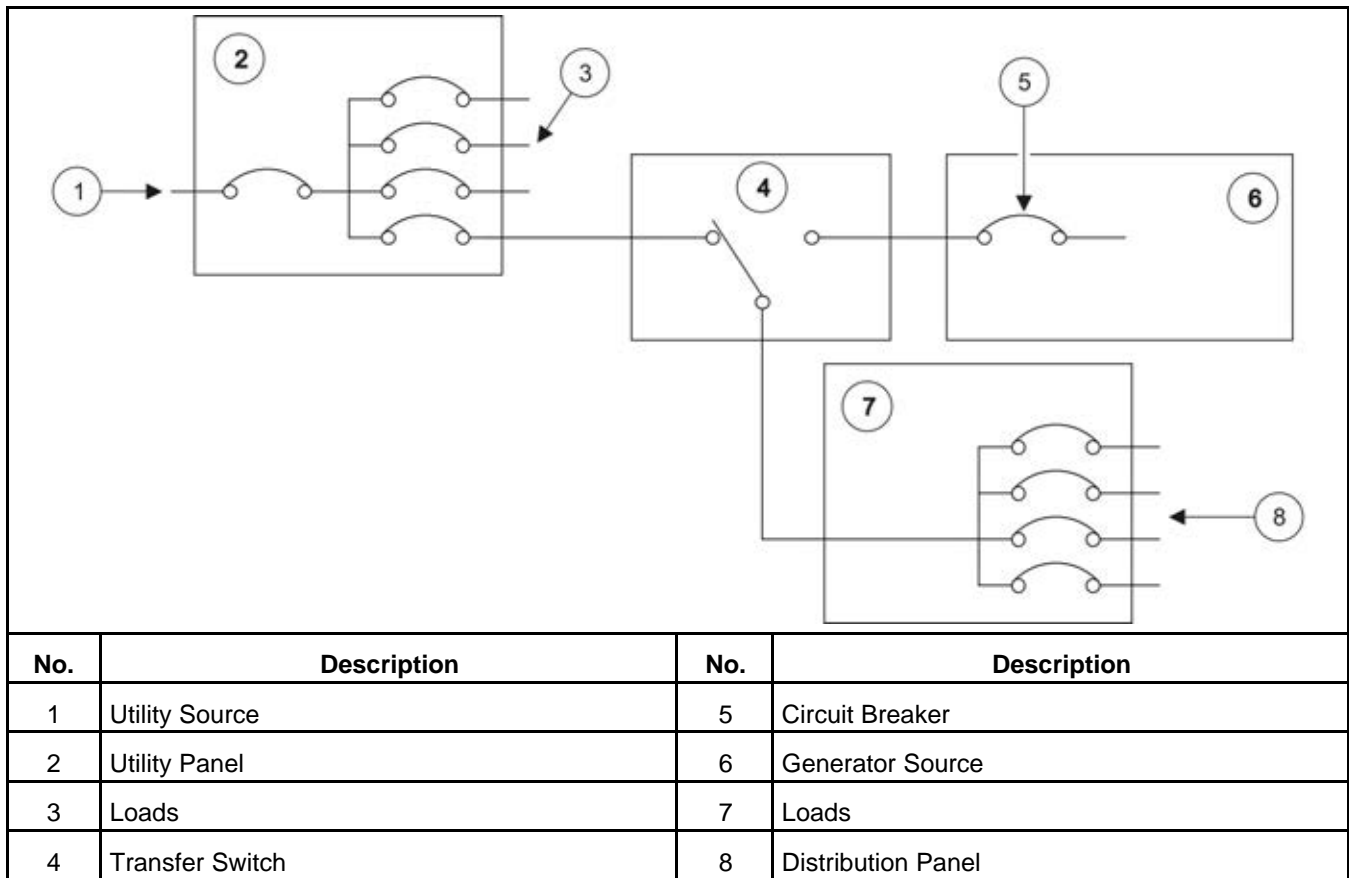


FIGURE 14. PARTIAL COVERAGE SYSTEM (NON-SERVICE ENTRANCE MODEL)

NOTICE

Service entrance (SE) model transfer switches are rated service entrance equipment. The main bonding jumper is factory installed in the connected position between Neutral and the Ground bus bar. By installing a transfer switch as shown in the figure below, the main bonding jumper should be removed or moved from a connected position to a disconnected position

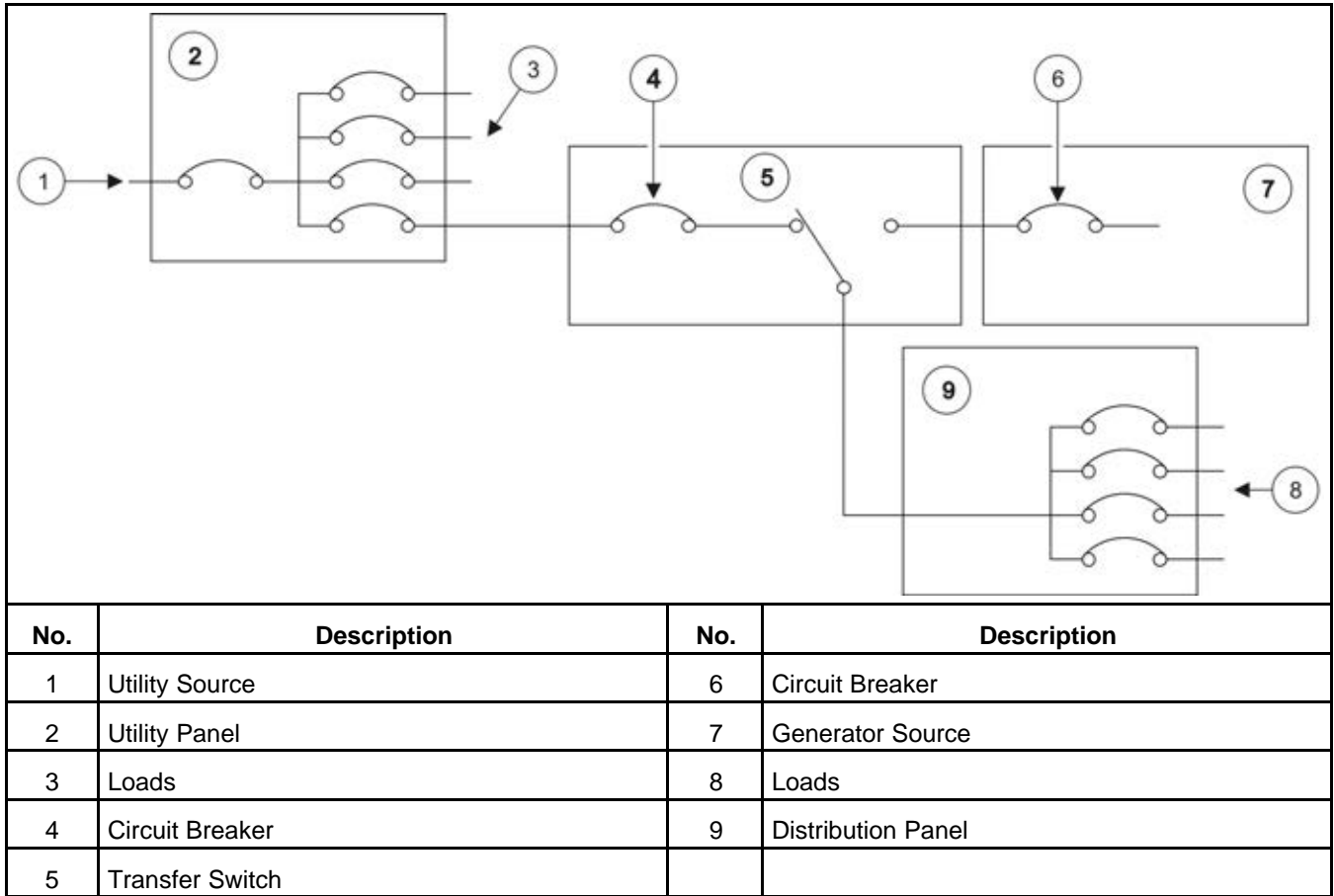


FIGURE 15. PARTIAL COVERAGE SYSTEM (SERVICE ENTRANCE MODEL)

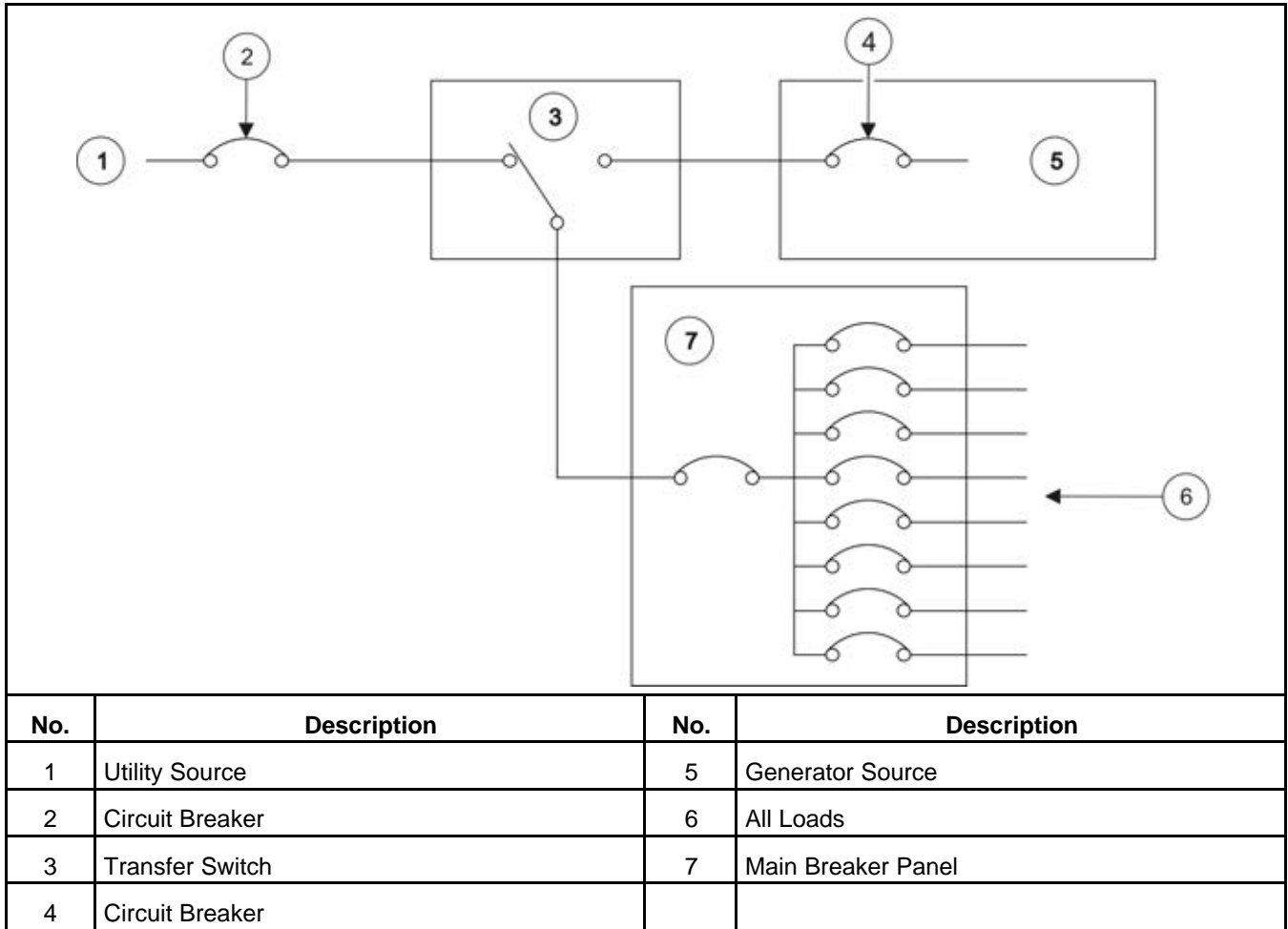


FIGURE 16. TOTAL COVERAGE SYSTEM (NON-SERVICE ENTRANCE MODEL)

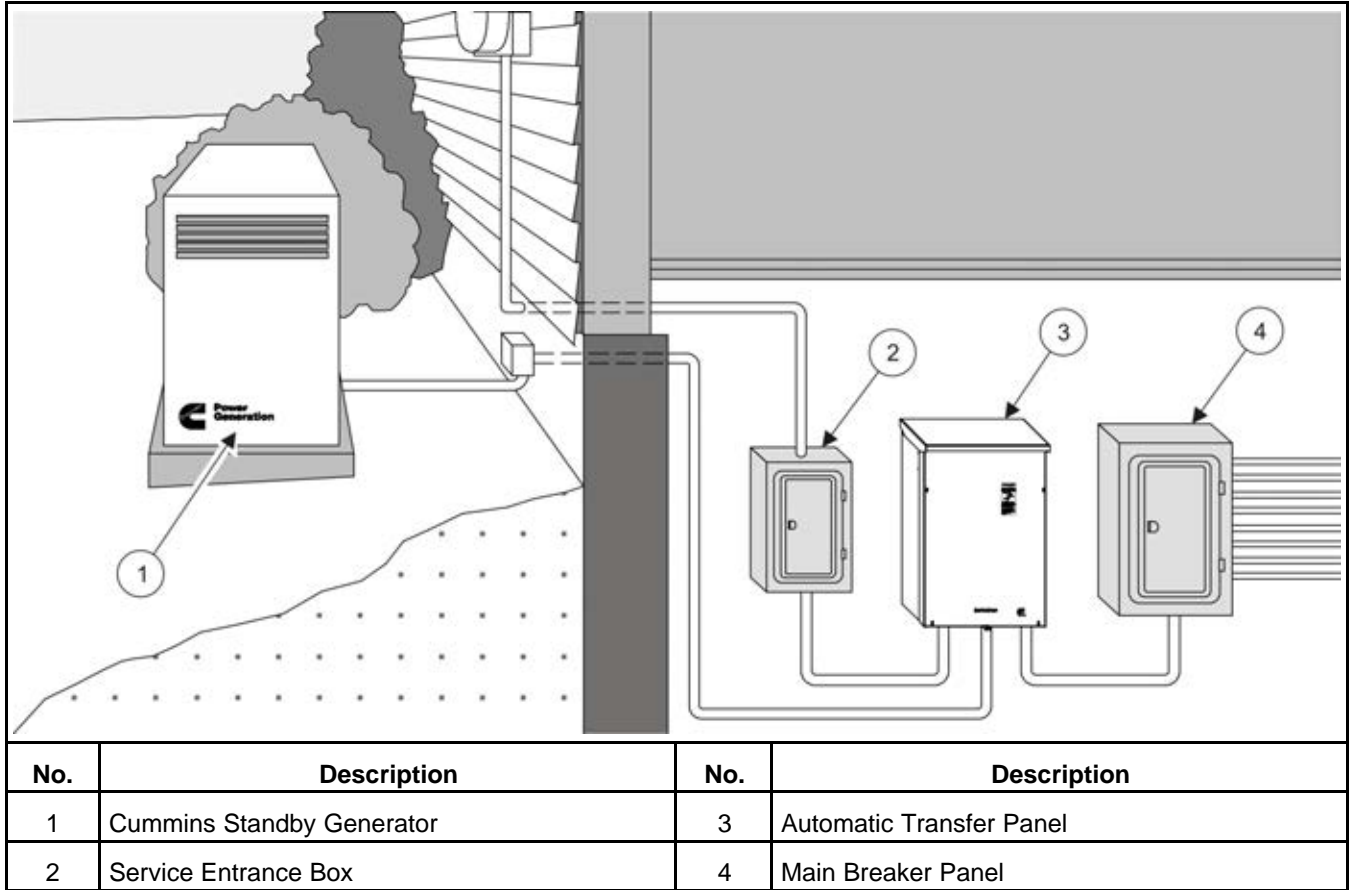


FIGURE 17. TYPICAL WALL-MOUNT INSTALLATION OF NON-SERVICE ENTRANCE MODELS

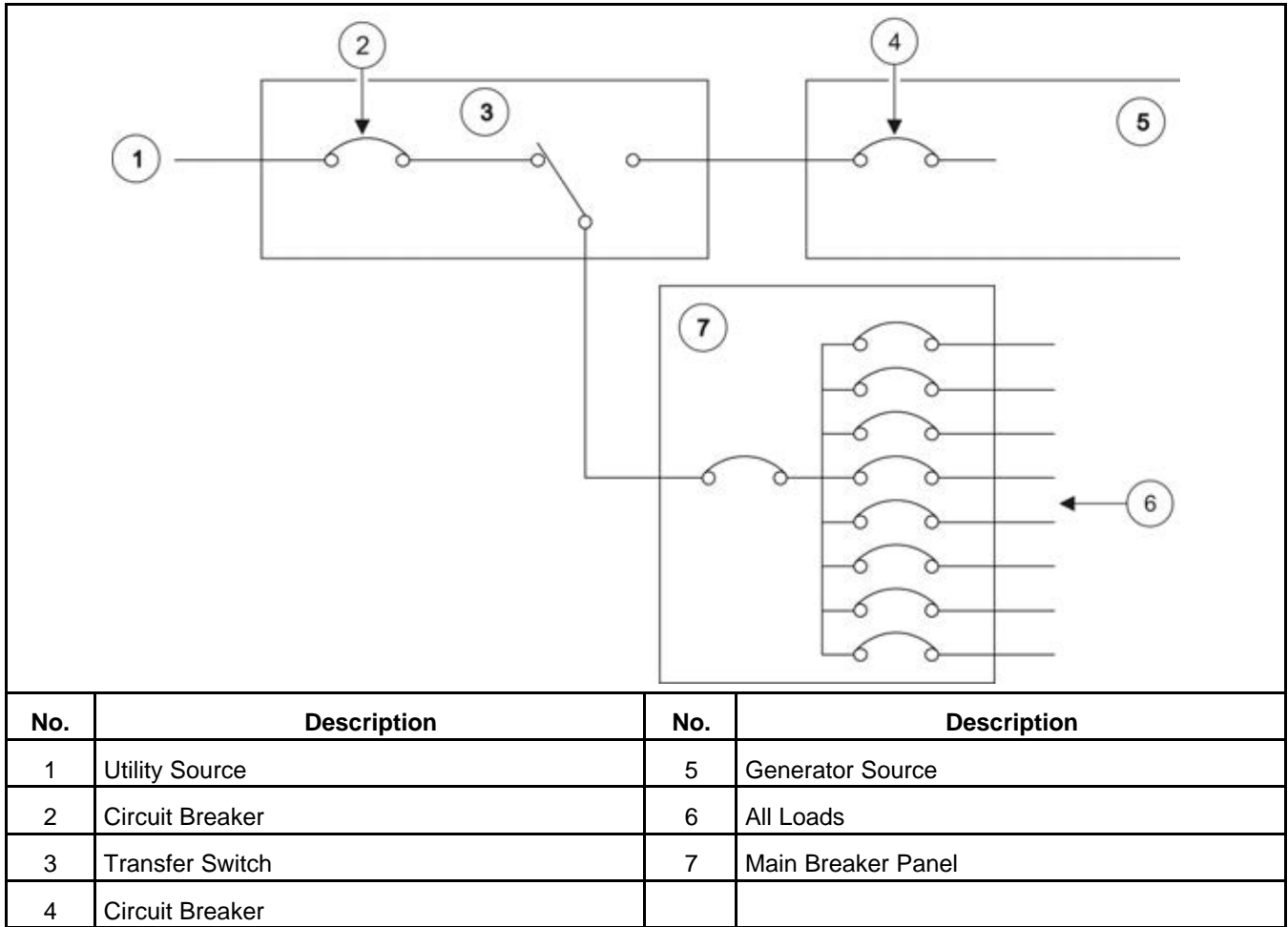


FIGURE 18. TOTAL COVERAGE SYSTEM (SERVICE ENTRANCE MODEL)

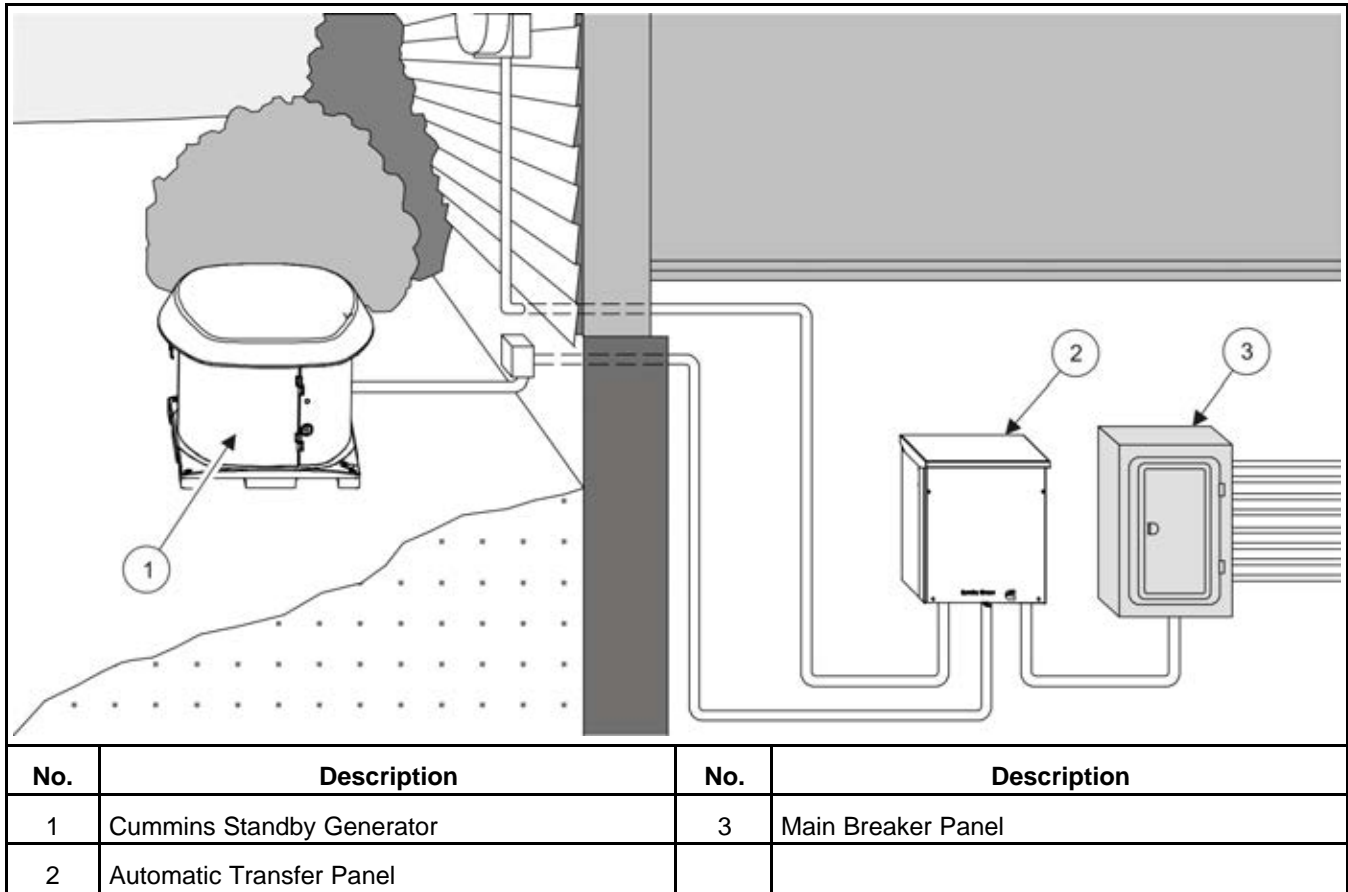


FIGURE 19. TYPICAL WALL-MOUNT INSTALLATION OF SERVICE ENTRANCE MODELS

TABLE 1. APPROXIMATE CABINET DIMENSIONS

Switch Current Rating	Height	Width	Depth	Weight
100 Amp NSE	24.0 in (619 mm)	17.0 in (433 mm)	7.1 in (181 mm)	33 lb (15 kg)
200 Amp NSE	27.1 in (688 mm)	18.2 in (463 mm)	7.1 in (181 mm)	46 lb (21 kg)
100 and 200 Amp SE	23.3 in (591 mm)	19.8 in (503 mm)	7.5 in (191.2 mm)	58 lb (26 kg)
400 Amp NSE	36.9 in (937 mm)	24.6 in (623.9 mm)	11.3 in (287.2 mm)	64 lb (29 kg)
400 Amp SE	47.9 in (1218 mm)	23.2 in (588 mm)	11.1 in (282.4 mm)	96 lb (44 kg)

3.1.5 Mounting Method

RA Series transfer switches are mounted to a wall. Follow the appropriate set of mounting instructions and refer to the outline drawings in [Appendix C](#) for installation dimensions, specifications, and mounting hole patterns. Enough room must be allowed to remove the door panel for inspection and servicing of the switch, as per NEC and local codes.

3.1.5.1 Wall Mounting

1. Make sure that the wall where the transfer switch is to be mounted is suitable to hold firmly the weight and size of the transfer switch, within a reasonable safety factor.

2. Check the location to be sure that no wires or plumbing, gas, or exhaust lines run behind the wall.

NOTICE

For Service Entrance models with integrated circuit breakers, the National Electric Code stipulates that the installed height of the circuit breaker selector switch is not more than 6 ft 7 in. above the floor, grade, or platform.

3. Make sure that the anchorage fasteners used to bolt the switch to the wall are strong enough to withstand the switch weight and its vibration during operation, within a reasonable safety factor.
4. Use four 1/4 inch bolts for wall mounting. Measure and mark the wall for drilling.
5. Install two mounting bolts in the wall for the top cabinet mounting keyholes.
6. With the shipping box standing so that the cabinet is lying down, carefully remove the top and the foam from the box.

⚠ WARNING

Improper lifting can cause severe personal injury. Have sufficient manpower for lifting and mounting the cabinet.

7. Remove the transfer switch from the box and remove the plastic covering.

⚠ WARNING

Unit will not be stable when supported only by bottom bolts. Additional support is required to keep unit vertical while top bolts are installed.

8. Raise the cabinet and mount it on the two mounting bolts in the wall. Provide support for the cabinet during installation.

NOTICE

Make sure wall mounting brackets are not bent during installation.

9. Install the two bottom mounting bolts, but do not tighten them. **(Do not remove the cabinet support until all bolts are installed.)**
10. Push the cabinet against the wall. If the cabinet does not align flush against the wall, shim the mounting bosses as required, using metal shims.
11. Tighten all mounting bolts.

3.2 Installation - Wiring

Refer to [Reconnect AC Power \(When Finished\)](#) for component locations.

⚠ WARNING

AC voltages and currents present an electrical shock hazard that can cause severe personal injury or death. Only trained and experienced personnel are to perform the following procedures.

⚠ CAUTION

Installation debris can cause equipment failure and damage. Use extreme care to keep drill chips and filings out of the relays, contacts, and other parts of the automatic transfer switch when mounting or connecting conduit. Screwdrivers should be used carefully to prevent damage to components.

When installing conduit, observe the following precautions:

1. The RA Series transfer switch includes cutouts on the bottom of the cabinet for wiring. **If you decide to drill your own holes in the top of the cabinet instead of using the cutouts provided, cover the transfer switch to prevent accidental entry of metal chips before beginning conduit installation.**
2. If using rigid conduit between the generator set and the transfer switch, install at least 2 feet (610 mm) of flexible conduit between the rigid conduit and generator set to absorb vibration.
3. Run control circuit wiring in separate conduit from the AC wiring; otherwise, induced currents could cause operational problems within the switch. Cutouts are available through the bottom of the cabinet. Refer to the switch outline drawings included in [Appendix C](#).

3.2.1 AC Connections

RA Series transfer switches are supplied with screw type terminals for the Utility, Generator, Load, and Neutral power connections. Either copper or aluminum cables can be used for AC connections.

Connect the Utility, Generator, Load, and Neutral conductors to the clearly marked terminals on the transfer switch. Use a wire brush to remove any surface oxides from the cables. Verify that all connections are correct before tightening the lugs. All lug connections must be tightened to the proper torque values listed in the tables below.

Perform wiring in the following sequence:

1. Test the operation of the generator set from its own controls.

⚠ WARNING

Failure to prevent the generator set from starting before wiring procedures are performed presents a shock hazard that can cause severe personal injury or death. Disconnect generator set battery, negative (-) terminal first, before proceeding.

2. Stop the generator set and remove the negative lead from the cranking battery to prevent starting.

⚠ WARNING

AC voltages and currents present an electrical shock hazard that can cause severe personal injury or death. Make sure that both AC power sources are disconnected.

3. Make sure that both AC power sources are disconnected.
4. Connect power cables of sufficient size to carry rated current from the line, load, and generator directly to the transfer switch terminals or circuit breaker(s), which are marked A and B. A neutral bar is standard on the switches. For wire sizes and torque specifications, see the tables below.

TABLE 2. SCREW TYPE TERMINALS AND TORQUE VALUES FOR EXTERNAL POWER GENERATION ON NON-SERVICE ENTRANCE TRANSFER SWITCHES

Switch Size (Amps)	Terminal Description								
	Utility, Generator, and Load Terminals			Neutral Bar Terminals			Ground Terminals		
	Cables per Pole	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque
100 Amp	1	#14 to 2/0 AWG	120 in-lb (14 Nm)	3	#14 to 2/0 AWG	120 in-lb (14 Nm)	2	#14 to 1/0 AWG	120 in-lb (14 Nm)
200 Amp	1	#6 AWG to 300 MCM	275 in-lb (31 Nm)	3	#6 AWG to 300 MCM	275 in-lb (31 Nm)	2	#14 to 1/0 AWG	120 in-lb (14 Nm)
400 Amp	1	3/0 AWG to 600 MCM	275 in-lb (31 Nm)	3	#3/0 AWG to 600 MCM	275 in-lb (31 Nm)	3	#6 to 3/0 AWG	120 in-lb (14 Nm)

TABLE 3. SCREW TYPE TERMINALS AND TORQUE VALUES FOR SERVICE ENTRANCE MODEL POWER CONNECTIONS (UTILITY CIRCUIT BREAKER AND GENERATOR AND LOAD TERMINALS)

Switch Size (Amps)	Terminal Description					
	Utility Circuit Breaker			Generator and Load Terminals		
	Cables per Pole	Range of Wire Size	Tightening Torque	Cables per Pole	Range of Wire Sizes	Tightening Torque
100 Amp	1	#4 AWG to 300 MCM	250 in-lb (28 Nm)	1	#14 to 2/0 AWG	120 in-lb (14 Nm)
200 Amp	1	#4 AWG to 300 MCM	250 in-lb (28 Nm)	1	#6 AWG to 300 MCM	275 in-lb (31 Nm)
400 Amp	2	2/0 AWG to 250 MCM	275 in-lb (31 Nm)	1	3/0 AWG to 600 MCM	275 in-lb (31 Nm)

TABLE 4. SCREW TYPE TERMINALS AND TORQUE VALUES FOR SERVICE ENTRANCE MODEL POWER CONNECTIONS (NEUTRAL TERMINALS, GENERATOR NEUTRAL TERMINALS, AND GROUND TERMINALS)

Switch Size (Amps)	Terminal Description								
	Neutral Terminals			Generator Neutral Terminals			Ground Terminals		
	No. of Cables	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque
100 Amp	3	#14 to 2/0 AWG	120 in-lb (14 Nm)	1	#14 to 2/0 AWG	120 in-lb (14 Nm)	4	#14 to 1/0 AWG	120 in-lb (14 Nm)
200 Amp	3	#14 to 2/0 AWG	120 in-lb (14 Nm)	1	#14 to 2/0 AWG	120 in-lb (14 Nm)	4	#14 to 1/0 AWG	120 in-lb (14 Nm)

Switch Size (Amps)	Terminal Description								
	Neutral Terminals			Generator Neutral Terminals			Ground Terminals		
	No. of Cables	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque	No. of Cables	Range of Wire Sizes	Tightening Torque
400 Amp	3	3/0 AWG to 600 MCM	275 in-lb (31 Nm)	1	3/0 AWG to 600 MCM	275 in-lb (31 Nm)	4	#6 to 3/0 AWG	160 in-lb (18 Nm)

3.2.2 Low Voltage Signal Connections

3.2.2.1 Control Wiring Connections

For RA 100A/200A, control wiring connections are made at terminal block TB4, located on the *lower* left side of the enclosure.

For RA 400A, control wiring connections are made at terminal block TB4, located on the *upper* left area of the enclosure.

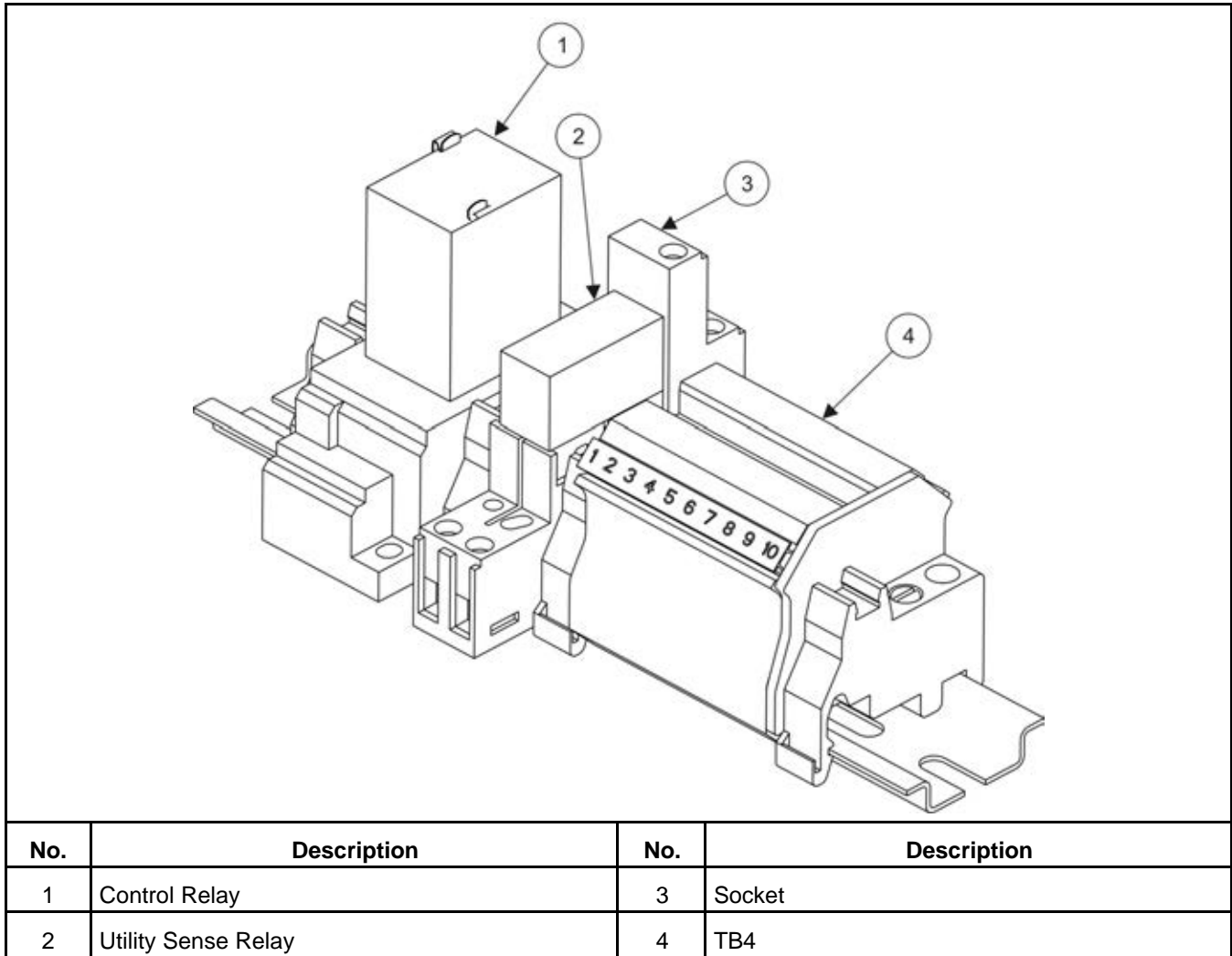


FIGURE 20. CONTROL WIRING CONNECTIONS

3.2.2.2 Connecting the Transfer Switch to the Generator

⚠ WARNING

AC voltages and currents present an electrical shock hazard that can cause severe personal injury or death. Disconnect the AC power source.

Make sure the generator set is not running and cannot be started. Disconnect the batteries and make sure the generator set's control is in the Off position.

Consult the generator manual and the Transfer Switch Interconnect Diagram ([Appendix B](#)) for required electrical connections to the generator control.

TABLE 5. MAXIMUM WIRE LENGTH BY WIRE SIZE

Wire Size (AWG)	Distance in Feet (One Way)
16	125
14	200
12	300
10	500

The transfer switches are factory wired to provide Ground (B-) signals for all customer connections:

1. N/C or N/O Utility Source Available Indicators: Ground (B-) present when Utility Source is available (TB4-2); Ground (B-) present when Utility Source is not available (TB4-1).
2. Transfer Switch Control (TB4-3): Transfers to available Generator Source upon receiving Ground (B-) signal and retransfers to available Utility Source when Ground (B-) signal is removed.
3. Transfer Switch Position Indicators: Ground (B-) signal present when closed to Utility (TB4-5) and closed to Generator (TB4-6).

Wire resistance must not exceed 0.5 ohm per line. Use stranded or solid wire. For connection to the screw terminal, strip the insulation back 3/8 inch (10 mm).

3.2.3 Final Inspection and Cleanup

Prior to energizing the transfer switch:

1. Inspect all wiring to be certain that:
 - All cabled connections are correct.
 - All generator start low voltage signal connections are correct (refer to drawings at the end of this manual and in the generator manual).
 - Wiring does not interfere with switch operation.
 - Wiring is not damaged as the door opens and closes.
 - Wiring does not contact sharp or abrasive surfaces.
 - No wiring is left loose and unconnected.

⚠ CAUTION

Debris lodged in the electrical and mechanical components may result in equipment damage. Do not use a blower to remove debris.

2. Use a vacuum cleaner to remove any dust, filings, chips, or debris from the cabinet interior and components.
3. Check the lug torque values of the power connections.

NOTICE

Lug torque values are specified on the label inside of the enclosure and in the [Section 3.2.1](#) tables.

4. Double check the power supply voltages to make sure they match the voltages listed on the nameplate.
5. Make sure that all covers and barriers are installed and properly fastened.

NOTICE

The mechanism is shipped in the Utility side position. For service entrance transfer switches, the circuit breaker is shipped in the Off position.

4 Troubleshooting

4.1 Introduction

This section describes troubleshooting issues, as well as the sequence of events for transfer switch operations that do not include a controller.

4.2 Troubleshooting Procedures for Experienced Service Personnel

This section describes a typical transfer switch sequence of events, and provides detailed troubleshooting procedures for experienced service personnel. The troubleshooting procedures use conditional schematics and symptoms to diagnose all possible problems.

⚠ WARNING

Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.

⚠ WARNING

AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. The following procedures are to be performed only by technically trained and experienced personnel.

4.2.1 Utility-to-Generator Sequence of Events

Refer to the Transfer Switch Interconnect diagram ([Appendix B](#)) for transfer switch control wiring and signal information.

The following steps describe what normally happens when the transfer switch is connected to the Utility, utility power fails, and the switch transfers to the Generator.

1. While the transfer switch is connected to the utility, utility power fails. K2 de-energizes, which closes K2-14/11 and opens K2-12/11, removing the ground (B-) signal from TB4-1 and applying the ground (B-) signal to TB4-2. The generator control starts the generator.
2. After the generator warms up, the generator control signals the relay coil (K1), energizing the relay coil which opens K1-1/K1-9 and K1-2/K1-10 and closes K1-7/K1-11 and K1-8/K1-12 to move the transfer switch from the Utility position to the Generator position. The S2 auxiliary switch within the transfer switch mechanism breaks the signal to the ATS operator coil (C).
3. Limit switch ASW removes the ground (B-) signal (TB4-5), signaling that the transfer switch has disconnected from the Utility; then the BSW limit switch provides a ground (B-) signal to TB4-6, signaling that the transfer switch has connected to the Generator.
4. The load is transferred to the generator.

4.2.2 Generator-to-Utility Sequence of Events

The following steps describe what normally happens when the transfer switch is connected to the generator, utility power returns, and the switch moves from the Generator position to the Utility position.

1. The utility returns.
2. The generator control receives a ground (B-) signal from the TB4-1 utility sense relay.
3. The generator control de-energizes the relay coil (K1), which closes K1-1/K1-9 and K1-2/K1-10 and opens K1-7/K1-11 and K1-8/K1-12 to move the transfer switch from the Generator position to the Utility position.
4. The S1 auxiliary switch within the transfer switch mechanism breaks the signal to the ATS operator coil (C).
5. The BSW limit switch removes the ground (B-) signal (TB4-6), signaling the transfer switch has disconnected from the generator.
6. The ASW limit switch provides a ground (B-) signal to TB4-5, signaling that the transfer switch has connected to the utility.
7. The load is retransferred to the utility.
8. After a delay to let the engine cool down, the generator stops.

4.2.3 Troubleshooting with Symptoms

Use the troubleshooting guide to help diagnose transfer switch problems. It is divided into sections based on the symptom. Common problems are listed with their possible causes. Refer to the corrective action column for the appropriate test or adjustment procedure. The section in the right column lists the location of the test or adjustment procedure in the manual.

Always refer to the schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

Make a thorough inspection of the transfer switch wiring to make sure that good wire harness and ground connections are made. Correct wiring problems before performing any test or replacing any components.

4.2.4 Important Troubleshooting Reminders

When troubleshooting the transfer switch, it is important to remember the following:

- The generator control may use limit switches (ASW and BSW) on either side of the transfer switch to determine if the switch has opened or closed. If either the ASW or BSW limit switches are bad, the generator control may display a transfer switch signal failure.
- This is a two position transfer switch. It can be connected only to either one source. There is no neutral position.
- The generator control energizes relay coil K1 by supplying B+ (CH13N6H, CH17N6H, CH20N6H) or a B- (all other models).
- Terminal Block Jumper (A034N106) provided with Generator Set is installed between TB4-3 and TB-4 on Air Cooled Generator Sets (CH13N6H, CH17N6H, CH20N6H).

The transfer switch design is intended to signal when the utility voltage is not present and when it returns. The utility sense relay coil will energize or stay energized at voltages other than nominal. Therefore, the unit should not be expected to signal a failed utility to the genset during utility undervoltage or overvoltage conditions.

4.2.5 Troubleshooting for Transfer Switches

For information on the generator controller indicator fault signals, refer to the generator service manual. The tables below list troubleshooting issues for RA Series transfer switches.

 WARNING

AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, and etc. Prior to working with live circuits, remove all sources of AC power and remove power to the door by removing the fuse from the FB fuse block. The following procedures are to be performed only by technically trained and experienced personnel.

 WARNING

Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in you generator set manuals.

TABLE 6. TROUBLESHOOTING THE TRANSFER SWITCH (PROBLEM #1)

Problem	Possible Cause	Corrective Action
The transfer switch failed to transfer to the generator	<ol style="list-style-type: none"> 1. The K1 relay coil may not have received a ground (B-) signal from the controller. 2. K1 relay may malfunction. 3. There may be a defective wire. 4. The switch mechanism solenoid may be burnt out. 5. There may be loose or broken parts within the switch mechanism. 6. TB4 jumper is incorrectly installed (on Air-Cooled Generator Sets only) 	<ol style="list-style-type: none"> 1. Check for a relay coil signal (B-) on TB4-3 and 12VDC on TB4-7. 2. Verify the relay coils are energizing. <ol style="list-style-type: none"> a. If the coils are energizing, <ul style="list-style-type: none"> • Check the wiring between the relays and the transfer switch (B1 and B2). It should be 240 VAC. • Check to see if the transfer switch is faulty. b. The coils are not energizing, <ul style="list-style-type: none"> • Check to see if the K1 relay is faulty. • If faulty, replace the K1 relay. 3. Check, inspect, or replace the defective wire. 4. Manually operate the switch by using the operator handle to manually transfer the switch. If the switch manually transfers, the solenoids are burnt out; replace the switch mechanism. 5. Manually operate the switch by using the operator handle to manually transfer the switch. If the switch does not manually transfer, replace the switch mechanism. 6. Refer to interconnect diagram in Appendix B and check for the transfer command signal at TB4. Generator Set Models C13N6H, C17N6H and C20N6H require a jumper between TB4-3 and TB4-4.

TABLE 7. TROUBLESHOOTING THE TRANSFER SWITCH (PROBLEM #2)

Problem	Possible Cause	Corrective Action
<p>The transfer switch failed to transfer to the utility</p>	<ol style="list-style-type: none"> 1. The Utility source may not be present. 2. The K2 relay is faulty — used to detect if utility voltage is present. 3. The K1 relay coil may not have received a ground signal 4. K1 relay may malfunction. 5. There may be a defective wire. 6. The switch mechanism solenoid may be burnt out. 7. There may be loose or broken parts within the switch mechanism. 8. TB4 jumper is incorrectly installed (on Air-Cooled Generator Sets only). 	<ol style="list-style-type: none"> 1. Check: <ol style="list-style-type: none"> a. To see that the Utility service disconnect (circuit breaker) is in the ON position. b. For a ground (B-) signal on TB4-1. 2. Replace the relay. 3. Check for a relay coil signal (B-) on TB4-3 and 12VDC on TB4-7. 4. Verify the relay coils are energizing. <ol style="list-style-type: none"> a. If the coils are energizing, <ul style="list-style-type: none"> • Check the voltage between the relays and the transfer switch (A1 and A2). It should be 240 VAC. • Check to see if the transfer switch is faulty. b. If the coils are not energizing, <ul style="list-style-type: none"> • Check to see if the K1 relay is faulty. • If faulty, replace the K1 relay. 5. Check, inspect, or replace the defective wire. 6. Manually operate the switch by using the operator handle to manually transfer the switch. If the switch manually transfers, the solenoids are burnt out; replace the switch mechanism. 7. Manually operate the switch by using the operator handle to manually transfer the switch. If the switch does not manually transfer, replace the switch mechanism. 8. Refer to interconnect diagram in Appendix B and check for the transfer command signal at TB4. Generator Set Models C13N6H, C17N6H and C20N6H require a jumper between TB4-3 and TB4-4.

TABLE 8. TROUBLESHOOTING THE TRANSFER SWITCH (PROBLEM #3)

Problem	Possible Cause	Corrective Action
Transfer switch signal failure	<ol style="list-style-type: none">1. No feedback to indicate switch position either on Utility or Generator side.2. The ASW or BSW limit switch may be faulty.	<ol style="list-style-type: none">1. Check the wiring connection and verify the signal.2. Replace the limit switch.

5 Transfer Switch Service

5.1 Introduction

This section covers the removal and replacement procedures for transfer switch components.

NOTICE

For servicing purposes, each transfer switch assembly is removed and replaced as a single component; there are no serviceable sub-components.

5.2 Hardware Torque Specifications

Unless otherwise stated, use the following recommendations when torquing hardware:

TABLE 9. HARDWARE TORQUE SPECIFICATIONS

Models	Description	Recommended Torque
All	M3 Nut, Screw, or Bolt	5 - 6 in-lb (0.6 - 0.72 Nm)
	M4 Nut, Screw, or Bolt	13 - 17 in-lb (1.5 - 1.9 Nm)
	M5 Nut, Screw, or Bolt	24 - 30 in-lb (2.7 - 3.4 Nm)
	M6 Nut, Screw, or Bolt	40 - 50 in-lb (4.6 - 5.7 Nm)
	1/4-20 Nut, Screw, or Bolt	70 - 80 in-lb (7.9 - 9.0 Nm)
100A and 200A Only	Source A, B, and Load Power Terminal Screws Securing Busbar to Mechanism Housing:	
	-- 100A	62.0 - 70.8 in-lb (7.0 - 8.0 Nm)
	-- 200A	70 - 80 in-lb (7.9 - 9.0 Nm)
	<i>SE Models Only:</i> Stainless Steel Inner and Outer Door Panel Screws	62 - 77 in-lb (7.0 - 8.7 Nm)
<i>SE Models Only:</i> Source A Power Terminal Screws Securing Busbar to Circuit Breaker	70 - 80 in-lb (7.9 - 9.0 Nm)	

5.3 Switch Removal and Replacement Procedure

5.3.1 Disconnect AC Power

WARNING

The transfer switch is a shock hazard that can cause severe personal injury or death unless all AC power is removed. Disconnect all sources of AC power to the transfer switch before servicing.

⚠ WARNING

If the cabinet must be opened for any reason, disconnect AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

⚠ WARNING

Accidental starting of the generator can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables before performing service. Remove the negative (-) cable(s) first to reduce the risk of arcing.

⚠ WARNING

Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Disconnect the starting battery cables before performing service. Remove the negative (-) cable(s) first to reduce the risk of arcing.

1. Remove all sources of power from the transfer switch in the following order:
 - a. Move the operation selector switch on the generator to Stop (Off). The selector switch is located on the generator set control panel.

⚠ CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- b. If there is an external battery charger, disconnect the battery charger from its AC power source.
- c. Disconnect the generator set starting battery negative (-) cable. Disconnect the negative (-) lead first.
- d. Remove all AC power to the automatic transfer switch.

5.3.2 Transfer Switch Assembly Removal

1. *RA 100A/200A transfer switch assembly removal only:*
 - a. Remove the applicable door panel(s):
 - *Non-service entrance models only:* Remove the transfer switch cabinet door panel.
 - *Service entrance models only:* Remove the outer and inner door panels.
 - b. Remove all control and power wiring from the switch terminals.
 - c. Loosen and remove the switch assembly:
 - Loosen and remove the four screws, nuts, and washers that secure the switch panel and switch to the rear wall of the cabinet.
 - Loosen the six 1/4-20 bolts securing the mechanical lugs.

- Loosen and remove the two screws, nuts, and washers securing the bracket at the load and emergency side (bottom) of the switch.
 - Loosen and remove all M6 nuts and lock washers securing the switch to the rear wall of the cabinet.
 - Remove the switch and bottom bracket from the cabinet.
- d. Mark the busbar of each phase of the Utility/Generator and Load. Then remove all of the busbars from the old switch.

⚠ CAUTION

Mounting the busbar in the wrong direction may increase the risk of a short to ground. Mount the busbar with the long end toward the breaker.

- e. Remove the switch from the mounting panel.
2. *RA 400A transfer switch assembly removal only:*
- a. Remove the applicable door panel(s):
- *Non-service entrance models only:* Remove the transfer switch cabinet door panel.
 - *Service entrance models only:* Remove the outer and inner door panels.
- b. Remove all control and power wiring from the switch terminals.
- c. Loosen and remove switch assembly hardware:
- *Non-service entrance models only:* Loosen and remove the two terminal rings, four M6 bolts, washers, and nuts that secure the mechanical lugs on the utility side (top) of the switch.
 - *Service entrance models only:*
 - Loosen and remove the two 3/8-16 bolts and washers that secure the busbars to the breaker.
 - Loosen and remove the two terminal rings, four M6 bolts, washers, and nuts that secure the busbars to the utility side (top) of the switch.
 - *All models:*
 - Loosen and remove the two terminal rings, four nuts, and eight M6 bolts and washers that secure the mechanical lugs on the load and emergency side (bottom) of the switch.
 - Loosen and remove the three M8 nuts and washers that secure the switch to the rear wall of the cabinet.
- d. Remove the switch from the cabinet.
- e. Mark the location and orientation of all hardware, lugs, and any busbars that were removed.

⚠ CAUTION

Mounting the busbar in the wrong direction may increase the risk of a short to ground.

5.3.3 Transfer Switch Replacement

⚠ CAUTION

Carefully follow all hardware torque requirements to avoid damage to parts.

1. *RA 100A/200A transfer switch replacement only:*
 - a. Install the busbars on the new switch in accordance with the markings. Make sure that the long end of the busbar is connected to the breaker.
 - b. Use the hardware that was previously removed to install the new switch in the cabinet. Torque the M6 nuts to 50 in-lbs (5.6 Nm) and torque the 1/2-20 screws to 80 in-lbs (9 Nm).
 - c. Use the hardware that was previously removed to install the bracket at the load and emergency side of the switch. Torque the M6 nuts to 50 in lbs (5.6 Nm).
 - d. Tighten the 1/4-20 bolts securing the mechanical lugs. Torque the bolts to 80 in-lbs (9 Nm).
 - e. Reinstall the cabinet door panel(s).
2. *RA 400A transfer switch replacement only:*
 - a. Use the hardware that was previously removed to install the new switch in the cabinet. Torque the three M8 bolts to 168 in-lbs (19 Nm).
 - b. *Service entrance models only:* Install the busbars on the new switch in accordance with the markings:
 - i. Make sure to secure the busbars and two terminal rings in the proper location and orientation. Torque four M6 bolts to 124 in-lbs (14 Nm).
 - ii. Secure the busbars to the breaker. Torque two 3/8-16 bolts to 159 in-lbs (18 Nm).
 - c. *Non-service entrance models only:* Install mechanical lugs and two terminal rings on the new switch in accordance with the markings. Torque four M6 bolts to 124 in-lbs (14 Nm).
 - d. Install two lugs to the emergency side of the switch. Torque four M6 bolts to 124 in-lbs (14 Nm).
 - e. Install two lugs to the load side of the switch. Torque four M6 bolts to 124 in-lbs (14 Nm).
 - f. Reinstall the cabinet door panel(s). Take care to properly align the bolts to avoid cross-threading:
 - i. *Service entrance models only:* Torque six M6 bolts to 48.7 in-lbs (5.5 Nm).
 - ii. *Non-service entrance models only:* Torque eight M6 bolts to 79.7 in-lbs (9.0 Nm).

5.3.4 Reconnect AC Power (When Finished)

1. Connect the generator set starting battery (negative (-) battery cable last).

⚠ WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

2. If there is an external battery charger, connect the battery charger to its AC power source.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

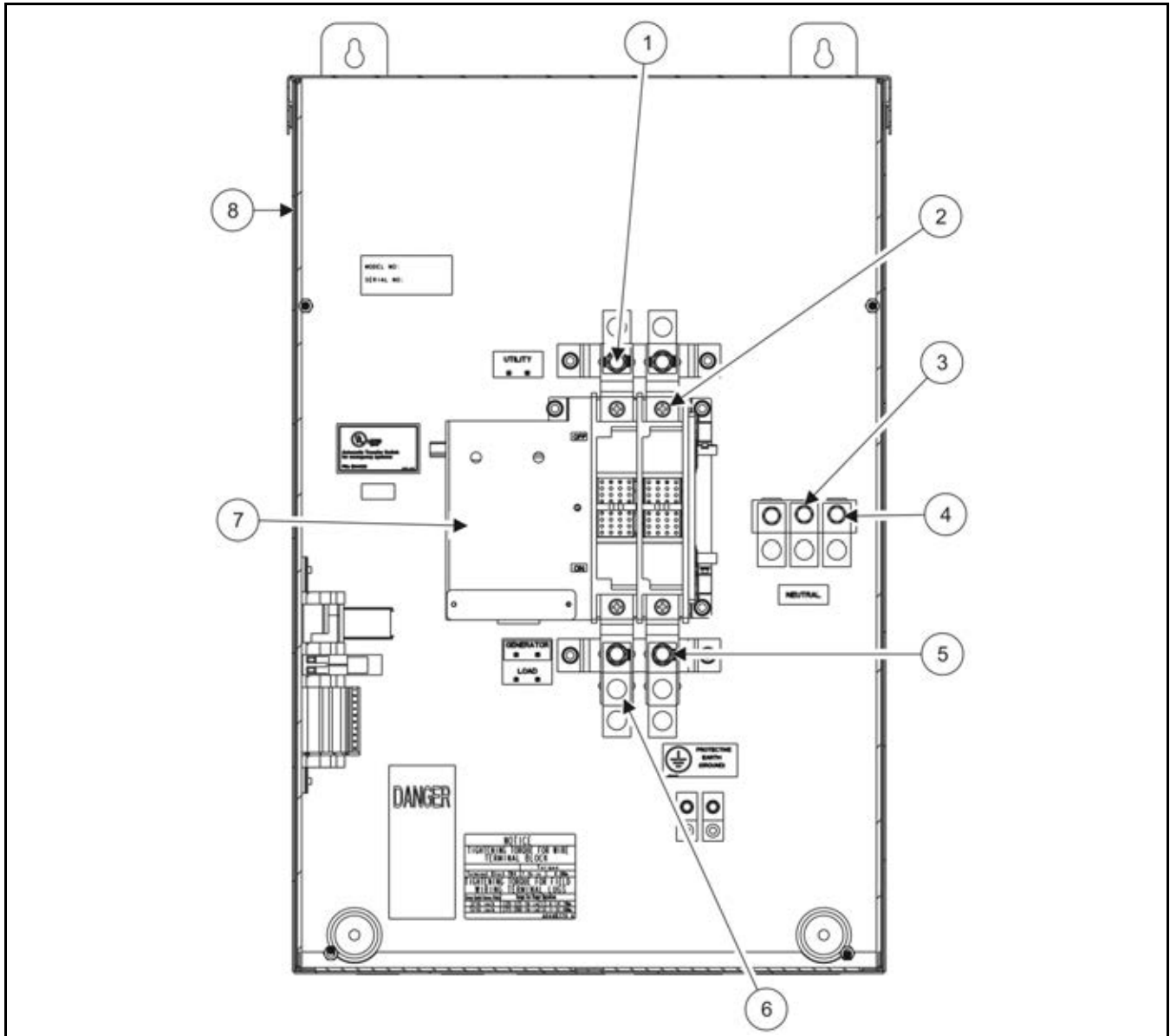
⚠ WARNING

Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before connecting battery cables. Connect the negative (-) cable (s) first to reduce the risk of arcing.

3. Reconnect utility power (Normal) and generator set power (Emergency).
4. Set the operation selector switch on the generator set to in the Remote (or Auto) position.

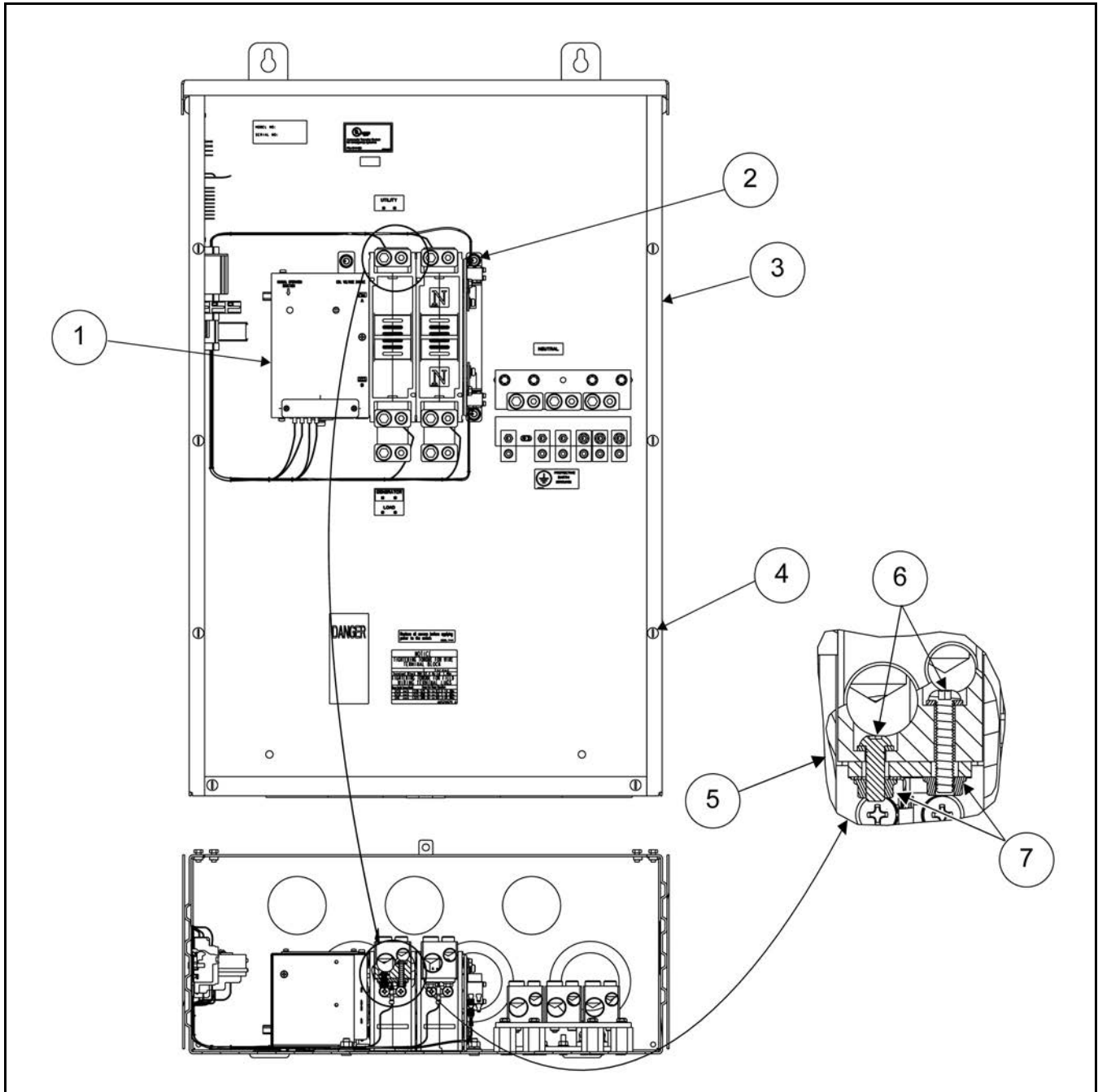
⚠ WARNING

AC power in the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.



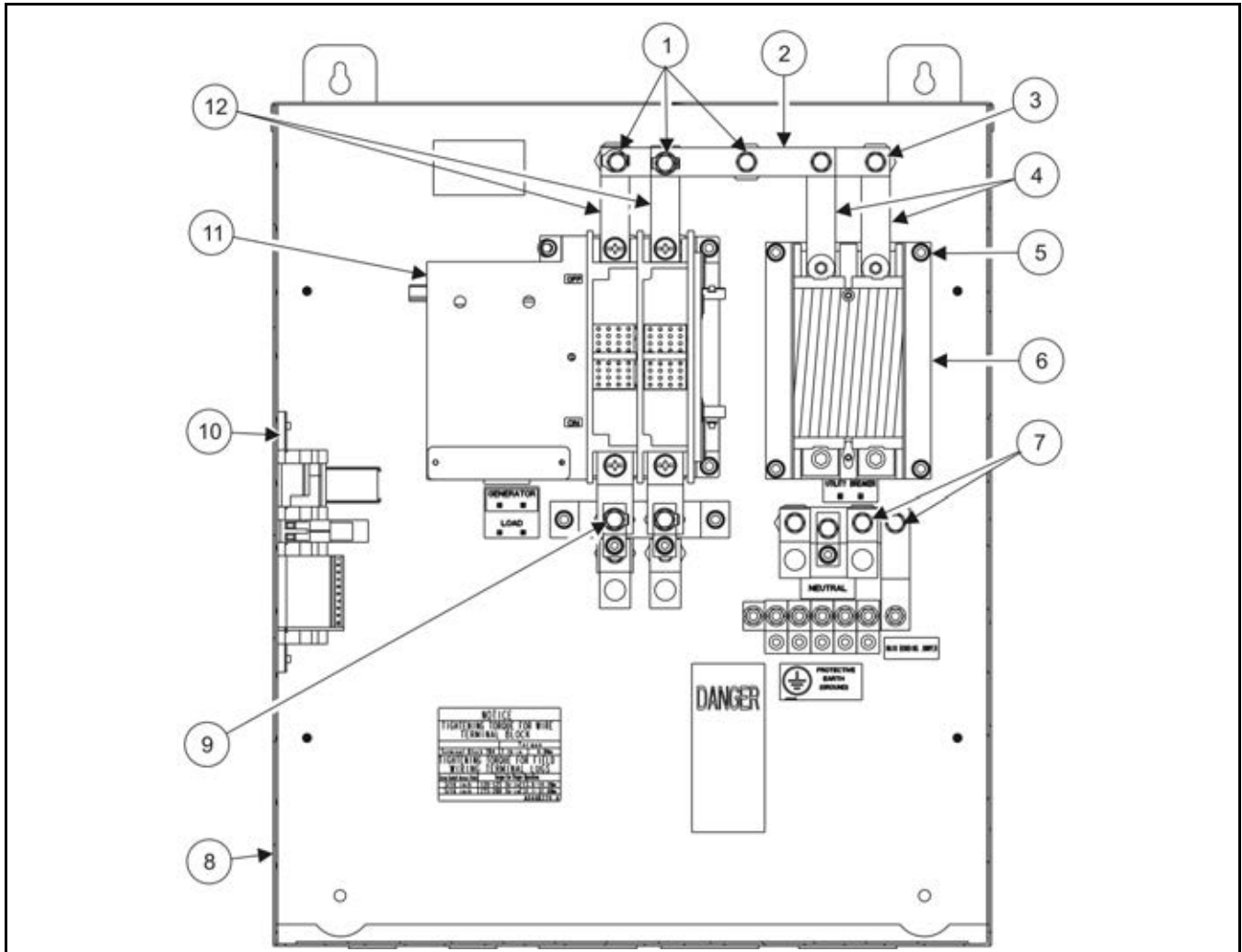
No.	Description	No.	Description
1	Hex Head Screw	5	Ring Terminal
2	Ring Terminal	6	Hex Head Screw
3	Hex Head Screw	7	Switch Mechanism
4	Hex Head Screw	8	Cabinet

FIGURE 21. INTERIOR COMPONENTS FOR RA 100A/200A NON-SERVICE ENTRANCE MODELS



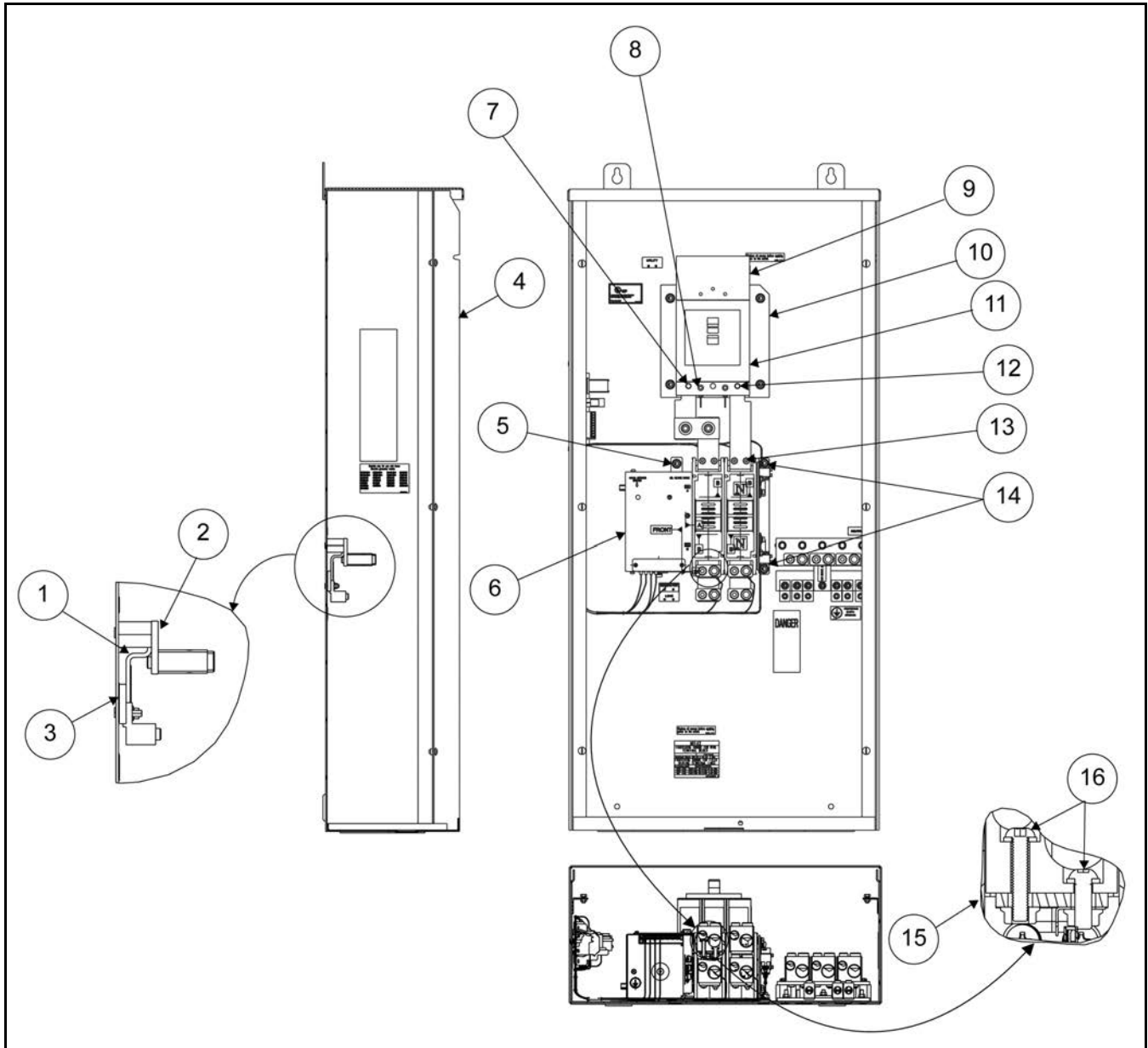
No.	Description	No.	Description
1	Switch Mechanism	5	Ring Terminal Detail (Shown from Bottom View)
2	M8 Bolts and Washers	6	M6 Screws and Lock Washers
3	Cabinet	7	M6 Nuts
4	M6 Bolts		

FIGURE 22. INTERIOR COMPONENTS FOR RA 400A NON-SERVICE ENTRANCE MODELS



No.	Description	No.	Description
1	Hex Head Screws	7	Hex Head Screws
2	Busbar	8	Cabinet
3	Hex Head Screw	9	Ring Terminal
4	Busbars	10	Hex Nut
5	Hex Nut	11	Switch Mechanism
6	Circuit Breaker	12	Busbars

FIGURE 23. INTERIOR COMPONENTS FOR RA 100A/200A SERVICE ENTRANCE MODELS



No.	Description	No.	Description
1	Busbar, Bonding Jumper	9	Plastic Barrier
2	Busbar, Neutral	10	Breaker Mounting Bracket
3	Busbar, Ground	11	Circuit Breaker
4	Cabinet	12	3/8-16 Hardware
5	M8 Bolts	13	M6 Hardware
6	Switch Mechanism	14	M8 Bolts
7	3/8-16 Hardware	15	Ring Terminal Detail (Shown from Bottom View)
8	#10-32 Hardware	16	M6 Hardware

FIGURE 24. INTERIOR COMPONENTS FOR RA 400A SERVICE ENTRANCE MODELS

5.4 Limit Switch Replacement Procedure

WARNING

The transfer switch presents a shock hazard that can cause severe personal injury or death. Before beginning installation, remove all sources of AC power. If a generator provides emergency power, move the generator operation selector switch to Stop, disconnect AC line power, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [-] lead first).

1. Remove all sources of power from the transfer switch in the following order.
 - a. Move the operation selector switch on the generator to Stop (Off).

CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- b. If there is an external battery charger, disconnect the battery charger from its AC power source.

WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

WARNING

Accidental starting of the generator can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables, before performing service. Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Remove the negative (-) cable (s) first to reduce the risk of arcing.

- c. Disconnect the generator starting battery (negative [-] lead first).

WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

- d. Remove AC power to the automatic transfer switch.
2. Remove the transfer switch cabinet door panel.
3. Mark and disconnect all wires connected to the limit switches; see [Figure 26](#).
4. Remove the faulty limit switch.
5. Install the new limit switches. Use the manual operation handle; see [Figure 28](#) to rotate the shaft so that the limit switches are installed as shown in [Figure 26](#).

6. Restore power.
 - a. Reconnect the generator starting battery (negative [-] lead first).
 - b. If there is an external battery charger, reconnect the battery charger to its AC power source.
 - c. Restore AC power to the automatic transfer switch.
 - d. Move the operation selector switch on the generator to the Remote (or Auto) position.

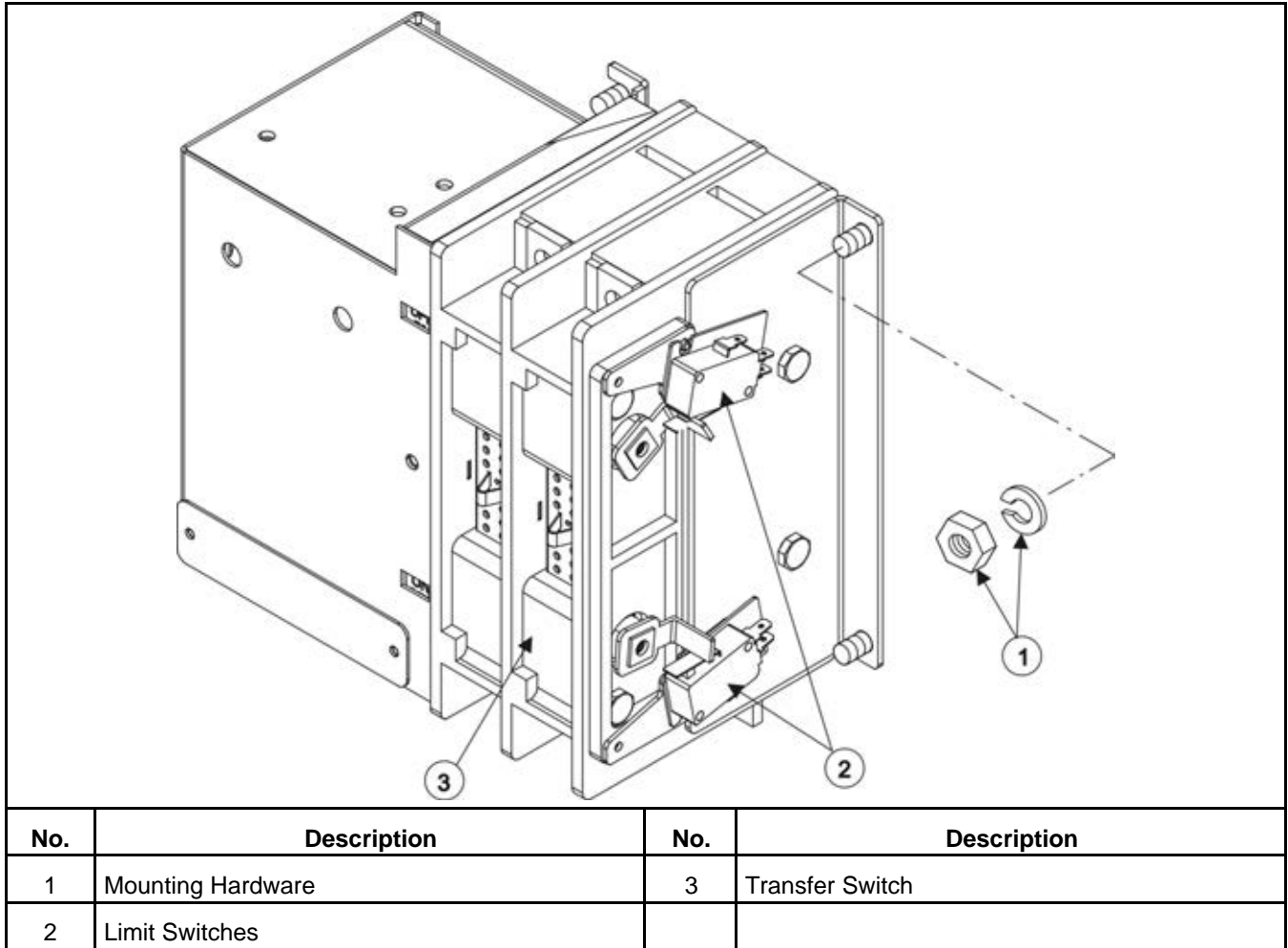
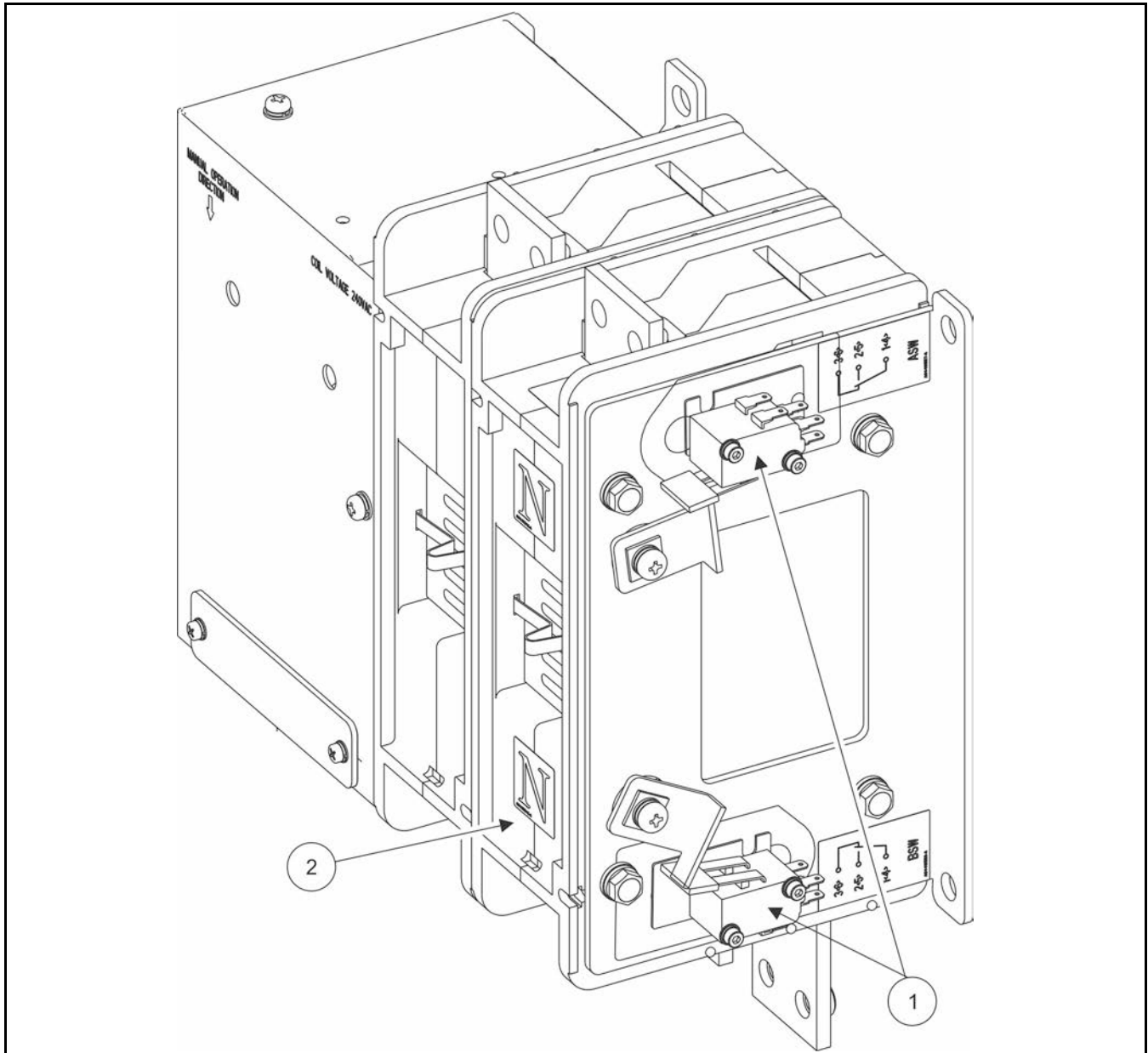
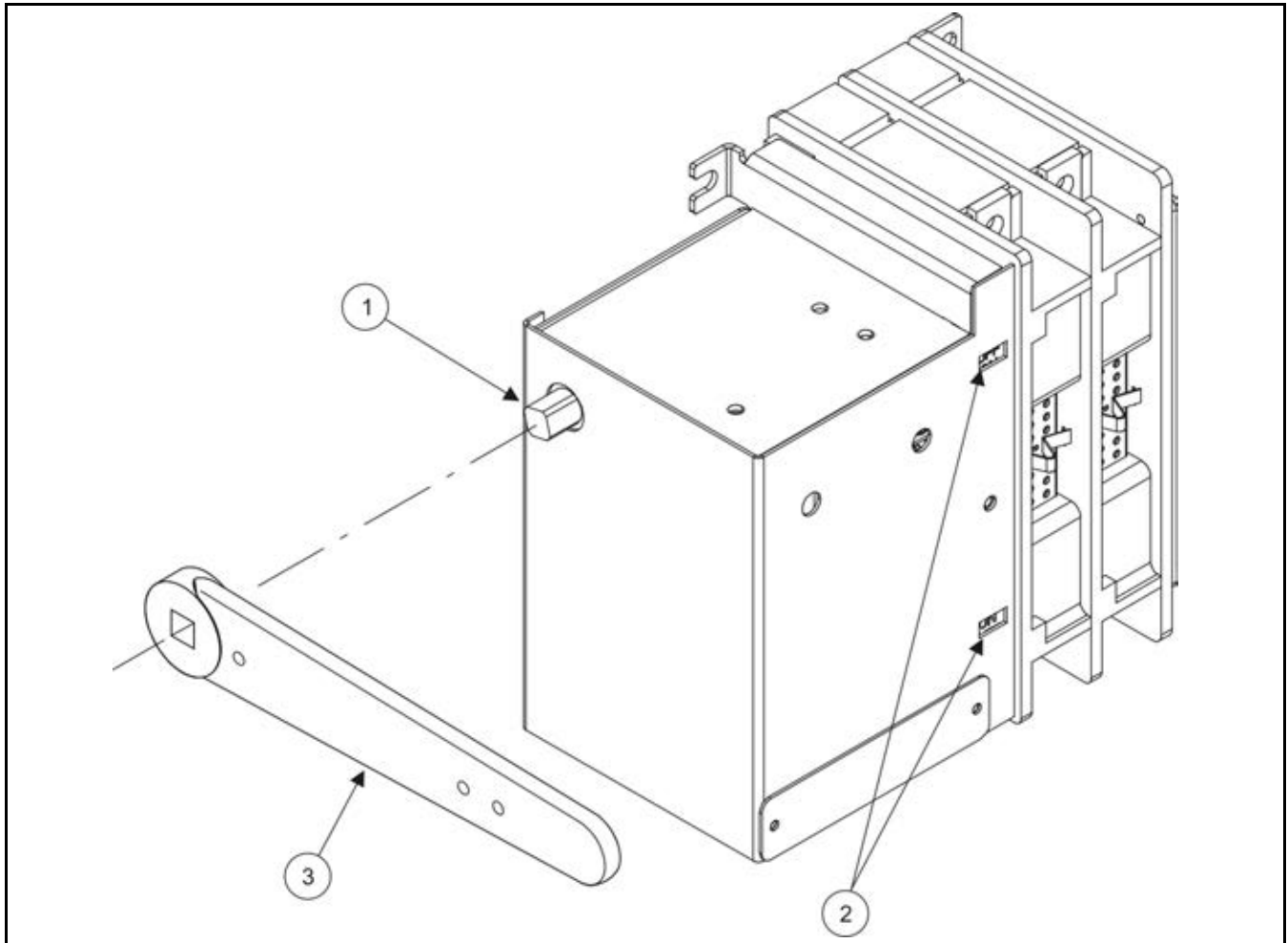


FIGURE 25. RA 100A/200A TRANSFER SWITCH REMOVAL



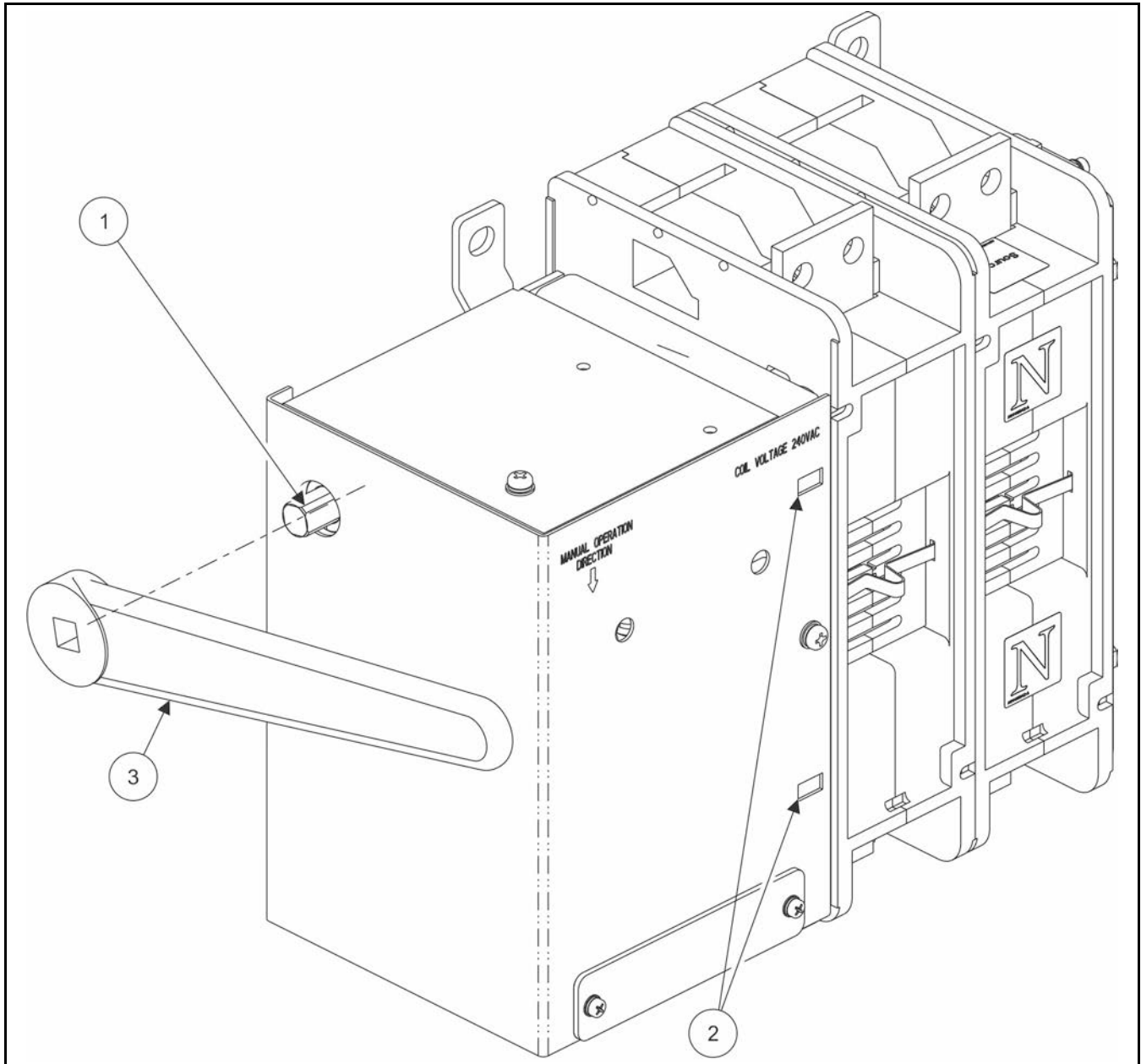
No.	Description	No.	Description
1	Limit Switches	2	Transfer Switch

FIGURE 26. RA 400A TRANSFER SWITCH REMOVAL



No.	Description	No.	Description
1	Transmission Shaft	3	Transfer Switch Manual Operation Handle
2	Switch Position Indicators Red ON or Green OFF		

FIGURE 27. RA 100A/200A MANUAL OPERATION HANDLE



No.	Description	No.	Description
1	Transmission Shaft	3	Transfer Switch Manual Operation Handle
2	Switch Position Indicators Red ON or Green OFF		

FIGURE 28. RA 400A MANUAL OPERATION HANDLE

5.5 Control Relay (K1) Replacement Procedure

WARNING

The transfer switch presents a shock hazard that can cause severe personal injury or death. Before beginning installation, remove all sources of AC power. If a generator provides emergency power, move the generator operation selector switch to Stop, disconnect AC line power, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [-] lead first).

1. Remove all sources of power from the transfer switch in the following order.
 - a. Move the operation selector switch on the generator to Stop (Off).

CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- b. If there is an external battery charger, disconnect the battery charger from its AC power source.

WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

WARNING

Accidental starting of the generator can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables, before performing service. Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Remove the negative (-) cable (s) first to reduce the risk of arcing.

- c. Disconnect the generator starting battery (negative [-] lead first).

WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

- d. Remove AC power to the automatic transfer switch.
2. Remove the transfer switch cabinet door panel.
3. Spread the relay clips apart and remove the relay(s) from the relay base(s).
4. Install the new relay(s) on the relay base(s), making sure the screw head on the bottom of the relay matches up with the hole in the relay base.
5. Make sure the relay clips are securing the relay(s) to the base(s).
6. Restore power.

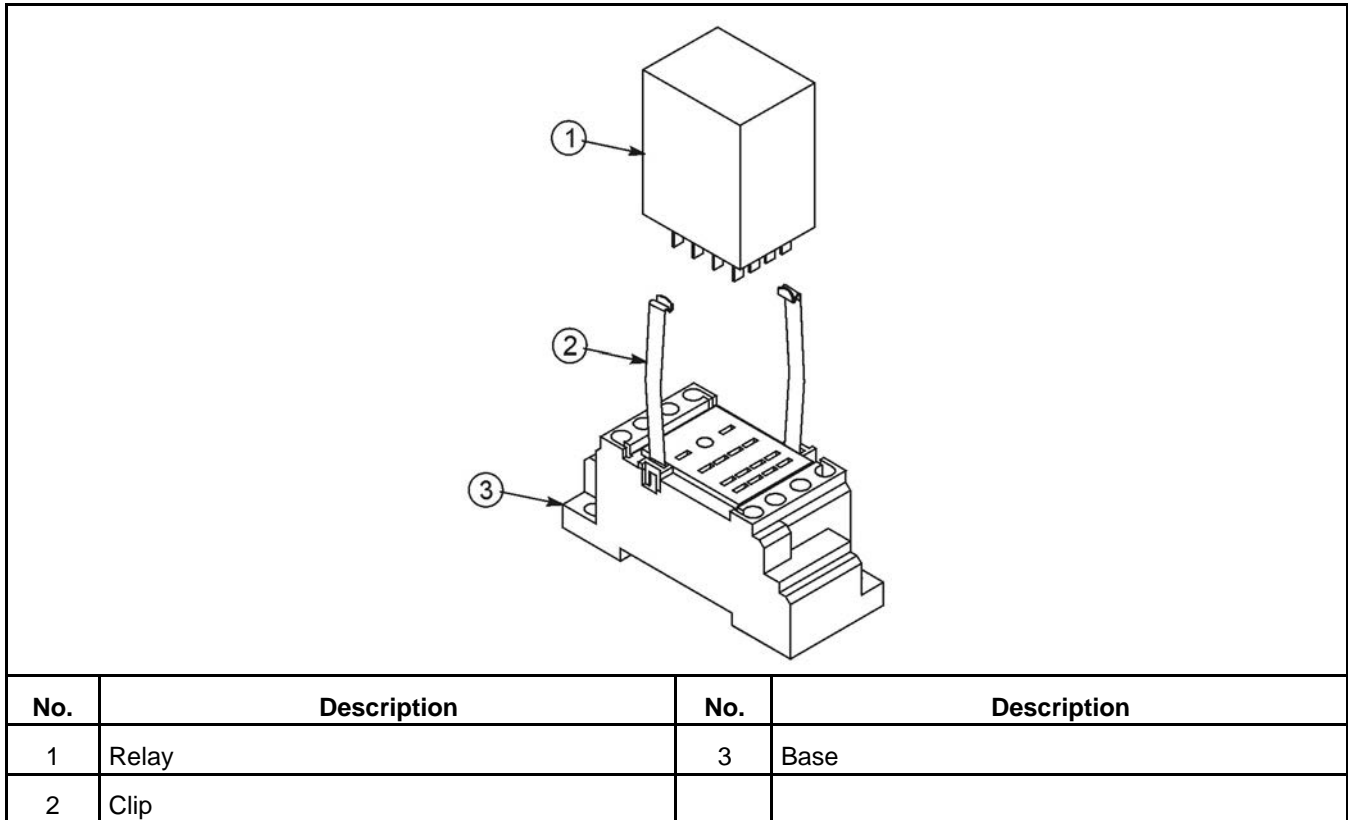


FIGURE 29. CONTROL RELAY INSTALLATION

5.6 Circuit Breaker Replacement Procedures

These procedures are only for RA Series service entrance transfer switches.

⚠ WARNING

The transfer switch presents a shock hazard that can cause severe personal injury or death. Before beginning installation, remove all sources of AC power. If a generator provides emergency power, move the generator operation selector switch to Stop, disconnect AC line power, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [-] lead first).

1. RA 100A/200A transfer switch models only:
 - a. Remove all sources of power from the transfer switch in the following order.
 - i. Move the operation selector switch on the generator set to Stop (Off).

⚠ CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- ii. If there is an external battery charger, disconnect the battery charger from its AC power source.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

⚠ WARNING

Accidental starting of the generator set can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables, before performing service. Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Remove the negative (-) cable (s) first to reduce the risk of arcing.

- iii. Disconnect the generator set starting battery (negative [-] lead first).

⚠ WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

- iv. Remove AC power to the automatic transfer switch.
- b. Remove the transfer switch cabinet door panel.
- c. Remove the hardware securing the busbars to the circuit breaker.
- d. Remove the two #8-32 screws securing the circuit breaker to the circuit breaker bracket.
- e. Remove the circuit breaker.
- f. Use the two #8-32 screws removed in step 4 to install the new circuit breaker.
- g. Use the hardware removed in step 3 to reinstall the busbars. Tighten the bolts to 80 in-lb (9 Nm).
- h. Restore power.
 - i. Reconnect the generator set starting battery (negative [-] lead first).
 - ii. If there is an external battery charger, reconnect the battery charger to its AC power source.
 - iii. Restore AC power to the automatic transfer switch.
 - iv. Move the operation selector switch on the generator set to the Remote (or Auto) position.

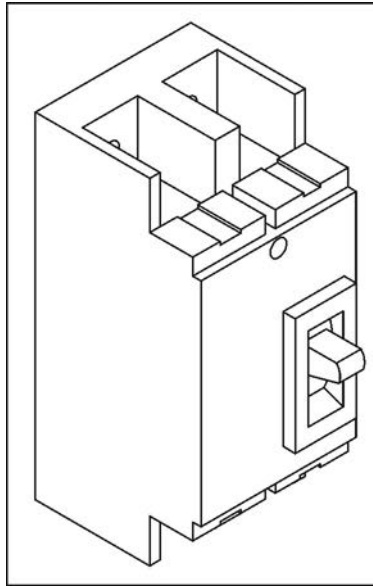


FIGURE 30. RA 100A/200A CIRCUIT BREAKER

2. RA 400A service entrance transfer switch models only:
- a. Remove all sources of power from the transfer switch in the following order.
 - i. Move the operation selector switch on the generator set to Stop (Off).

⚠ CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- ii. If there is an external battery charger, disconnect the battery charger from its AC power source.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

⚠ WARNING

Accidental starting of the generator set can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables, before performing service. Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Remove the negative (-) cable (s) first to reduce the risk of arcing.

- iii. Disconnect the generator set starting battery (negative [-] lead first).

⚠ WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

- iv. Remove AC power to the automatic transfer switch.
 - b. Remove the transfer switch cabinet door panel.
 - c. Remove the following:
 - i. The plastic barrier covering access to the mechanical lugs
 - ii. The two M10X1.25 bolts and washers securing the mechanical lugs to the circuit breaker
 - iii. The two 3/8-16 bolts and washers securing the busbars to the breaker
 - iv. The four #10-32 bolts, washers, and nuts securing the breaker to the breaker mounting bracket
 - v. The circuit breaker
 - d. Use the hardware removed in the previous step to install the replacement circuit breaker.
 - i. Secure the circuit breaker to the circuit breaker mounting bracket with the four #10-32 bolts. Torque to 17 in-lb (2 Nm).
 - ii. Secure the busbars to the breaker with the two 3/8-16 bolts. Torque to 159 in-lb (18 Nm).
 - iii. Secure the mechanical lugs to the circuit breaker with two M10X1.25 bolts. Torque to 150 in-lb (17 Nm).
 - iv. Secure the plastic barrier to the circuit breaker.
 - v. Secure the inner and outer door panels to the cabinet before restoring power. Torque six M6 bolts to 48.7 in-lb (5.5 Nm). Be sure to properly align the bolts to avoid cross-threading.
 - e. Restore power.
 - i. Reconnect the generator set starting battery (negative [-] lead first).
 - ii. If there is an external battery charger, reconnect the battery charger to its AC power source.
 - iii. Restore AC power to the automatic transfer switch.
 - iv. Move the operation selector switch on the generator set to the Remote (or Auto) position.

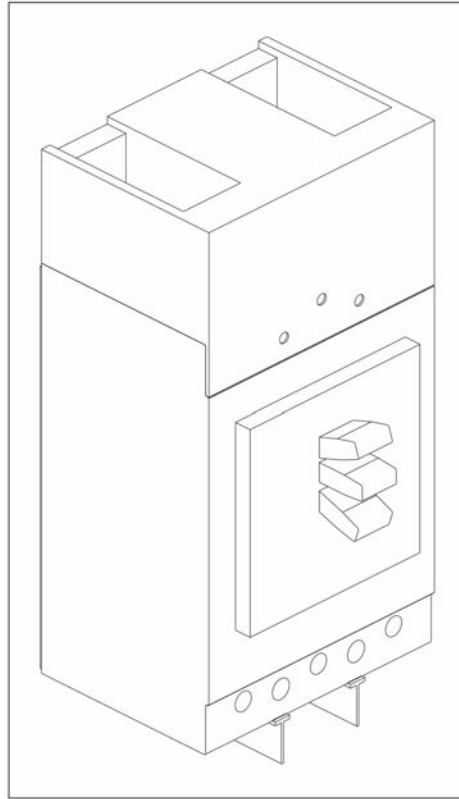


FIGURE 31. RA 400A CIRCUIT BREAKER

5.7 Utility Sense Relay (K2) Replacement Procedure

⚠ WARNING

The transfer switch presents a shock hazard that can cause severe personal injury or death. Before beginning installation, remove all sources of AC power. If a generator set provides emergency power, move the generator set operation selector switch to Stop, disconnect AC line power, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [-] lead first).

1. Remove all sources of power from the transfer switch in the following order.
 - a. Move the operation selector switch on the generator to Stop (Off).

⚠ CAUTION

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits.

- b. If there is an external battery charger, disconnect the battery charger from its AC power source.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.

⚠ WARNING

Accidental starting of the generator set can cause severe personal injury or death due to electrocution or contact with moving parts. Disconnect the starting battery cables, before performing service. Batteries emit hydrogen, a highly explosive gas. Thoroughly ventilate the battery compartment before removing battery cables. Remove the negative (-) cable (s) first to reduce the risk of arcing.

- c. Disconnect the generator starting battery (negative [-] lead first).

⚠ WARNING

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

- d. Remove AC power to the automatic transfer switch.
2. Remove the transfer switch cabinet door panel.
 3. Grasp the relay and pull it straight out of the socket (see [Figure 20](#)).
 4. Place the new relay on the socket while aligning pins to socket holes.
 5. Firmly push the relay straight down onto the socket until you feel the relay is seated securely.
 6. Restore power.
 - a. Reconnect the generator starting battery (negative [-] lead first).
 - b. If there is an external battery charger, reconnect the battery charger to its AC power source.
 - c. Restore AC power to the automatic transfer switch.
 - d. Move the operation selector switch on the generator to the Remote (or Auto) position.

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Appendix A. Parts Information

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- Figure 34. RA Series 100A/200A Service Entrance Transfer Switch Model 66
- Figure 35. RA Series 400A Service Entrance Transfer Switch Model 67
- Figure 36. RA Series 100A/200A Non-Service Entrance Models 68
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This section includes information on replaceable parts used with RA transfer switches for both service entrance and non-service entrance models.

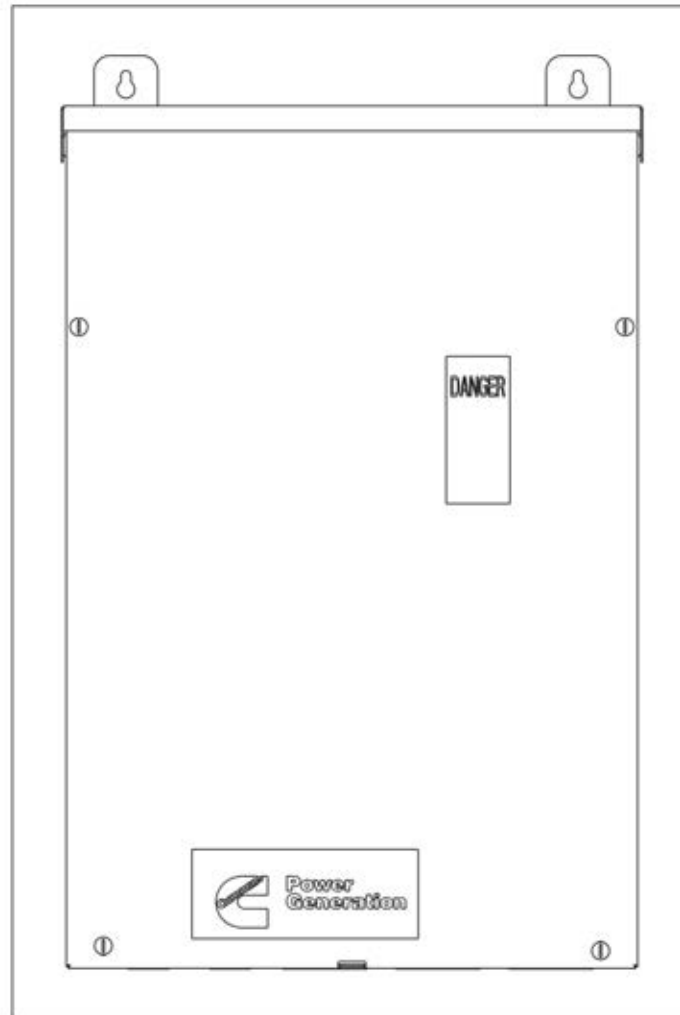


FIGURE 32. RA SERIES 100A/200A NON-SERVICE ENTRANCE TRANSFER SWITCH MODEL

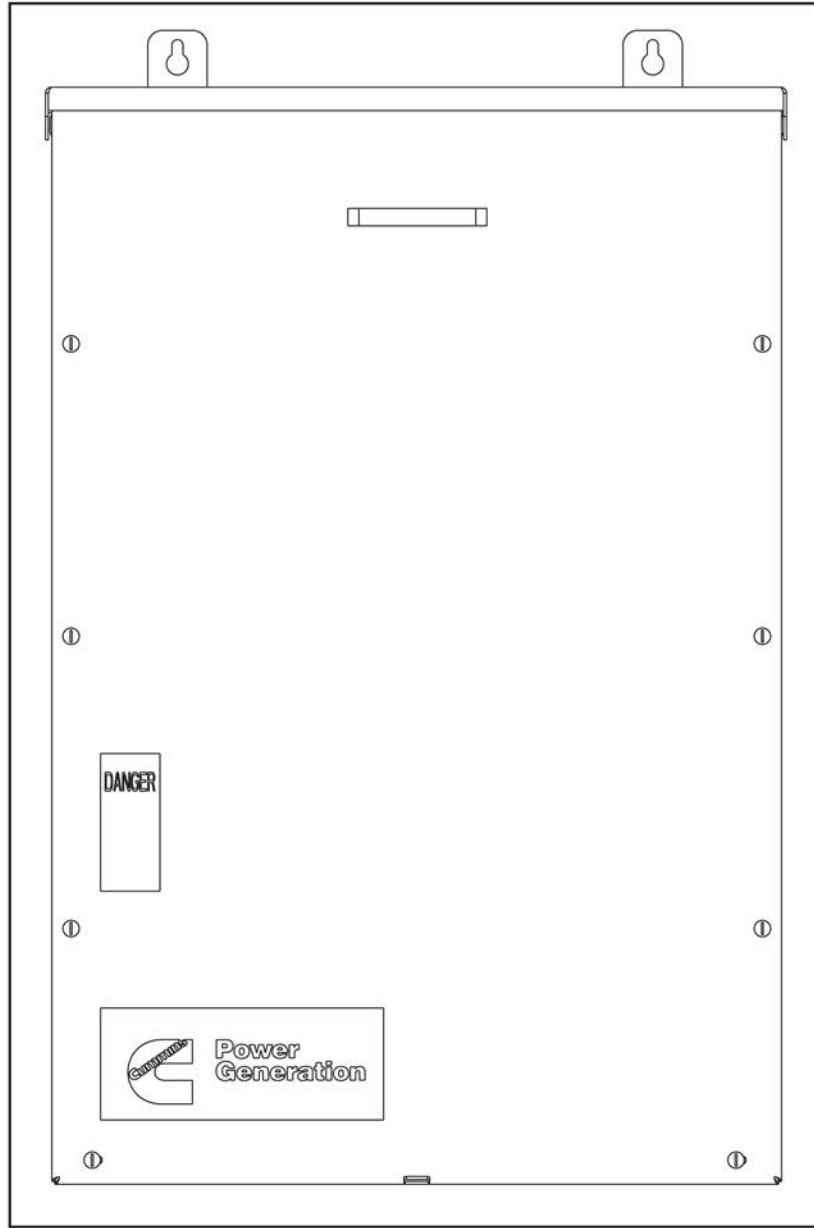


FIGURE 33. RA SERIES 400A NON-SERVICE ENTRANCE TRANSFER SWITCH MODEL

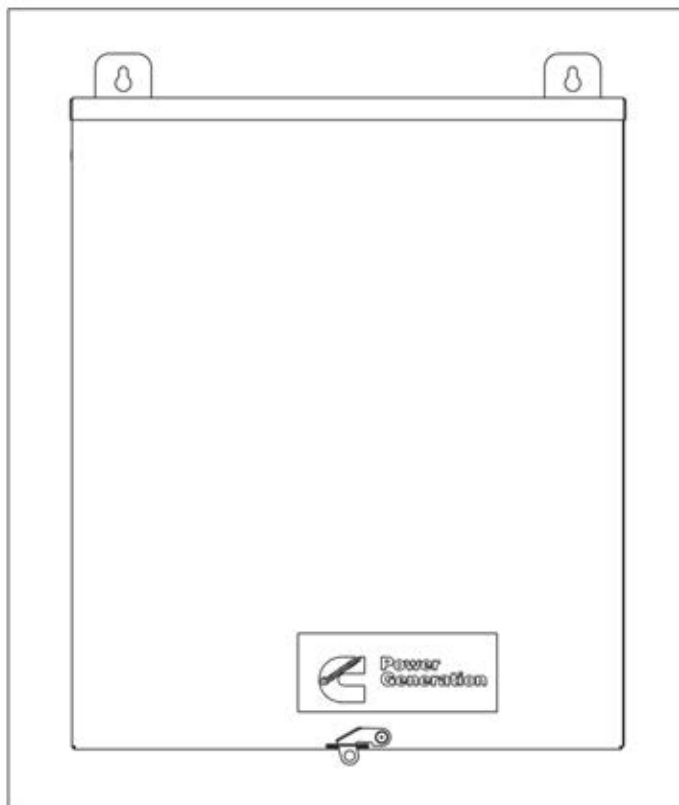


FIGURE 34. RA SERIES 100A/200A SERVICE ENTRANCE TRANSFER SWITCH MODEL

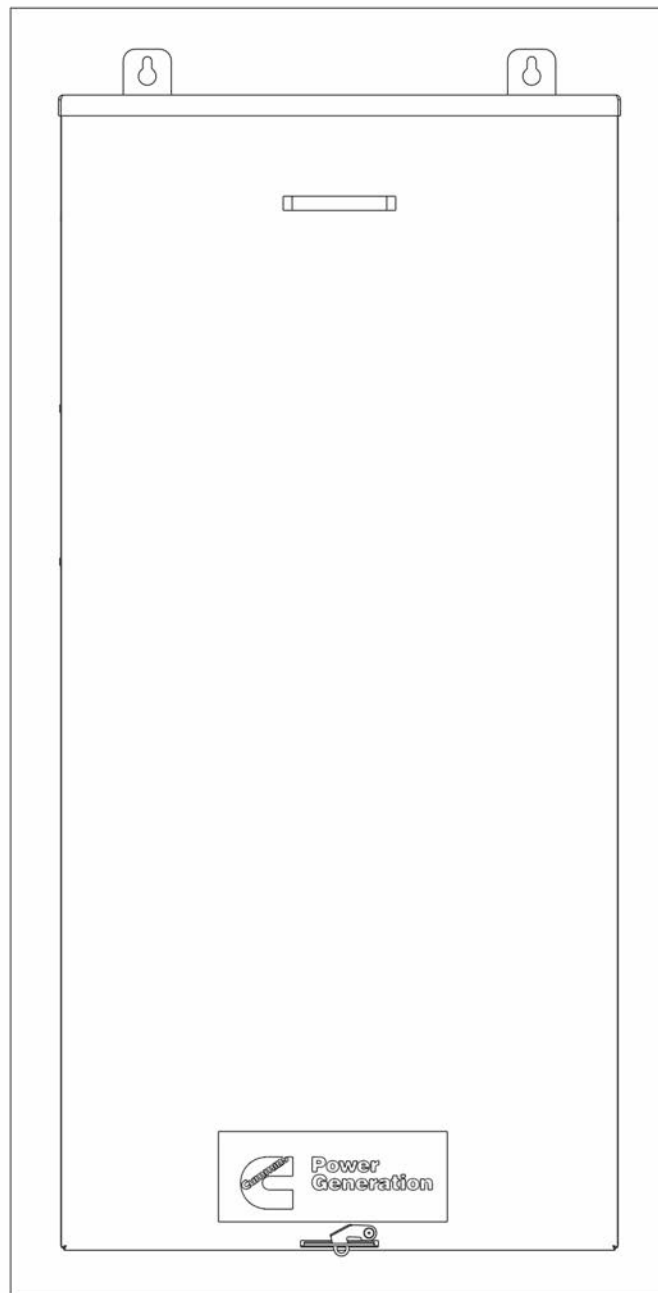


FIGURE 35. RA SERIES 400A SERVICE ENTRANCE TRANSFER SWITCH MODEL

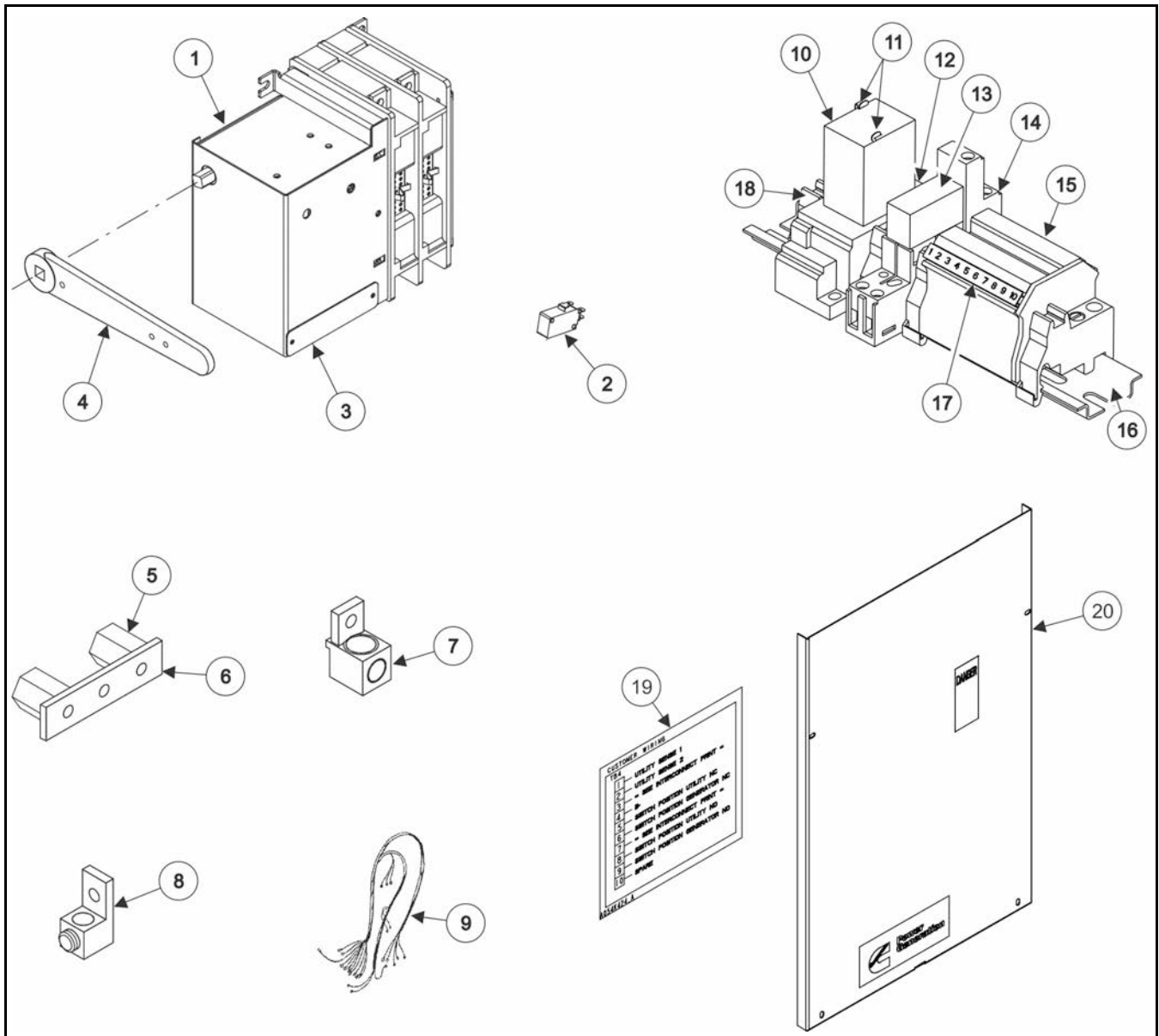


FIGURE 36. RA SERIES 100A/200A NON-SERVICE ENTRANCE MODELS

TABLE 11. RA SERIES 100A/200A NON-SERVICE ENTRANCE MODELS

Ref No.	Part No.	Qty.	Part Description
1	-	-	Transfer Switch Mechanism (Includes Items 2 and 3)
	306-5191	1	100A
	306-5192	1	200A
2	308-1235	2	Limit Switch
3	319-6882	1	Terminal Cover, Switch Mechanism

Ref No.	Part No.	Qty.	Part Description
4	306-5297	1	Handle, Manual Operation
5	332-2370	2	Standoff, Insulated
6	-		Neutral Bus Bar
	337-3927	1	100A
	337-3982	1	200A
7	-		Lug, Mechanical (Neutral and Mechanical)
	332-3084	9	100A
	332-3038	9	200A
8	332-3647	2	Lug, Ground
9	A044N259	1	Harness
10	-	-	Relay Assembly, Control (Includes Items #11-18)
11	0307-3077	2	Bracket, Relay Clip
12	0307-3147	1	Base, Relay
13	A044K057	1	Relay
14	A044K055	1	Socket, Relay
15	0332-4396	1	Rail, Terminal Block
16	0332-2879-03	2	Rail, Terminal
17	0098-8900-01	1	Label, Terminal Block
18	0332-4145	4	Terminal Block
19	A054K424	1	Label, Customer Connection
20	-	-	Door Panel
	A044H305	1	100A
	A044H307	1	200A

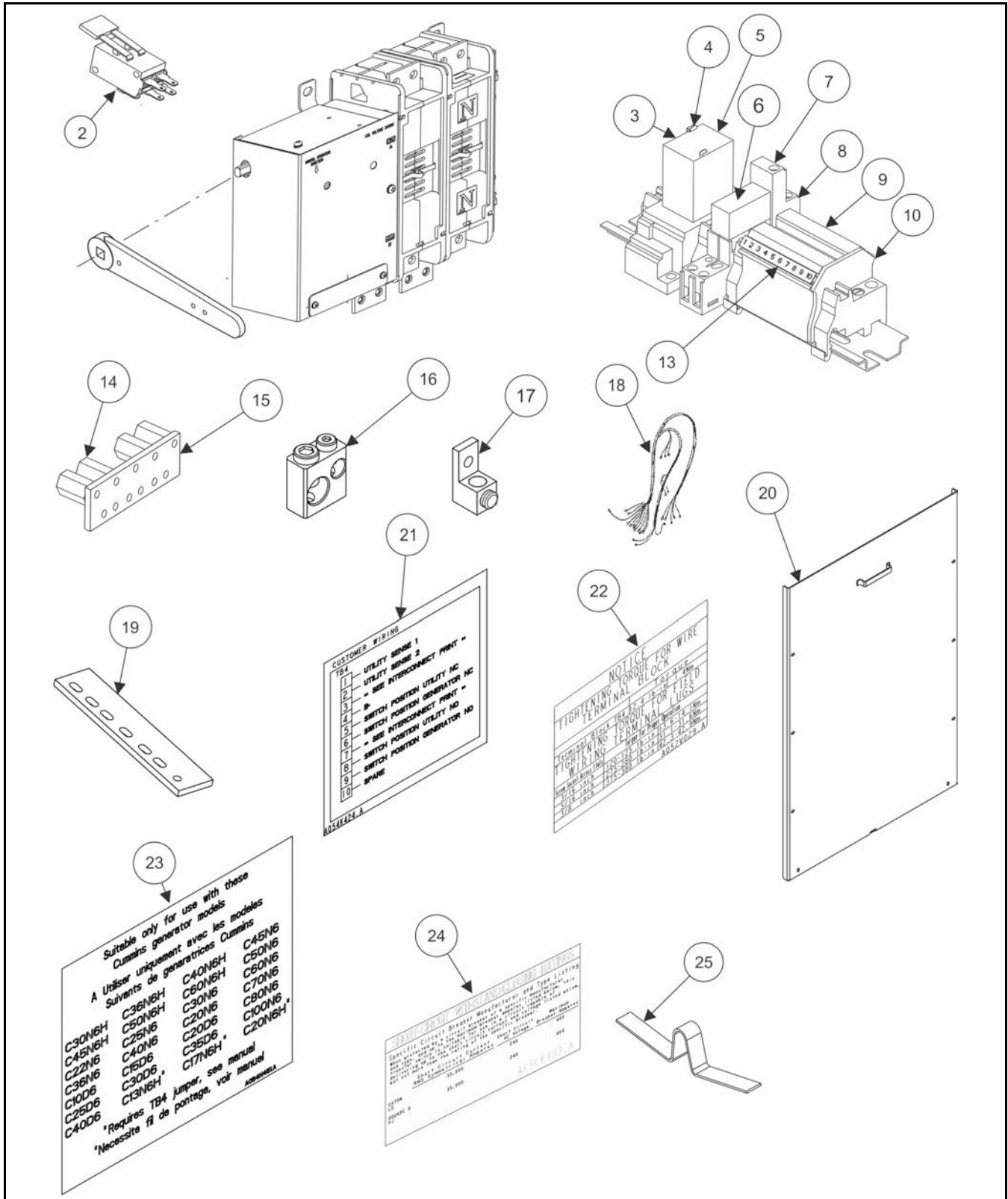


FIGURE 37. RA SERIES 400A NON-SERVICE ENTRANCE MODELS

TABLE 13. RA SERIES 400A NON-SERVICE ENTRANCE MODELS

No.	Part No.	Qty.	Part Description
1	A044P761	1	Cassette, Switch
2	A045Z512	2	Limit Switch
3	A044K059	1	Relay Assembly, Control (Includes Items #4-13)
4	0307-3077	2	Bracket, Relay Clip
5	0307-3146	1	Relay, Control
6	0307-3147	1	Base, Relay
7	A044K057	1	Relay
8	A044K055	1	Socket, Relay
9	0332-4373-01	1	Rail, Terminal Block
10	0332-4396	1	Rail, Terminal Block End Cap
11	0332-2879-03	1	Rail, Terminal
12	0332-4145	1	Terminal Block
13	0098-8900-01	1	Label, Terminal Block
14	0332-2370	4	Standoff, Insulated
15	A049G445	1	Load Busbar
16	A042W626	7	Lug, Mechanical (Neutral and Mechanism)
17	0332-3492-01	3	Lug, Ground
18	A049K240	1	Harness
19	A049E035	1	Busbar
20	A050H794	1	Door
21	A054K424	1	Label, Information
22	A049Z511	1	Label, Customer Connection
23	A054N451	1	Label, Information
24	A050K433	1	Label, Information
25	A052U748	1	Clamp, Vee Band

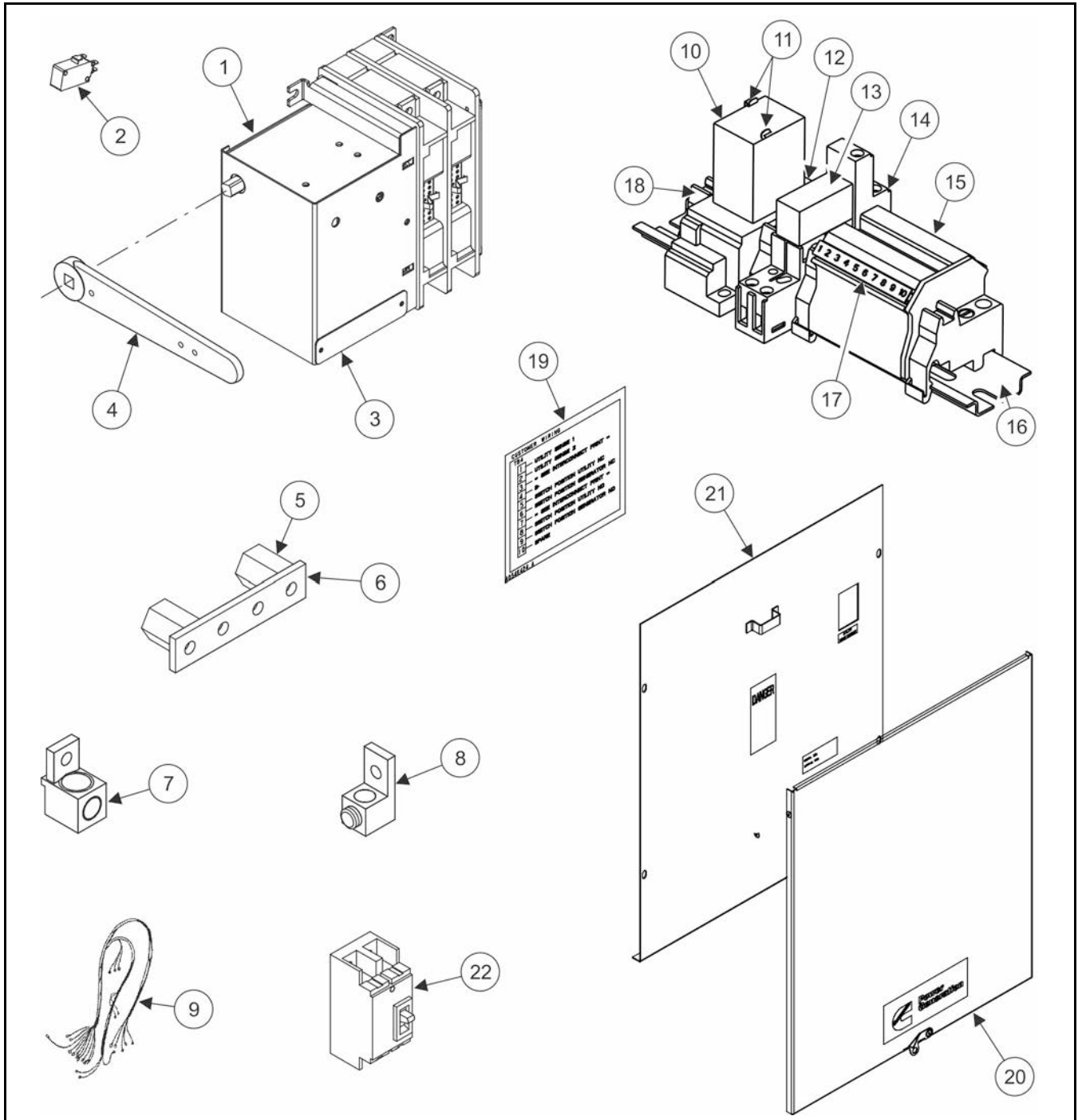


FIGURE 38. RA SERIES 100A/200A SERVICE ENTRANCE MODELS

TABLE 15. RA SERIES 100A/200A SERVICE ENTRANCE MODELS

Ref No.	Part No.	Qty.	Part Description
1	-	-	Transfer Switch Mechanism (Includes Items 2 and 3)
	306-5191	1	100A
	306-5192	1	200A
2	308-1235	2	Limit Switch
3	319-6882	1	Terminal Cover, Switch Mechanism
4	306-5297	1	Handle, Manual Operation
5	332-2370	2	Standoff, Insulated
6	-	-	Neutral Bus Bar
	337-3942	1	100A
	337-3984	1	200A
7	-	-	Lug, Mechanical (Neutral and Mechanical)
	332-3084	7	100A
	332-3038	4	200A
8	332-3647	5	Lug, Ground
9	A044N259	1	Harness
10	-	-	Relay Assembly, Control (Includes Items #11-16)
11	0307-307	2	Bracket, Relay Clip
12	0307-314	1	Base, Relay
13	A044K057	1	Relay
14	A044K055	1	Socket, Relay
15	0332-4396	1	Rail, Terminal Block
16	0332-2879-03	2	Rail, Terminal
17	0098-8900-01	1	Label, Terminal Block
18	0332-4145	4	Terminal Block
19	A054K424	1	Label, Customer Connection
20	A044H297	1	Door Panel, Outer
21	A044K311	1	Door Panel, Inner
22	-	-	Circuit Breaker
	320-2473-01	1	100A
	320-2473-02	1	200A

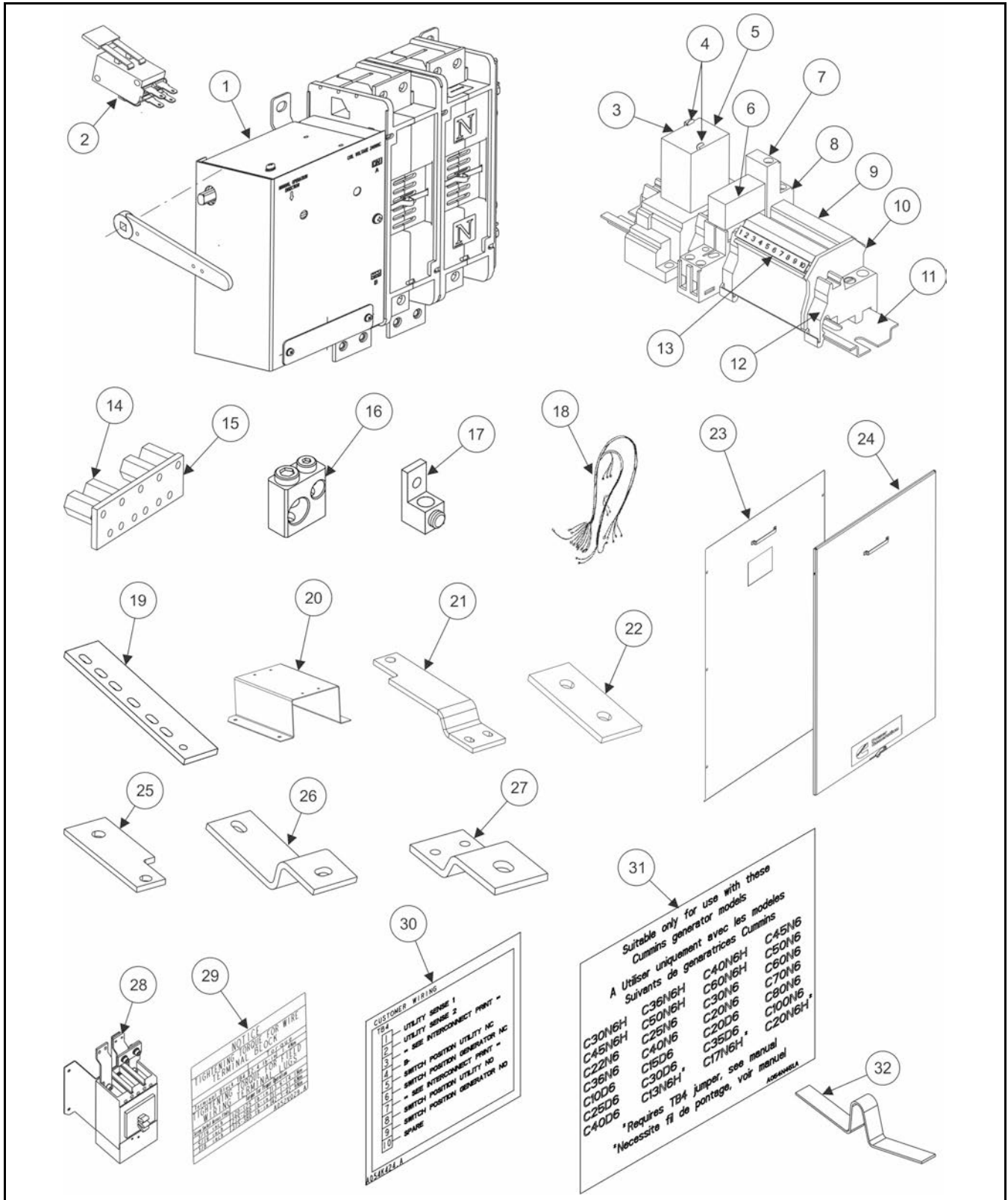


FIGURE 39. RA SERIES 400A SERVICE ENTRANCE MODELS

TABLE 17. RA SERIES 400A SERVICE ENTRANCE MODELS

Ref No.	Part No.	Qty.	Part Description
1	A044P761	1	Cassette, Switch
2	A045Z512	2	Limit Switch
3	A044K059	1	Relay Assembly, Control (Includes Items #4-13)
4	0307-3077	2	Bracket, Relay Clip
5	0307-3146	1	Relay-Control
6	0307-3147	1	Base, Relay
7	A044K057	1	Relay
8	A044K055	1	Socket, Relay
9	0332-4373-01	1	Rail, Terminal Block
10	0332-4396	1	Rail, Terminal Block End Cap
11	0332-2879-03	1	Rail, Terminal
12	0332-4145	1	Terminal Block
13	0098-8900-01	1	Label, Terminal Block
14	0332-2370	4	Standoff, Insulated
15	A049G445	1	Load Busbar
16	A042W626	7	Lug, Mechanical (Neutral and Mechanism)
17	0332-3492-01	3	Lug, Ground
18	A049K240	1	Harness
19	A049E035	1	Busbar, Ground
20	A049L135	1	Plate, Transfer Switch
21	A049L128	1	Busbar, Load
22	A049L131	1	Busbar, Load
23	A049E263	1	Door, Inner
24	A049E277	1	Door, Outer
25	A049L133	1	Busbar, Load
26	A049E037	1	Busbar, Bonding Jumper
27	A049L138	1	Busbar, Load
28	A049T377	1	Circuit Breaker
29	A052V029	1	Label, Information
30	A054K424	1	Label, Customer Connection
31	A054N451	1	Label, Information
32	A052U748	1	Clamp, Vee Band

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Appendix B. Wiring Diagrams

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Figure 42. RA Series 400A Transfer Switch Wiring Diagram (Sheet 1 of 2) 81

Figure 43. RA Series 400A Transfer Switch Wiring Diagram (Sheet 2 of 2) 82

Figure 44. RA Series 100A and 200A Transfer Switch Interconnections (Sheet 1 of 2) 83

Figure 45. RA Series 100A and 200A Transfer Switch Interconnections (Sheet 2 of 2) 84

Figure 46. RA Series 400A Transfer Switch Interconnections (Sheet 1 of 2) 85

Figure 47. RA Series 400A Transfer Switch Interconnections (Sheet 2 of 2) 86

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

B.1 RA Series 100A/200A Transfer Switch Wiring Diagram (Sheet 1 of 2)

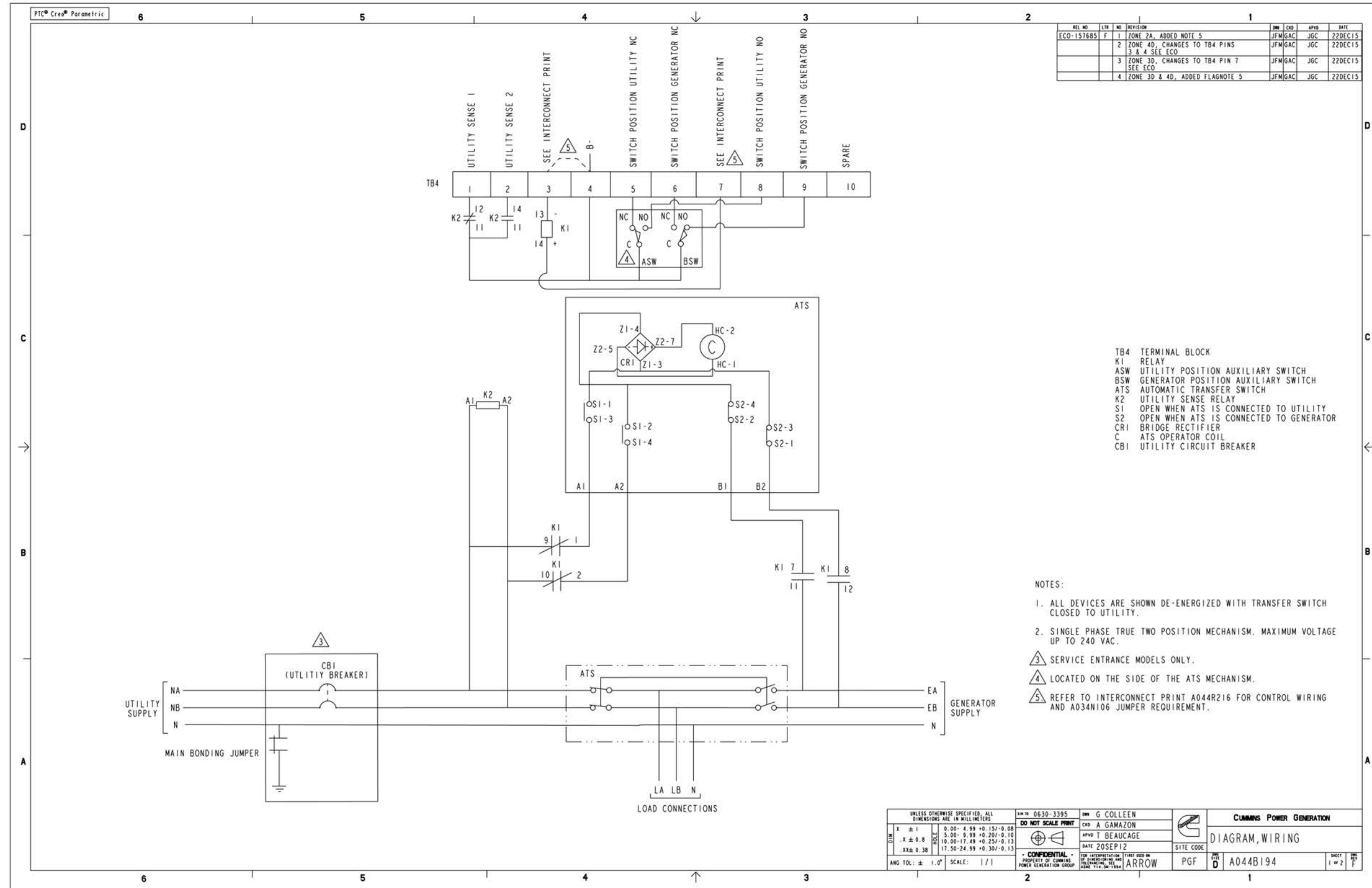


FIGURE 40. RA SERIES 100A/200A TRANSFER SWITCH WIRING DIAGRAM (SHEET 1 OF 2)

B.2 RA Series 100A/200A Transfer Switch Wiring Diagram (Sheet 2 of 2)

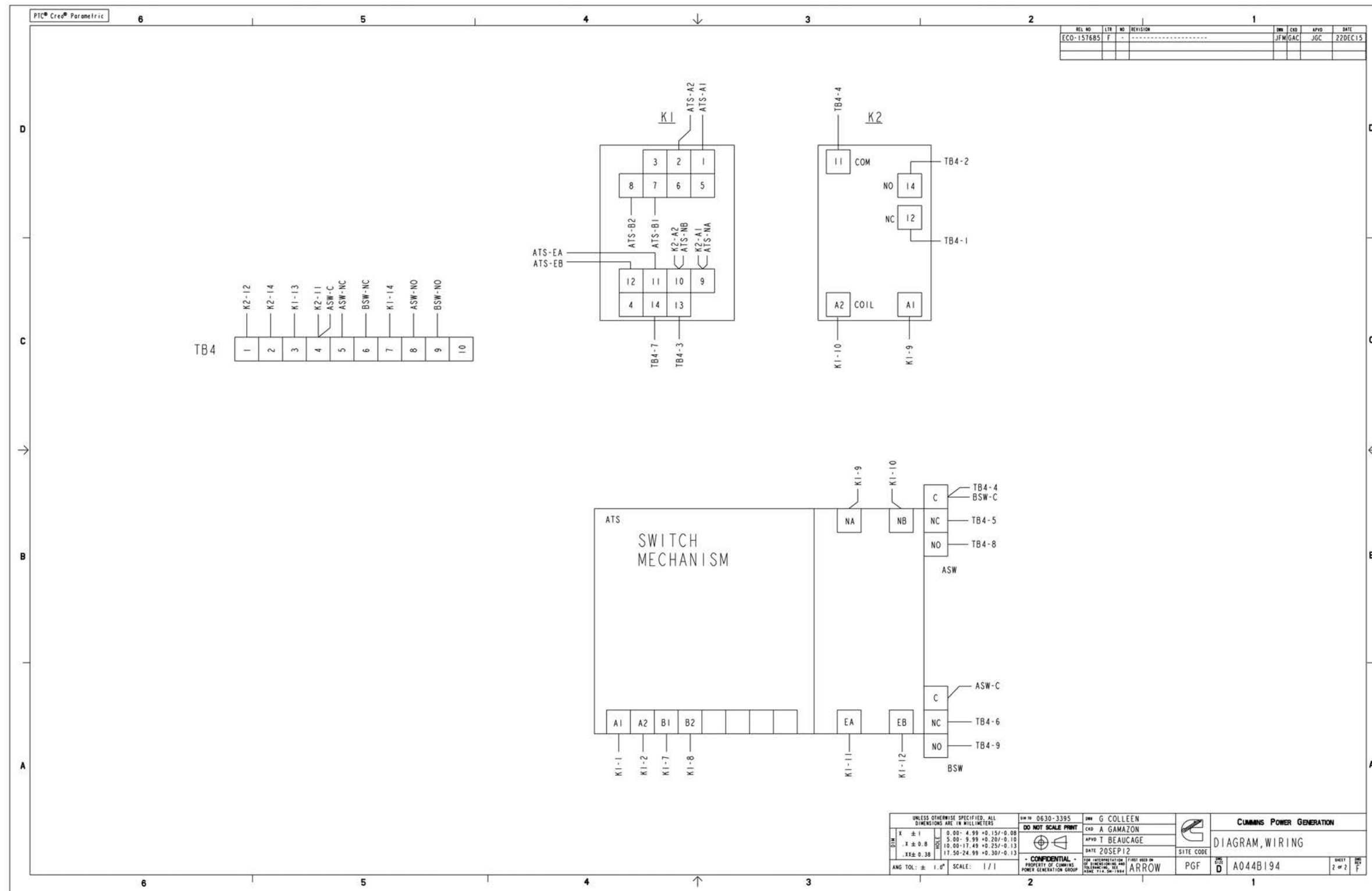


FIGURE 41. RA SERIES 100A/200A TRANSFER SWITCH WIRING DIAGRAM (SHEET 2 OF 2)

B.3 RA Series 400A Transfer Switch Wiring Diagram (Sheet 1 of 2)

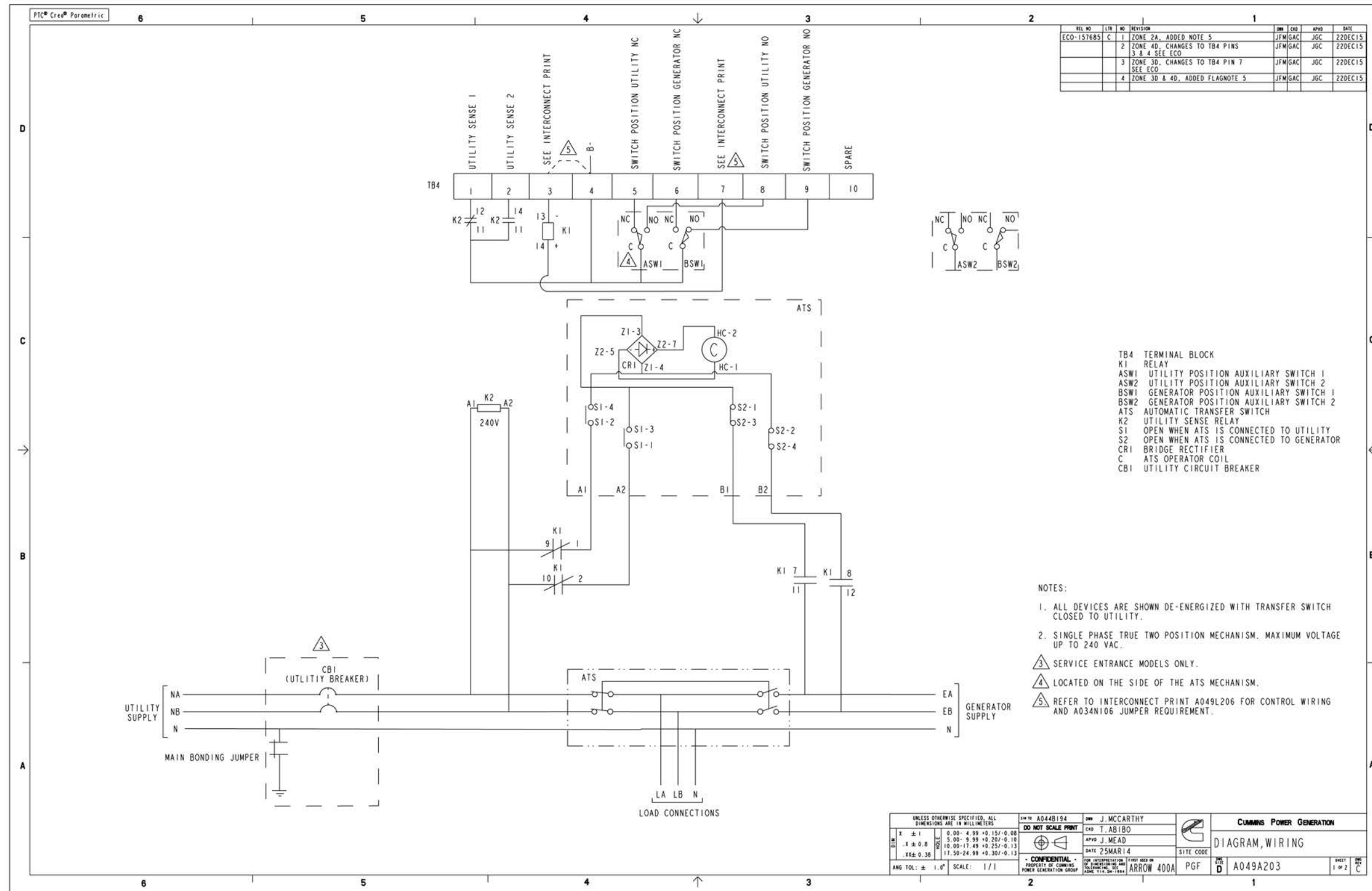


FIGURE 42. RA SERIES 400A TRANSFER SWITCH WIRING DIAGRAM (SHEET 1 OF 2)

B.4 RA Series 400A Transfer Switch Wiring Diagram (Sheet 2 of 2)

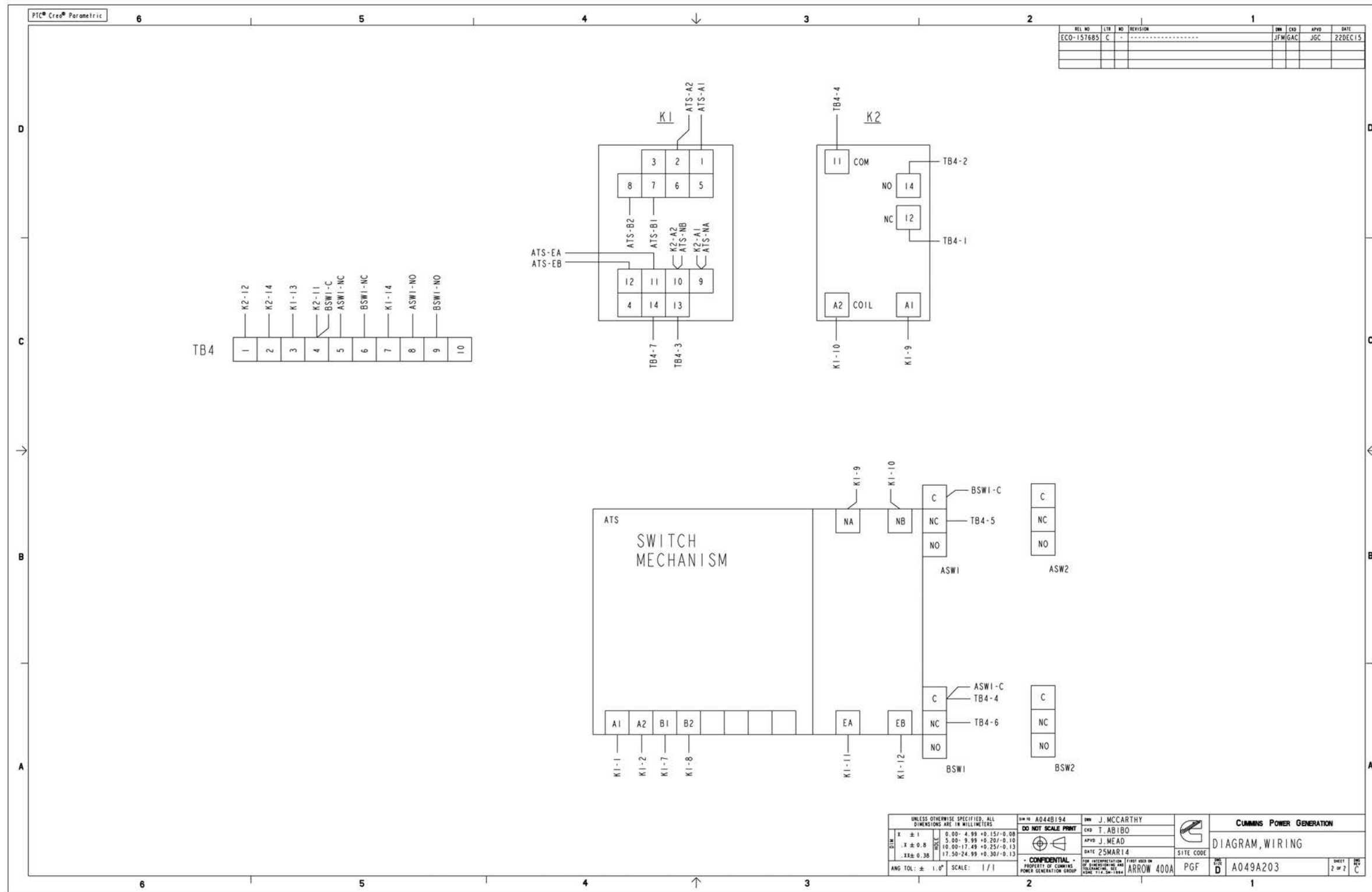


FIGURE 43. RA SERIES 400A TRANSFER SWITCH WIRING DIAGRAM (SHEET 2 OF 2)

B.5 RA Series 100A and 200A Transfer Switch Interconnections

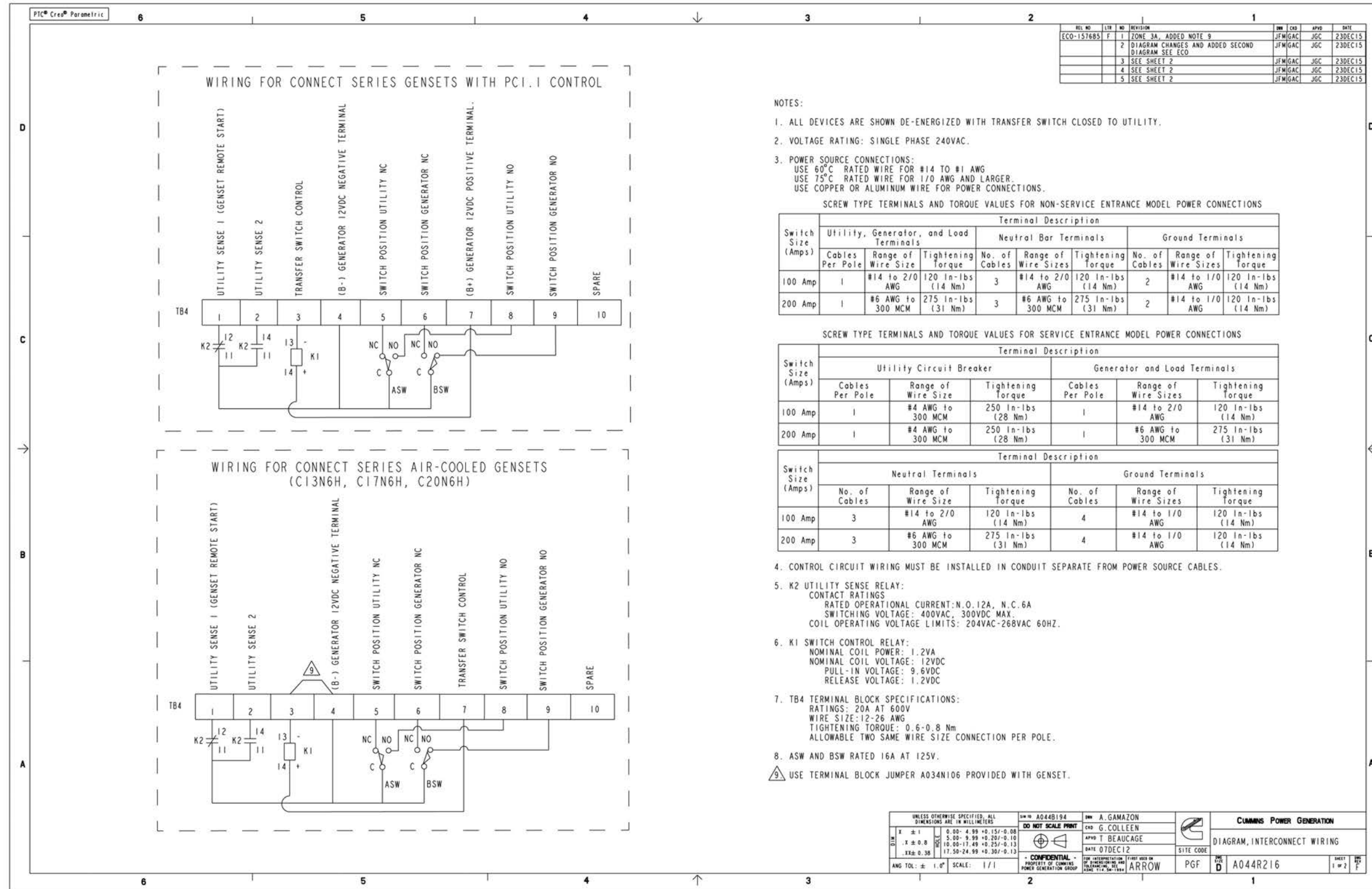


FIGURE 44. RA SERIES 100A AND 200A TRANSFER SWITCH INTERCONNECTIONS (SHEET 1 OF 2)

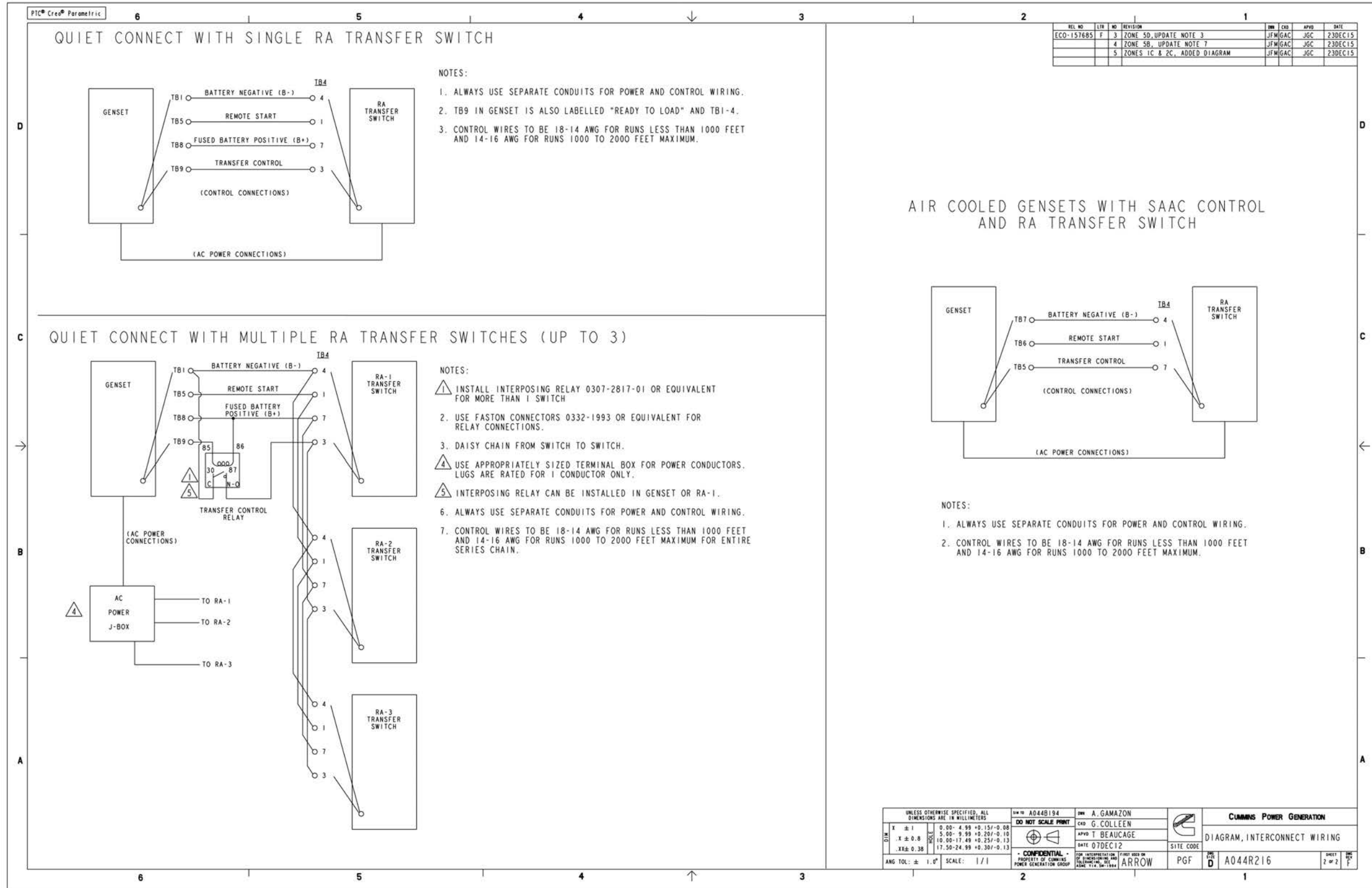


FIGURE 45. RA SERIES 100A AND 200A TRANSFER SWITCH INTERCONNECTIONS (SHEET 2 OF 2)

B.6 RA Series 400A Transfer Switch Interconnections

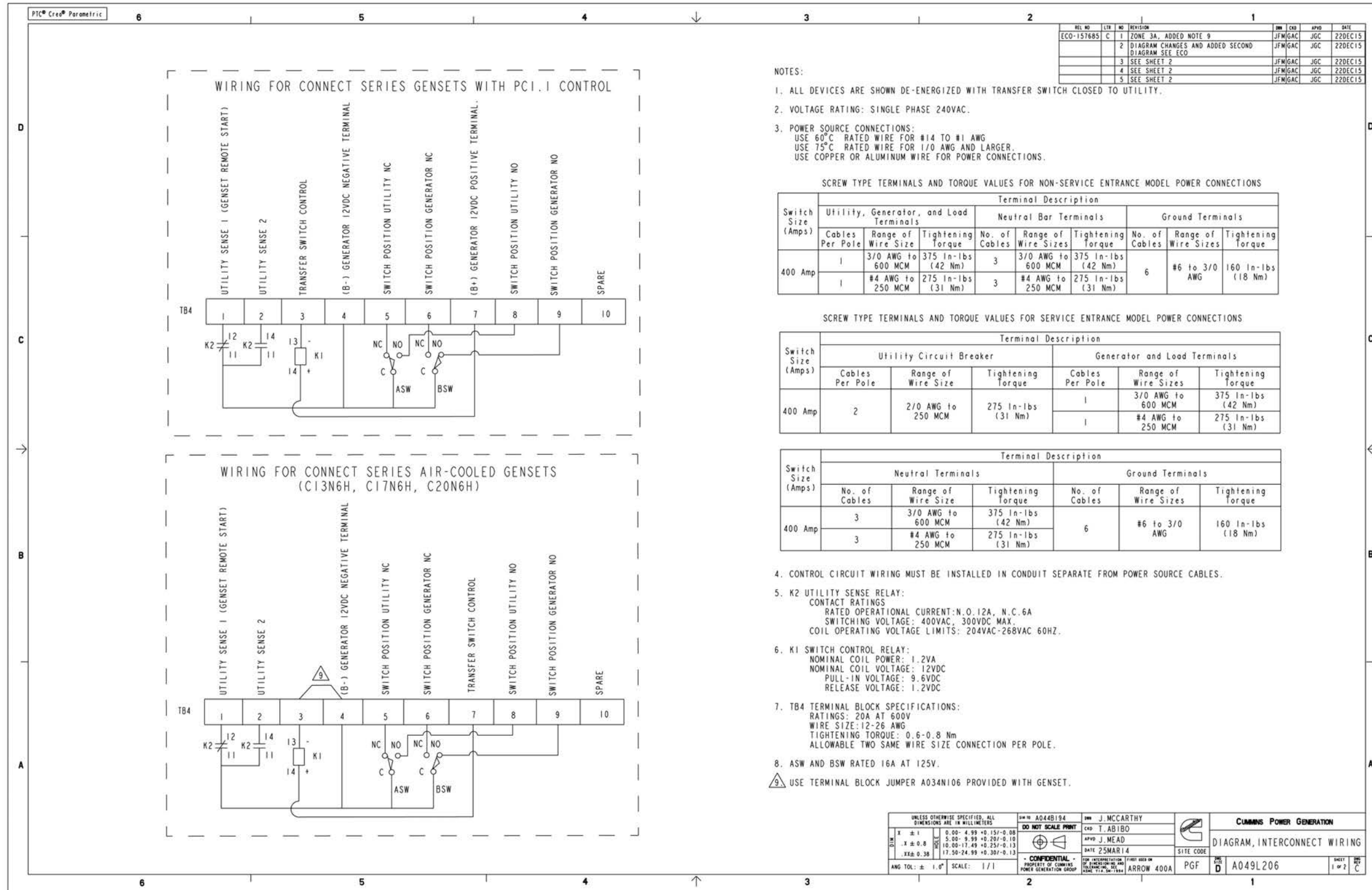


FIGURE 46. RA SERIES 400A TRANSFER SWITCH INTERCONNECTIONS (SHEET 1 OF 2)

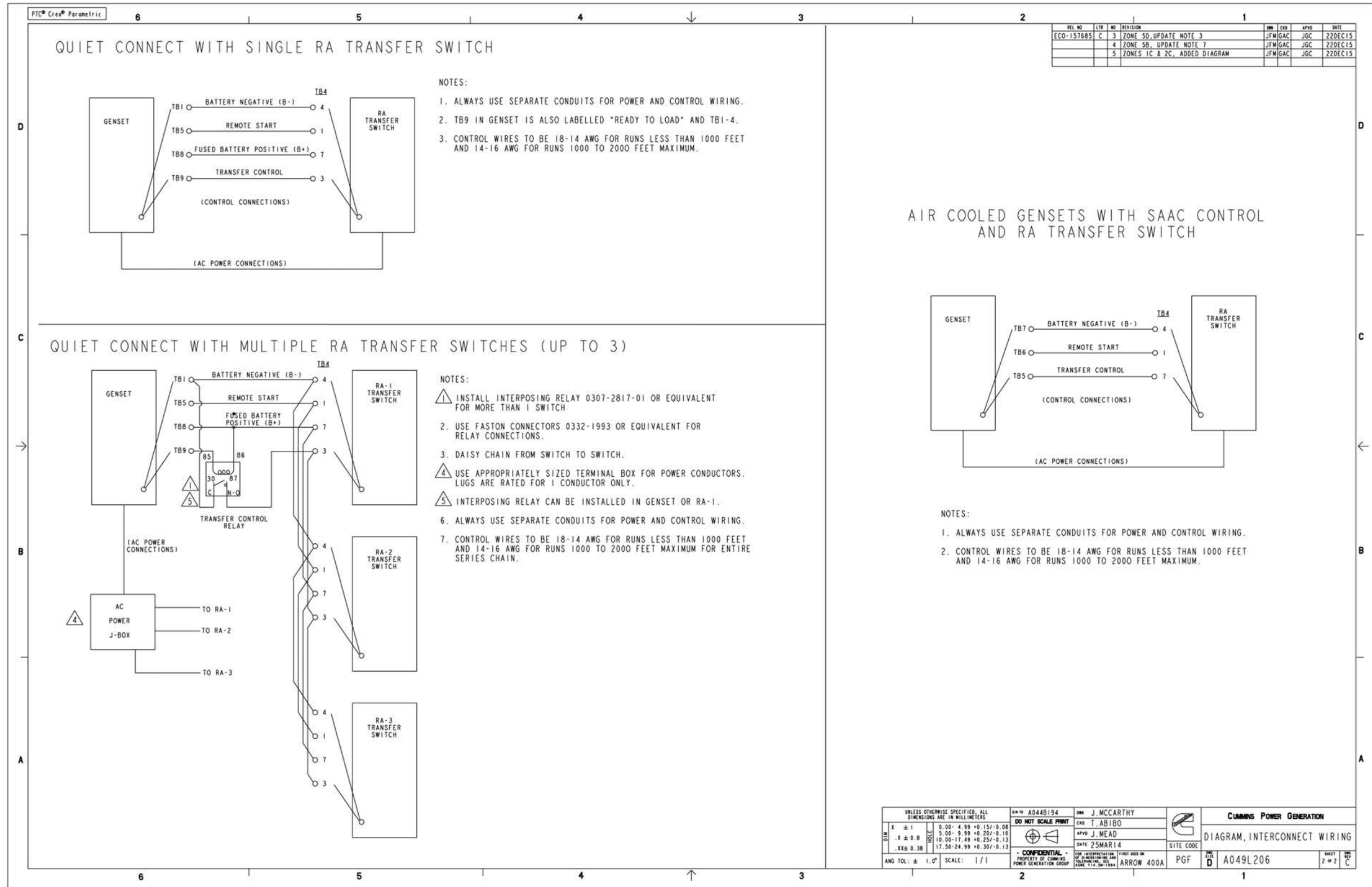


FIGURE 47. RA SERIES 400A TRANSFER SWITCH INTERCONNECTIONS (SHEET 2 OF 2)

Appendix C. Outline Drawings

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Figure 52. RA412S3 Control Box Outline Drawing 93

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

C.1 RA112N3 Control Box Outline Drawing

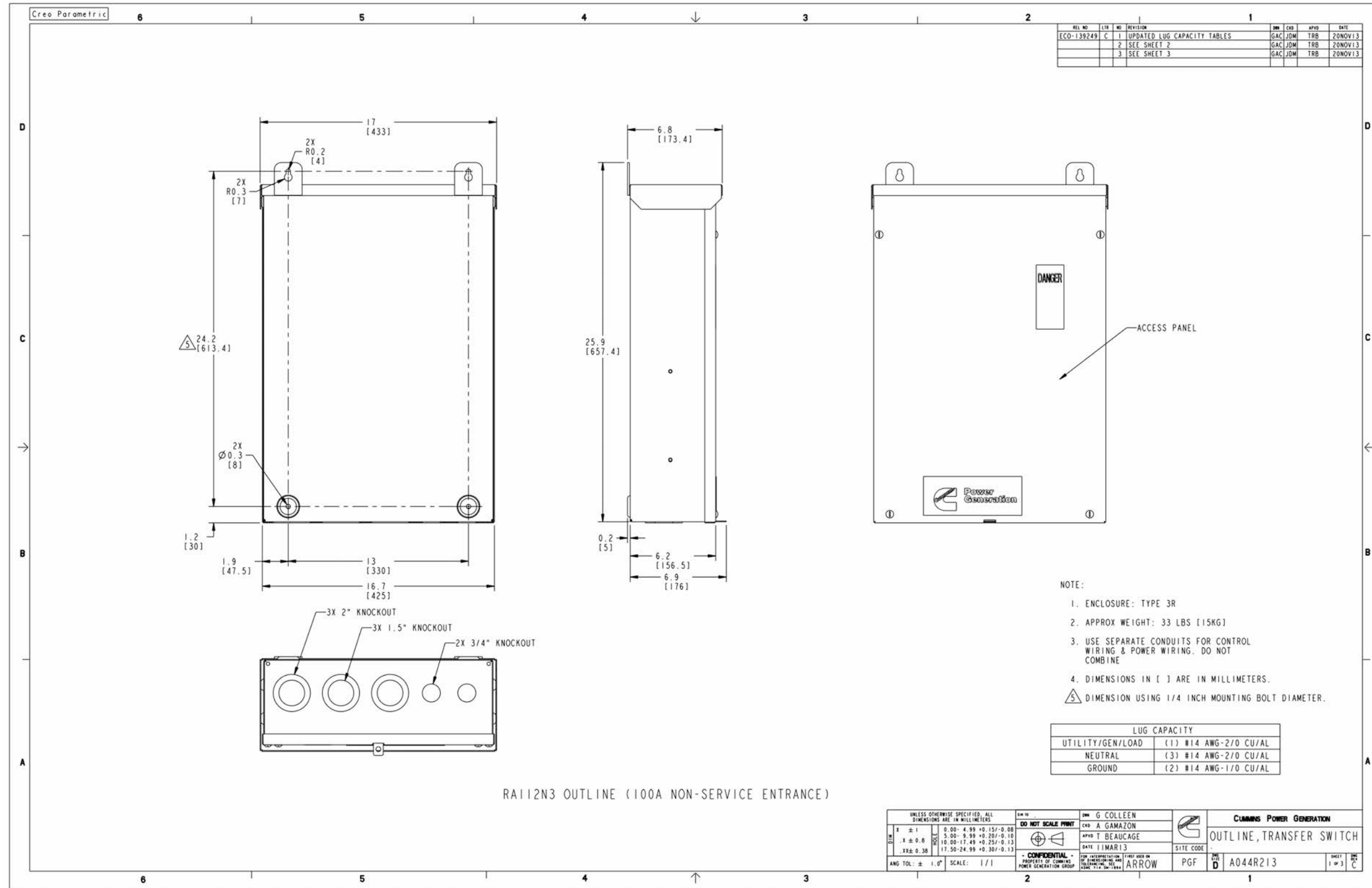


FIGURE 48. RA112N3 CONTROL BOX OUTLINE DRAWING

C.3 RA112S3 and RA212S3 Control Box Outline Drawing

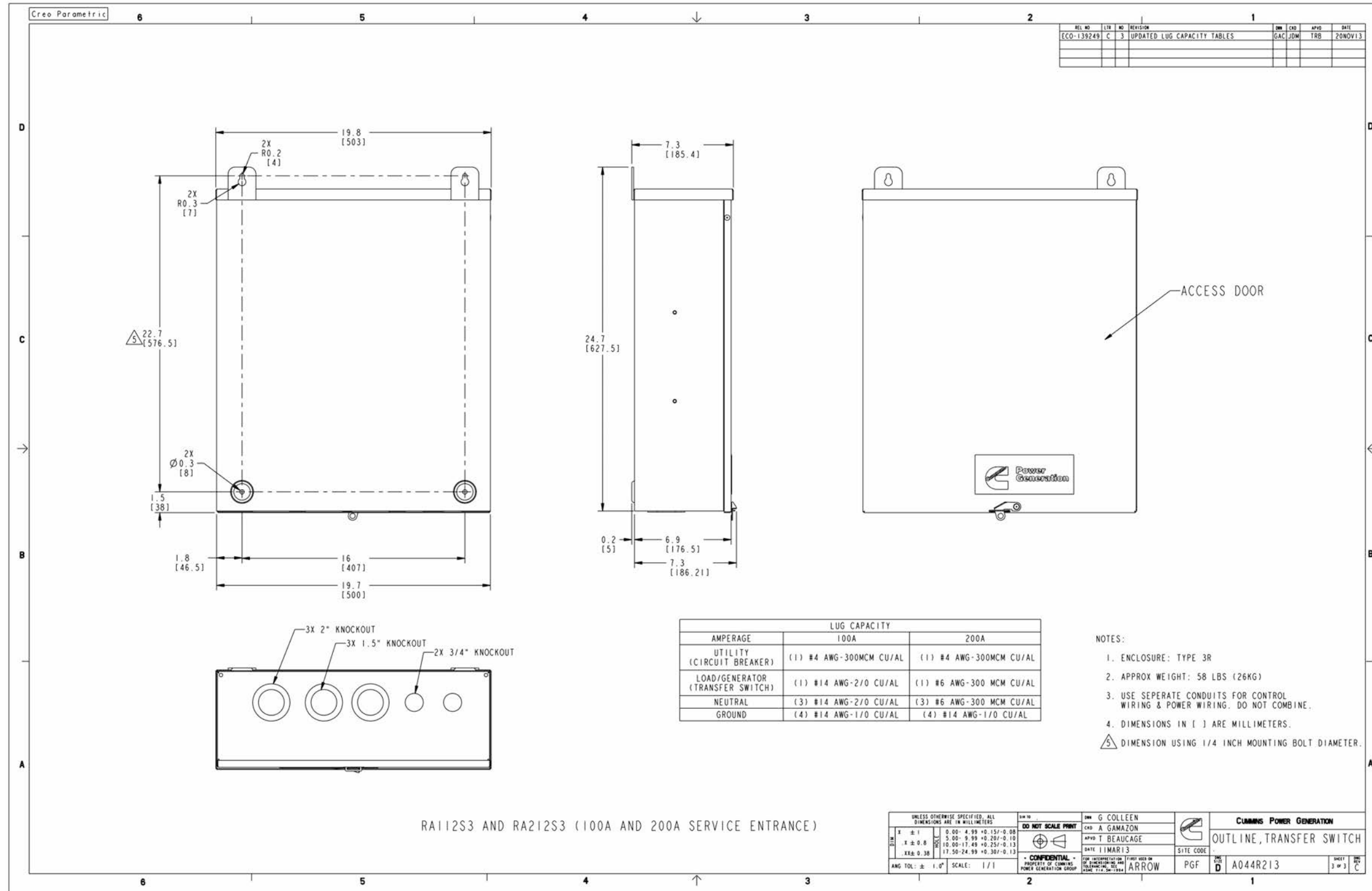


FIGURE 50. RA112S3 AND RA212S3 CONTROL BOX OUTLINE DRAWING

C.4 RA412N3 Control Box Outline Drawing

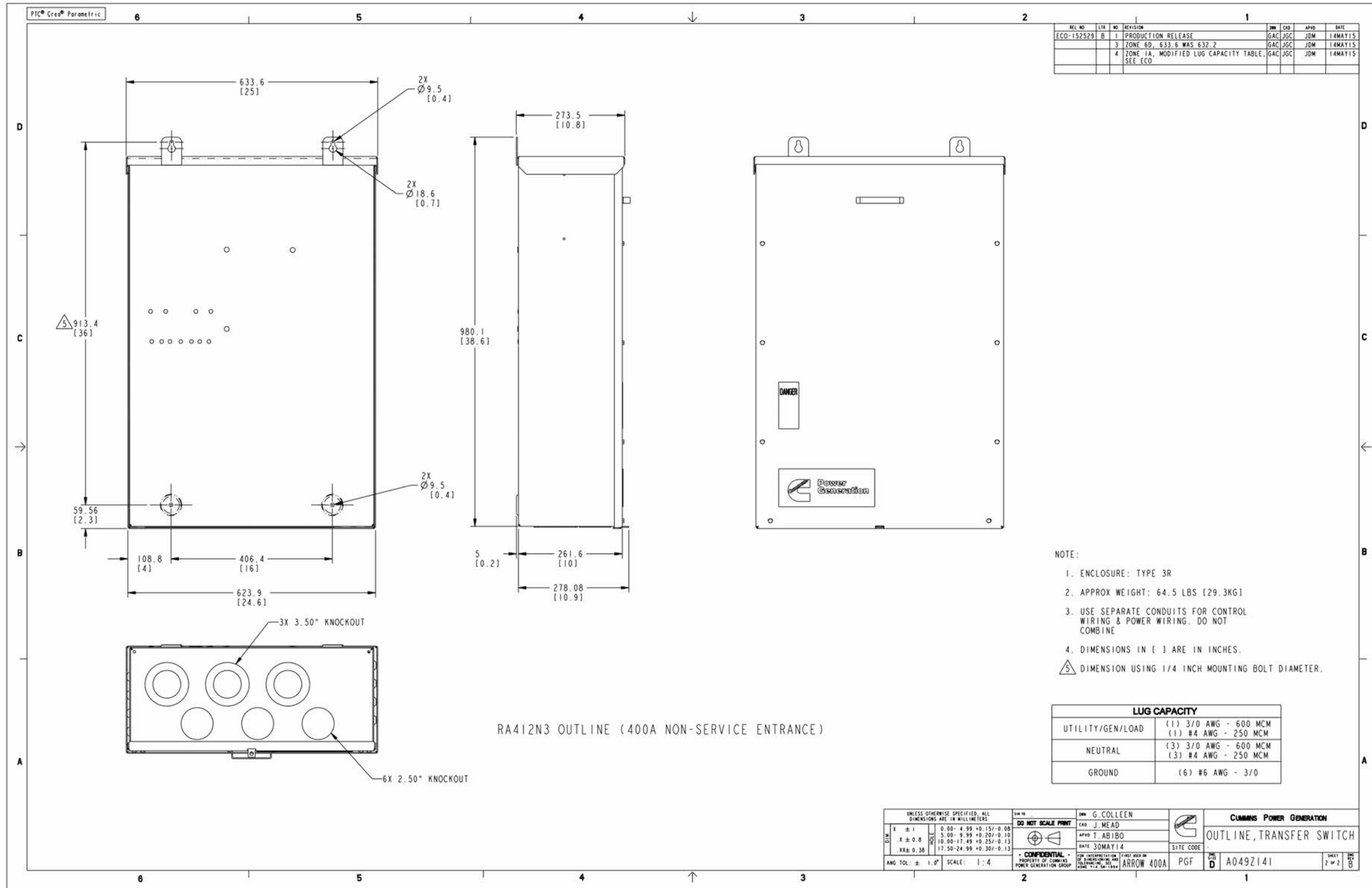


FIGURE 51. RA412N3 CONTROL BOX OUTLINE DRAWING

C.5 RA412S3 Control Box Outline Drawing

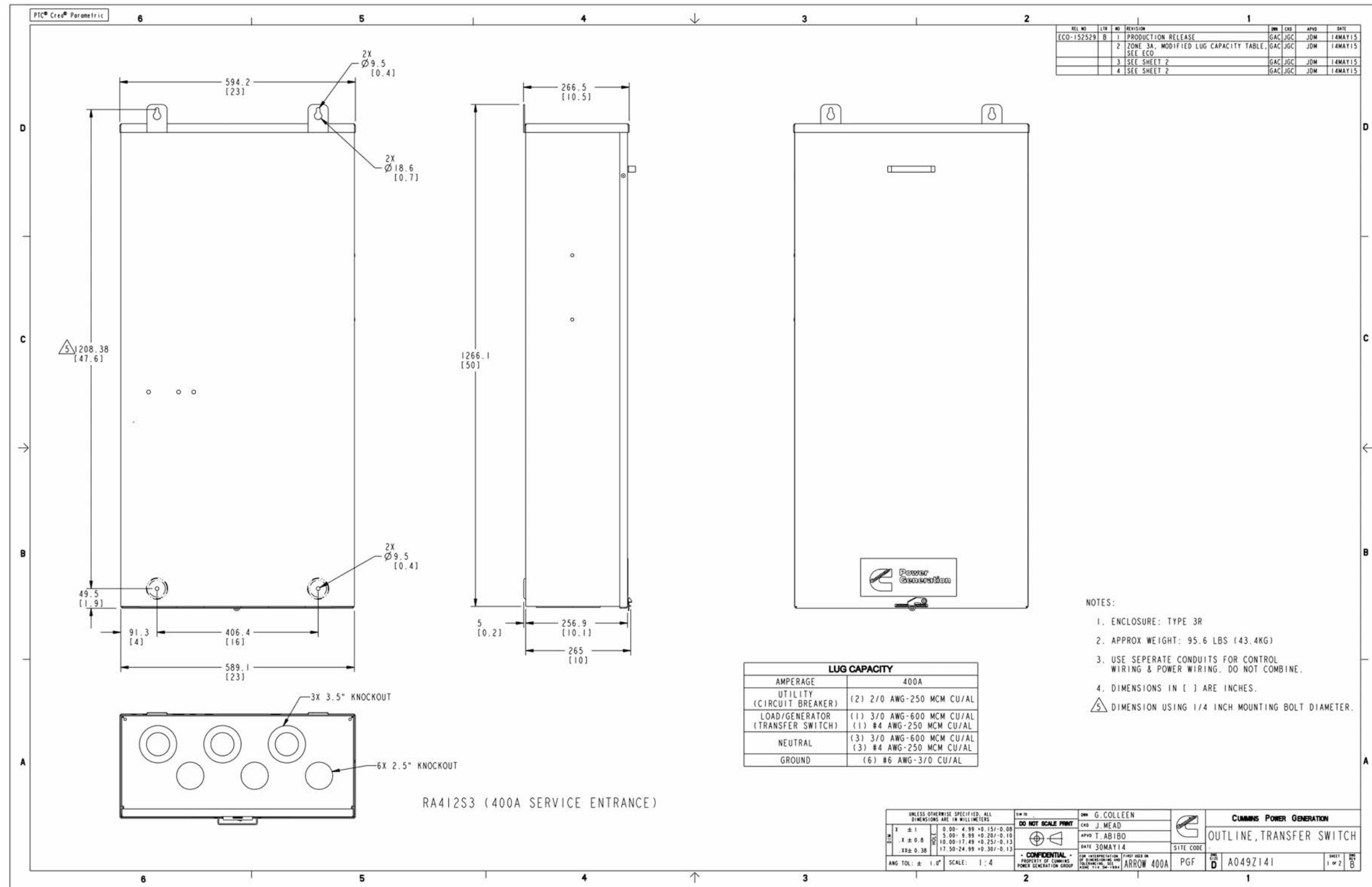


FIGURE 52. RA412S3 CONTROL BOX OUTLINE DRAWING

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