Installation Manual

Generator Set

QSK60 Engine with PowerCommand® 3.3 Control

DQKAD (Spec F)
DQKAE (Spec F)
DQKAF (Spec F)

English
Original Instructions
9-2018
A055D999 (Issue 6)

Table of Contents

This page is intentionally blank.

1 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS. This manual contains important instructions that should be followed during installation and maintenance of the generator set and batteries.

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
Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

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 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 General Safety Precautions

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

Do not open the pressure cap while the engine is running. Let the engine cool down before removing the cap. Turn the cap slowly and do not open it fully until the pressure has been relieved.

⚠ WARNING

Moving Parts

Moving parts can cause severe personal injury.

Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

Toxic Hazard

Used engine oils have been identified by some state and federal agencies to cause cancer or reproductive toxicity.

Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil. Wear protective gloves and face guard.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation can cause severe personal injury or death.

Do not operate equipment when fatigued, or after consuming any alcohol or drug.

⚠ WARNING

Toxic Gases

Substances in exhaust gases have been identified by some state and federal agencies to cause cancer or reproductive toxicity.

Do not breathe in or come into contact with exhaust gases.

⚠ WARNING

Combustible Liquid

Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.

Do not store fuel, cleaners, oil, etc., near the generator set.

⚠ WARNING

High Noise Level

Generator sets in operation emit noise, which can cause hearing damage.

Wear appropriate ear protection at all times.

⚠ WARNING

Hot Surfaces

Contact with hot surfaces can cause severe burns.

The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Toxic Hazard

Ethylene glycol, used as an engine coolant, is toxic to humans and animals.

Wear appropriate PPE. Clean up coolant spills and dispose of used coolant in accordance with local environmental regulations.

⚠ WARNING

Combustible Liquid

Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.

Do not use combustible liquids like ether.

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Fire Hazard

Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.

Make sure the generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.

⚠ WARNING

Fire Hazard

Accumulated grease and oil are a fire hazard. Fire can cause severe burns or death.

Keep the generator set and the surrounding area clean and free from obstructions. Repair oil leaks promptly.

⚠ WARNING

Fall Hazard

Falls can result in severe personal injury or death.

Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.

⚠ WARNING

Fire Hazard

Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.

Keep the generator set and the surrounding area clean and free from obstructions.

⚠ WARNING

Pressurized System

Pressurized systems can rupture/leak which can result in severe personal injury or death.

Use appropriate lock out/tag out safety procedures to isolate from all energy sources before performing any service tasks. Use PPE.

⚠ WARNING

Confined Areas

Confined spaces or areas with restricted access or potential to entrap can cause severe personal injury or death.

Use appropriate lock out/tag out safety procedures to isolate from all energy sources. Use PPE. Follow site specific lone worker protocols/permits to work.

⚠ CAUTION

Manual Handling Heavy Objects

Handling heavy objects can cause severe personal injury.

Use appropriate lifting equipment and perform tasks with two people where doing so would make completion of the task safe.

⚠ CAUTION

Power Tools and Hand Tools

Tools can cause cuts, abrasions, bruising, puncture injuries.

Only trained and experienced personnel should use power tools and hand tools. Use PPE.

⚠ CAUTION

Sharp Edges and Sharp Points

Projecting corners/parts may cause cuts, abrasions and other personal injury.

Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

NOTICE

Keep multi-type ABC fire extinguishers close by. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquid fuels and gaseous fuels. Class C fires involve live electrical equipment. (Refer to NFPA No. 10 in the applicable region.)

NOTICE

Before performing maintenance and service procedures on enclosed generator sets, make sure the service access doors are secured open.

NOTICE

Stepping on the generator set can cause parts to bend or break, leading to electrical shorts, or to fuel leaks, coolant leaks, or exhaust leaks. Do not step on the generator set when entering or leaving the generator set room.

1.3 Generator Set Safety Code

Before operating the generator set, read the manuals and become familiar with them and the equipment. 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.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Read and follow all Safety Precautions, Warnings, and Cautions throughout this manual and the documentation supplied with the generator set.

1.3.1 Moving Parts Can Cause Severe Personal Injury or Death

- Keep hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect the battery charger from its AC source, then disconnect the starting batteries using an insulated wrench, negative (–) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps; keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- If any adjustments must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

1.3.2 Positioning of Generator Set - Open Sets

The area for positioning the set should be adequate and level, and the area immediately around the set must be free of any flammable material.

1.4 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Contact with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher can cause electrical shock and electrical arc flash. Refer to standard NFPA 70E or equivalent safety standards in corresponding regions for details of the dangers involved and for the safety requirements.

Guidelines to follow when working on de-energized electrical systems:

- Use proper PPE. Do not wear Jewellery and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- De-energize and lockout/tagout electrical systems prior to working on them. Lockout/Tagout is intended to prevent injury due to unexpected start-up of equipment or the release of stored energy. Please refer to the lockout/tagout section for more information.
- De-energize and lockout/tagout all circuits and devices before removing any protective shields or making any measurements on electrical equipment.
- Follow all applicable regional electrical and safety codes.

Guidelines to follow when working on energized electrical systems:

NOTICE

It is the policy of Cummins Inc. to perform all electrical work in a de-energized state. However, employees or suppliers may be permitted to occasionally perform work on energized electrical equipment only when qualified and authorized to do so and when troubleshooting, or if de-energizing the equipment would create a greater risk or make the task impossible and all other alternatives have been exhausted.

NOTICE

Exposed energized electrical work is only allowed as per the relevant procedures and must be undertaken by a Cummins authorized person with any appropriate energized work permit for the work to be performed while using proper PPE, tools and equipment.

In summary:

- Do not tamper with or bypass interlocks unless you are authorized to do so.
- Understand and assess the risks - use proper PPE. Do not wear Jewellery and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- Make sure that an accompanying person who can undertake a rescue is nearby.

1.4.1 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 accepts no responsibility for providing the means of isolation.

1.4.1.1 AmpSentry

Generator sets with PC 3.3 control utilize AmpSentry™ protective relay which includes integral AC protective functions for the alternator and conductors, if conductors are rated for operation at a minimum of 100% of the generator nameplate rating.

1.4.2 AC Disconnect Sources

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

The equipment may have more than one source of electrical energy. Disconnecting one source without disconnecting the others presents a shock hazard. Before starting work, disconnect the equipment, and verify that all sources of electrical energy have been removed.

1.4.3 Medium Voltage Equipment (601 V to 15 kV - U.S. and Canada)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and experienced to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

1.5 Fuel and Fumes Are Flammable

Fire, explosion, and personal injury or death can result from improper practices.

- Do not fill fuel tanks while the engine is running unless the tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- Do not permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Make sure all fuel supplies have a positive shutoff valve.
- Make sure the battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

1.5.1 Spillage

Any spillage that occurs during fueling, oil top-off, or oil change must be cleaned up before starting the generator set.

1.5.2 Fluid Containment

NOTICE
Where spillage containment is not part of a Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses and sources.

If fluid containment is incorporated into the bedframe, it must be inspected at regular intervals. Any liquid present should be drained out and disposed of in line with local health and safety regulations. Failure to perform this action may result in spillage of liquids which could contaminate the surrounding area.

Any other fluid containment area must also be checked and emptied, as described above.

1.5.3 Do Not Operate in Flammable and Explosive Environments

Flammable vapor can cause an engine to over speed and become difficult to stop, resulting in possible fire, explosion, severe personal injury, and death. Do not operate a generator set where a flammable vapor environment can be created, unless the generator set is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the generator set are solely responsible for operating the generator set safely. Contact your authorized Cummins distributor for more information.

1.6 Exhaust Gases Are Deadly

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas, and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust system daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Make sure the unit is well ventilated.

1.6.1 Exhaust Precautions

⚠ WARNING

Hot Exhaust Gases

Contact with hot exhaust gases can cause severe burns.

Wear personal protective equipment when working on equipment.

⚠ WARNING

Hot Surfaces

Contact with hot surfaces can cause severe burns.

The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.

⚠ WARNING

Toxic Gases

Inhalation of exhaust gases can cause asphyxiation and death.

Pipe exhaust gas outside and away from windows, doors, or other inlets to buildings. Do not allow exhaust gas to accumulate in habitable areas.

⚠ WARNING

Fire Hazard

Contaminated insulation is a fire hazard. Fire can cause severe burns or death.

Remove any contaminated insulation and dispose of it in accordance with local regulations.

The exhaust outlet may be sited at the top or bottom of the generator set. Make sure that the exhaust outlet is not obstructed. Personnel using this equipment must be made aware of the exhaust position. Position the exhaust away from flammable materials - in the case of exhaust outlets at the bottom, make sure that vegetation is removed from the vicinity of the exhaust.

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated they must be replaced before the generator set is run.

To minimize the risk of fire, make sure the following steps are observed:

- Make sure that the engine is allowed to cool thoroughly before performing maintenance or operation tasks.
- Clean the exhaust pipe thoroughly.

1.7 Earth Ground Connection

The neutral of the generator set may be required to be bonded to earth ground at the generator set location, or at a remote location, depending on system design requirements. Consult the engineering drawings for the facility or a qualified electrical design engineer for proper installation.

NOTICE

The end user is responsible to make sure that the ground connection point surface area is clean and free of rust before making a connection.

NOTICE

The end user is responsible for making sure that an earthing arrangement that is compliant with local conditions is established and tested before the equipment is used.

1.8 Decommissioning and Disassembly

NOTICE

Decommissioning and disassembly of the generator set at the end of its working life must comply with local guidelines and legislation for disposal/recycling of components and contaminated fluids. This procedure must only be carried out by suitably trained and experienced service personnel. For more information contact your authorized distributor.

2 Introduction

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only a trained and experienced electrician makes generator set electrical output connections, in accordance with the installation instructions and all applicable codes.

⚠ WARNING

Electrical Generating Equipment

Faulty electrical generating equipment can cause severe personal injury or death.

Generator sets must be installed, certified, and operated by trained and experienced person in accordance with the installation instructions and all applicable codes.

2.1 About This Manual

The purpose of this manual is to provide the users with sound, general information. It is for guidance and assistance with recommendations for correct and safe procedures. Cummins Inc. cannot accept any liability whatsoever for problems arising as a result of following recommendations in this manual.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins Inc. policy of continuous development and improvement, information may change at any time without notice. The users should therefore make sure that before commencing any work, they have the latest information available. The latest version of this manual is available on QuickServe Online (**https://quickserve.cummins.com**).

Users are respectfully advised that, in the interests of good practice and safety, it is their responsibility to employ competent persons to carry out any installation work. Consult your authorized distributor for further installation information. It is essential that the utmost care is taken with the application, installation, and operation of any engine due to their potentially hazardous nature. Careful reference should also be made to other Cummins Inc. literature. A generator set must be operated and maintained properly for safe and reliable operation.

For further assistance, contact your authorized distributor.

2.1.1 Additional Installation Manual Information

The purpose of this manual is to provide the Installation Engineer with sound, general information for the installation of the generator set. Refer to the Generator Set Operator Manual for additional information which must also be read before operating the set.

This manual provides installation instructions for the generator set models listed on the front cover. This includes the following information:

- **Mounting Recommendations** - for fastening the generator set to a base and space requirements for normal operation and service.
- **Mechanical and Electrical Connections** - covers most aspects of the generator set installation.
- **Prestart** - checklist of items or procedures needed to prepare the generator set for operation.
- **Installation Checklist** - reference checks upon completion of the installation.

This manual **DOES NOT** provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the Specification and Data Sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets." To find this manual online:

1. Go to **powersuite.cummins.com**
2. Click on "Login" on the Home page.
3. Click on "Library".
4. Click on "Technical Documents".
5. Click on "Technical information".
6. Click on "Liquid Cooled Genset Application Manual".

2.2 Schedule of Abbreviations

This list is not exhaustive. For example, it does not identify units of measure or acronyms that appear only in parameters, event/fault names, or part/accessory names.

AmpSentry, INSITE, and InPower are trademarks of Cummins Inc. PowerCommand is a registered trademark of Cummins Inc.

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AC	Alternating Current	LED	Light-emitting Diode
AMP	AMP, Inc., part of Tyco Electronics	LTS	Long Term Storage
ANSI	American National Standards Institute	LVRT	Low Voltage Ride Through
ASOV	Automatic Shut Off Valve	MFM	Multifunction Monitor
ASTM	American Society for Testing and Materials (ASTM International)	Mil Std	Military Standard
ATS	Automatic Transfer Switch	MLD	Masterless Load Demand
AVR	Automatic Voltage Regulator	NC	Normally Closed
AWG	American Wire Gauge	NC	Not Connected
CAN	Controlled Area Network	NFPA	National Fire Protection Agency
CB	Circuit Breaker	NO	Normally Open
CE	Conformité Européenne	NWF	Network Failure
CFM	Cubic Feet per Minute	OEM	Original Equipment Manufacturer
CGT	Cummins Generator Technologies	OOR	Out of Range
CMM	Cubic Meters per Minute	OORH / ORH	Out of Range High
CT	Current Transformer	OORL / ORL	Out of Range Low
D-AVR	Digital Automatic Voltage Regulator	PB	Push Button
DC	Direct Current	PCC	PowerCommand® Control

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
DEF	Diesel Exhaust Fluid	PGI	Power Generation Interface
DPF	Diesel Particulate Filter	PGN	Parameter Group Number
ECM	Engine Control Module	PI	Proportional/Integral
ECS	Engine Control System	PID	Proportional / Integral / Derivative
EMI	Electromagnetic interference	PLC	Programmable Logic Controller
EN	European Standard	PMG	Permanent Magnet Generator
EPS	Engine Protection System	PPE	Personal Protective Equipment
E-Stop	Emergency Stop	PT	Potential Transformer
FAE	Full Authority Electronic	PTC	Power Transfer Control
FMI	Failure Mode Identifier	PWM	Pulse-width Modulation
FRT	Fault Ride Through	RFI	Radio Frequency Interference
FSO	Fuel Shutoff	RH	Relative Humidity
Genset	Generator Set	RMS	Root Mean Square
GCP	Generator Control Panel	RTU	Remote Terminal Unit
GND	Ground	SAE	Society of Automotive Engineers
LCT	Low Coolant Temperature	SCR	Selective Catalytic Reduction
HMI	Human-machine Interface	SPN	Suspect Parameter Number
IC	Integrated Circuit	SWL	Safe Working Load
ISO	International Organization for Standardization	SW_B+	Switched B+
LBNG	Lean-burn Natural Gas	UL	Underwriters Laboratories
LCD	Liquid Crystal Display	UPS	Uninterruptible Power Supply
		VPS	Valve Proving System

2.3 Related Literature

Before any attempt is made to operate the generator set, the operator should take time to read all of the manuals supplied with the generator set and familiarize themselves with the warnings and operating procedures.

NOTICE

A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The Operator manual includes a maintenance schedule and a troubleshooting guide.

The Health and Safety manual must be read in conjunction with this manual for the safe operation of the generator set:

- Health and Safety Manual (0908-0110)

The relevant manuals appropriate to your generator set are also available, the documents below are in English:

- Operator Manual for DQKAD, DQKAE, and DQKAF Generator Sets with PowerCommand 3.3 Controller (A055E000)
- Installation Manual DQKAD, DQKAE, and DQKAF Generator Sets (A055D999)
- Service Manual for DQKAD, DQKAE, and DQKAF Generator Sets (A056H611)
- Recommended Spares List (RSL) for DQKAD Generator Sets (A056A610)
- Recommended Spares List (RSL) for DQKAE Generator Sets (A056A611)
- Recommended Spares List (RSL) for DQKAF Generator Sets (A056A612)
- Parts Manual for DQKAD, DQKAE, and DQKAF Generator Sets (A034V858)
- *Standard Repair Times - FD Family (A029F346)*
- Fuels for Cummins Engines Service Bulletin (3379001)
- Universal Annunciator Owner Manual (0900-0301)
- Service Tool Manual (A043D529)
- Failure Code Manual (F1115C)
- Engineering Application Manual *T-030: Liquid Cooled Generator Sets* (A040S369)
- Engine Operation & Maintenance Manual for QSK60 (3666260)
- Warranty Administration Manual (4021290)
- Global Commercial Warranty Statement (A028U870)

2.3.1 Further Information - Literature

Contact your authorized distributor for more information regarding related literature for this product.

2.4 After Sales Services

Cummins offers a full range of maintenance and warranty services.

2.4.1 Maintenance

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

For expert generator set service at regular intervals, contact your local distributor. Each local distributor offers a complete maintenance contract package covering all items subject to routine maintenance, including a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing year-round assistance if necessary. Specialist engineers are available to maintain optimum performance levels from generator sets. Maintenance tasks should only be undertaken by trained and experienced technicians provided by your authorized distributor.

2.4.2 Warranty

For details of the warranty coverage for your generator set, refer to the warranty statement listed in the Related Literature section.

In the event of a breakdown, prompt assistance can normally be given by factory trained service technicians with facilities to undertake all minor and many major repairs to equipment on site.

Extended warranty coverage is also available.

For further warranty details, contact your authorized service provider.

NOTICE
Damage caused by failure to follow the manufacturer's recommendations will not be covered by the warranty. Please contact your authorized service provider.

2.4.2.1 Warranty Limitations

For details of the warranty limitations for your generator set, refer to the warranty statement applicable to the generator set.

This page is intentionally blank.

3 System Overview

This section provides an overview of the generator set.

3.1 Generator Set Identification

Each generator set is provided with a nameplate similar to that shown below. The nameplate provides information unique to the generator set.

3.1.1 Nameplate

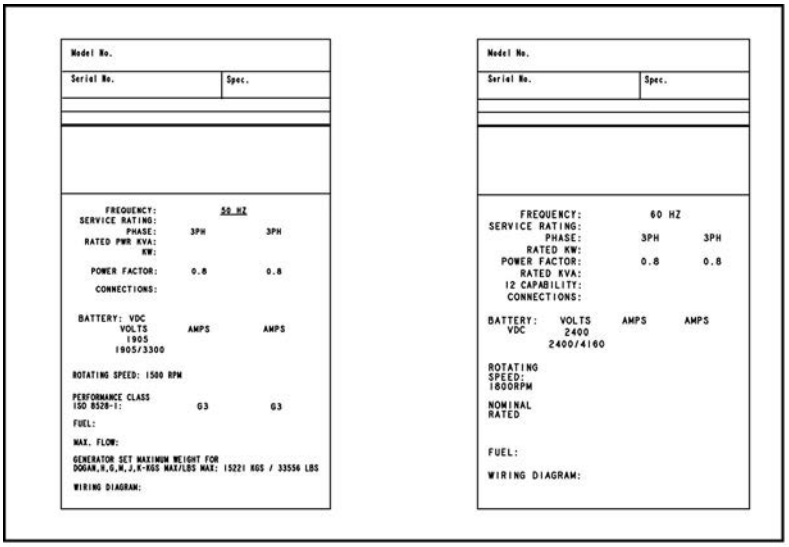
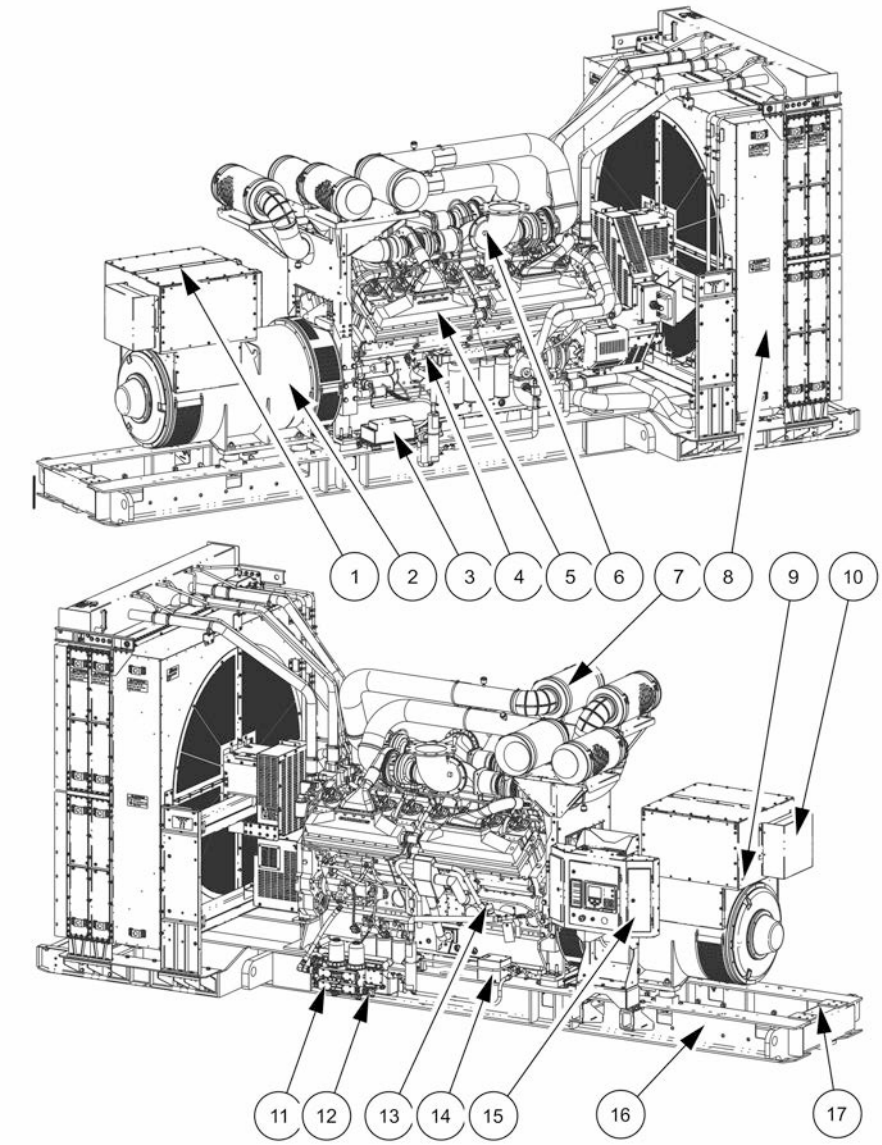


FIGURE 1. TYPICAL GENERATOR SET NAMEPLATE

3.2 Generator Set Components

The main components of a typical QSK60 engine generator set are shown below, and referred to within this section.

There are various options listed although they may not be available for all models.



No.	Description	No.	Description	No.	Description
1	Circuit Breaker Box or Entrance Box (optional)	7	Air Cleaners	13	Oil Fill
2	Alternator	8	Radiator	14	Coolant Heater Control (optional)
3	Pre-Lube Control (optional)	9	Alternator Heater (optional)	15	Control
4	Oil Sampling Valve (optional)	10	RTD Auxiliary Box (optional)	16	Skid
5	Engine	11	Fuel Filter	17	Control (optional location)
6	Exhaust Temperature Sensor (optional)	12	Oil Drain		

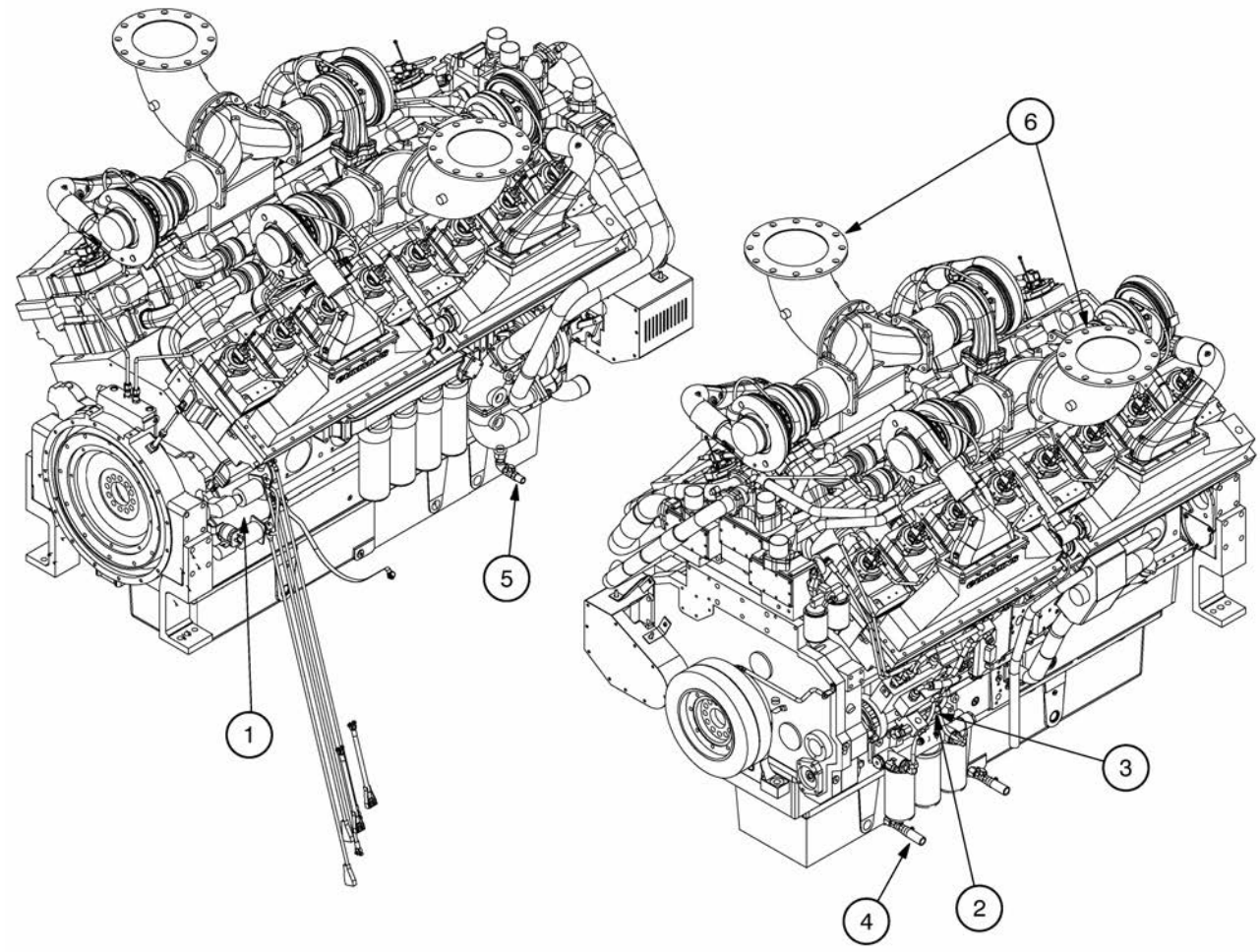
FIGURE 2. GENERATOR SET WITH CIRCUIT BREAKER BOX

3.3 Generator Set Rating

For details of the generator set rating, refer to the generator set nameplate. For operation at temperatures or altitudes above those stated on the nameplate, a derate may be necessary.

3.4 Engine

For additional engine specific information, refer to the relevant engine manual for your generator set.



No.	Description	No.	Description
1	Starter	4	Oil Drain
2	Oil Filler Cap	5	Coolant Drain
3	Dipstick	6	Exhaust Connections

FIGURE 3. TYPICAL QSK60 ENGINE COMPONENTS

3.5 Sensors

Various generator set parameters are measured by sensors, and the resulting signals are processed by the control board.

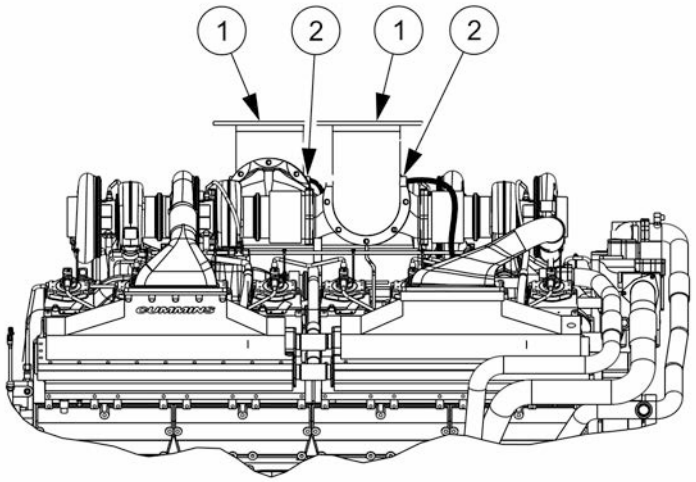
Engine-mounted sensors monitor a number of different systems, such as:

- Lube Oil Pressure
- Cooling System Temperature

3.6 Pyrometers - Engine Exhaust

A pyrometer measures engine exhaust gas temperature. A separate temperature meter is used to monitor each exhaust outlet elbow.

3.6.1 Pyrometer Position



No.	Description	No.	Description
1	Exhaust Outlet Elbows	2	Temperature Sender

FIGURE 4. PYROMETER LOCATION

3.7 System Options

3.7.1 Annunciators

The annunciator's lamps and alarm indicate the operating status and fault conditions of an emergency power system. For more information, see **Section 10.10 on page 116**.

3.7.2 Battery Charger

Battery chargers can be wall, bench, or skid mounted. For more information, see **Section 10.12.1**

3.7.3 Battery Isolator

NOTICE
Isolating the battery with the isolator switch while the generator set is running may damage the battery and charging circuit. Do not operate the battery isolator switch while the generator set is running.

The battery isolator isolates the negative feed from the battery to the engine. Isolating the battery prevents battery drain during prolonged periods of generator set inactivity or where static battery charging is not available.

3.7.4 Circuit Breaker Box Cable Chute

A cable chute is used with bottom entry circuit breaker boxes. For information on installing the chute assembly, see **Section 7.6 on page 57**.

3.7.5 Fuel Filter Kits

Fuel filter kits must be installed during generator set installation. For more information, see the Fuel Filter Kit Installation section.

3.7.6 Heavy Duty Air Cleaner

If not already installed, a heavy duty air cleaner assembly will need to be installed at the site. Refer to **Section 7.8 on page 60**.

3.7.7 Heaters

3.7.7.1 Heater Supply and Isolation

An external power supply is required for the operation of the generator set heaters.

NOTICE
If not already provided, it is the sole responsibility of the customer to provide the power supply and the means to isolate the AC input to the terminal box. Cummins accepts no responsibility for providing the means of isolation.

3.7.7.2 Alternator Heaters

Alternator heaters are used to help keep the alternator free of condensation when the generator set is not running. For more information on alternator heater components and specifications, refer to **Section 10.7 on page 112**.

3.7.7.3 Coolant Heater

Coolant heaters heat the coolant to maintain a minimum engine temperature when the generator set is not running. For more information on coolant heater components and specifications, see **Section 10.6 on page 111**.

3.7.7.4 Control Box Heater

A control box heater provides a means of humidity and temperature control of the control box interior. It protects the components when the generator set is subjected to varying ambient air conditions during extended periods of non-use. For more information on heater components and wiring, see **Section 10.8 on page 113**.

3.7.8 Skid Mounted Radiator Installation

Radiators shipped separately must be installed at the site. Refer to **Chapter 8**

3.7.9 Remote Radiator Installation

Special requirements apply if your generator set includes a remote radiator. For more information, refer to **Section 7.10 on page 70**.

3.7.10 Relays

3.7.10.1 Customer Relays

These relays are used for customer-specific applications. For more information, see **Section 9.2 on page 99**.

3.7.10.2 Ground Fault Relays

Ground fault relays can be used in the following applications:

- Local CT for 4-pole transfer switch
- Remote CT for 3-pole transfer switch

For more information on ground fault relay components and wiring, see **Section 9.4 on page 102**.

3.7.10.3 Paralleling Circuit Breaker Control Relays

Paralleling circuit breaker control relays can be installed on generator sets used in paralleling applications. For more information on relay components and wiring, see **Section 9.3 on page 100**.

3.7.11 Seismic Installation Requirements

Seismically certified generator set installations have special requirements, as defined by IAA-VMC (Independent Approval Agency, the VMC Group).

For special installation requirements, refer to the tabulated and written seismic requirements listed in the Seismic Requirements appendix. The installation of the seismically certified generator set should be overseen by the installation project structural engineer of record.

The "Seismic Certificate of Compliance" should be kept with the Warranty and other generator set documents.

The seismic requirements installation drawing and the Seismic Certificate of Compliance for generator sets are included in the literature package of each seismically certified generator set.

4 Installation Overview

These installation recommendations apply to typical installations with standard model generator sets. 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 authorized distributor for assistance.

4.1 Application and Installation

A power system must be carefully planned and correctly installed for proper operation. This involves two essential elements.

- **Application** (as it applies to generator set installations) refers to the design of the complete power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers or other trained specialists are responsible for the design of the complete power system and for selecting the materials and products required.
- **Installation** refers to the actual set-up and assembly of the 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 system normally requires the special skills of qualified electricians, plumbers, sheet-metal workers, etc. to complete the various segments of the installation. This is necessary so that all components are assembled using standard methods and practices.

4.2 Safety Considerations

The generator set 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 is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) 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.

⚠ WARNING

Fall Hazard

Falls can result in severe personal injury or death.

Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.

4.3 Seismic Installations

Seismically certified generator set installations have special requirements, as defined by IAA-VMC (Independent Approval Agency, the VMC Group).

For special installation requirements, refer to the tabulated and written seismic requirements listed in **Appendix E on page 221**.

The installation of the seismically certified generator set should be overseen by the installation project structural engineer of record.

The "Seismic Certificate of Compliance" should be kept with the Warranty and other generator set documents.

The seismic requirements installation drawing and the Seismic Certificate of Compliance for generator sets are included in the literature package of each seismically certified generator set.

4.3.1 Seismic Installation Notes

1. The design of post-installed anchors in concrete used for the component anchorage is pre-qualified for seismic applications in accordance with "ACI 355.2" and documented in a report by a reputable testing agency. (ex. the evaluation service report issued by the International Code Council)
2. Anchors must be installed to an embedment depth as recommended in the pre-qualification test report as defined in Note 1. For "IBC 2000" and "IBC 2003" applications, the minimum embedment must be 8X for the anchor diameter.
3. Anchors must be installed in minimum 4000 PSI compressive strength normal weight concrete. Concrete aggregate must comply with "ASTM C33". Installation in structural lightweight concrete is not permitted unless otherwise approved by the structural engineer of record.
4. Anchors must be installed to the torque specification as recommended by the anchor manufacturer to obtain maximum loading.
5. Anchors must be installed in locations specified in this section.
6. Wide washers must be installed at each anchor location between the anchor head and equipment for tension load distribution. Wide washers must be Series "W" of American National Standard Type "A" plain washers (ANSI B18.22.1-1965, R1975) with the nominal washer size selected to match the specified nominal anchor diameter.
7. Concrete floor slab and concrete housekeeping pads must be designed and rebar reinforced for seismic applications in accordance with "ACI 318". The design loads shall be taken as those specified in this section.
8. All housekeeping pad thicknesses must be designed in accordance with the pre-qualification test report as defined in Note 1 or a minimum of 1.5X the anchor embedment depth, whichever is largest.
9. All housekeeping pads must be dowelled or cast into the building structural floor slab and designed for seismic application per "ACI 318" and as approved by the structural engineer of record.
10. Wall mounted equipment must be installed to a rebar reinforced structural concrete wall that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the wall.
11. Floor mounted equipment (with or without a housekeeping pad) must be installed to a rebar reinforced structural concrete floor that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the floor.
12. When installing to a floor or wall, rebar interference must be considered.
13. Attaching seismic certified equipment to any floor or wall other than those constructed of structural concrete and designed to accept the seismic loads from said equipment is not permitted by this specification and beyond the scope of this certification.
14. Attaching seismic certified equipment to any floor constructed of light weight concrete over steel decking is not permitted by this specification and beyond the scope of this certification.
15. Attaching the seismic certified equipment to any concrete block walls or cinder block walls is not permitted by this specification and beyond the scope of this certification.
16. Installation upon a rooftop steel dunnage shall be coordinated with the structural engineer of record.

17. Installation upon any rooftop curb shall be coordinated with the curb manufacturer and the structural engineer of record. Any curb or concrete pad that supports the generator set unit is beyond the scope of this certification.
18. Connections to the equipment, including but not limited to conduit, wiring from cable trays, other electrical services, ducting, piping such as exhaust, steam, water, coolant, refrigerant, fuel, or other connections, are the responsibility of the installing contractor and beyond the scope of this document. Typical requirements for these connections are stated in the equipment installation manual. Special considerations for seismic applications are as follows; connections to non-isolated components or equipment may be installed as typical for that particular application. Connections to isolated components (ex. breaker box bolted directly to an isolated generator set) or isolated equipment (ex. an enclosed generator set mounted on external isolators) must be flexibly attached. The flexible attachment must provide for enough relative displacement to remain connected to the equipment and functional during and after a seismic event.

4.4 Standby Heating Devices

Cummins requires installing standby generator sets (life safety systems) with engine jacket water coolant heaters in order to ensure a 10 second start. Jacket water coolant heaters are also recommended in prime and continuous applications where time and load acceptance is to be minimized.

The jacket water coolant heater provided by Cummins rated to provide the above requirements in ambient temperatures as low as 4 °C (40 °F). Although most Cummins generator sets will start in temperatures down to –32 °C (–25 °F) when equipped with engine jacket water coolant heaters, it might take more than 10 seconds to warm the engine before a load can be applied when ambient temperatures are below 4 °C (40 °F).

On generator sets equipped with a graphic display, the **Low Coolant Temperature** message, in conjunction with illumination of the Warning LED, is provided to meet the current requirements. The engine cold sensing logic initiates a warning when the engine jacket water coolant temperature falls below 21 °C (70 °F). In applications where the ambient temperature falls below 4 °C (40 °F), or there exists a high amount of cold airflow, the jacket water coolant heater may not provide the necessary heating. Under these conditions, although the generator set may start, it may not be able to accept load within 10 seconds. When this condition occurs, check the coolant heaters for proper operation. If the coolant heaters are operating properly, other precautions may be necessary to warm the engine before applying a load.

4.5 Product Modifications

Agency certified products purchased from Cummins comply only with those specific requirements and as noted on company product specification sheets. Subsequent modifications must meet commonly accepted engineering practices and/or local and national codes and standards. Product modifications must be submitted to the local authority having jurisdiction for approval.

This page is intentionally blank.

5 Specifications

5.1 Generator Set Specifications - QSK60 Engine

TABLE 1. DQKAD, DQKAE, AND DQKAF SPECIFICATIONS

Models	DQKAD	DQKAE	DQKAF
Engine			
Cummins Diesel Series	QSK60-G6	QSK60-G6	QSK60-G14
Generator kW Rating	See generator set nameplate for rating information.		
Engine Fuel Connection			
Inlet/Outlet Thread Size	Refer to the generator set outline drawing supplied in **Appendix D on page 169**.		
Maximum Weight			
Generator Set with P7 Alternator	Dry: 16182 kg (35675 lb); Wet: 16882 kg (37218 lb)		
Generator Set with P80 Alternator	Dry: 19150 kg (42218 lb); Wet: 19870 kg (43805 lb)		
Fuel			
Max. Fuel Inlet Restriction	33.9 kPa (10 inHg)		
Max. Fuel Inlet Temperature	71 °C (160 °F)		
Fuel Flow Rate	1037 L/hr (274 gal/hr)		
Exhaust			
Outlet Size	1800 RPM	1800 RPM	1800 RPM
Standby kW (kVA) Rating			
Max. Allowable Back Pressure	10 in. NB	10 in. NB	10 in. NB
Exhaust Flow at Rated Load	1750 kW (2187 kVA)	2000 kW (2500 kVA)	2250 kW (2812 kVA)
Exhaust Temperature	6.7 kPa (27 in H_2O)	6.7 kPa (27 in H_2O)	6.7 kPa (27 in H_2O)
Prime kW (kVA) Rating	378 m^3/min (13330 cfm)	436 m^3/min (15385 cfm)	473 m^3/min (16700 cfm)
Max. Allowable Back Pressure	463 °C (865 °F)	482 °C (900 °F)	474 °C (885 °F)
Exhaust Flow at Rated Load	1600 kW (2000 kVA)	1825 kW (2281 kVA)	1825 kW (2281 kVA)
Exhaust Temperature	6.7 kPa (27 in H_2O)	6.7 kPa (27 in H_2O)	6.7 kPa (27 in H_2O)
	360 m^3/min (12715 cfm)	385 m^3/min (13580 cfm)	402 m^3/min (14205 cfm)
	457 °C (855 °F)	466 °C (870 °F)	457 °C (855 °F)
Electrical System			
Starting Voltage	24 Volts DC		
Battery Group Number	8D		
Battery CCA	1400 A		
Genset Minimum CCA	2200 A		
Cold Soak @ 0 °F (-18 °C)	at -18 °C to 0 °C (0 °F to 32 °F)		
Required Battery Quantity	4 (Two 12 Volts batteries per starter)		

Models	DQKAD	DQKAE	DQKAF
Cooling System			
Capacity with 43° C High Ambient Radiator	537 Liters (142 US Gallons)		
Capacity with 50° C Enhanced High Ambient Radiator	606 Liters (160 US Gallons)		
Capacity with Spec D 50° C Enhanced High Ambient Radiator	677.89 Liters (179.08 US Gallons)		
Lubricating System			
Oil Capacity with Filters	280 Liters (74 US Gallons)		

5.2 Engine Fuel Consumption - QSK60 Engine

TABLE 2. FUEL CONSUMPTION (L/HR) AT 1800 RPM (60 HZ)

Model	DQKAD	DQKAE	DQKAF
Engine	**QSK60-G6 NR2**	**QSK60-G6 NR2**	**QSK60-G14 NR2**
Engine Performance Data at 60Hz[1]	**457**	**511**	**574.6**

1. Standby/Full Load

Refer to Data Sheets for other applications. In line with the Cummins inc policy of continuous improvement, these figures are subject to change.

TABLE 3. FUEL CONSUMPTION (GAL/HR) AT 1800 RPM (60 HZ)

Model	DQKAD	DQKAE	DQKAF
Engine	**QSK60-G6 NR2**	**QSK60-G6 NR2**	**QSK60-G14 NR2**
Engine Performance Data at 60Hz[1]	**120.6**	**135**	**151.8**

1. Standby/Full Load

Refer to Data Sheets for other applications. In line with the Cummins Inc policy of continuous improvement, these figures are subject to change.

6 Installing the Generator Set

Generator set installations must be engineered so that the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire regulations, and other applicable regulations.

Requirements to be considered prior to installation are:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of generator set air
- Non-combustible mounting surface
- Discharge of exhaust gases
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

NOTICE

Depending on the location and intended use, ensure that international, national or local laws and regulations regarding Air Quality Emissions have been observed and complied with. Be sure to consult local pollution control or air quality authorities before completing construction plans.

6.1 Transportation

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained and experienced personnel transport and handle generator sets and associated components.

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points. Do not stand under or near the generator set when lifting.

NOTICE

Any panels or doors must be locked before re-positioning and must remain locked during transportation and siting.

- Ensure the generator set is prepared for transport. If necessary drain fluids and ensure that acid or fumes do not leak from the battery (where applicable).
- If the generator set is transported over long distances, protect it against environmental influences by sealing it in a plastic cover or similar.
- Ensure the generator set is secured to the vehicle with suitable securing straps. Wooden chocks and pallets alongside the securing straps can prevent movement during transportation.
- If required, attached impact indicators to the generator set. Upon delivery, check these impact indicators and contact the transport company immediately if an impact has been detected. Impacts can cause serious damage to the generator set and its components.
- Ensure that the generator set cannot turn over during transportation.
- Do not overload the transport vehicle. Under no circumstances should the generator set be started while inside a truck.
- Lifting eyes, where fitted, are to be checked at regular intervals to ensure they are damage free and tight.

6.2 Location

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Incorrect installation

Incorrect installation of the generator set, service or parts replacement, can result in severe personal injury, death, and/or equipment damage.

Service personnel must be trained and experienced to perform electrical and mechanical component installation.

NOTICE

Depending on your location and intended use, additional laws and regulations may require for you to obtain an air quality emissions permit before beginning installation of your generator set. Be sure to consult local pollution control or air quality authorities before completing your construction plans.

Generator set location is decided mainly by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power service entrance. Exhaust gases must not be able to enter or accumulate around inhabited areas.

Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions.

Use the following information to locate the generator set for optimal operating conditions:

Surface: Concrete or compacted gravel with the generator set resting on solid, poured concrete blocks, or timber blocks spaced at reasonable intervals around the perimeter of the generator set.

Leveling: Level the generator set from side-to-side within + 3.5°, and end-to-end within +2.5°.

Placement:

- Generator sets should be a minimum of 5 m (16.4 ft) apart to allow for adequate access.
- Make sure that the air inlets are not obstructed by surrounding trees, buildings, or other obstructions.
- Make sure noise distribution (to prevent echoing) is kept to a minimum.
- Consider exhaust for immediate neighbors.
- The prevailing wind direction should be considered so that the engine combustion air inlet is upwind and the exhaust discharge is downwind.
- The immediate area around the proposed location of the mounting surface should be evaluated for proper drainage so that moisture run-off is sufficient to prevent ponding around the unit(s).

6.3 Moving the Generator Set

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained and experienced personnel transport and handle generator sets and associated components.

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points. Do not stand under or near the generator set when lifting.

⚠ WARNING

Mechanical Hazard

Failed components may be ejected or operate incorrectly which can cause severe personal injury or death.

Do not climb the generator set; this may damage critical parts.

NOTICE

Make sure that any shipping brackets supplied with the generator set are fitted, before moving the generator set. Failure to install the shipping brackets before moving may result in damage to the generator set.

NOTICE

Access or service doors must be closed and locked before repositioning, and they must remain locked during transportation and siting.

It is essential that there are sufficient trained and experienced personnel in attendance to make sure the lifting and transportation of the generator set is undertaken in a safe and appropriate manner, and in accordance to local guidelines and legislation.

Before lifting the generator set, lifting points, angle of slings, mass, access to intended site, and the distance of movement should all be taken into account when organizing a suitable crane/hoist. Consult the generator set information supplied with the generator set for details of dimensions and mass.

- Make sure that the crane operating area is able to support the mass of the crane and the generator set.
- Make sure the equipment used for lifting is adequate to support the weight of the generator set.
- Attach the lifting device to the lifting points only using suitable shackles, chains, and spreader bars.
- Slowly tighten the slings. Inspect the lifting attachments before commencing a full lift to make sure they are attached correctly.
- Hoist the generator set slowly using the indicated lifting points only.
- Guide the generator set with ropes at a safe distance to prevent uncontrolled rotation when positioning the generator set.
- Move the generator set to the desired location and place in position, bringing the set down slowly.
- Loosen the slings; unhook and remove the shackles.

6.4 Rigging Instructions

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points. Do not stand under or near the generator set when lifting.

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained and experienced personnel transport and handle generator sets and associated components.

1. Consult the generator set outline drawing for weight and center-of-gravity information.
2. Attach cables from the lifting lugs to a spreader bar. Never make the spreader bar cable attachment points wider than the attachment points on the skid or the bars. Make sure cables do not touch any other part of the generator set other than the skid.

NOTICE

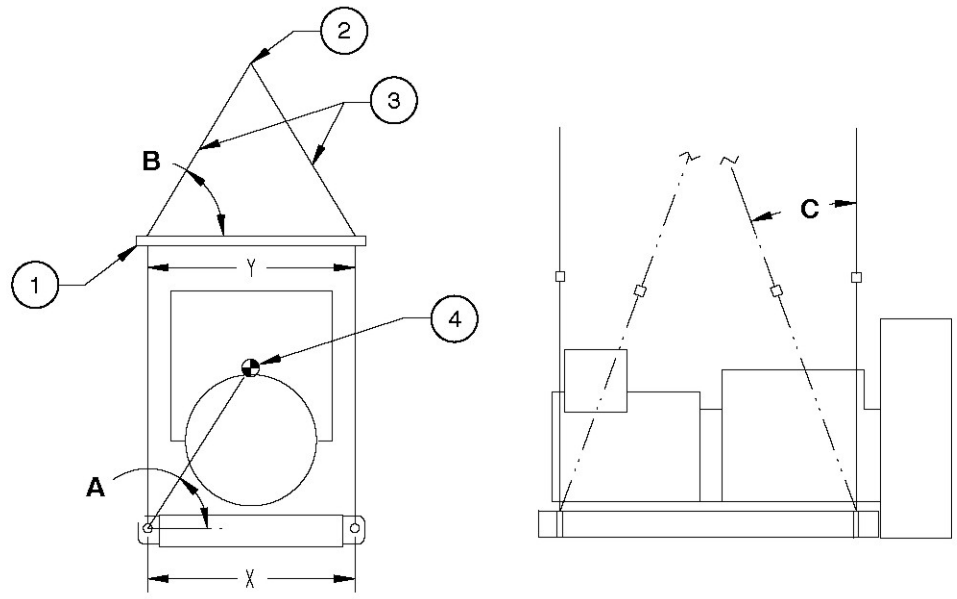
Spreader bar cable attach points width "Y" must never be wider than skid cable attach points "X." Distance "X" is the narrowest width.

NOTICE

Angle B must be slightly greater than angle A. Angle B should be as close to 90 degrees as possible to provide a stable lift.

3. With pedestal box (not shown), the spreader bars (front and back) should be used to clear the pedestal box and the attachment cables must be as vertical as possible.

NOTICE
The lifting angle (angle C) must not exceed 20° from vertical.



Item	Description	No.	Description
A	Angle A	1	Spreader Bar
B	Angle B	2	Lifting Point
C	Angle C (20° Maximum)	3	Lifting Cables
X	The Narrowest Width (On the Skid)	4	Center of Gravity
Y	This Distance Must be Less than Distance "X"		

FIGURE 5. RIGGING

6.5 Mounting

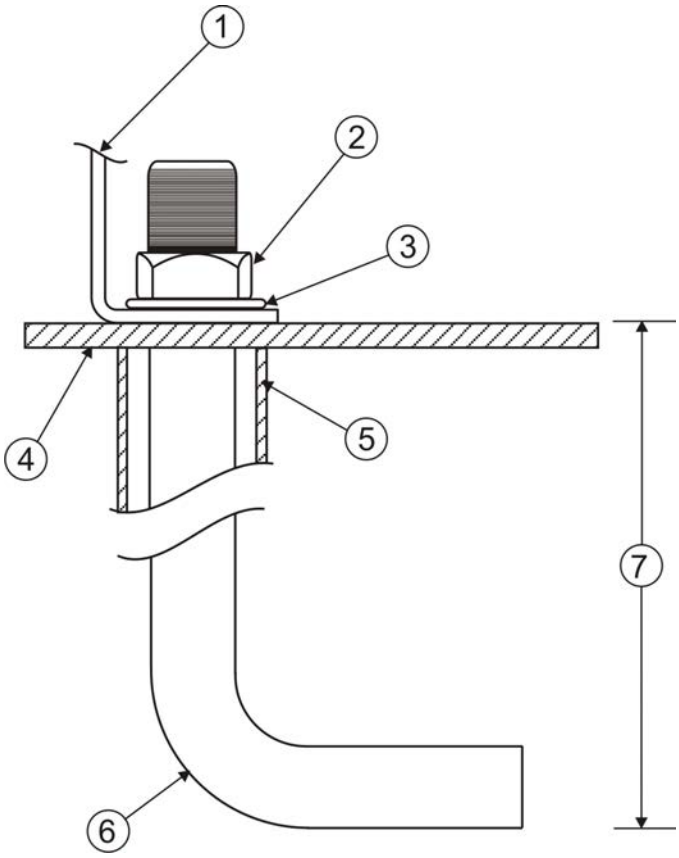
Generator sets are mounted on a steel skid that provides proper support. The engine-generator assembly is isolated from the skid frame by rubber mounts that provide adequate vibration isolation for normal installations. Where required by building codes or special isolation needs, generator sets may be mounted on rubber pads or mechanical spring isolators.

NOTICE
The use of unapproved isolators may result in harmful resonances and may void the generator set warranty.

Mount the generator set on a substantial and level base such as a concrete pad. A non-combustible material must be used for the pad.

Use 16 mm ($^5/_8$ in) or anchored mounting bolts to secure the generator set bedframe to the base. Use a flat washer and hexagonal nut for each bolt (see **Figure 6**). The 38 x 152 mm (1½ x 6 in) pipe inserted over the mounting bolts allows minor adjustment of the bolts to align them to the holes in the bedframe.

The fixing centers for the mounting bolts can be found on the generator set *Outline Drawing*.



No.	Description	No.	Description
1	Generator Bedframe Flange	5	38 mm x 152 mm Pipe (1½ inch x 6 inch)
2	Hexagonal Nut	6	Mounting Bolt Set in Concrete
3	Flat or Bevel Washer	7	305 mm (12 inch)
4	Mounting Base on Concrete		

FIGURE 6. BOLT DIAGRAM

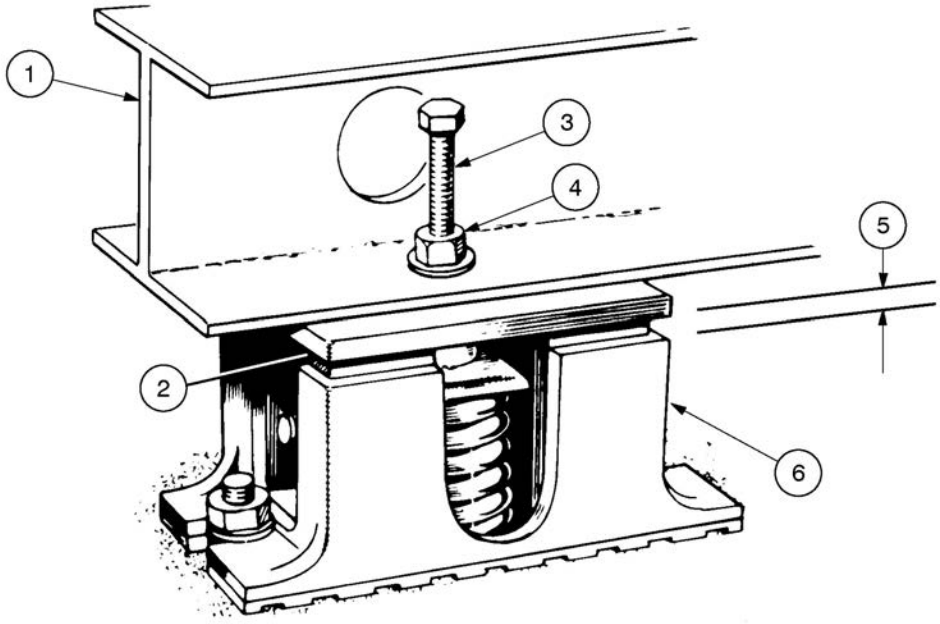
6.6 Access to Generator Set

Generally, at least 1 meter (3.3 ft) of clearance should be provided on all sides of the generator set for maintenance and service access. (Increase clearance by width of door if optional housing is used.) A raised foundation or slab of 152 mm (6 in) or more above floor level will make servicing easier. Lighting should be adequate for operation, maintenance and service operations and should be connected on the load side of the transfer switch so that it is available at all times.

6.7 Vibration Isolator Installation and Adjustment Procedure

1. Place the vibration isolators (see **Figure 7**) on the generator set support structure. The isolators should be shimmed or grouted to make sure that all of the isolator bases are within 0.25 inch (6 mm) elevation of each other. The surface that the isolator bases rest on must also be flat and level.
2. Loosen the side snubber lock nuts so that the top plate of the isolator is free to move vertically and horizontally. Be sure that the top plate is correctly aligned with the base and springs.
3. Place the generator set onto the isolators while aligning the skid's mounting with the threaded isolator hole. The top plates will move down and approach the base of the isolator as load is applied.
4. Once the generator set is in position, the isolators may require adjusting so that the set is level. The isolators are adjusted by inserting the leveling bolt through the skid and into the isolator (the leveling bolt's locking nut should be threaded up towards the bolt head).

   The leveling bolt will adjust the clearance between the top plate and the isolator base. A nominal clearance of 0.25 inch (6 mm) or greater is desired. This will provide sufficient clearance for the rocking that occurs during startup and shutdown. If the 0.25 inch (6 mm) clearance is not present, turn the leveling bolt until the desired clearance is achieved.
5. If the radiator and engine are mounted on separate skids, make sure the radiator skid and engine/alternator skid are level with each other after adjusting the isolators. If not level, proper fan belt alignment cannot be achieved.
6. If the generator set is not yet level, adjust the leveling bolts until the set is level and sufficient clearance still remains. (Clearance on all isolators should be roughly equal).
7. Once all isolators have been set, lock the leveling bolt in place with the lock nut.
8. The snubber nuts must remain loose to provide better isolation between the generator set and the support structure.



No.	Description	No.	Description
1	Skid	4	Lock Nut
2	Snubber	5	Clearance
3	Leveling Bolt	6	Base

FIGURE 7. VIBRATION ISOLATOR INSTALLATION

6.8 Generator Set Long Term Storage

If long term storage of the generator set is required refer to the Long Term Storage section in the generator set service manual. Long term storage procedures must be repeated every 12 months for Modular Common Rail Fuel System (MCRS) fuel equipped engines.

7 Mechanical Connections

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation, and cooling systems. Before starting any type of fuel installation, all pertinent state and local codes must be complied with and the installation must be inspected before the unit is put in service.

7.1 Fuel System

Cummins engines normally use a diesel fuel specified to ASTM D975 grade 2 or BS EN 590:2000 is for automotive diesel, BS 2869:2010+A1:2011 Fuel oils for agricultural, domestic and industrial engines and boilers.

In all fuel system installations, cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture, dirt, or contaminants of any kind into the fuel system. Clean all fuel system components before installing.

NOTICE
A fuel filter/strainer/water separator of 100-120 mesh or equivalent (approximately 150 microns nominal) must be fitted between either the main tank and day tank, or between the main tank and the engine.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Buried fuel lines must be protected from corrosion.

NOTICE
Never use galvanized or copper fuel lines, fittings, or fuel tanks. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.

An electric solenoid valve in the supply line is recommended for all installations and required for indoor automatic or remote starting installations. Connect the solenoid wires to the generator set “Switched B+” circuit to open the valve during generator set operation.

Separate fuel return lines to the day tank or supply tank must be provided for each generator set in a multiple-set installation to prevent the return lines of idle sets from being pressurized. Fuel return lines must not contain a shutoff device. Engine damage will occur if the engine is run with the return fuel lines blocked or restricted.

NOTICE
Never install a shutoff device in fuel return line(s). If fuel return line(s) is blocked or exceeds fuel restriction limit, engine damage will occur.

NOTICE
A base mounted fuel tank may be part of the generator set build. An additional external fuel system may be required if the on board fuel capacity is not sufficient for the application.

7.1.1 Fuel Return Restrictions (or Pressure) Limit

Fuel return drain restriction (consisting of friction head and static head) between the engine injector return line connection and the fuel tank must not exceed the limit stated in the model-specific generator set *Specification Sheet*.

7.1.2 Fuel Line Connections

⚠ WARNING

Combustible Liquid

Fuel leaks are a fire and explosion hazard which can cause severe personal injury or death.

Always use flexible tubing between the engine and fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet all application codes.

⚠ WARNING

Combustible Liquid

Ignition of fuel is a fire and explosion hazard which can cause severe personal injury or death.

Do not route fuel lines near electrical wiring.

⚠ WARNING

Hot Surface

Hot surfaces can ignite fuel. Ignited fuel is a fire and explosion hazard which can cause severe burns or death.

Do not route fuel lines near hot exhaust parts.

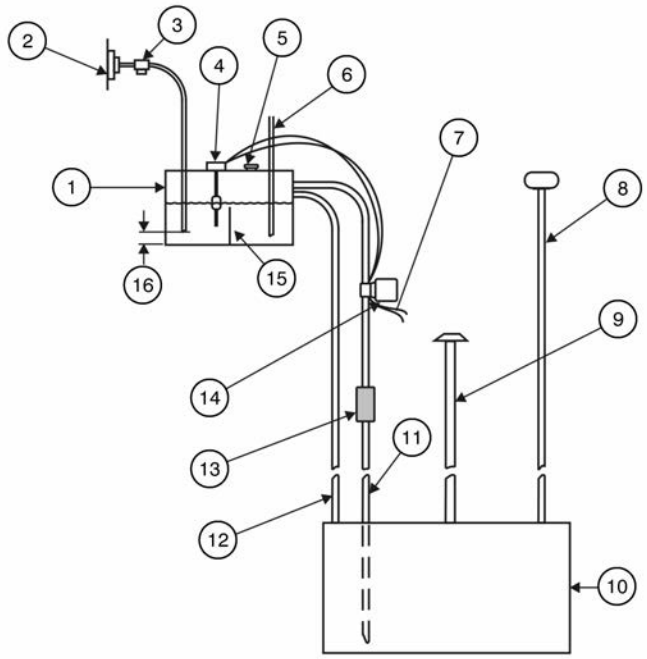
NOTICE

Fuel lines must be routed and secured to maintain a 12.7 mm (½ inch) minimum clearance from electrical wiring and a 51 mm (2 inch) minimum clearance from hot exhaust parts.

Flexible lines for connecting between the engine and the skid mounted fuel tank (if fitted) are supplied as standard equipment.

Flexible lines for connecting between the engine and an external fuel supply must be used between the engine fuel system, and the fuel supply and return lines to protect the fuel system from damage caused by vibration, expansion, and contraction.

For additional information refer to T-030 Application Manual.



No.	Description	No.	Description
1	Day Tank/Skid Mounted Fuel Tank	9	Fill Pipe
2	Engine Fuel Pump	10	Main Fuel Tank
3	Shut Off Valve	11	Supply Line
4	Float Switch	12	Larger Overflow Line 120 Mesh Fuel Strainer
5	Vented Fill Cap	13	120 Mesh Fuel Strainer
6	Injector Fuel Return Line	14	Fuel Transfer Pump Electric Motor Driven
7	Connect to AC Output	15	Baffle
8	Vent Pipe	16	25.4 mm (1 inch) Clearance

FIGURE 8. TYPICAL FUEL SUPPLY INSTALLATION

7.1.3 Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections. All models require a fuel return line from the injectors to the tank.

7.1.4 Supply Tank

The fuel supply tank, day tank, or other reservoir must be arranged so that the highest fuel level does not exceed the maximum height above the fuel injectors specified for the engine. The lowest level must not fall below the specified lift height of the engine fuel lift pump. In critical start applications, the lowest level should not be less than 150 mm (6 inches) above the engine fuel pump inlet to make sure there is no air in the fuel line during startup. Provisions must be made for draining or pumping out water.

For critical start applications, where generator sets are paralleled or must satisfy emergency start-time requirements, it is recommended that a fuel tank or reservoir be located such that the lowest possible fuel level is not less than 150 mm (6 in) above the fuel pump inlet. This will prevent air from accumulating in the fuel line while the generator set is in standby, eliminating the period during startup when it has to be purged.

Locate the fuel tank as close as possible to the generator set and within the restriction limitations of the fuel pump.

Install a fuel tank that has sufficient capacity to supply the generator set depending on its application:

- Continuous power
- Prime power
- Standby power

Refer to the Model Specifications section for fuel consumption data.

If the fuel inlet restriction exceeds the defined limit due to the distance/customer-supplied plumbing between the generator set and the main fuel tank, a transfer tank (sometimes referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components.

For additional information on the size and installation of a supply tank for the application, consult your local authorized Cummins distributor or dealer.

7.1.5 Fuel Inlet Pressure/Restriction Limit

Engine performance and fuel system durability is compromised if the fuel inlet pressure or restriction limits are not adhered to. Fuel inlet pressure or restriction must not exceed the limits stated in the model-specific generator set *Specification Sheet*.

7.1.6 Fuel Filters

Some generator sets require the installation of a fuel filter kit as part of the installation of the generator set.

7.1.6.1 Fuel Filters

The types of fuel filters that are available are:

- Single Fuel Filter - Standard filter for standby applications
- Duplex Fuel Filter - Optional filter for standby or prime applications
- Dual Fuel Filter - Optional filter for standby applications
- Triple Fuel Filter - Standard filter for prime applications
- Triplex Fuel Filter - Optional filter for standby or prime applications

The fuel filter assembly provides an all-in-one fuel filtration, fuel/water separator, and fuel warmer system.

The filter cover allows you to view the fuel level. When new, the fuel level in the filter is low. As it is used, the fuel level rises to show how much filter life remains.

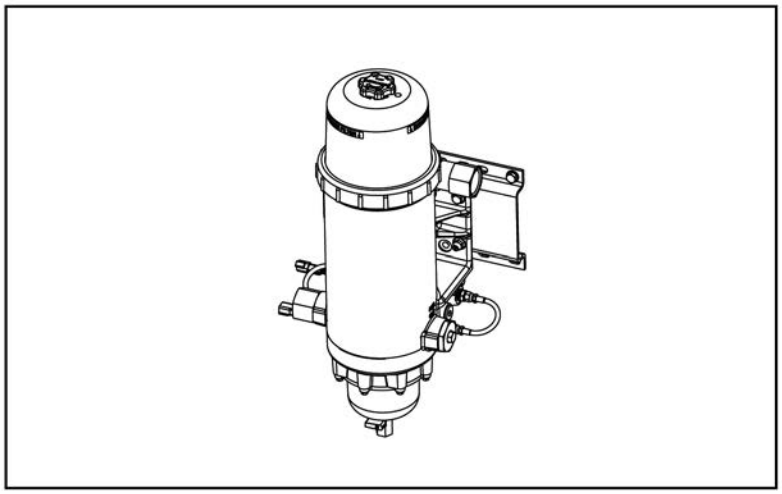


FIGURE 9. SINGLE TALL FUEL FILTER

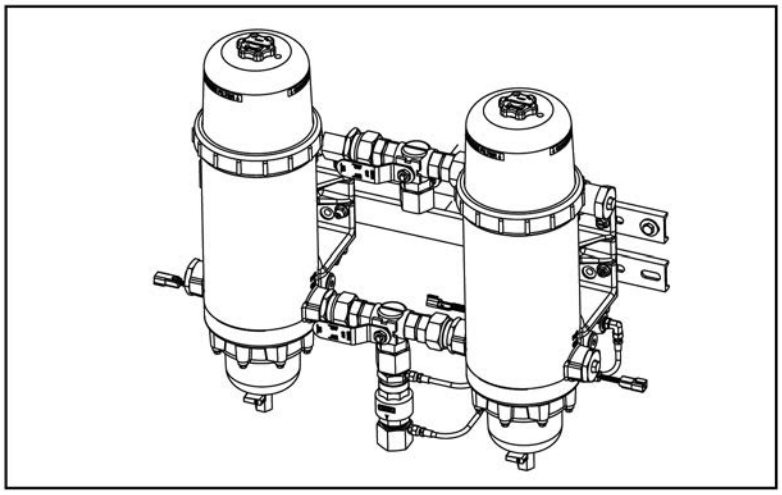


FIGURE 10. DUPLEX FUEL FILTER

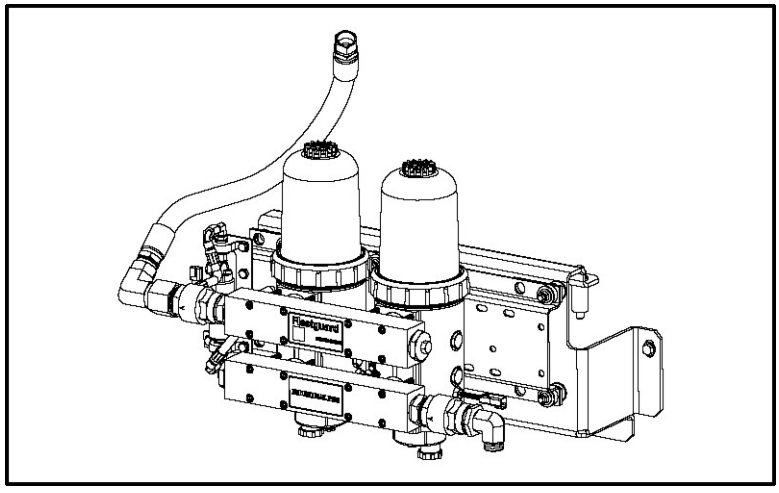


FIGURE 11. DUAL FUEL FILTER

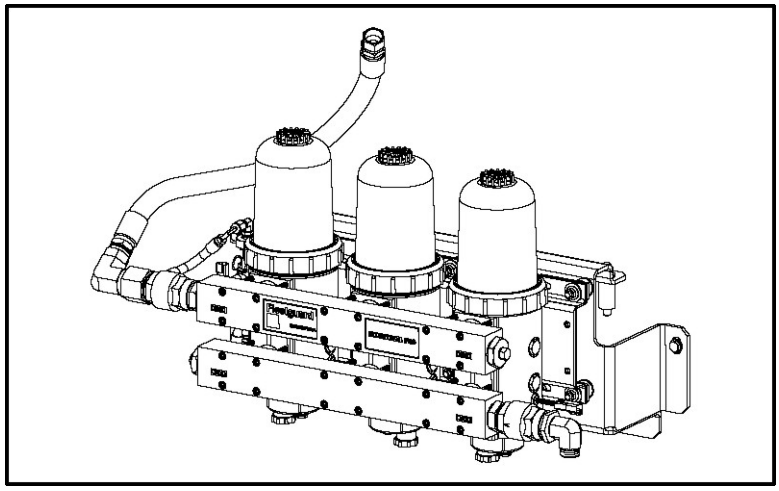


FIGURE 12. TRIPLE FUEL FILTER

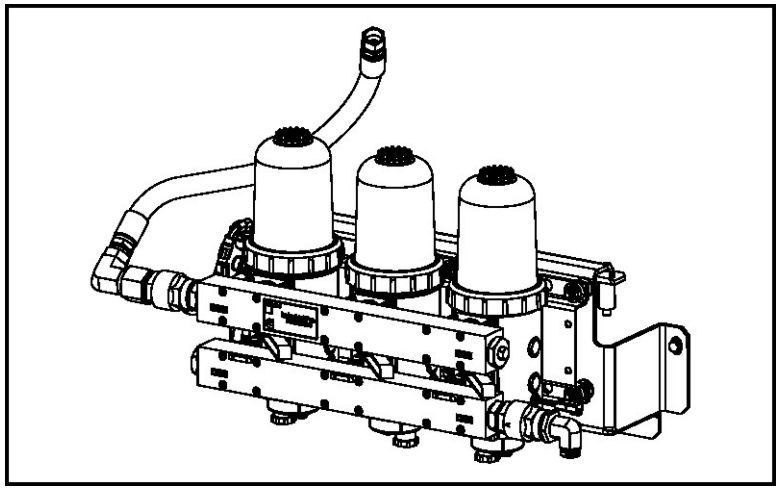
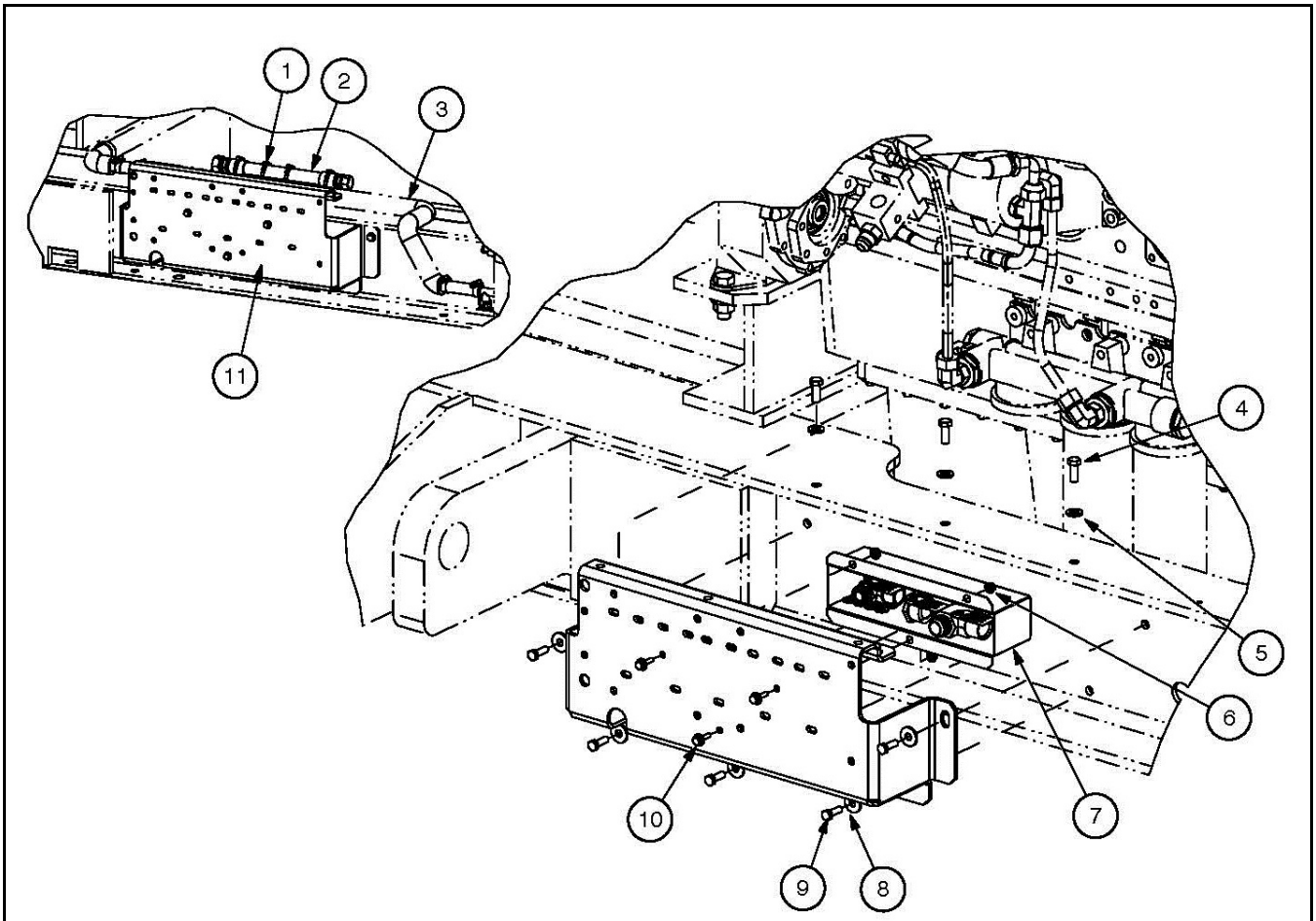


FIGURE 13. TRIPLEX FUEL FILTER

7.1.6.1.1 Fuel Filter Mounting Kit Removal

When shipped from the factory, the fuel filter mounting kit is secured to the skid.



No.	Description	No.	Description
1	Tie Wrap	7	Stock Box
2	Fuel Line	8	Flat Washer
3	Heater Tube	9	Hex Head Screw
4	Hex Head Bolt	10	M8 Hex Head Screw
5	Flat Washer	11	Fuel Filter Mounting Bracket
6	M8 Hex Head Nut		

FIGURE 14. PRE-INSTALLED FUEL FILTER MOUNTING KIT

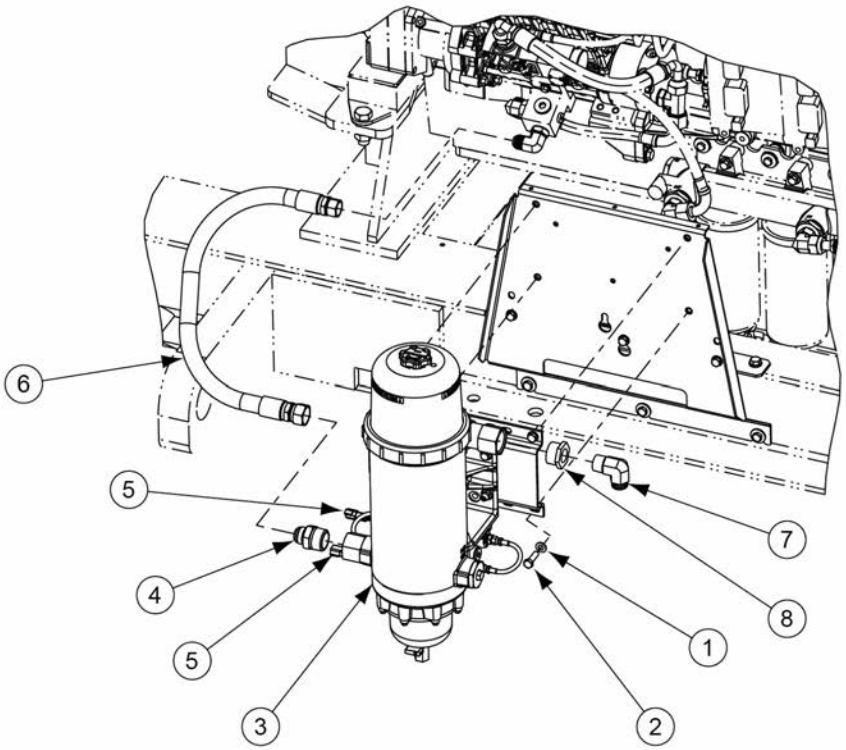
To remove the fuel filter mounting kit from the skid,

1. Cut the tie wraps (item 1) and remove the fuel line (item 2).
2. Remove the five hex head screws and washers (items 8 and 9) securing the fuel filter mounting bracket (item 11) to the side of the skid.
3. Remove the three screws and nuts (items 6 and 10) securing the stock box (item 7) to the inside of the fuel filter mounting bracket.
4. Remove the contents of the stock box (includes three fittings (two elbows and one reducer, each having a fuel tag) and a plastic bag containing eight washers and six cable ties).

5. Discard the stock box and its mounting hardware.

7.1.6.1.2 Single Fuel Filter Kit Installation

Figure 16 shows the installation of the fuel filter kit.



No.	Description	No.	Description
1	Washer M10	5	Electrical Connectors (Two)
2	Screw M10 x 35	6	Fuel Line - Hose
3	Fuel Filter Assembly - Single	7	Pipe Elbow - 1 to 1 1-3/16 ORFS
4	Pipe Adapter - 1-5/16 flare 1-1/4 NPT	8	Pipe Reducer - 1-1/4 to 1 NPT

FIGURE 15. SINGLE FUEL FILTER KIT INSTALLATION

⚠ WARNING

Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical component installations.

⚠ WARNING

AC voltages and currents present an electrical 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. Only trained and experienced personnel are to perform the following procedures.

Turn off or remove AC power from the battery charger and then remove the negative (–) battery cable from the set starting battery. This is to make sure the set will not start while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

⚠ CAUTION

If present, 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 of the generator set.

⚠ WARNING

Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).

Make certain the battery area has been well-ventilated before servicing the battery. Wear goggles. Stop the generator set and disconnect the charger before disconnecting battery cables. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when a cable is removed or re-attached, or when the negative (–) battery cable is connected and a tool used to connect or disconnect the positive (+) battery cable touches the frame or other grounded metal part of the generator set. Always remove the negative (–) cable first, and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near a battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

Ventilate the battery area before working on or near the battery. Wear goggles. Stop the generator set and disconnect the battery charger before disconnecting battery cables-Disconnect the negative (–) cable first and reconnect it last.

To install the fuel filter assembly on the skid:

1. Make sure the generator set is disabled.
   a. Press the STOP button on the operator panel to make sure the control is in the Off mode.
   b. Activate the E-stop button and wait one minute.

      ⚠ WARNING

      Disconnect the battery charger from its AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes which can cause damage to the DC control circuits of the generator set.

   c. If equipped, disconnect the battery charger. Remove any other electrical supply sources.
   d. Disconnect the generator set negative (–) battery cable.
2. Disconnect the negative (–) cable from the starting battery to prevent accidental starting.
3. If not already removed, remove the box - stock, keep the contents. Discard the box and M8 mounting screws and nuts.
4. Use four M10 screws and flat washers (items 1 and 2) to secure the fuel filter bracket to the mounting plate (secured to the skid at the factory). Torque the screws to 50–61 Nm (37–45 ft-lbs).

5. Remove the cap from the fuel inlet port of the engine.
6. Cut the cable ties securing the fuel line pipe (item 6) to the skid.
7. Apply thread sealant and install the fuel line (item 6) to the elbow on the upper part of the fuel filter pump.
8. Apply thread sealant and install the pipe adapter (item 4) to the fuel filter.
9. Connect the fuel line (item 6) to the fuel inlet connector (item 4).
10. Apply thread sealant and install the 1-1/4 to 1-inch reducer (item 8) on the side of the fuel filter.
11. Apply thread sealant and install the elbow (item 7) on the reducer (item 8).
12. Connect the engine harness to the respective WIF and lift pump fuel filter harness connector (item 5).
13. Apply thread sealant an connect the fuel supply line to the fuel inlet (item 7) on the fuel filter assembly.
14. Reconnect the negative (–) cable to the starting battery.
15. Reconnect the battery charger (if equipped).
16. Twist and release the Stop button (if locked).
17. Open the fuel shutoff valve (if equipped).
18. Prime the fuel system. Start the generator set and check for fuel leaks. If any fuel leaks are discovered, make sure they are fixed before placing the generator set in service.

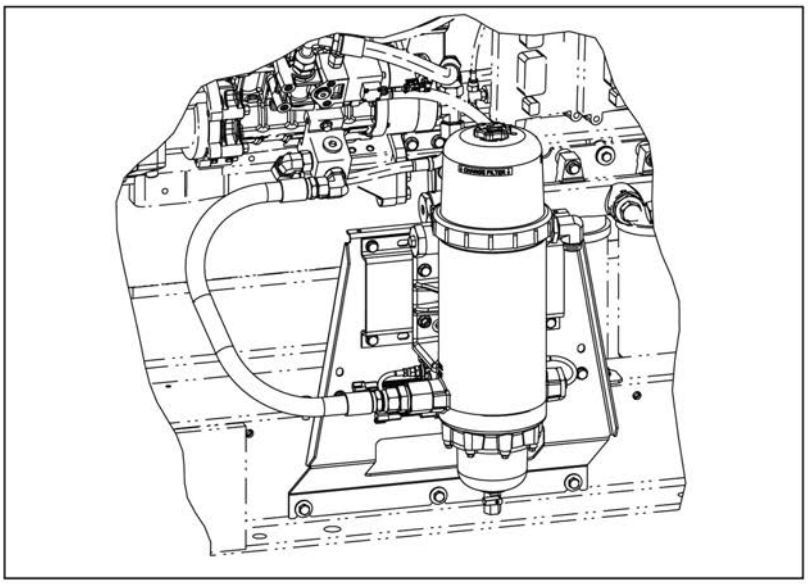
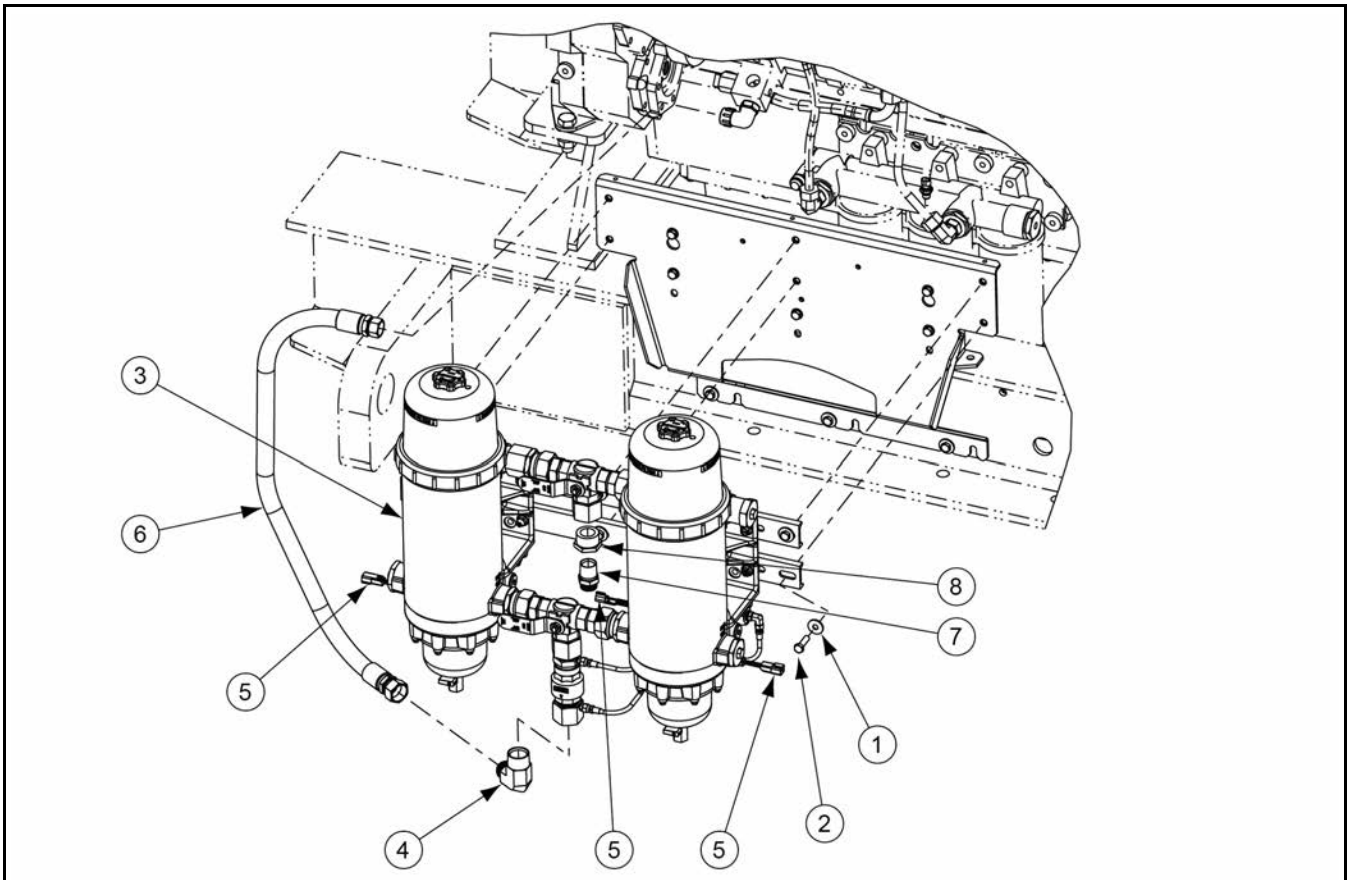


FIGURE 16. INSTALLED FUEL FILTER ASSEMBLY

7.1.6.1.3 Duplex Fuel Filter Kit Installation

Figure 18 shows the installation of the fuel filter kit.



No.	Description	No.	Description
1	Washer M10 (6 off)	5	Electrical Connectors (Three)
2	Screw M10 x 35 (6 off)	6	Fuel Line - Hose
3	Fuel Filter Assembly - Duplex	7	Pipe Adapter - 1 to 1 1-3/16 ORFS
4	Pipe Elbow - 1-5/16 flare 1-1/4 NPT	8	Pipe Reducer - 1-1/4 to 1 NPT

FIGURE 17. DUPLEX FUEL FILTER KIT INSTALLATION

⚠ WARNING

Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical component installations.

⚠ WARNING

AC voltages and currents present an electrical 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. Only trained and experienced personnel are to perform the following procedures.

Turn off or remove AC power from the battery charger and then remove the negative (–) battery cable from the set starting battery. This is to make sure the set will not start while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

⚠ CAUTION

If present, 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 of the generator set.

⚠ WARNING

Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).

Make certain the battery area has been well-ventilated before servicing the battery. Wear goggles. Stop the generator set and disconnect the charger before disconnecting battery cables. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when a cable is removed or re-attached, or when the negative (–) battery cable is connected and a tool used to connect or disconnect the positive (+) battery cable touches the frame or other grounded metal part of the generator set. Always remove the negative (–) cable first, and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near a battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

Ventilate the battery area before working on or near the battery. Wear goggles. Stop the generator set and disconnect the battery charger before disconnecting battery cables-Disconnect the negative (–) cable first and reconnect it last.

To install the fuel filter assembly on the skid:

1. Make sure the generator set is disabled.
   a. Press the STOP button on the operator panel to make sure the control is in the Off mode.
   b. Activate the E-stop button and wait one minute.

      ⚠ WARNING

      Disconnect the battery charger from its AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes which can cause damage to the DC control circuits of the generator set.

   c. If equipped, disconnect the battery charger. Remove any other electrical supply sources.
   d. Disconnect the generator set negative (**–**) battery cable.
2. Disconnect the negative (**–**) cable from the starting battery to prevent accidental starting.
3. If not already removed, remove the box - stock, keep the contents. Discard the box and M8 mounting screws and nuts.
4. Use six M10 screws and flat washers (items 1 and 2) to secure the fuel filter bracket to the mounting plate (secured to the skid at the factory). Torque the screws to 50–61 Nm (37–45 ft-lbs).
5. Remove the cap from the fuel inlet port of the engine.
6. Cut the cable ties securing the fuel line pipe (tem 6) to the skid.

7. Apply thread sealant and install the fuel line (item 6) to the elbow on the upper part of the fuel filter pump.
8. Apply thread sealant and install the elbow (item 4) to the bottom of the fuel filter.
9. Connect the fuel line (item 6) to the fuel inlet connector (item 4).
10. Apply thread sealant and install the 1-1/4 to 1-inch reducer (item 8) to the upper pipe assembly of the fuel filter.
11. Apply thread sealant and install the adapter (item 7) on the reducer (item 8).
12. Connect the engine harness to the respective WIF and lift pump fuel filter harness connector (item 5).
13. Apply thread sealant an connect the fuel supply line to the fuel inlet (item 7) on the fuel filter assembly.
14. Reconnect the negative (–) cable to the starting battery.
15. Reconnect the battery charger (if equipped).
16. Twist and release the Stop button (if locked).
17. Open the fuel shutoff valve (if equipped).
18. Prime the fuel system. Start the generator set and check for fuel leaks. If any fuel leaks are discovered, make sure they are fixed before placing the generator set in service.

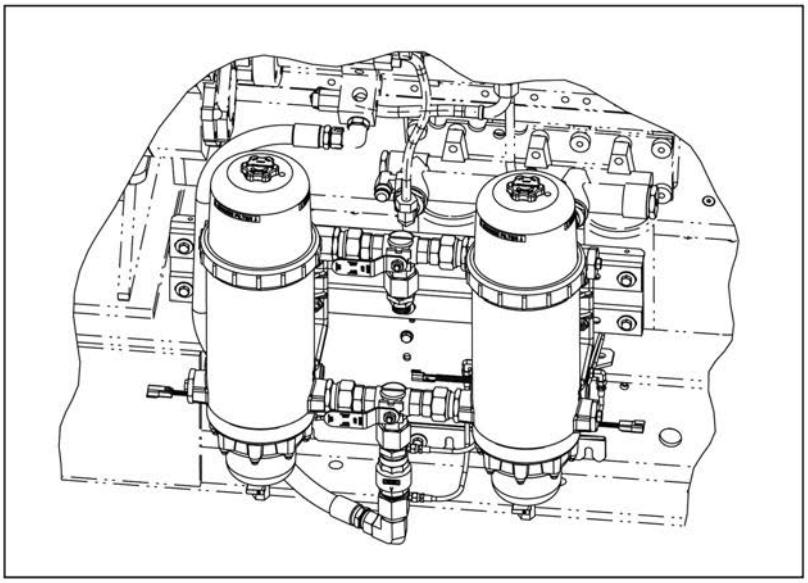


FIGURE 18. INSTALLED FUEL FILTER ASSEMBLY

7.1.6.1.4 Double and Triplex Fuel Filter Kit Installation

⚠ WARNING

Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical component installations.

⚠ WARNING

AC voltages and currents present an electrical 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. Only trained and experienced personnel are to perform the following procedures.

Turn off or remove AC power from the battery charger and then remove the negative (**–**) battery cable from the set starting battery. This is to make sure the set will not start while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

⚠ WARNING

Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables, negative (–) first).

- ***Make certain the battery area has been well-ventilated before servicing the battery.***
- ***Wear goggles.***
- ***Stop the generator set and disconnect the charger before disconnecting battery cables.***
- ***Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when a cable is removed or re-attached, or when the negative (–) battery cable is connected and a tool used to connect or disconnect the positive (+) battery cable touches the frame or other grounded metal part of the generator set.***
  - ***Always remove the negative (–) cable first, and reconnect it last.***
  - ***Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.***

⚠ WARNING

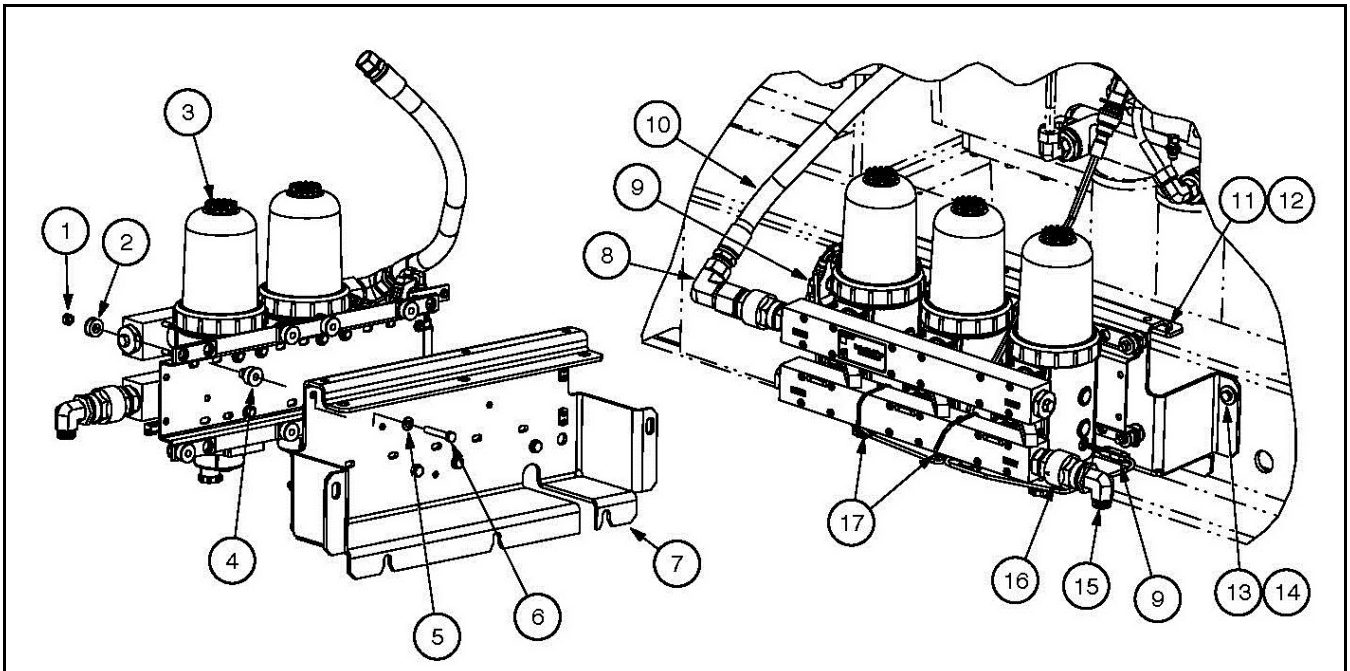
Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near a battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

- ***Ventilate the battery area before working on or near the battery.***
- ***Wear goggles.***
- ***Stop the generator set and disconnect the battery charger before disconnecting battery cables. Disconnect the negative (–) cable first and reconnect it last.***

⚠ CAUTION

If present, 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 of the generator set.

The figure below shows the installation of the fuel filter kit:



No.	Description	No.	Description
1	Flange Nut (M10 x 1.5)	10	Fuel Line
2	Isolator Ring	11	Hex Head Screw
3	Fuel Filter and Pump Assembly	12	Flat Washer
4	Isolator	13	Hex Head Screw (M12)
5	Flat Washer (3/8 inch) Fuel Filter Harness Connector	14	Flat Washer (M12)
6	Hex Head Screw (3/8-16 x 1 inch) Hex Head Screw (M10 x 30mm)	15	Tube Elbow (1 NPT x 1 3/16 ORFS)
7	Fuel Filter Bracket Flat Washer (M10)	16	Reducer (1 1/4 x 1 NPT)
8	Tube Elbow (1 5/16-12 x 1 1/4 NPT)	17	Cable Ties
9	Electrical Harness Connection		

FIGURE 19. FUEL FILTER KIT INSTALLATION (DUAL FILTER SHOWN)

To install the fuel filter assembly on the skid,

1. Make sure the generator set is disabled.
   a. Press the STOP button on the operator panel to make sure the control is in the Off mode.
   b. Activate the E-stop button and wait one minute.

⚠ WARNING

Disconnect the battery charger from its AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes which can cause damage to the DC control circuits of the generator set.

c. If equipped, disconnect the battery charger. Remove any other electrical supply sources.

d. Disconnect the generator set negative (–) battery cable.

2. Disconnect the negative (–) cable from the starting battery to prevent accidental starting.
3. Secure the fuel filter and pump assembly (item 3) to the fuel filter bracket (item 7) using the provided eight flange nuts, isolator rings, isolator, flat washers, and hex head screws (items 1, 2, 4, 5, and 6). Torque the M10 flange nuts to 50–61 Nm (37–45 ft-lb).
4. Use five M10 screws and flat washers (items 13 and 14) to secure the fuel filter bracket to the side of the skid. Torque the screws to 50–61 Nm (37–45 ft-lb).
5. Use three screws and flat washers (items 11 and 12) to secure the fuel filter bracket to the top of the skid. Torque to 90–109 Nm (66–81 ft-lb).
6. Remove the cap from the fuel inlet port of the engine.
7. Apply thread sealant and install the 1-5/16 inch elbow (item 8) on the upper part of the fuel filter pump.
8. Install the fuel line to the elbow installed above.
9. Apply thread sealant and install the 1-1/4 to 1-inch reducer (item 16) on the lower part of the fuel filter pump.
10. Apply thread sealant and install the 1-inch elbow (item 15) on the reducer.
11. Connect the fuel line (item 10) to the fuel inlet connector.
12. Connect the engine harness to the respective WIF and lift pump fuel filter harness connectors (item 9).
13. Reconnect the negative (–) cable to the starting battery.
14. Reconnect the battery charger (if equipped).
15. Open the fuel shutoff valve (if equipped).
16. Prime the fuel system.
17. Start the generator set and check for fuel leaks. If any fuel leaks are discovered, make sure they are fixed before placing the generator set in service.

7.2 Exhaust System

⚠ WARNING

Toxic Gases

Inhalation of exhaust gases can cause asphyxiation and death.

Use extreme care during installation to provide a tight exhaust system. Terminate exhaust pipes away from enclosed or sheltered areas, windows, doors, and vents. Do not use exhaust heat to warm a room, compartment, or storage area.

⚠ WARNING

Hot Surface

Hot surfaces can start a fire which can cause severe burns or death.

Use an approved thimble where exhaust pipes pass through wall or partitions.

NOTICE

Weight applied to the engine manifold can result in turbocharger damage. Support the silencer and exhaust piping so no weight or stress is applied to the engine exhaust elbow.

NOTICE

Gaseous fuels are susceptible to high condensation levels in the exhaust. It is important to have properly routed/sized exhaust systems to prevent harm to turbochargers and Oxygen sensors (HEGO).

NOTICE

Liability for injury, death, damage, and warranty expense due to use of unapproved silencers or modifications to the exhaust system becomes the responsibility of the person installing the unapproved silencer or performing the modification. Contact your authorized distributor for approved exhaust system parts.

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlets away from any air inlets to avoid gases re-entering the enclosure. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation, and light loads. Regularly inspect the exhaust system both visually and audibly to see that the entire system remains fume tight and safe for operation.

NOTICE

Enclosed generator sets are not generally designed to be used in a building. If the generator set is to be used in a building, additional requirements must be applied.

Where an enclosed generator set is used in a building, the exhaust system should be extended to vent the exhaust gases. Use sealed joint type fittings where possible to provide a tight exhaust system. Use of slip type fittings (secured with a clamp) may allow leakage of exhaust gases into the building if not fitted correctly. Check to make sure there are no exhaust leaks.

When a unit is provided with a partially installed or incomplete exhaust system, exhaust piping and chimneys shall be designed, constructed, and installed in accordance with the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, or applicable local standards. Build according to the code requirements in effect at the installation site.

For indoor installation, the exhaust system should use sealed joint type fittings where possible to provide a tight exhaust system. Use of slip type fittings (secured with a clamp) may allow leakage of exhaust gases into the building if not fitted correctly fitted. Check to make sure there are no exhaust leaks.

Use an approved thimble (see **Figure 20 on page 54**) where exhaust pipes pass through a wall or partition. Insulated wall/roof thimbles are used where exhaust pipes pass through a combustible roof or wall. This includes structures, such as wood framing or insulated steel decking, etc. Uninsulated wall/roof thimbles are used where exhaust pipes pass through a non-combustible wall or roof, such as concrete. When a unit is provided with a partially installed or incomplete exhaust system, exhaust piping and chimneys shall be designed, constructed, and installed in accordance with the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, or applicable local standards. Build according to the code requirements in effect at the installation site.

Rain caps are available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

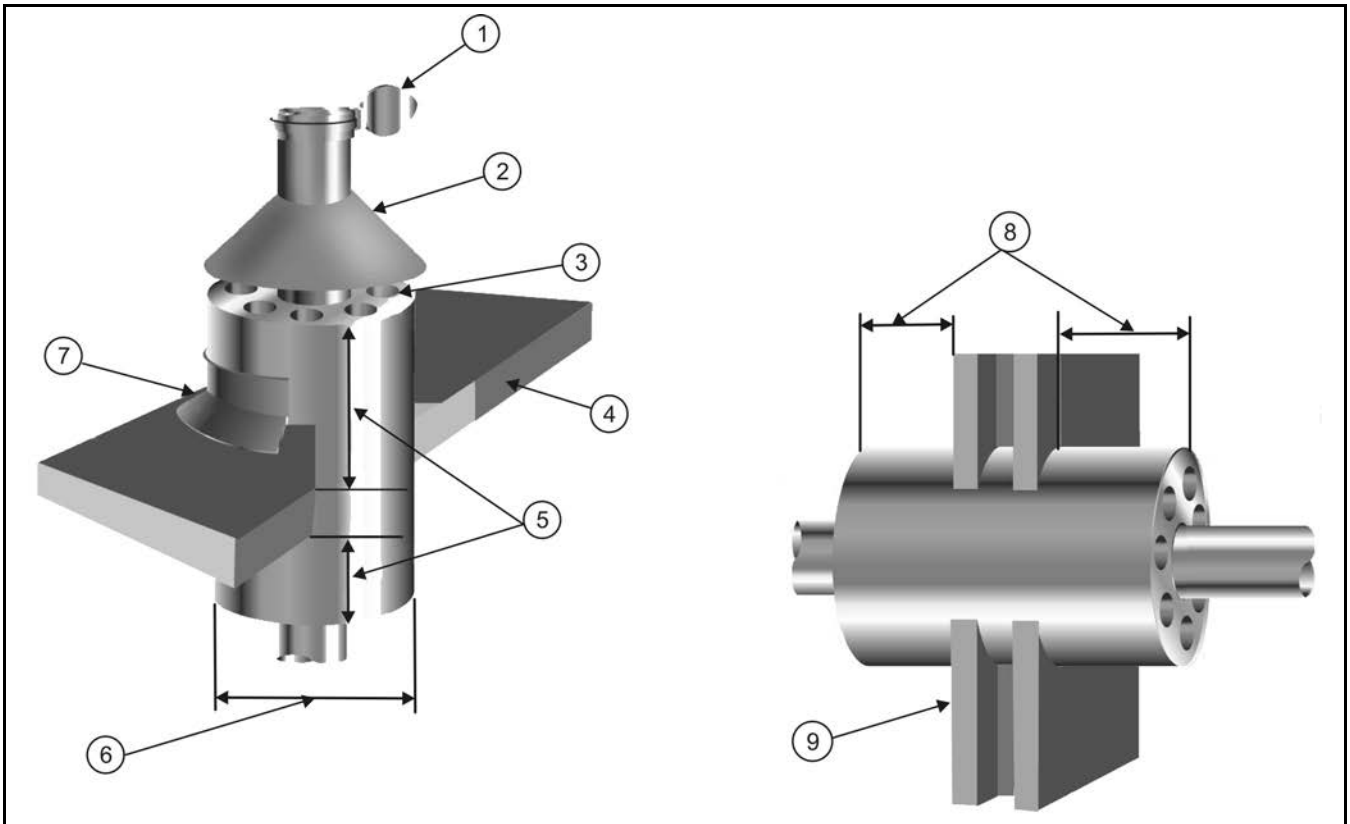
Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support the exhaust system to prevent weight from being applied to engine exhaust outlet elbow/turbocharger connection.

The exhaust system design should meet local code requirements.

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for the silencer and tailpipe. Pitch a horizontal run of exhaust pipe downward (away from engine) to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (see **Figure 21 on page 55**).

Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 305 mm (12 inches) of clearance if the pipes pass close to a combustible wall or partition. Before installing insulation on exhaust system components, check the exhaust system for leaks while operating the generator set under full load and correct all leaks.

Refer to Application Manual T-030, *Liquid Cooled Generator Sets* for more detailed information about sizes of exhaust system pipes and fittings.



No.	Description	No.	Description
1	Rain Cap	6	Exhaust Pipe Diameter Plus 304 mm (12 Inches)
2	Drip Cap	7	Flashing
3	Holes in End of Inner Sleeve	8	230 mm (9 Inches) Minimum
4	Roof	9	Outside or Dividing Wall
5	230 mm (9 inches) Minimum		

FIGURE 20. EXHAUST THIMBLE

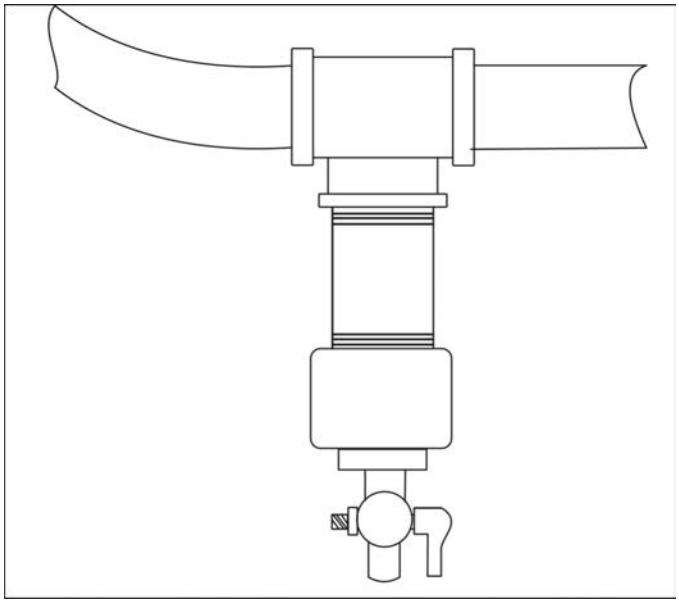
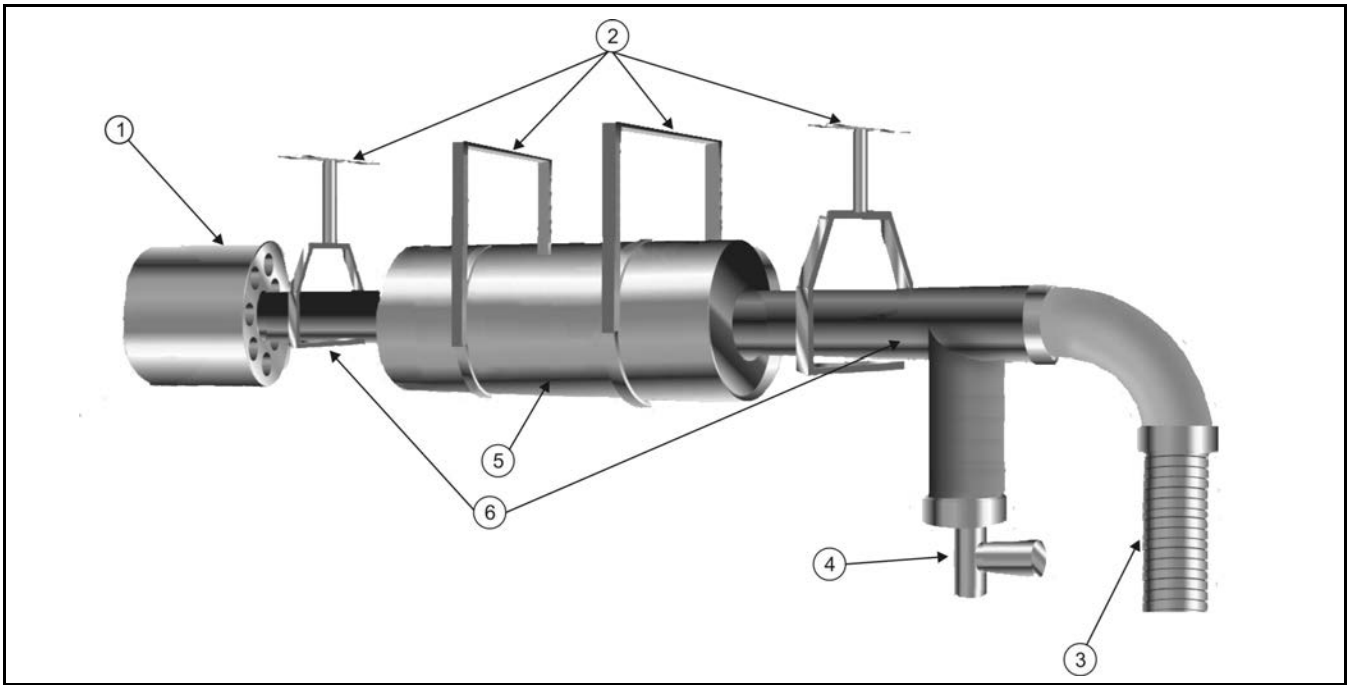


FIGURE 21. CONDENSATION TRAP



No.	Description	No.	Description
1	Exhaust Thimble	4	Water Trap with Drain
2	Support Brackets	5	Muffler
3	Flexible Bellows	6	Exhaust Pipe

FIGURE 22. TYPICAL SUSPENDED EXHAUST SYSTEM

7.3 Ventilation and Cooling

⚠ WARNING

Toxic Gases

Engine and radiator cooling air may carry carbon monoxide gas, which can cause asphyxiation and death.

Pipe exhaust gas outside and away from windows, doors, or other inlets to buildings. Do not allow exhaust gas to accumulate in habitable areas.

Generator sets create considerable heat that must be removed by proper ventilation.

Generator sets in factory-mounted housings for outdoor installation are designed for proper cooling and ventilation.

Indoor installations require careful design with respect to cooling and ventilation. In an indoor installation, all radiator cooling air must be discharged to the out-of-doors. Duct adapter kits are available.

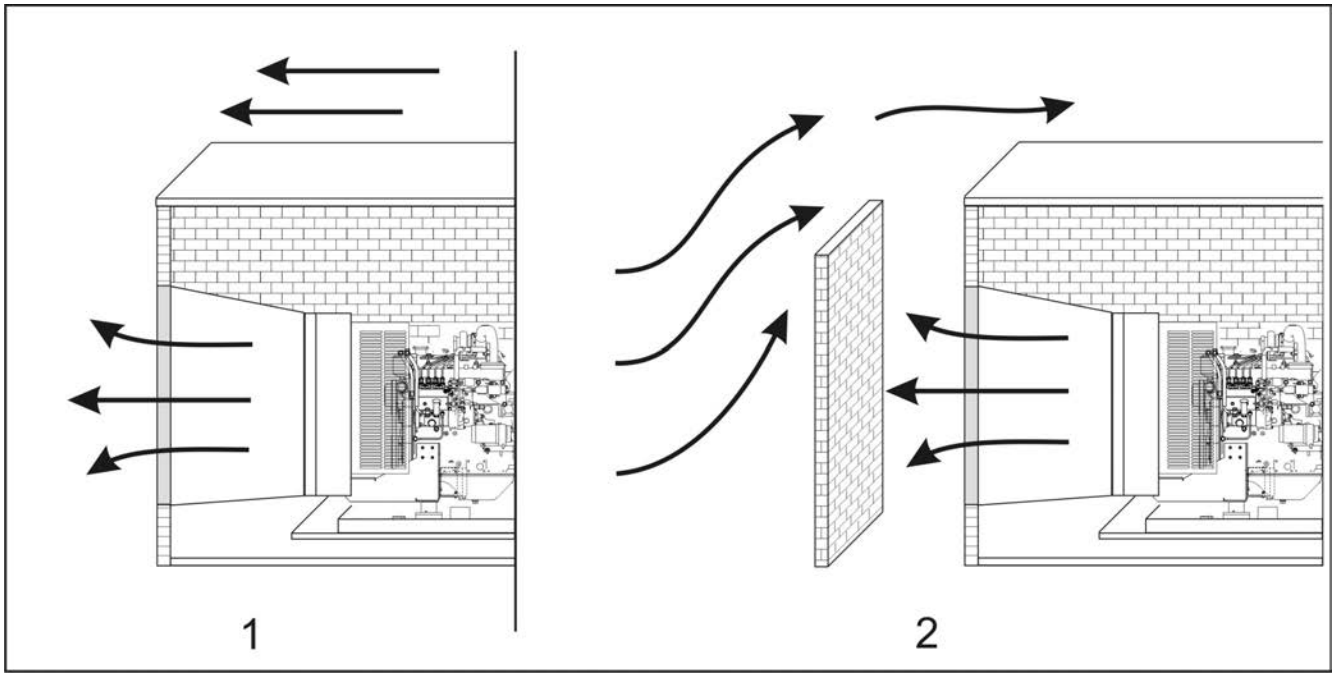
Outdoor installations normally rely on natural air circulation but indoor installations need properly sized and positioned vents for required airflow.

7.4 Vents and Ducts

1. For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement.
2. Size the vents and ducts so they are large enough to allow the required flow rate of air.
3. Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated, or if the outlet vent cannot be located as mentioned, install a wind barrier. See **Figure 23**.

NOTICE

The "free area" of ducts must be as large as the exposed area of the radiator. Refer to the generator set Specification Sheet for the airflow requirements and allowed airflow restriction.



No.	Description	No.	Description
1	Prevailing Wind Away from Air Outlet Vent	2	Prevailing Wind Towards Air Outlet Vent, Wind Barrier Installed

FIGURE 23. WIND BARRIER

7.5 Dampers

Dampers or louvers protect the generator set and equipment room from the outside environment. Their operation of opening and closing should be controlled by operation of the generator set.

In cold climates, the radiator exhaust air can be recirculated to modulate the ambient air temperature in the generator set room. This will help the generator set warm up faster, and help to keep fuel temperatures higher than the cloud point of the fuel. If recirculation dampers are used, they should be designed to 'fail closed', with the main exhaust dampers open, so that the generator set can continue to operate when required. Designers should be aware that the generator set room operating temperature will be very close to the outdoor temperature, and either not route water piping through the generator set room, or protect it from freezing.

7.6 Cable Chute

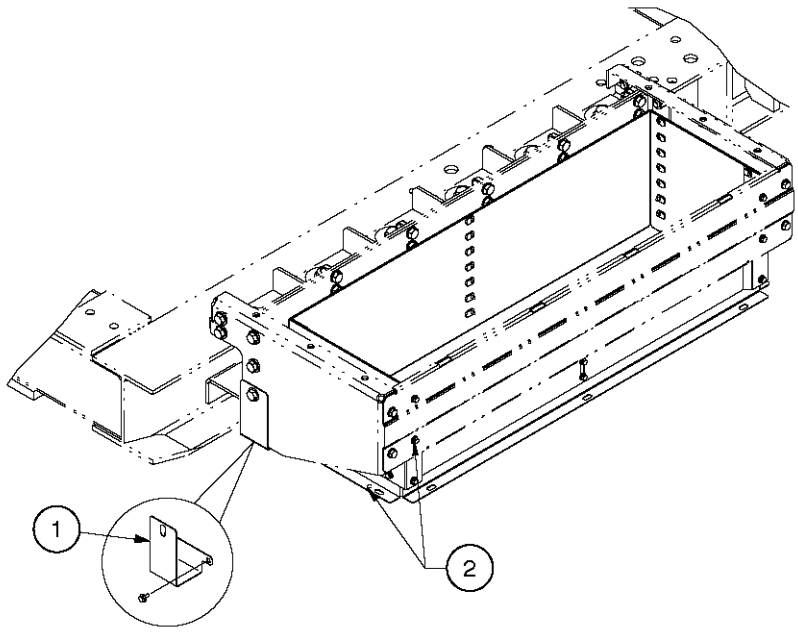
7.6.1 Cable Chute Installation

A cable chute is used with bottom entry circuit breaker boxes. The chute assembly is attached to the skid and must be installed at the site.

To remove the chute assembly from the skid (see **Figure 24**),

1. Remove the screws securing the shipping brackets to the skid and remove the chute assembly.
2. Remove the screws securing the shipping brackets (item 1) to the chute assembly. Discard the brackets and screws.

3. Remove the hole plugs (item 2) from the front panel of the chute and insert them into the flange of the duct adapter.

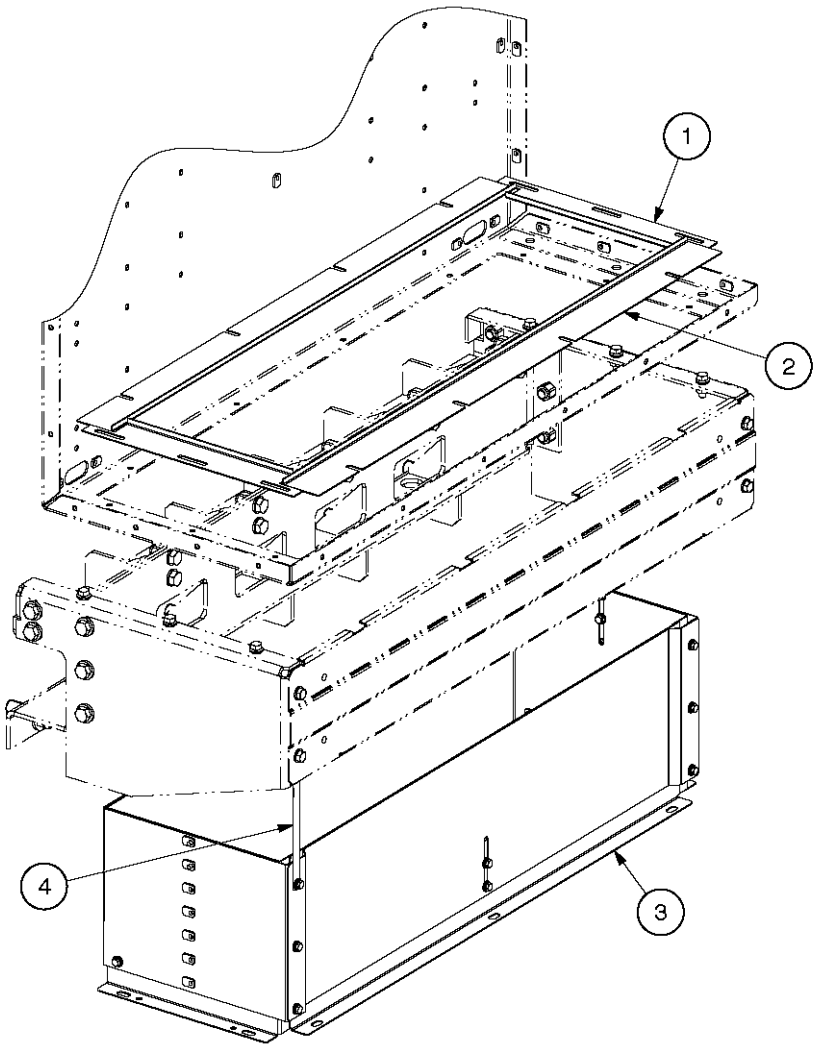


No.	Description	No.	Description
1	Shipping Bracket	2	Hole Plugs

FIGURE 24. CHUTE ASSEMBLY

To install the chute assembly (see **Figure 25**),

1. Use existing hardware to install the chute assembly (item 3) to the circuit breaker box mount.
2. Adjust the height of the chute as necessary.
3. Secure the electrical strap (item 4) to the circuit breaker box mount.
4. Use existing gland plate hardware to secure the cover plates (items 1 and 2) to the inside bottom of the circuit breaker box.



No.	Description	No.	Description
1	Cover Plate	3	Chute
2	Cover Plate	4	Electrical Strap

FIGURE 25. CHUTE INSTALLATION

7.7 Air Inlet and Outlet Openings

Louvers and screens over air inlet and outlet openings restrict air flow and vary widely in performance.

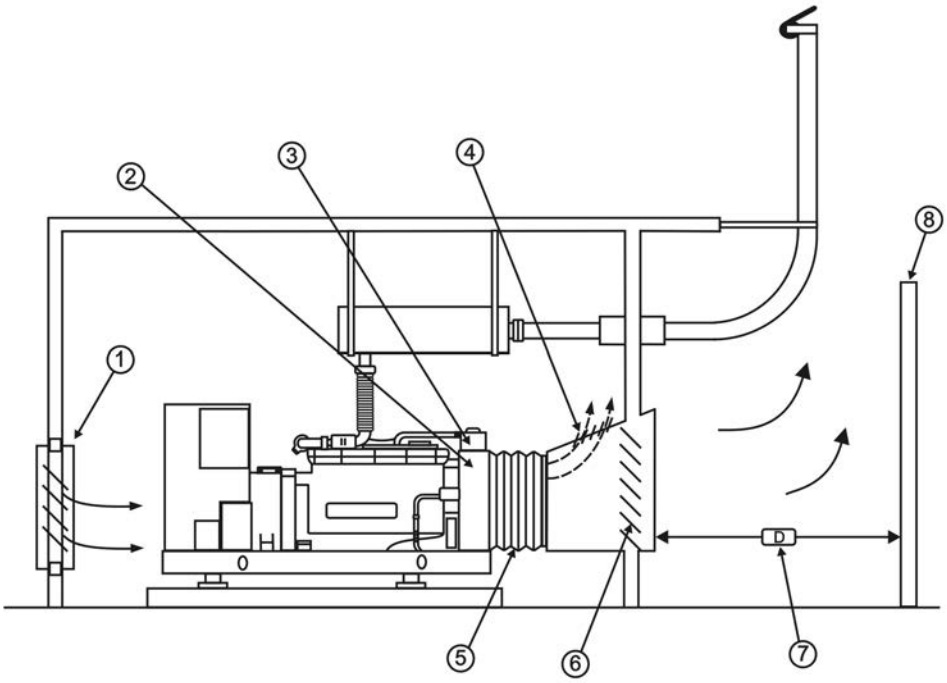
A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

Radiator set cooling air is drawn past the control end of the set by a pusher fan that blows air through the radiator. Locate the air inlet to the rear of the set. Make the inlet vent opening 1.5 times larger than the radiator area.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The outlet opening must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow.

A flexible duct connector must be provided at the radiator to prevent exhaust air recirculation around the radiator, to take up generator set movement and vibration, and to prevent transmission of noise. Attach the flexible duct using screws and nuts so that the duct can be removed for maintenance purposes. Before installing the duct, remove the radiator core guard.

Enclosed generator sets are primarily designed to work in an open environment. When considering installing an enclosed generator set in an enclosed environment specific application factors must be considered (air flow, exhaust gas extraction, fuel supply and storage, etc.). For advice, contact the Application Engineering Group at Cummins.



No.	Description	No.	Description
1	Cool Air Inlet Damper	5	Flexible Duct Connector
2	Engine Driven Fan	6	Hot Air Outlet Damper
3	Radiator	7	Distance Should Not be Less Than Height of Radiator
4	Thermostat Controlled Re-Circulating Damper	8	Wind/Noise Barrier

FIGURE 26. TYPICAL OPEN GENERATOR SET INSTALLATION

7.8 Heavy Duty Air Cleaner

If not already installed, the heavy duty air cleaner assembly must be installed at the site.

7.8.1 Heavy Duty Air Cleaner Installation

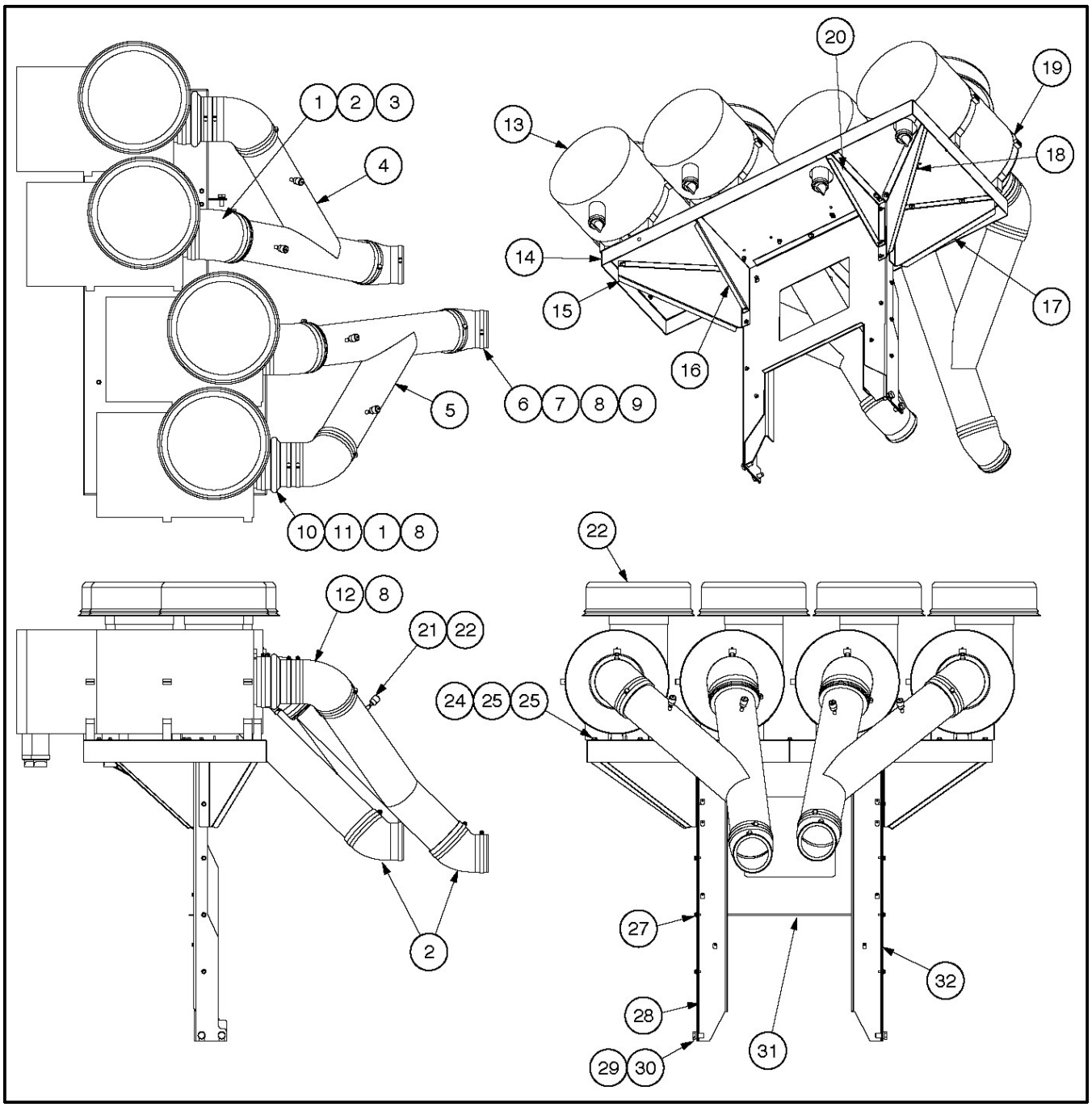


FIGURE 27. HEAVY DUTY AIR CLEANER PARTS

TABLE 4. PART DESCRIPTIONS

Item	Description	Qty	Item	Description	Qty
1	Hose Clamp (209.6 - 231.9mm)	6	17	Air Filter Bracket	1
2	Reducer Insert - 8" to 7"	2	18	Air Filter Bracket	1

Item	Description	Qty	Item	Description	Qty
3	Hose Elbow - 45 Degree, 8"	2	19	Mounting Band	8
4	Intake Manifold	1	20	Air Filter Bracket	1
5	Air Tube	1	21	Filter Fitting (1/8-27 NPT)	4
6	Reducer Elbow - 45 Degree, 7" to 6"	2	22	Service Indicator	4
7	Reducer Insert - 6" to 5.5"	2	23	Air Inlet Hood	4
8	Hose Clamp (184.2 - 206.5mm)	8	24	Hex Flange Nut (M10)	16
9	Hose Clamp (158.8 - 181.1mm)	2	25	Flat Washer (M10)	16
10	Hump Hose - 8" to 7"	2	26	Hex Head Screw - M10 x 25mm	16
11	Air Tube (177.8 x 100mm)	2	27	Hex Head Screw - M8 x 20mm	37
12	Intake Elbow	2	28	Air Filter Bracket (LH)	1
13	Air Filter	4	29	Hex Head Screw - 3/4-10 x 1-1/2"	4
14	Air Filter Support (Top)	1	30	Lock Washer - 3/4"	4
15	Air Filter Bracket	1	31	Air Filter Support (Rear)	1
16	Air Filter Bracket	1	32	Air Filter Bracket (RH)	1

The numbers in parenthesis ( ) correspond to the part callout numbers in **Figure 27** and **Table 4**.

⚠ WARNING

Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical component installations.

⚠ WARNING

AC voltages and currents present an electrical 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. Only trained and experienced personnel are to perform the following procedures.

Turn off or remove AC power from the battery charger and then remove the negative (–) battery cable from the set starting battery. This is to make sure the set will not start while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

⚠ CAUTION

If present, 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 of the generator set.

⚠ WARNING

Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).

Make certain the battery area has been well-ventilated before servicing the battery. Wear goggles. Stop the generator set and disconnect the charger before disconnecting battery cables. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when a cable is removed or re-attached, or when the negative (–) battery cable is connected and a tool used to connect or disconnect the positive (+) battery cable touches the frame or other grounded metal part of the generator set. Always remove the negative (–) cable first, and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

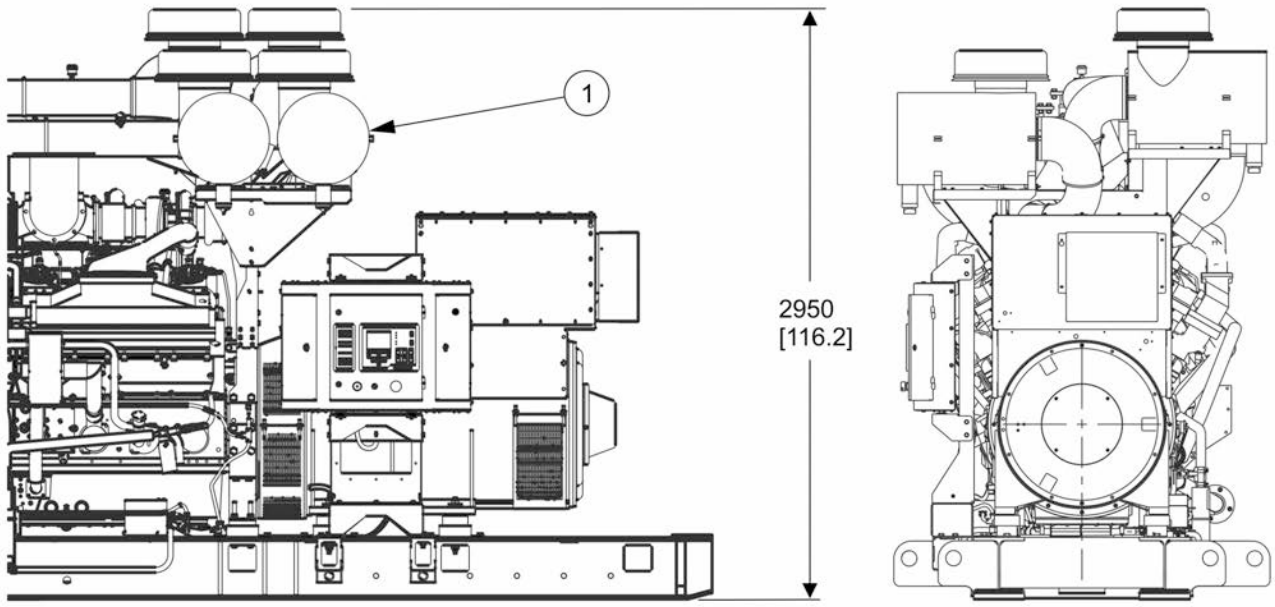
⚠ WARNING

Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near a battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

Ventilate the battery area before working on or near the battery. Wear goggles. Stop the generator set and disconnect the battery charger before disconnecting battery cables-Disconnect the negative (–) cable first and reconnect it last.

1. Make sure the generator set is disabled.
    a. Press the STOP button on the operator panel to make sure the control is in the Off mode.
    b. Activate the E-stop button and wait one minute.
    c. If equipped, disconnect the battery charger. Remove any other electrical supply sources.
    d. Disconnect the generator set negative (**–**) battery cable.
2. Install the air filter support assembly on the engine.
    a. Use M8 x 20mm hex head screws (27) to secure the two air filter brackets (28 and 32) to the inside of the rear air filter support (31).
    b. Use four 3/4-10 x 1-1/2 inch screws and lock washers (29 and 30) to secure the rear air filter bracket assembly to the engine.
    c. Torque the 3/4-10 x 1-1/2 inch screws to 420 40 N·m.
    d. Use three M8 x 20mm hex head screws (27) to secure the top air filter support (14) to the rear air filter bracket assembly.
    e. Use M8 x 20mm hex head screws (27) to secure the five air filter brackets (15, 16, 17, 18, and 20) to the top air filter support and rear air filter bracket assembly.
    f. Torque the M8 screws to 24 2 N·m.
3. Use four M10 screws, flat washers, and hex nuts (24, 25, and 26) and two mounting bands (19) to secure each of the air filters (13) to the air filter support assembly. Torque the M10 screws to 52 10 N·m. Torque the screws on the mounting bands to 5.5 1 N·m.
4. Install an air inlet hood (23) on each of the air filters.
5. Make sure that the interior of the connections between the air cleaner outlet and the turbocharger inlet end of the elbow are clean.
6. Use one large hose clamp (1) to secure a hose hump (10) on each of the outside air filters.
7. Use one medium hose clamp (8) to secure an air tube (11) to each of the hose humps.

8. Use one medium hose clamp (8) to secure an intake elbow (12) to each of the air tubes.
9. Use one large hose clamp (1) to secure a reducer insert (2) to each of the inside air filters.
10. Use one large hose clamp (1) to secure a hose elbow (3) on each of the reducer inserts.
11. Use two large hose clamps (1) and two medium hose clamps (8) to secure the intake manifold (4) and air tube (5) to the elbows.
12. Use two medium hose clamps (8) to secure a reducer insert (7) and reducer elbow (6) on the intake manifold and air tube.
13. Use two small hose clamps (9) to secure the air cleaner assembly to the engine.
14. Install the four filter fittings (21) and service indicators (22) on the intake manifold and air tube.
15. Reconnect the negative (–) cable to the battery.
16. If equipped, connect the battery charger and turn it on.
17. Place the control in the desired mode.



No.	Description
1	Air Cleaner

FIGURE 28. INSTALLED HEAVY DUTY AIR CLEANER

7.9 Breakerless Conductor Connections

7.9.1 Overload and Short Circuit Protection of Generator

NFPA 70: National Electrical Code compliant generator sets are required to be protected from an overload. Cummins generator sets with UL Listed AmpSentry Protective Relay as a standard feature do not require a circuit breaker or other protective device for NEC compliance or UL 2200 Listing.

CEC: Each conductor between the generator terminal and the point where load receives supply of generator current must be protected by an overcurrent device in accordance with the requirement of CEC 14-100: Overcurrent Protection of Conductor.

UL label indicates to the Authority Having Jurisdiction (AHJ) that the generator set incorporates a UL Listed Protective Relay that provides overload and short circuit protection for the generator and its conductors. The generator set does not require use of a circuit breaker or other protective device for NFPA 70: National Electrical Code compliance or UL 2200 Listing.

7.9.1.1 AmpSentry Labels

These are typical labels for compliant generator sets produced after January 2012.

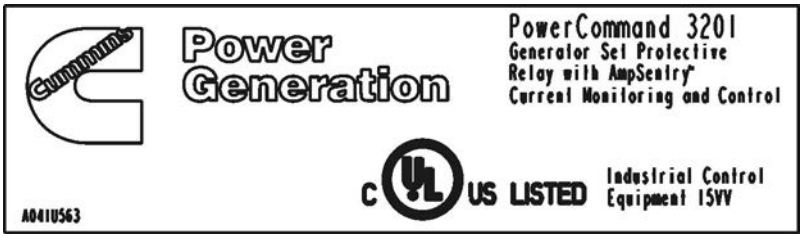
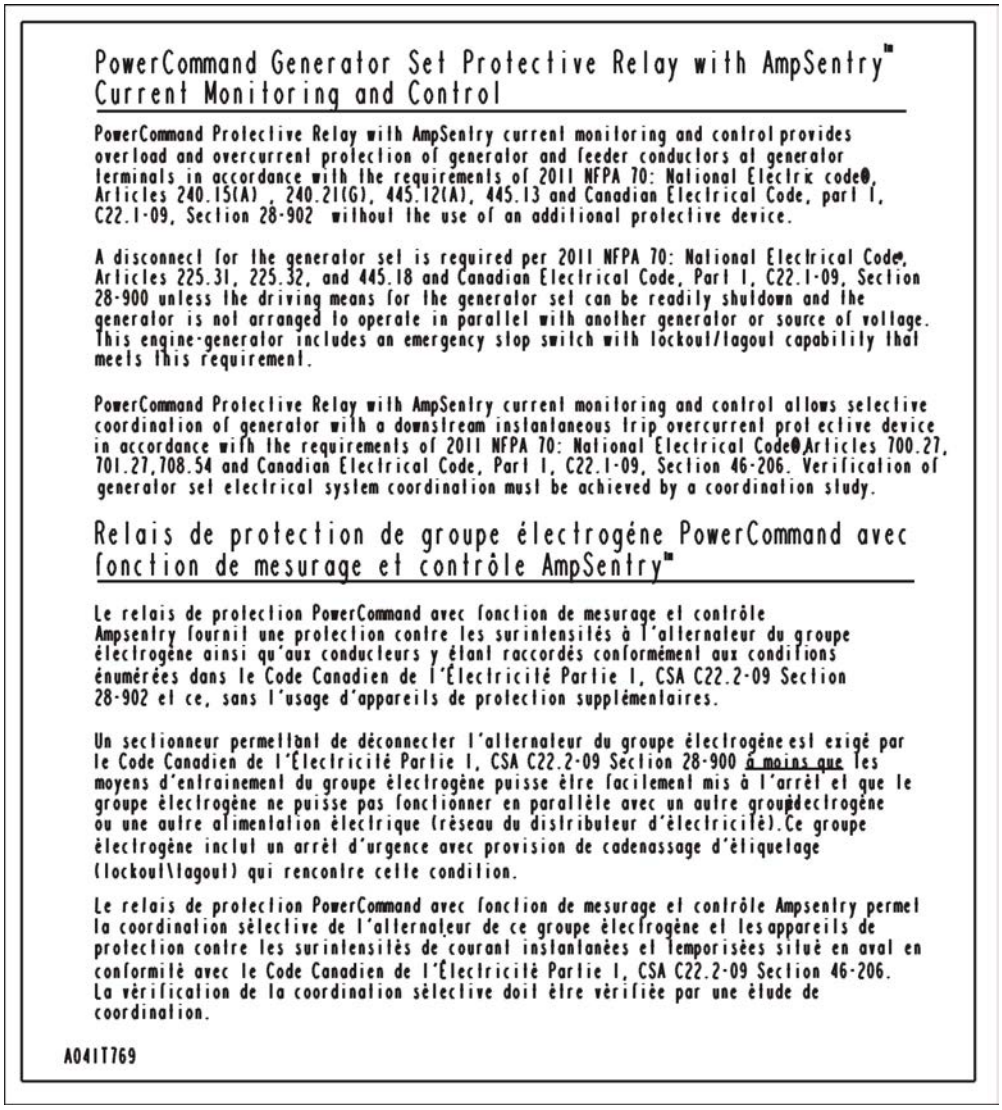


FIGURE 29. POWERCOMMAND 3201 LABEL



PowerCommand Generator Set Protective Relay with AmpSentry™ Current Monitoring and Control

PowerCommand Protective Relay with AmpSentry current monitoring and control provides overload and overcurrent protection of generator and feeder conductors at generator terminals in accordance with the requirements of 2011 NFPA 70: National Electric code®, Articles 240.15(A) , 240.21(G), 445.12(A), 445.13 and Canadian Electrical Code, part I, C22.1-09, Section 28-902 without the use of an additional protective device.

A disconnect for the generator set is required per 2011 NFPA 70: National Electrical Code®, Articles 225.31, 225.32, and 445.18 and Canadian Electrical Code, Part I, C22.1-09, Section 28-900 unless the driving means for the generator set can be readily shutdown and the generator is not arranged to operate in parallel with another generator or source of voltage. This engine-generator includes an emergency stop switch with lockout/tagout capability that meets this requirement.

PowerCommand Protective Relay with AmpSentry current monitoring and control allows selective coordination of generator with a downstream instantaneous trip overcurrent protective device in accordance with the requirements of 2011 NFPA 70: National Electrical Code® Articles 700.27, 701.27, 708.54 and Canadian Electrical Code, Part I, C22.1-09, Section 46-206. Verification of generator set electrical system coordination must be achieved by a coordination study.

Relais de protection de groupe électrogéne PowerCommand avec fonction de mesurage et contrôle AmpSentry™

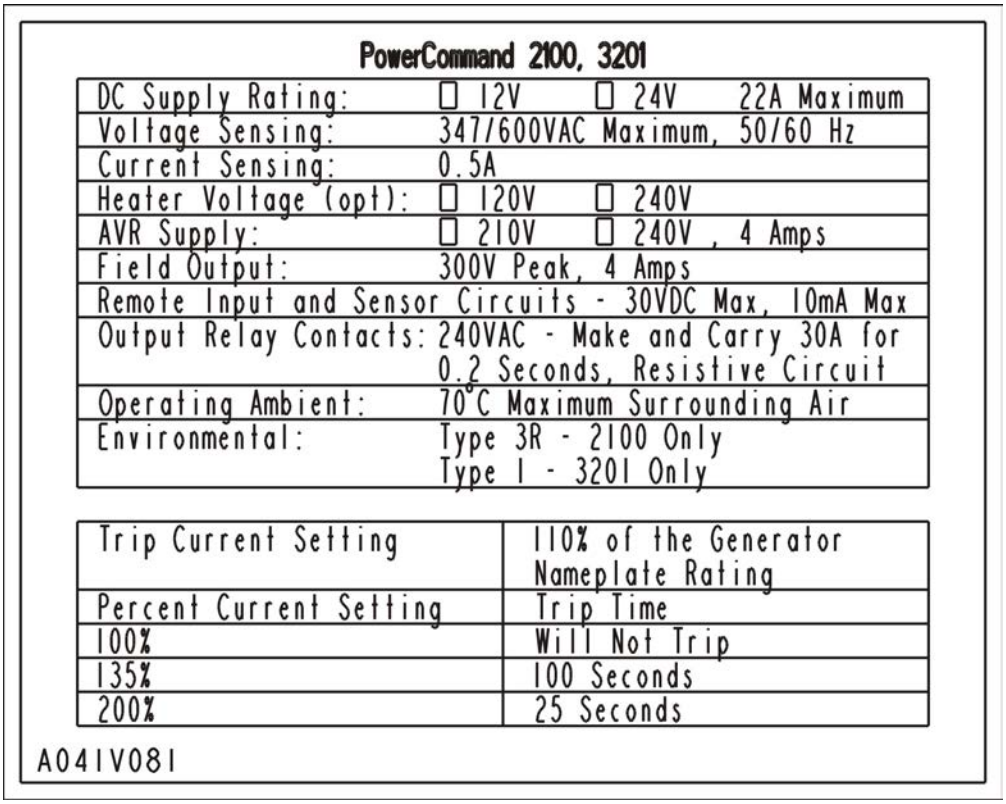
Le relais de protection PowerCommand avec fonction de mesurage et contrôle Ampsentry fournit une protection contre les surintensités à l'alternateur du groupe électrogène ainsi qu'aux conducteurs y étant raccordés conformément aux conditions énumérées dans le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 28-902 et ce, sans l'usage d'appareils de protection supplémentaires.

Un sectionneur permettant de déconnecter l'alternateur du groupe électrogène est exigé par le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 28-900 à moins que les moyens d'entrainement du groupe électrogène puisse être facilement mis à l'arrêt et que le groupe électrogène ne puisse pas fonctionner en parallèle avec un autre groupeélectrogène ou une autre alimentation électrique (réseau du distributeur d'électricité). Ce groupe électrogène inclut un arrêt d'urgence avec provision de cadenassage d'étiquetage (lockout\tagout) qui rencontre celle condition.

Le relais de protection PowerCommand avec fonction de mesurage et contrôle Ampsentry permet la coordination sélective de l'alternateur de ce groupe électrogène et les appareils de protection contre les surintensités de courant instantanées et temporisées situé en aval en conformité avec le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 46-206. La vérification de la coordination sélective doit être vérifiée par une étude de coordination.

A041T769

FIGURE 30. TYPICAL INFORMATION LABEL



PowerCommand 2100, 3201

DC Supply Rating:	☐ 12V ☐ 24V 22A Maximum
Voltage Sensing:	347/600VAC Maximum, 50/60 Hz
Current Sensing:	0.5A
Heater Voltage (opt):	☐ 120V ☐ 240V
AVR Supply:	☐ 210V ☐ 240V , 4 Amps
Field Output:	300V Peak, 4 Amps
Remote Input and Sensor Circuits - 30VDC Max, 10mA Max	
Output Relay Contacts:	240VAC - Make and Carry 30A for 0.2 Seconds, Resistive Circuit
Operating Ambient:	70°C Maximum Surrounding Air
Environmental:	Type 3R - 2100 Only Type 1 - 3201 Only

Trip Current Setting	110% of the Generator Nameplate Rating
Percent Current Setting	Trip Time
100%	Will Not Trip
135%	100 Seconds
200%	25 Seconds

A041V081

FIGURE 31. POWERCOMMAND 2100 AND 3201 SPECIFIC CHECK LABEL

7.9.2 AmpSentry Protective Relay Time-Over Current Characteristic Curve

The protection provided is shown in the figure below, which shows the time-current characteristic of the supplied protection. This protection curve is specifically designed to protect the generator supplied, so adjustments to the operation points for this curve are not allowed.

NOTICE

The values shown on the current scale are shown based on the value of 1.0 being equal to the nameplate rated current of the generator set for the specific operating voltage.

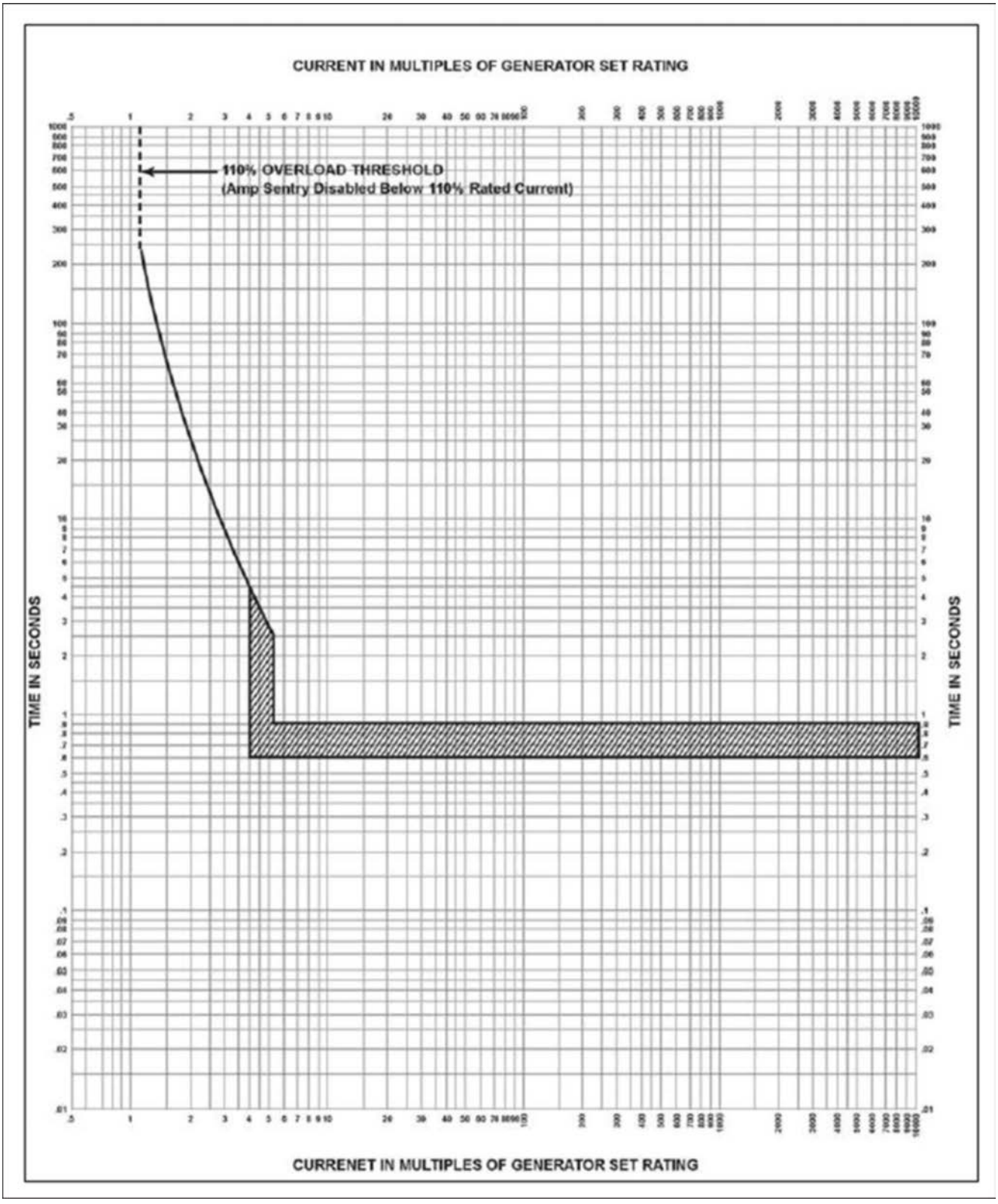


FIGURE 32. AMPSENTRY PROTECTIVE RELAY TIME OVER-CURRENT CHARACTERISTIC CURVE

7.9.3 Coordination of Protective Devices

Conduct a selective coordination (discrimination) study on the distribution system that incorporates the generator set when choosing a generator set. Visit **power.cummins.com** for a copy of document R-1053, or it can be found using SKM Power Tools for Windows library or from your distributor.

7.9.4 Additional AmpSentry Protective Relay Information

TABLE 5. ADDITIONAL AMPSENTRY PROTECTIVE RELAY INFORMATION FOR POWERCOMMAND 2100 CONTROL

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
Battery Supply	8-30 V		DC	22 A	TB1 (17-22)
Voltage Sense Input	347/600 V	3	50/60	10 mA	J8 (4, 7, 12, 20)
Current Sense Input		3	50/60	5 A	J7 (11, 12, 15, 16, 19, 20)
AVR Shunt Supply	240 V	1	50/60	100 mA	J8 (21-23)
AVR PMG Supply	210 V	1	50/60	100 mA	
AVR Output (Continuous)	300 V (Peak)	1	PWM	4 A	J8 (5,13)
AVR Output (Max/10 seconds)	300 V (Peak)	1	PWM	6 A	
Run Relay Output	30 V		DC	8 A; 1.44 A Pilot Duty	TB1 (17-22)
Customer Relay Output	30 V		DC	5 A	TB1 (8-15)
	250 V	1	AC	5 A; C300 Pilot Duty	
Indicator Supply	5 V		DC	50 mA	J2
Engine Sensors	5 V		DC	3 mA	J7 (13, 17, 21, 22, 25, 26, 29-35)
Governor Drive	5-30 V		DC	100 mA	J7 (14, 24, 28, 36)
Power Out	8-30 V		DC	100 mA	J7 (1-8, 18)
Solenoid Driver Signal	5-30 V		DC	100 mA	J7 (9, 10, 23, 27)
Switch Input	8-30 V		DC	1 mA	J1
Membrane Switch Input	5 V		DC	1 mA	J3
Customer Inputs	8-30 V		DC	1 mA	TB1 (1-6)

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
Power Transfer Status	5-30 V		DC	1 mA	TB2 (5)
Power Transfer Signal Supply	5-30 V		DC	100 mA	TB2 (3, 4, 6)
Interface	5 V		DC	1 mA	J50, J51, J4, J6
Communication	RS485				TB2 (1, 2)
	RS232				J9 (1-5, 9)
	CAN (Optional)				J10 (1-5)
Trip Current	110% generator nameplate FLA				
Percentage of Trip Current	100		300		600
Trip Times	500 seconds		10 seconds		1 second
Temperature	70 °C Maximum Surrounding Air Ambient				

7.10 Remote Radiator Cooling

The remote radiator cooling substitutes a remote mounted radiator and an electrically driven fan in place of generator set mounted components. Removal of the radiator and the fan from the generator set reduces noise levels without forcing dependence on a continuous cooling water supply (necessary with heat exchanger cooling). The remote radiator installation must be completely protected against freezing.

Remote radiator plumbing will vary with installation. Follow recommendations given in Application Manual T-030. See product for friction head and static head limits.

NOTICE

Before filling the cooling system, make sure all hardware is tight. This includes hose clamps, cap screws, fittings, and connections. Use flexible coolant lines with heat exchanger or remote mounted radiator.

NOTICE

All customer connections must be fully supported where they interface with flexible coolant flange. The support must be located within 100 mm from the flexible flange connection.

7.10.1 Remote Radiator Installation

Installations set up for remote radiator cooling may or may not include flanges. Refer to **Appendix D on page 169** for outline drawings showing remote radiator installations.

A low coolant level sender and a wiring harness are supplied with the generator set. Once the low coolant level sender is installed, refer to **Appendix A on page 133** for information on connecting the wiring harness.

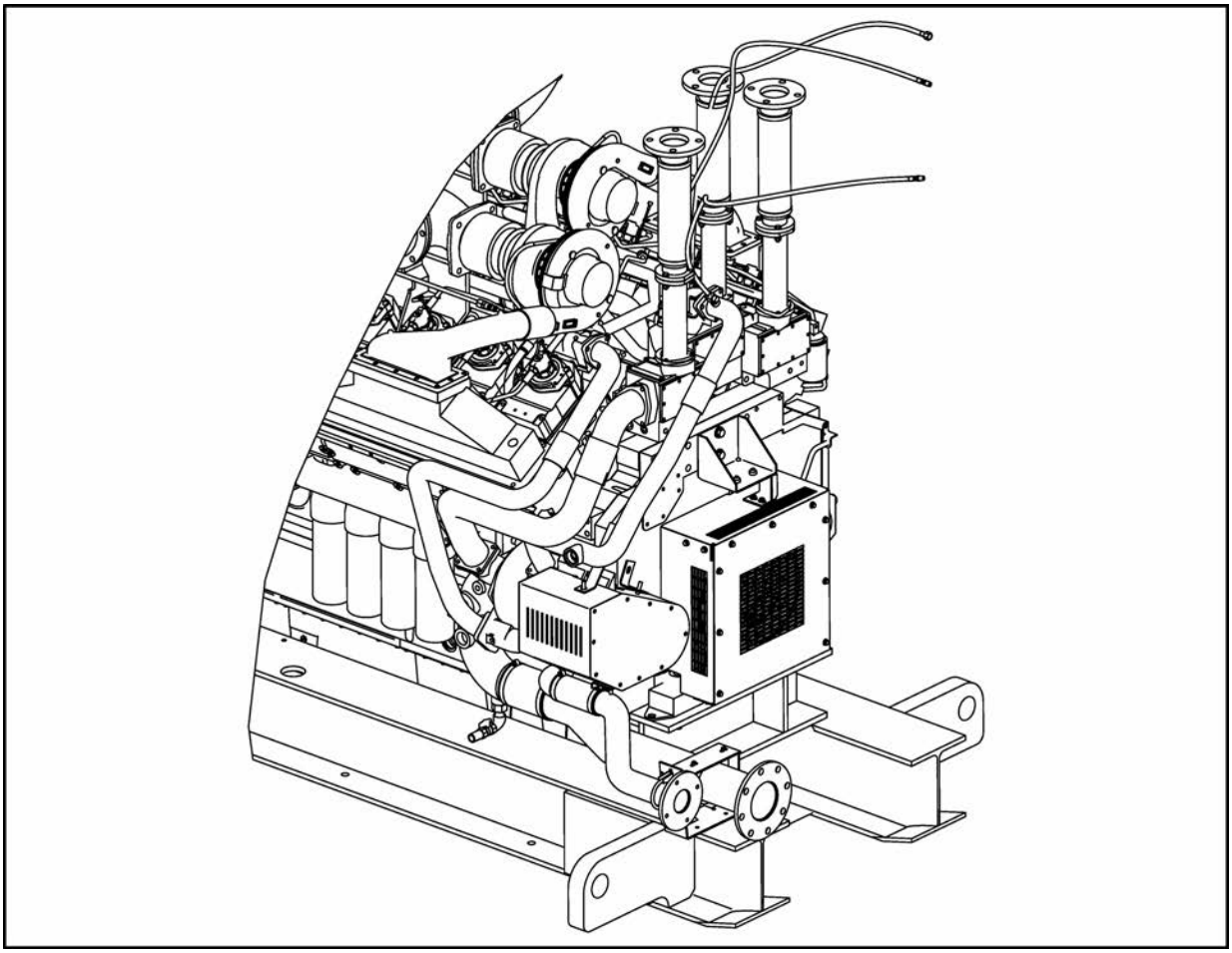


FIGURE 33. REMOTE RADIATOR COOLING COMPONENTS (INCLUDES FLANGES)

This page is intentionally blank.

8 Radiator Assembly Instructions

8.1 Introduction

The following procedure describes how to install the radiator assembly when the radiator and generator set are shipped as separate items.

This procedure includes:

1. Preparing for the installation
2. Removing the cooling system from the transportation skid and mounting it on the generator set skid
3. Installing the pulley
4. Connecting the radiator to the engine
5. Filling the coolant system
6. Aligning the fan drive
7. Test running the generator set

8.1.1 Required Tools

The following tools are required to complete this installation.

- Lifting straps with shackles capable of lifting six tons
- Spanner wrenches
- Impact sockets
- Air ratchet wrench
- Pulley alignment tools
- Strip of key stock or similar tool
- Large pry bar to align the radiator to the skid

8.1.2 Safety Precautions

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. Follow all local requirements when working on electrical equipment. Isolate all forms of electrical energy before working on the generator set.

⚠ CAUTION

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Disconnect the battery charger before isolating the battery.

⚠ CAUTION

Sharp Edges

Sharp edges/burrs on housing parts can cause cuts and puncture wounds.

When handling housing parts, use appropriate PPE.

Read these instructions completely and become familiar with safety warnings, cautions, and procedures before starting the installation.

The installer must be familiar with the techniques of working on heavy machinery. A hoist must be available which can support the weight of the radiator, with an appropriate lifting strength margin.

Turn off or remove AC power from the battery charger and then use an insulated wrench to remove the negative (**–**) battery cable from the set starting battery. This prevents the generator set from starting while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

8.1.3 Radiator Installation

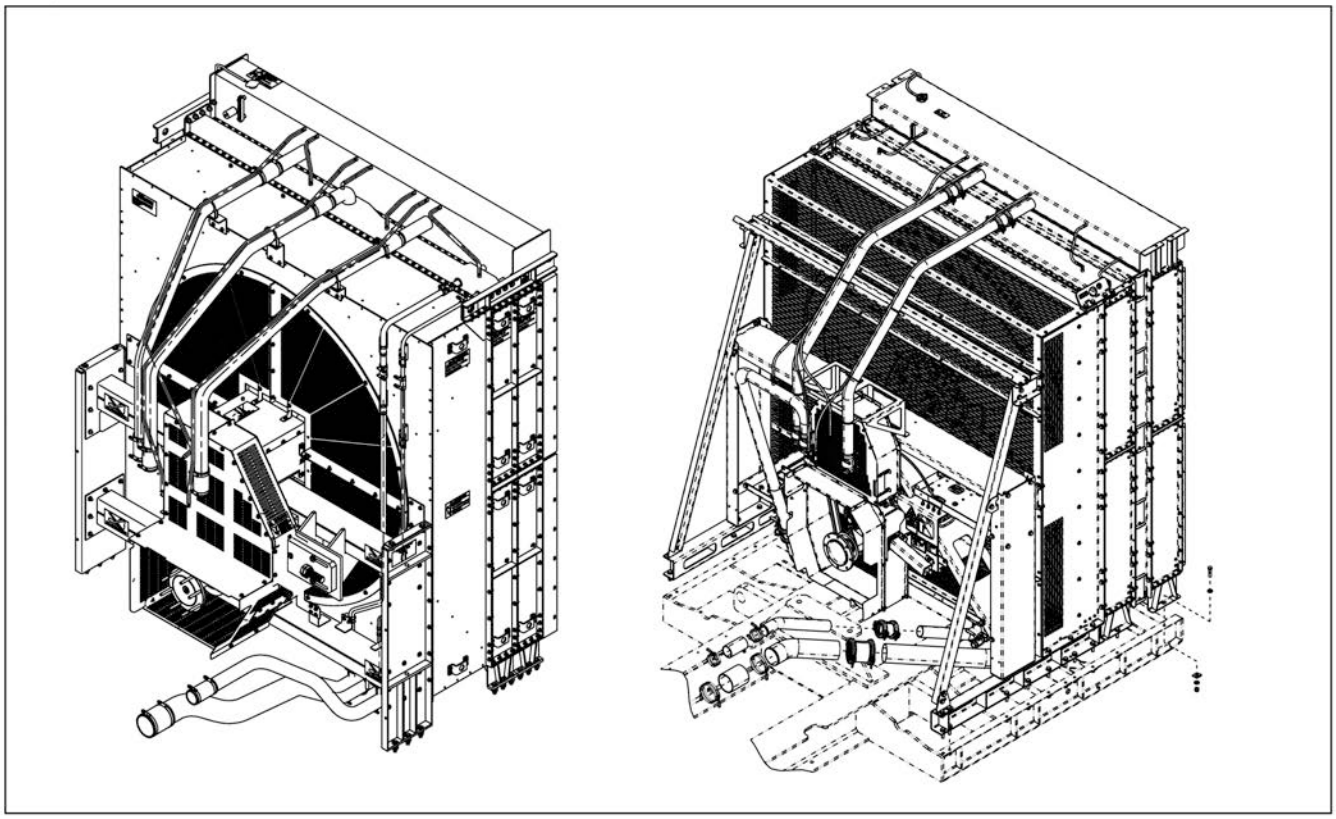


FIGURE 34. 40 °C (LEFT) AND 50 °C (RIGHT) RADIATORS

The cooling fan, along with the belt tensioner assembly, is pre-assembled with the radiator. The belt tensioner system (see the Installing the Pulley section) allows for manual adjustment of the horizontal positioning of the idler pulley. This chapter provides a procedure for manually adjusting the idler pulley in order to install the V-belts over the pulleys and set the recommended belt tension. Once the correct tension is set by adjusting the bolts and adjusting the position of the manual tensioner, completion of the belt installation requires locking the manual tensioner in place by tightening the bolts, as discussed in the Aligning the Fan Drive section.

The engine pulley must be assembled and aligned with the fan pulley before the radiator is completely installed. Belt guards must be installed last, after completion of the belt installation and alignment procedures and test running the generator set.

8.2 Preparing for the Installation

When installing the generator set, make sure you have also taken into consideration what is needed to install the cooling system.

1. Make sure you have all necessary tools and any additional items needed to complete the installation.

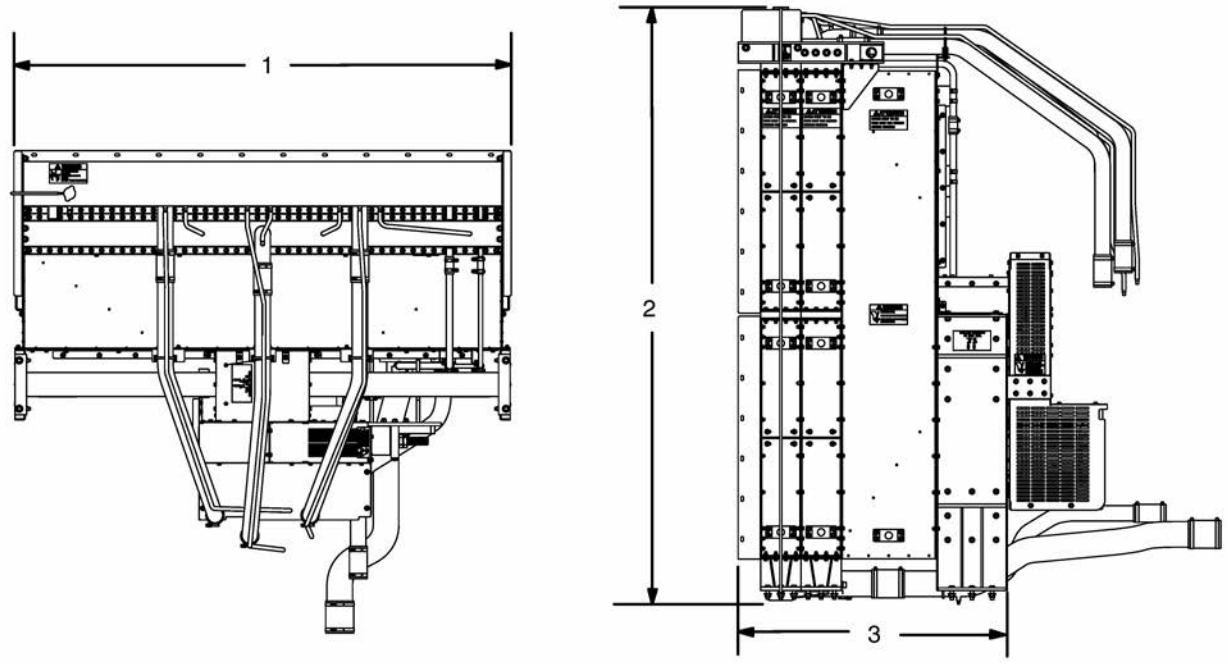
   The following items must be supplied by the customer to complete the installation.

   - Hellerine lubricant to be used when installing hoses
   - Cable ties to be used when installing the vent lines

- Coolant mixture:
  - For high ambient 43° C radiators: fully formulated, a 50% EG coolant mixture of 142 gallons (537.5 liters) is required to fill the radiator.
  - For enhanced high ambient 50° C radiators: fully formulated, a 50% EG coolant mixture of 155 gallons (587 liters) is required to fill the radiator.
- Low coolant level sensor - CPG part A035K363
- Low coolant level harness:
  - DQKAD, DQKAF, and DQKAE:
    - High Ambient Radiators (43° C) - CPG part A043K322
    - Enhanced High Ambient Radiators (50° C) - CPG part A043K322

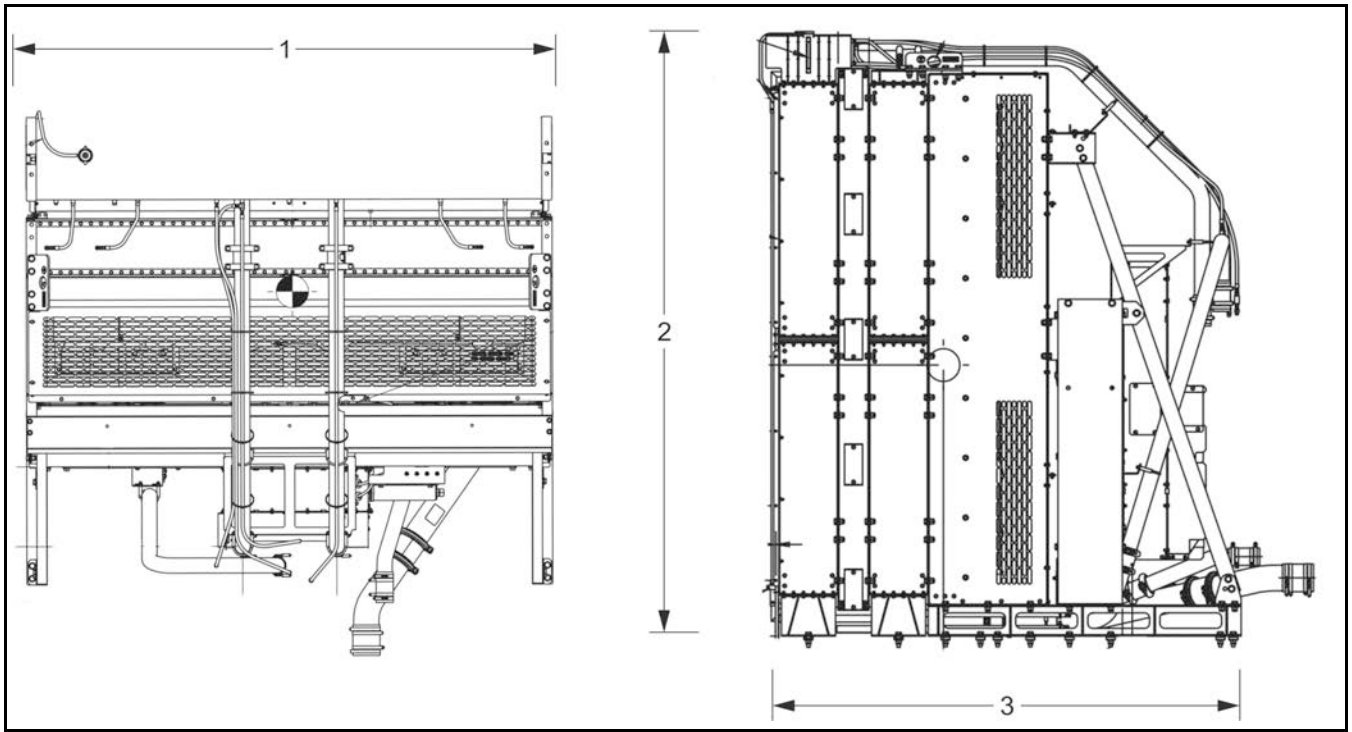
Some customers may wish to install check valves on the engine for the outside two vent lines (see **Figure 48**). If your installation is to include the two check valves (CPG part number 0309-0635-02), they must be supplied by the customer.

2. Make sure you have allowed enough space to install the radiator. Basic radiator dimensions are shown in **Figure 35** and **Figure 36**.



No.	Description	No.	Description
1	2468 MM (97 Inches)	3	1334.6 MM (53 Inches)
2	2893.1 MM (114 Inches)		

FIGURE 35. 43° C RADIATOR DIMENSIONS



No.	Description	No.	Description
1	2635.25 MM (103.75 Inches)	3	2305.05 MM (90.75 Inches)
2	2965.45 MM (116.75 Inches)		

FIGURE 36. 50° C RADIATOR DIMENSIONS

8.3 Mounting the Radiator - 43° C

The following procedure describes how to remove the radiator assembly from the transportation skid and install it on the generator set skid.

1. Unpack the radiator assembly. Remove the hardware and mounting straps (if present) securing the radiator assembly to the transportation skid (see **Figure 37**) and remove the components box. Kit parts are packed loose in the kit box.

   When shipped loose, 43° C Radiator Assembly is transported with the radiator in a sideways position on the pallet.

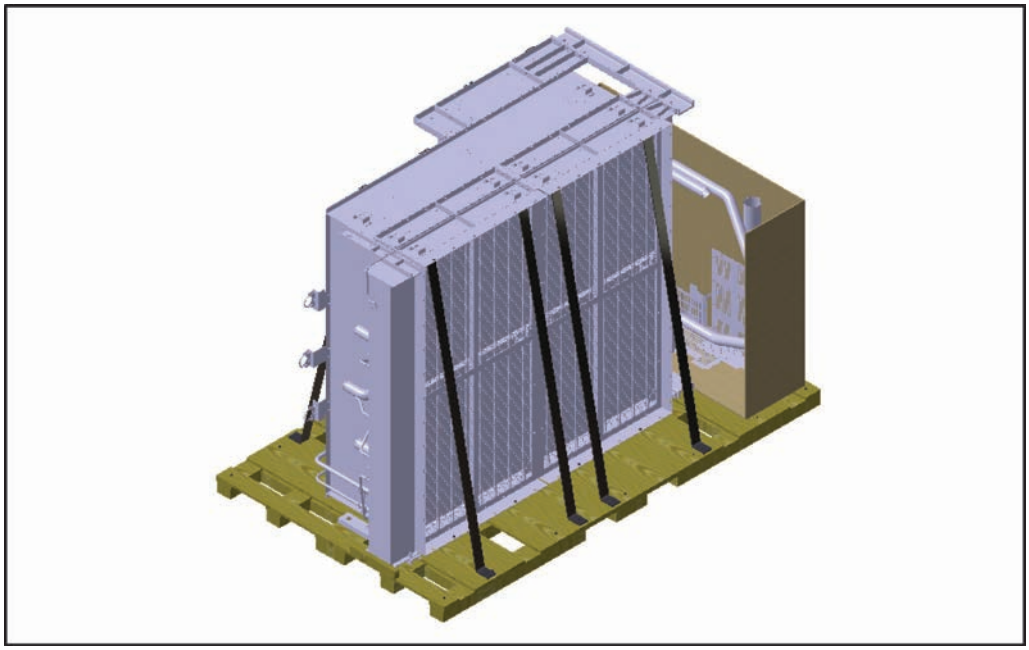
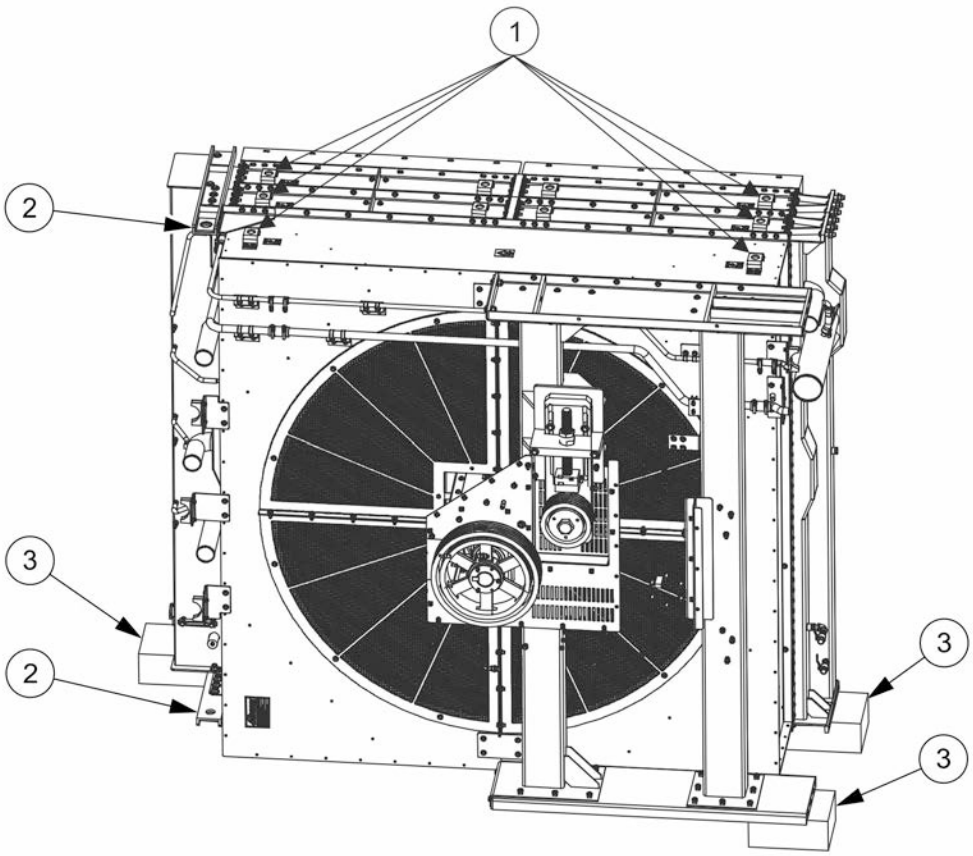


FIGURE 37. 43° C RADIATOR ASSEMBLY ON TRANSPORTATION SKID

⚠ WARNING

Dropping the radiator assembly can cause severe personal injury or death. The radiator cooling assembly is heavy. The 43° C radiator has an approximate dry weight of 1300 Kg (2870 pounds). Use a hoist of sufficient capacity. Set the radiator assembly upright before lifting and moving it to the desired location.

2. Attach lifting straps with shackles capable of lifting six tons to the lifting points on the radiator (see **Figure 38**).



No.	Description	No.	Description
1	Lifting Brackets	2	Not a lifting bracket. Do not use for lifting.
3	Wood blocks, quantity 4 (6 inches high, minimum)		

FIGURE 38. RADIATOR LIFTING POINTS

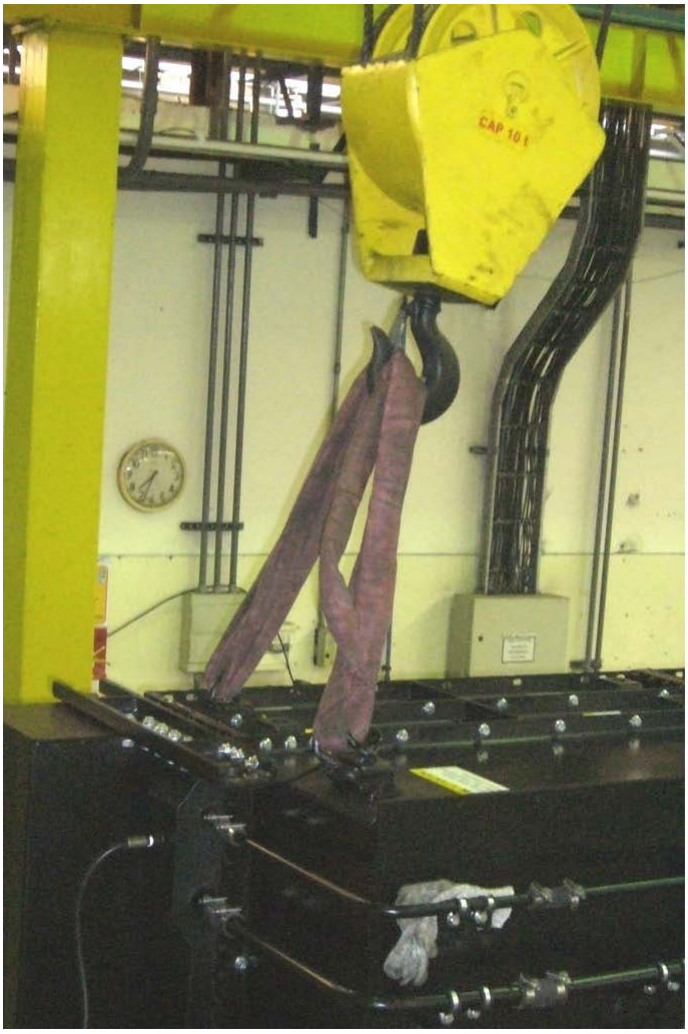
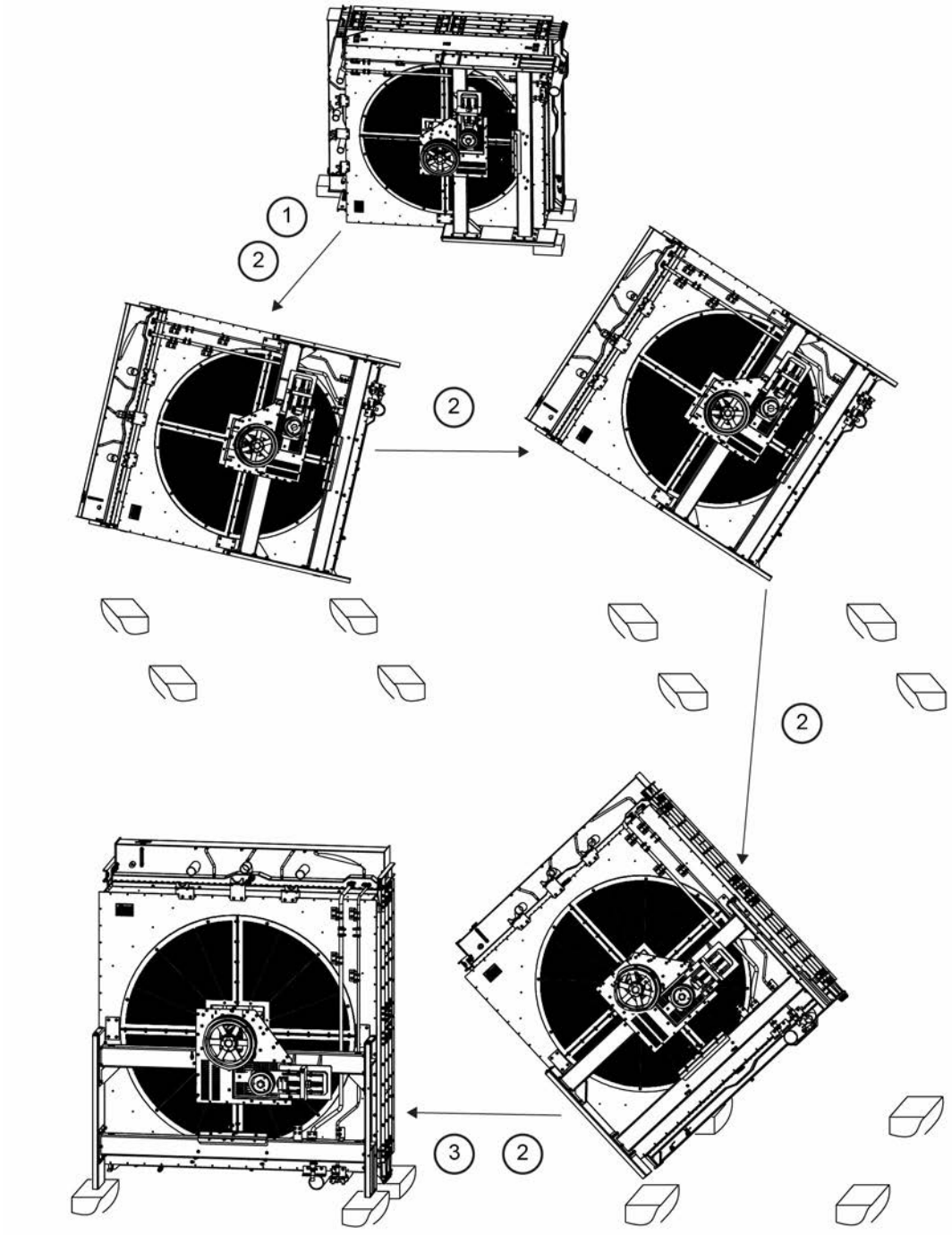


FIGURE 39. RADIATOR PREPARED FOR LIFTING

⚠ WARNING

Dropping the radiator assembly can cause severe personal injury or death. The radiator cooling assembly is heavy. The 43°C radiator has an approximate dry weight of 1300 Kg (2870 pounds). Use a hoist of sufficient capacity.

3. Lift radiator straight up and place on wooden blocks (6 inches high, minimum) on the floor.
4. Do the following if the radiator was shipped on its side. See **Figure 40**.
    a. Attach two cranes and two sets of shackles to the radiator. Attach one to the bottom right and left lifting points. Attach the second to the top right and left lifting points.
    b. Lift radiator straight up.
    c. Use the cranes to rotate the radiator to the vertical position.
    d. Place on wooden blocks (6 inches high, minimum) on the floor.
5. Attach one crane and shackles to the radiator top right and left lifting brackets.
6. Lift the radiator straight up and position the radiator on the generator set skid.



No.	Description	No.	Description
1	Lift radiator straight up, use two cranes	2	Use cranes to rotate radiator.
3	When vertical, place radiator on 4 wood blocks		

FIGURE 40. ROTATE RADIATOR

7. Use 18 M16 flange screws, lock washers, and lock nuts (27, 28, and 29) to secure the radiator assembly to the skid. Torque the bolts to 195 ± 20 Nm (143 ± 15 ft-lb).

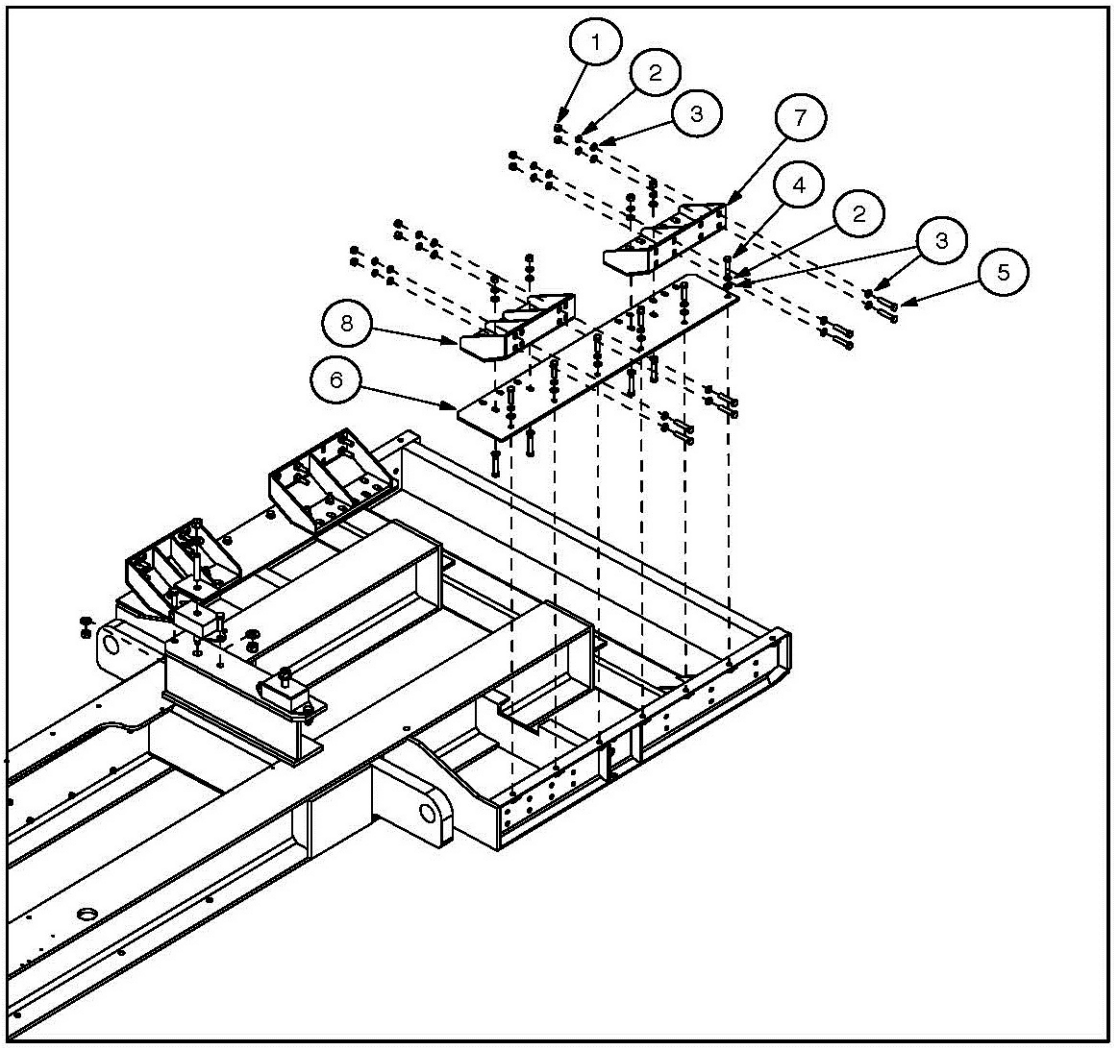
8.3.1 Instructions for Assembling the Skid Wing Plates for 40 °C Radiators

Some global regions include restrictions on the size of the containers that can be shipped. Where such restrictions exist, the skid wing plates may be shipped attached inwards on the skid and must be removed and installed in the correct location before the radiator is installed. The following procedure applies to instances when the skid plates need to be moved to the correct location. Parts referenced in the procedure are described below and illustrated in the following figures.

1. Remove the skid wing plate assembly from the skid (see the figure below).

FIGURE 41. SKID WING PLATES AS SHIPPED FROM THE FACTORY

a. Remove the hardware securing the small and large radiator support brackets (items 7 and 8) to the plate support (item 6).



No.	Description	No.	Description
1	Nut (M16)	5	Hex Head Screw (M16 x 75 mm)
2	Lock Washer (M16)	6	Plate Support
3	Flat Washer (M16)	7	Large Radiator Support Bracket
4	Hex Head Screw (M16 x 60 mm)	8	Small Radiator Support Bracket

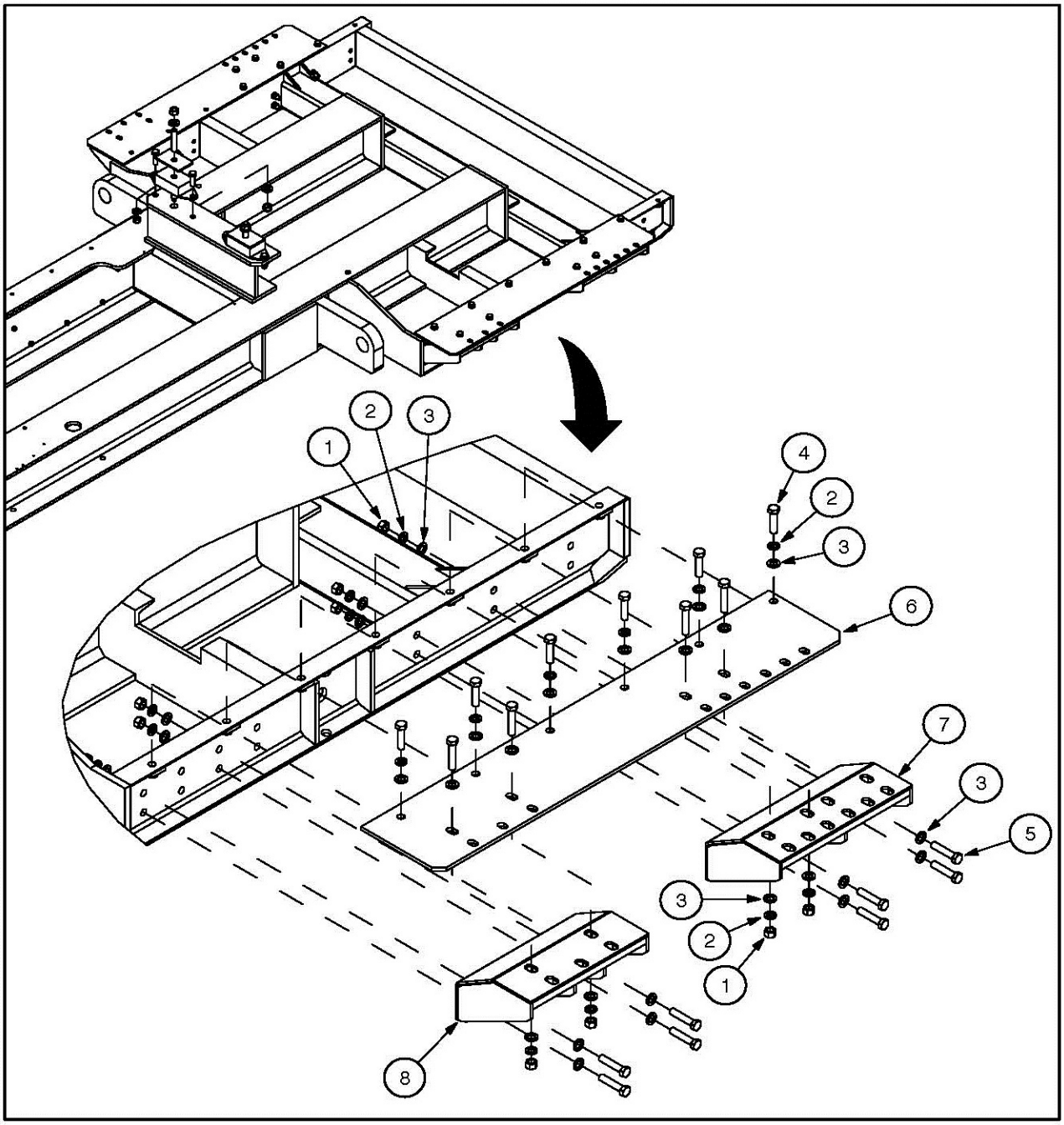
FIGURE 42. AS SHIPPED SKID WING PLATES ASSEMBLY

b. Remove the support brackets.

c. Remove the hardware securing the two plate supports (item 6) to the skid assembly.

d. Remove the plate supports.

2. Install the skid wing plate assembly in the appropriate location on the skid (see the figure below).



No.	Description	No.	Description
1	Nuts (M16)	5	Hex Head Screw (M16 x 75 mm)
2	Lock Washer (M16)	6	Plate Support
3	Flat Washer (M16)	7	Large Radiator Support Bracket
4	Hex Head Screw (M16 x 60 mm)	8	Small Radiator Support Bracket

FIGURE 43. SKID WING PLATE INSTALLATION

a. Use six M16 screws, twelve flat washers, six nuts, and six lock washers (items 5, 3, 1, and 2)

to loosely install each large radiator support bracket (item 7) on the skid chassis side frame. Do not torque the screws at this time.

b. Use four M16 screws, eight flat washers, four nuts, and four lock washers (items 5, 3, 1 and 2) to loosely install each small radiator support bracket (item 8) on the skid chassis side frame. Do not torque the screws at this time.

NOTICE
The small radiator support bracket is to be installed using the first and third set of holes, as shown below.

c. Use six M16 screws, lock washers, and nuts (items 4, 2, and 3) to install each plate support (item 6) on the skid chassis. Torque the screws to 90 ±10 Nm (66 ±7 ft-lb).

d. Use M16 screws and flat washers (items 4 and 3) to loosely secure each large (7) and small (8) radiator support bracket to the plate supports (6). Torque the screws to 90 ±10 Nm (66 ±7 ft-lb).

e. Torque the screws used to install the large and small radiator support brackets on the skid side frame to 90 ±10 Nm (66 ±7 ft-lb).

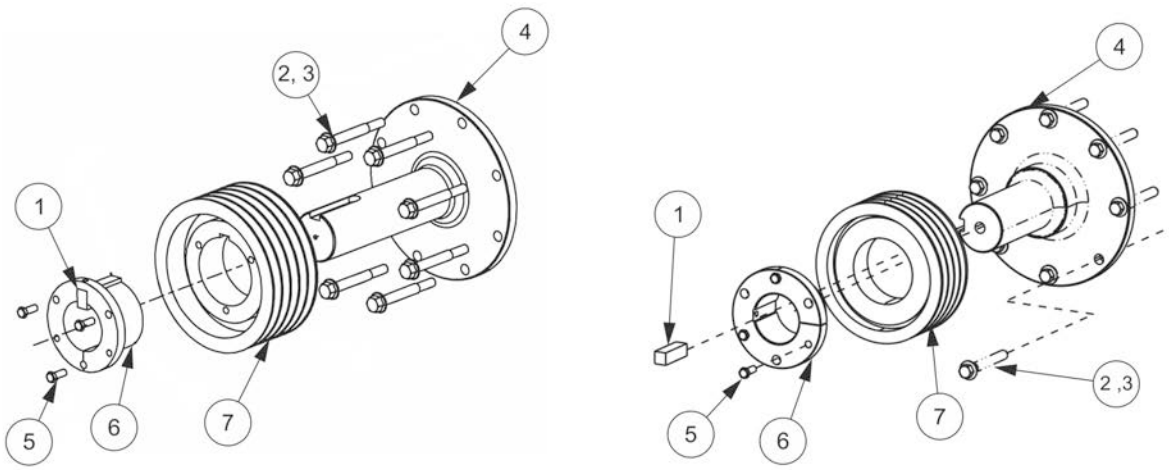
FIGURE 44. COMPLETED INSTALLATION OF THE SKID WING PLATE ASSEMBLY

8.4 Installing the Pulley for 43° C Radiator

This procedure describes installing the pulley assembly on the engine.

The numbers in parenthesis ( ) or correspond to the part callout numbers/letters in **Figure 45**.

1. Use eight hex head screws (2) and lock washers (3) to install the pulley shaft (4) on the engine crank shaft. Torque the screws to 180 ±10 Nm (132 ±15 ft-lbs).
2. Install the pulley (7), bushing (6), key (1), and cap screws (5) on the pulley shaft. Torque the cap screws to 39 Nm (28 ft-lbs).
3. Loosely install the tapered bushing into the tapered bore of the drive pulley and then slide this assembly onto the shaft (see **Figure 45**). Position the pulley on the shaft to the approximate setup offset distance from the other engine damper surface, as shown in View C of **Figure 46**. This setup will assist in the process of aligning with the fan pulley.
4. Align the shaft key seat with the bushing bore keyway and install the key. Make sure the key runs the entire length of the bushing bore. Position the driver pulley so that the keyway in the bore of the pulley is aligned with the external (barrel) key in the bushing.
5. Insert the cap screws through the non-threaded holes in the bushing flange and thread them by hand into the product three or four turns.
6. Position the bushing/pulley assembly axially on the shaft to the approximate setup offset distance from the outer engine damper surface, as shown in View C of **Figure 46**. This setup location is approximate and will assist in finalizing the correct alignment with the fan pulley.



No.	Description	No.	Description
1	Key	5	Cap Screw
2	Hex Head Screw	6	Bushing
3	Lock Washer	7	Pulley
4	Pulley Shaft		

FIGURE 45. IDLER PULLEY ASSEMBLY

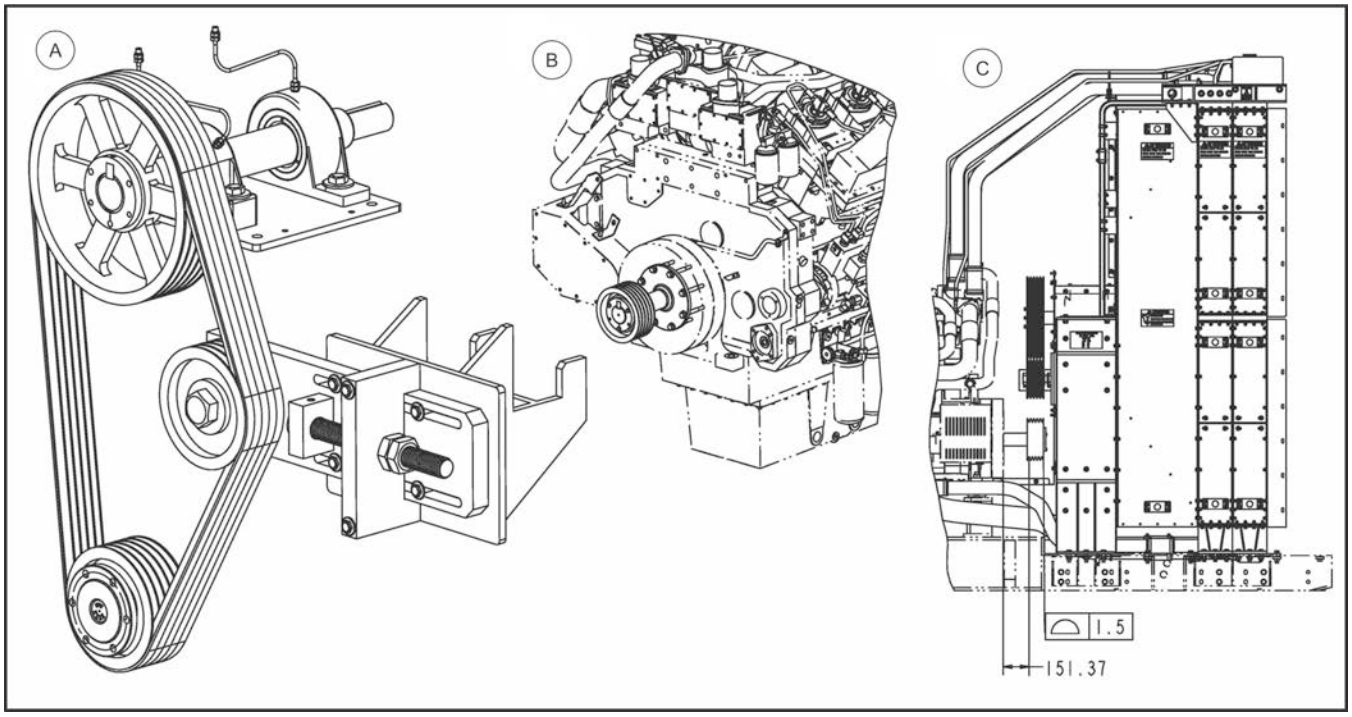


FIGURE 46. FAN DRIVE INSTALLATION ON 43°C RADIATOR ASSEMBLY

8.5 Connecting the 43 °C Radiator to the Engine

⚠ CAUTION

Equipment damage may occur if parts are not installed correctly. Use two people (one at the floor and one at the top of the engine) to install the radiator tubes.

This procedure describes installing the radiator tubes. Two people are required - one at the top of the radiator and one at the floor or the top of the engine.

The numbers in parenthesis ( ) correspond to the part callout numbers in **Table 6**, **Figure 47** (43° C cooling system installations).

TABLE 6. RADIATOR PARTS

No.	Description	No.	Description
1	V-Belt	21	Tube (3 Inch LTA Outlet)
2	Bushing	22	Tube (5 Inch JW Outlet)
3	Hex Head Screw	23	Hose (1-1/4 Inch)
4	Pulley Shaft	24	Hose Clamp (1-5/16 to 1-3/4 Inch)
5	Shaft Guard	25	Hose Clamp (1-3/16 to 1-1/2 Inch)
6	Belt Guard - Bottom Right	26	Flange Screw (not illustrated)
7	Belt Guard - Front	27	Flange Screw (M16 x 60mm, Class 8.8)
8	Belt Guard - Left	28	Lock Washer (M16)

No.	Description	No.	Description
9	Belt Guard - Top Right	29	Lock Nut (M16, Class 8.8)
10	Belt Guard (50°C Radiators Only)	30	Thread Sealant (not illustrated)
11	Pulley	31	Belt Guard
12	Hose Clamp (3-1/4 to 4-1/8 Inch)	21	Bracket
13	Hose (3 Inch)	33	Bracket
14	Tube (3 Inch JW Right Hand Side Inlet)	34	Belt Guard
15	Tube (3 Inch LTA Center Inlet)	35	Bracket
16	Tube (3 Inch JW Left Hand Side Inlet)		
17	Hose Clamp (5-1/4 to 6-1/8 Inch)	A	Key
18	Hose (5 Inch)	B	Optional Check Valve
19	Hose (3/4 Inch)	C	Clamp Plate and U-bolt Assembly
20	Petcock Valve (1/4-18 NPT)	D	Install the Low Coolant Level Sender at this location

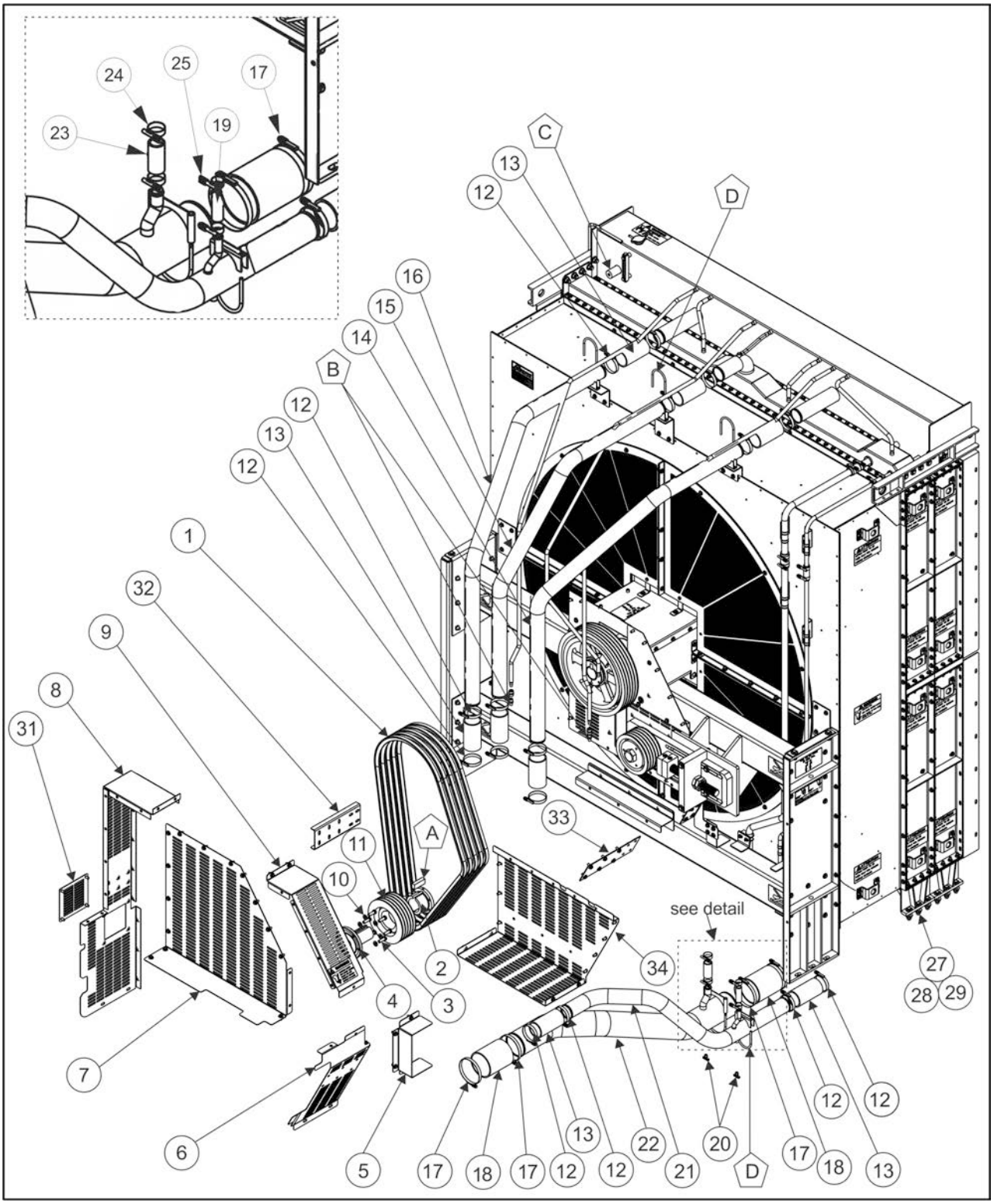
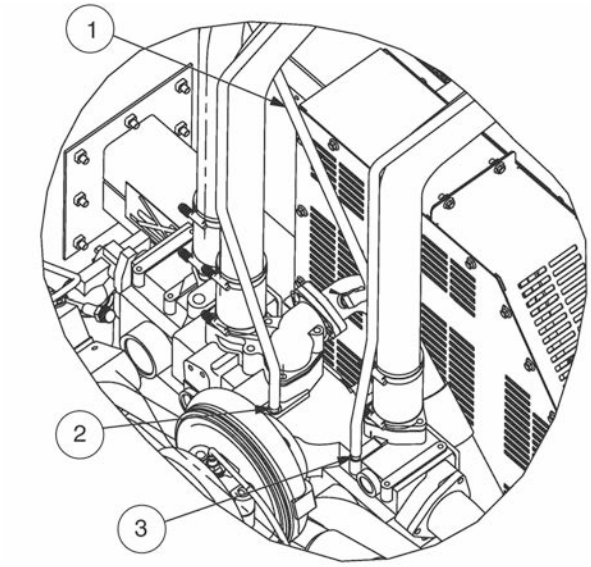


FIGURE 47. 43° C RADIATOR INSTALLATION

1. Remove all radiator hole plugs.

2. Remove the three clamp plate and U-bolt assemblies installed on the tube brackets located on the top rear of the radiator.
3. Install the inlet tube assemblies on the top of the radiator (see **Figure 47**).
    a. Use three hose clamps (12) to install three 3" rubber hoses (13) to the top of the radiator assembly. Torque the hose clamps to 8 ±1 N·m.
    b. Use three hose clamps (12) to secure the three radiator inlet tubes (14, 15, and 16) to the rubber hoses. Torque the hose clamps to 8 ±1 N·m.
    c. Reinstall the clamp plate and U-bolt assemblies removed in the previous step to secure the inlet tubes to the tube brackets. Position each inlet tube assembly and adjust the clamp plate and U-bolt assembly as necessary, using the vertical slots in the clamp plate to position while being careful not to pull the tube in any unintended direction. Finish by tightening the nuts on the U-bolts.
    d. Use hose clamps (12) to install a 3" rubber hose (13) to the end of each of the three radiator inlet tubes and secure them to the engine. Torque the hose clamps to 8 ±1 N·m.
4. Remove the two clamp plate and U-bolt assemblies installed on the tube brackets located on the bottom of the radiator.
5. Install the outlet tube assemblies on the bottom of the radiator (see **Figure 47**).
    a. Use a hose clamp (17) to secure a 5" hose (18) to the bottom of the radiator. Torque the hose clamp to 14 ±1 N·m.
    b. Use a hose clamp (17) to secure the JW outlet tube (22) to the hose. Torque the hose clamp to 14 ±1 N·m.
    c. Use two hose clamps (17) to secure a 5" hose (18) to the other end of the JW outlet tube and to the engine. Torque the hose clamps to 14 ±1 N·m.
    d. Use a hose clamp (12) to secure a 3" hose (13) to the bottom of the radiator. Torque the hose clamp to 8 ±1 N·m.
    e. Use a hose clamp (12) to secure the LTA outlet tube (21) to the hose. Torque the hose clamp to 8 ±1 N·m.
    f. Use two hose clamps (12) to secure a 3" hose (13) to the other end of the LTA outlet tube and to the engine. Torque the hose clamps to 8 ±1 N·m.
6. Apply thread sealant and install the petcock coolant drain valves (20) on the outlet tubes.
7. Attach the radiator outlet tubes to the outlet tubes (see detail in **Figure 47**).
8. Reinstall the clamp plate and U-bolt assemblies removed in step 18 to loosely secure the JW and LTA outlet tubes to the tube brackets. Position each outlet tube assembly and adjust the clamp plate and U-bolt assembly as necessary, using the vertical slots in the clamp plate to position while being careful not to pull the tube in any unintended direction. Finish by tightening the nuts on the U-bolts.
9. Connect the vent lines to the engine (see **Figure 48**).
    a. If your installation includes the optional two check valves, apply thread sealant and install them on the engine for the outside two vent lines.
    b. Connect the outside two vent lines to the optional check valves, if present. Otherwise, connect the vent lines directly on the engine.
    c. Connect the center vent line to the engine.
    d. Make sure the vent lines are installed in a continuous upward slope, without any dips or sags. Use cable ties as required to secure the vent lines in place.



No.	Description	No.	Description
1	Center Vent Line	3	Right Vent Line (with Optional Check Valve)
2	Left Vent Line		

FIGURE 48. 43° C RADIATOR

10. Use cable ties to secure the vent hoses to the radiator tubes.
11. Make sure all hose clamps are tight.
12. Install the low coolant level assembly.
    a. Apply thread sealant and install the customer-supplied low coolant level switch on the radiator expansion tank (see **Figure 47**).
    b. Connect the low coolant level sender harness from the sender to the main engine harness.
    c. Use six cable ties to secure the harness to the back of the left inlet tube (16).

8.6 Filling the Cooling System

After the generator set has been properly assembled and mounted, fill the cooling system.

NOTICE
The cooling system must be filled before aligning the fan drive. The weight of the coolant can change alignment.

8.6.1 Cooling System Filling Procedure

⚠ WARNING

The failure to properly replace coolant caps can result in hot pressurized coolant escaping from the radiator fill necks, causing severe personal injury and engine damage. Always make sure the radiator cap is properly secured before operating the generator set.

⚠ CAUTION

Failure to use the correct type of coolant, maintain the correct level, and bleed the systems of air can result in severe engine damage.

The system requires a 50/50 mixture of fully formulated coolant (ethylene glycol or propylene glycol). The quality requirements are defined by PGA drawing 0880-0152. The radiator-cooled generator set is shipped with 200 units (5 gallons [19 liters]) of Fleetguard supplemental coolant additive (SCA), trade name DCA4. If the radiators are not filled using Fleetguard "Compleat" brand antifreeze or equivalent antifreeze, the DCA4 needs to be added to the cooling systems.

Fill the radiator with a combination of coolant and corrosion inhibitor. Refer to the engine manufacturer's Owner's manual for recommended coolant type.

- For 40° C radiators, the system coolant capacity is 142 gallons (538 liters). Add 11 units of corrosion inhibitor (CPG part number 0880-0461) to 142 units of coolant (CPG part number 0880-0152-01).
- For 50° C radiators, the system coolant capacity is 155 gallons (587 liters). Add 13 units of corrosion inhibitor (CPG part number 0880-0461) to 155 gallons of coolant (CPG part number 0880-0152-01).

1. **Water-cooled turbochargers:**

   Open the petcock at the top of each of the two turbochargers.

   Non-water-cooled turbochargers:

   Loosen the vent line at the engine jacket water (JW) vent outlet located on top of the engine thermostat housing.

2. Begin filling the radiator with a 50/50 mixture and DCA4 or the fully formulated coolant. The combined circuits system capacity is 142 gallons (538 liters) for 40° C radiators or 155 gallons (587 liters) for 50° C radiators.

3. **Water-cooled turbochargers:**

   When coolant begins to flow from a petcock, close the petcock and continue filling the radiator.

   Non-water-cooled turbochargers:

   Tighten the vent line when coolant begins to flow from the vent outlet.

4. Observe the coolant level through the sight glass at the top of the expansion tank. Coolant level should be approximately at the fill level in the sight glass with a cool engine.

5. When the radiator is full, replace the radiator cap securely. Push down and twist clockwise until the cap lip hits the tank stop flange.

8.7 Aligning the Fan Drive- 43° C

Align the fan drive after the cooling system has been, assembled, and filled with coolant. The fan drive pulleys must be aligned and the belt tension must be correctly set for proper fan drive operation.

1. Align the pulleys by using a straight edge, placed on the outside face of both sheaves, to adjust parallel offset and angular alignments. The straight edge should be close to the shafts and contact each sheave in two places. The object is to have the shafts parallel and the center lines of the two sheaves in line (see **Figure 49**).

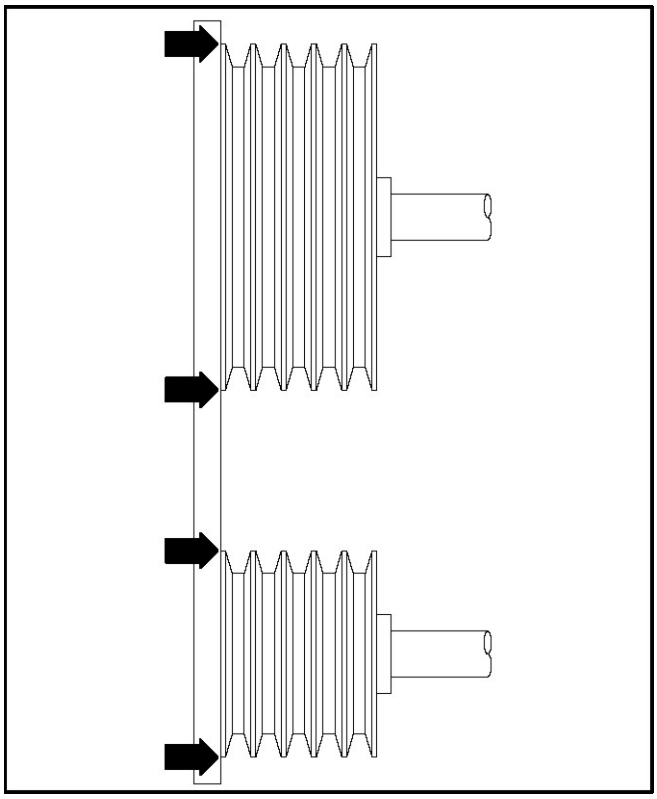
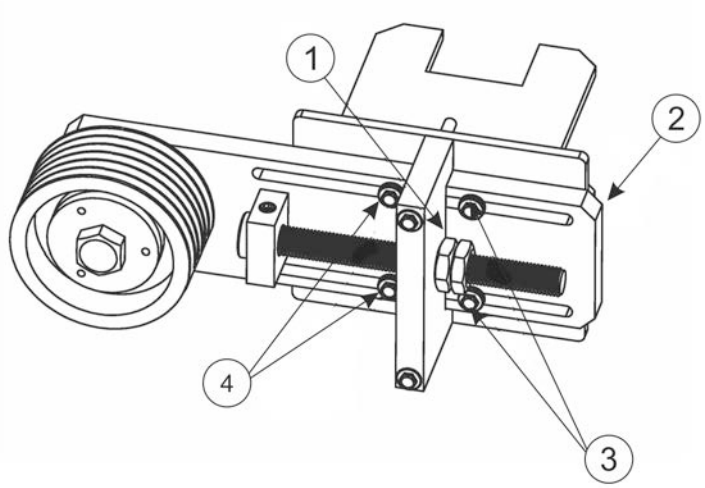


FIGURE 49. PULLEY ALIGNMENT

2. Use a torque wrench with the appropriate socket to tighten the bushing cap screws sequentially until each is tightened to 39 N·m (29 ft-lbs). When the cap screw torque is at or near the recommended torque, make at least two more sequential rounds to make sure all screws are torqued to the recommended value.
3. Verify the alignment. Since tightening the cap screws may affect the axial position of the driver pulley, confirm that the pulleys are still axially aligned. If alignment is required, then determine how much of the driver pulley/bushing assembly must be moved to be in proper alignment. Loosen the bushing/pulley assembly and adjust the driver pulley position on the shaft to the desired axial position to complete alignment. Reinstall the cap screws and torque them, as described in the previous step. Recheck the alignment and repeat this procedure until proper alignment is achieved.
4. Install the five V-belts and adjust the belt tension (see View A in **Figure 46**.
    a. Loosen the four M16 bolts in the manual tensioner (see **Figure 50**.



No.	Description	No.	Description
1	Lock Nut	3	M16 Bolts
2	Tensioner	4	M16 Bolts

FIGURE 50. BELT TENSIONER ASSEMBLY

b. Loosen the lock nut and slide the manual tensioner inward. Having the idler sheave close to the center will help facilitate installation of the belts.

⚠ WARNING

The fan belt idler is under tension. To avoid personal injury, do not allow your hands to get between the idler and the belt or the fan hub.

c. Install the five V-belts over the pulley grooves to loop around the pulleys.

d. Move all of the slack to the idler side and then remove all slack by sliding the manual tensioner outward. Rotate the pulley by hand for several revolutions to equalize the belt tension.

e. Apply force at right angles to one belt at the center of the span, as illustrated in **Figure 51** where "A" shows where the deflection length is to be measured. Use a strip of key stock or similar tool (not included). When applying the correct force for your application (refer to the following table) at one belt, the corresponding deflection length should match the measurement listed in the following table.

TABLE 7. DEFLECTION LENGTH

43° C Radiators			
1500 RPM (50 Hz) Engines		**1800 RPM (60 Hz) Engines**	
Force	**Deflection Length**	**Force**	**Deflection Length**
6 kg	11 mm (0.433 inch)	6.6 kg	11 mm (0.433 inch)

f. Increase the belt tension by sliding the idler pulley away from the center and check the deflection length to verify that the correct tension has been achieved.

g. Torque the lock nut until the system is locked.

h. Torque the four M16 bolts to 195 N·m (143 ft-lbs).

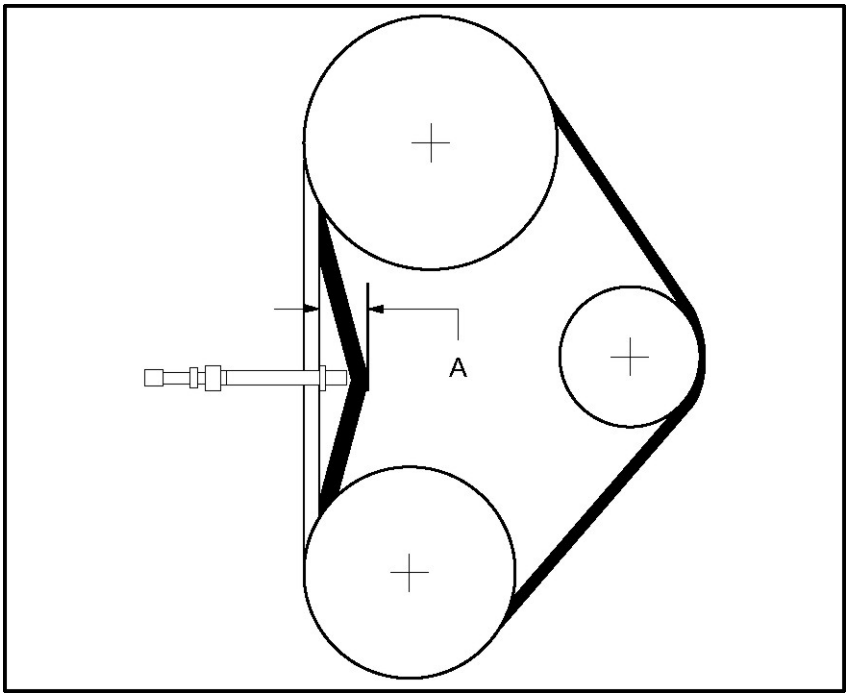


FIGURE 51. BELT DEFLECTION

8.8 Test Running the Generator Set

To verify that the installation has been done properly, it is important to observe the drive belts and confirm that the belts are properly seated in all grooves in all three pulleys while the generator set is running. To complete this visual inspection, the belt guards must not yet be installed.

⚠ WARNING

A misaligned fan drive or improperly installed drive belt can cause the belt to break, causing severe injury to near-by personnel. A properly aligned belt can grab loose clothing or body parts, causing severe personal injury. When the belt guards are not installed, wear safety glasses and stand back from the running fan drive.

1. Connect the negative (–) cable to the battery using an insulated wrench.
2. If equipped, connect the battery charger and turn it on.
3. In order to purge air from the coolant system, start the engine and allow it to warm up.
4. Verify that the V-belts are not squealing under peak load conditions and observe the drive belts to confirm that the belts are properly seated in all grooves in all three pulleys. If any of the belts "wander", "walk", or jump between pulleys, either the fan drive needs to be realigned, or the belts were improperly installed.
5. If any of the belts or the drive needs to be corrected, stop the engine, and disconnect the negative lead (–) of the starting batteries using an insulated wrench, and correct as necessary.
6. If necessary, make sure the belts are properly aligned.
7. If the V-belts were squealing, adjust the tension as necessary.

8. After the belt(s) have been properly installed, repeat step 4.

⚠ WARNING

Contact with belts or pulleys can result in severe personal injury. All guard pieces must be properly fastened in place to prevent unintended contact.

9. Use the flange screws (27) to install the pulley guard/shaft guard assembly, belt guard, and bracket (5, 6, 7, 8, 9, 31, 32, 33, 34, and 35 in **Figure 47**). Torque the screws to 46 Nm (35 ft-lbs).

⚠ WARNING

Contact with hot coolant can result in serious burns. Allow the engine to cool before loosening the radiator cap or coolant drain.

10. Stop the engine and when it has cooled down, check for coolant leaks and repair as necessary. Recheck coolant levels and add coolant, if required.

9 DC Control Wiring

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Avoid contact with the voltage sense and bus sense leads; voltages of up to 600 VAC may still be present. These voltages could be live even when the generator set is switched off.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure all power is off before performing control wire installation.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

To prevent accidental electrocution, stand on a clean dry wooden platform or clean rubber insulating mat, make sure your clothing and shoes are dry, remove all jewelry, and use tools with insulated handles.

The generator set control box contains connection points for remote control and monitor options.

NOTICE

Always run control circuit wiring in a separate metal conduit from the AC power cables to avoid inducing currents that could cause problems within the control.

Use cable ties to keep control wiring away from sharp edges and AC power cables within the control housing.

NOTICE

Stranded copper wire must be used for all customer connections to the control panel. Solid copper wire may break due to the generator set vibration.

Use flexible conduit for all wiring connections to the generator set.

9.1 Guidelines for Customer Connections to the Control System

- Torque terminals to 0.5 Nm (4.4 in-lb)
- Wire type: Use 60 C rated minimum copper wire
- Terminal screws (if fitted) are slotted 0.6 mm
- Use flat bladed screwdriver with 2.5 mm blade

- Strip wire length to 6.0 mm (0.236 in) for screw type terminals and 10 mm (0.75 in) for push type terminals

9.1.1 Digital Connections

Connection points, other than relayed outputs and network are considered digital connections. The type/gauge wire to use for these connections are:

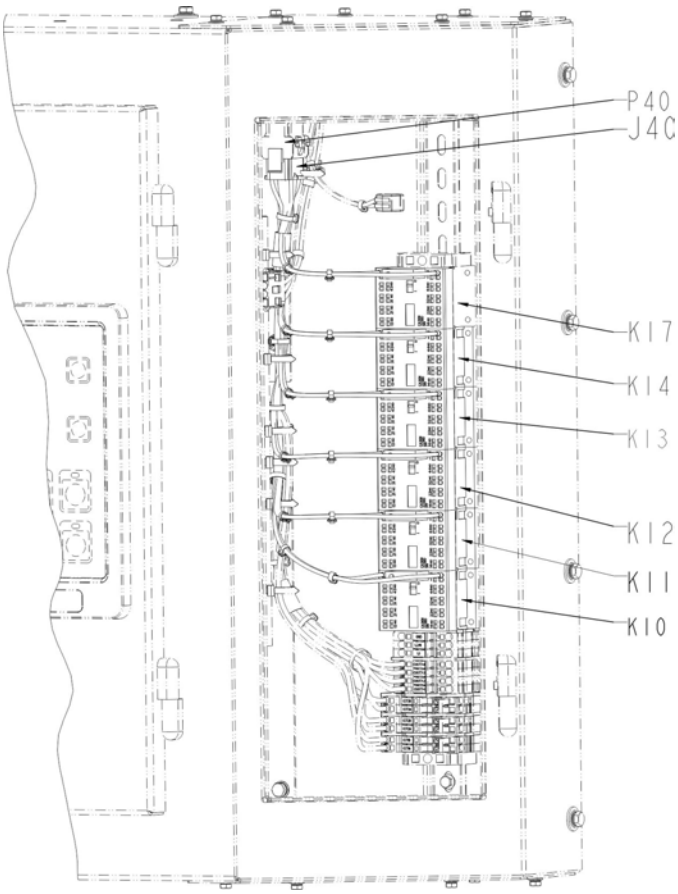
- Less than 305 m (1000 ft), use 0.5 mm^2 (20 gauge) stranded copper wire.
- 305 m to 610 m (1000 ft to 2000 ft), use 0.75 mm^2 (18 gauge) stranded copper wire.

9.1.2 Relay Connections

Due to the wide variety of devices that can be attached to the relay outputs, the electrical contractor must determine the gauge of the stranded copper wire that is used.

9.2 Customer Relays

9.2.1 Location of Customer Relays



No.	Description	No.	Description
K10	Configurable Output 1	K12	Configurable Output 4
K11	Configurable Output 3	K13	Common Alarm

FIGURE 52. LOCATION OF CUSTOMER RELAYS

9.2.1.1 Configurable Outputs

This relay is connected to the corresponding configurable output on the control. If the configurable output is active, the relay is active. If the configurable output is inactive, the relay is inactive.

This relay allows the configurable output to control larger devices, and it isolates the control from these devices.

9.2.1.2 Common Alarm

This output is active as long as any shutdown fault or warning fault is active.

9.2.1.3 Contact Specifications

The contacts are rated at 10 A at 600 VAC.

9.2.1.4 Schematic

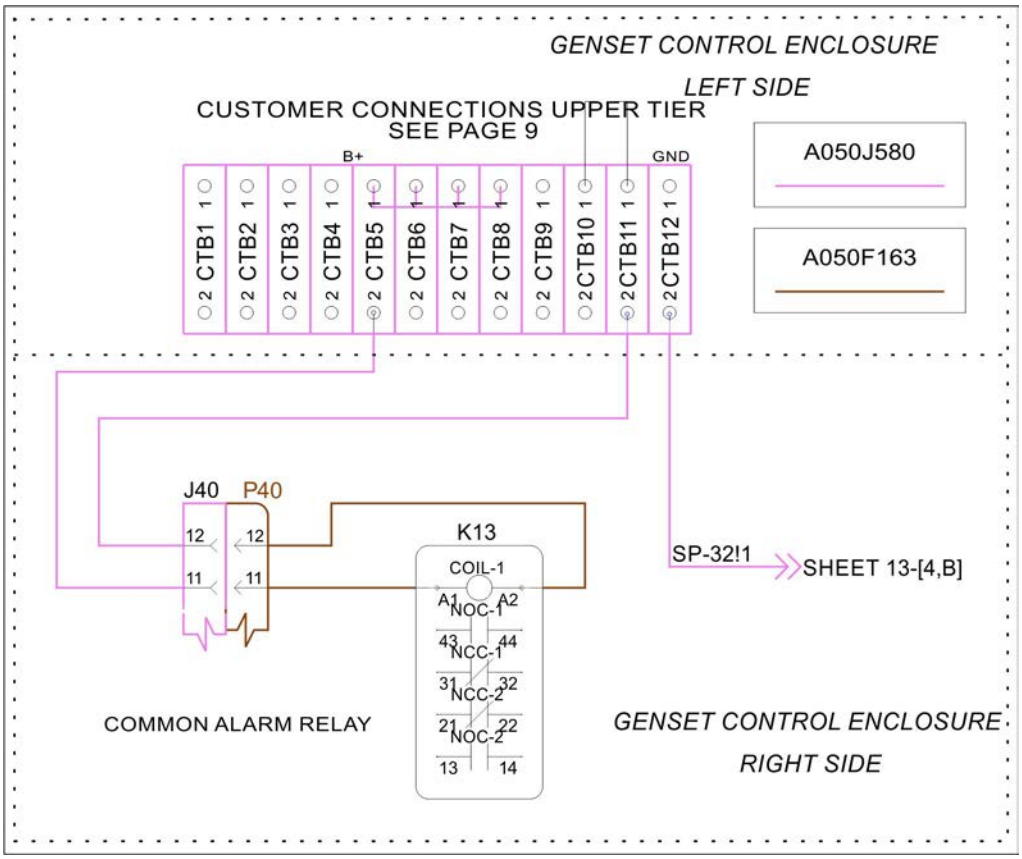


FIGURE 53. CUSTOMER CONNECTIONS (TOP) AND COMMON ALARM CONNECTIONS (BOTTOM)

9.3 Paralleling Circuit Breaker Control Relays

9.3.1 Paralleling Circuit Breaker Control Relays Installation

The circuit breaker control and monitor function manages opening and closing the generator set breaker. It also manages sensing/determining both generator set and utility breaker positions. The generator set breaker is controlled with two separate relays -one for closing and one for opening.

The control logic instructs the generator set breaker to always (except for a short delay) close or always open the breaker. Opening the breaker always takes priority over any close.

Only two functions can close the breaker - either a dead bus close or the permissive close (sync check).

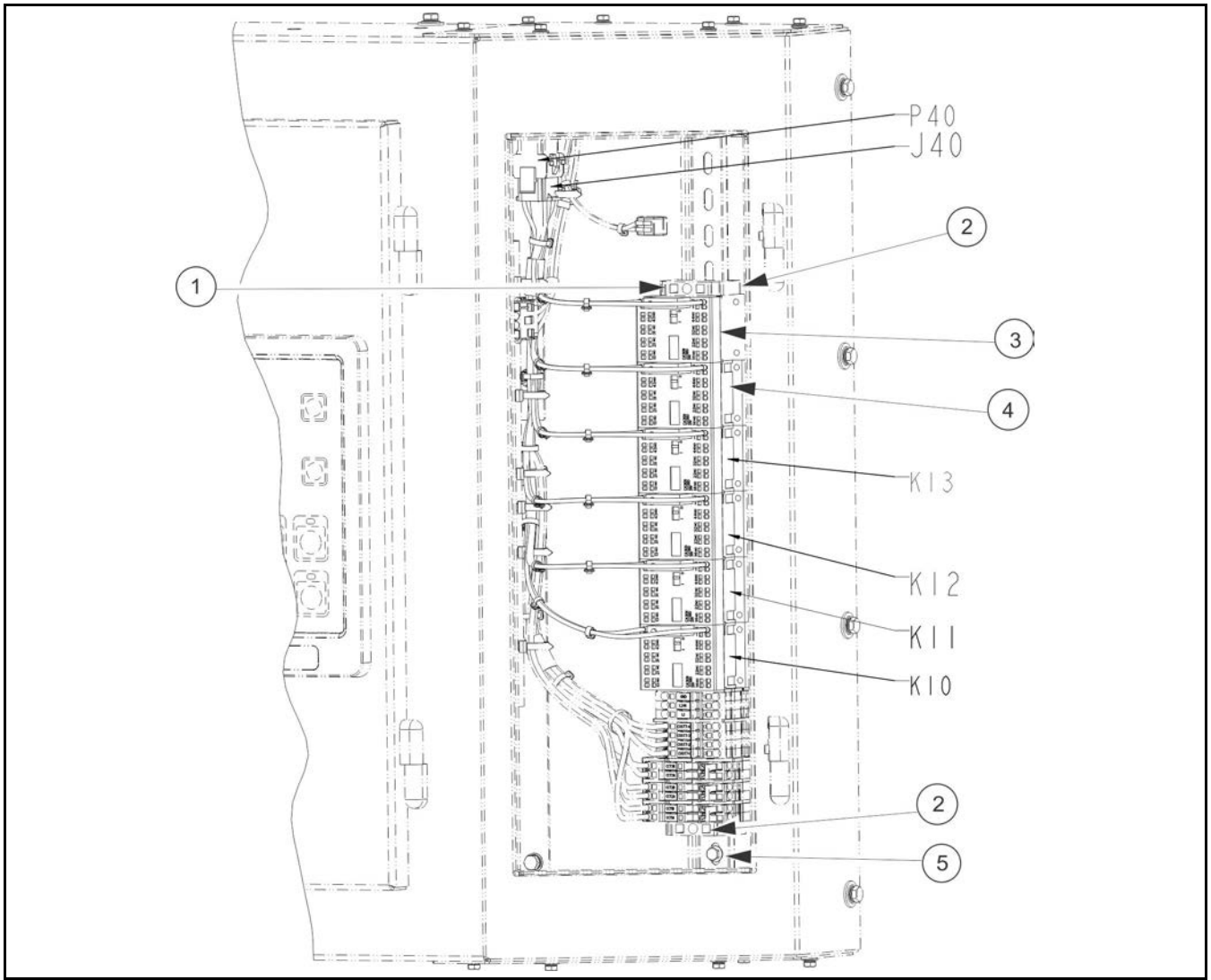
In single generator set applications, the relay contact used for breaker closing is capable of being set up to trip the breaker on fault shutdowns only and the breaker position is not sensed.

TABLE 8. BREAKER CONTROL FUNCTIONS

Connector Pins	Signal Name	Signal Type	Description of Default Function
TB5-1, TB5-2	Genset CB Close Status	Relay Output	Contact for closing generator set breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-3, TB5-4, TB5-5	Genset CB Open Status	Relay Output	Contact for opening generator set breaker, ratings 5A 30 VDC inductive L/R = 7 msec

Connector Pins	Signal Name	Signal Type	Description of Default Function
TB5-6, TB5-7	Utility CB Close Status	Relay Output	Contact for closing utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-8, TB5-9	Utility CB Open Status	Relay Output	Contact for opening utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec

Paralleling circuit breaker control relays are located in the control pedestal.



No.	Description	No.	Description
1	End Block	4	K14 Control Relay
2	Terminal End Bracket	5	Terminal DIN Rail
3	K17 Control Relay		

FIGURE 54. PARALLELING CIRCUIT BREAKER CONTROL RELAYS

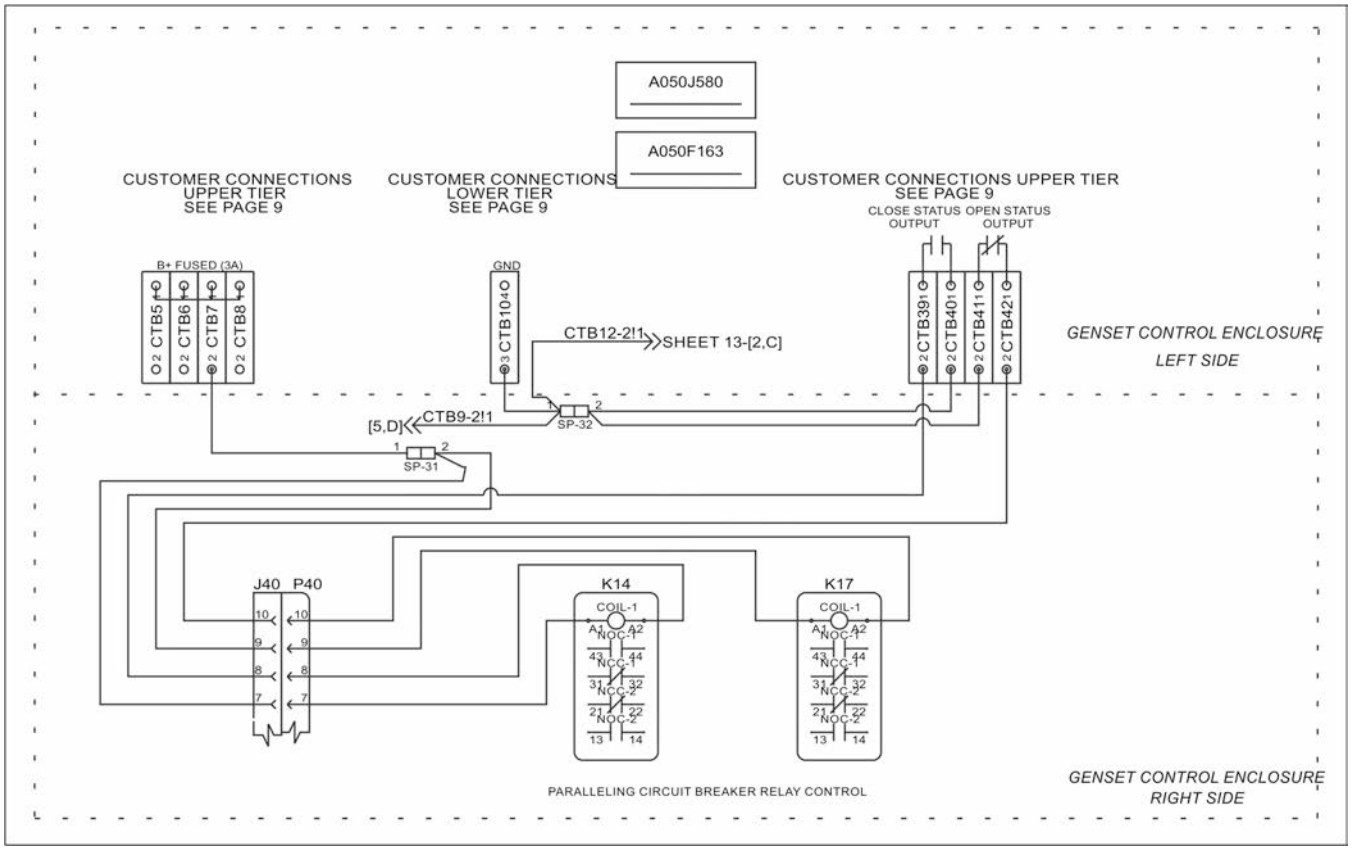


FIGURE 55. WIRING DIAGRAM OF PARALLELING CIRCUIT BREAKER CONTROL RELAYS

9.4 Ground Fault Relays

A Ground Fault Relay (GFR) continuously monitors the neutral-to-ground connection and activates a fault alarm when the connection is broken. During generator set operation, the relay continuously monitors the line-to-neutral and activates a fault alarm when a ground fault is sensed.

A control reset will clear the fault at the control panel and will also reset the ground fault relay.

9.4.1 Ground Fault Relay

TABLE 9. SPECIFICATIONS

Description	Specification
Maximum AC Terminal Voltage	600 VAC
Supply Voltage	12 – 48 VDC
Continuous Current	5 Amps
Operating Ambient Temperature	–10 to +60 Degrees C
Weight	Less than 250 Grams
Time Delay Setpoint	Adjustable 0 to 10 Seconds
Tip Current Setpoint	100 / 150 / 200 / 250 / 300 / 450 / 600 / 750 / 800 / 1200 Amps

Description	Specification
Burden	Less than 1.5 Watts
Response Time	Less than 200 MS
Rated Contact Voltage	8 Amps at 250 VAC
Rated Contact Voltage	8 Amps at 30 VDC

9.4.2 Ground Fault Relay Installation

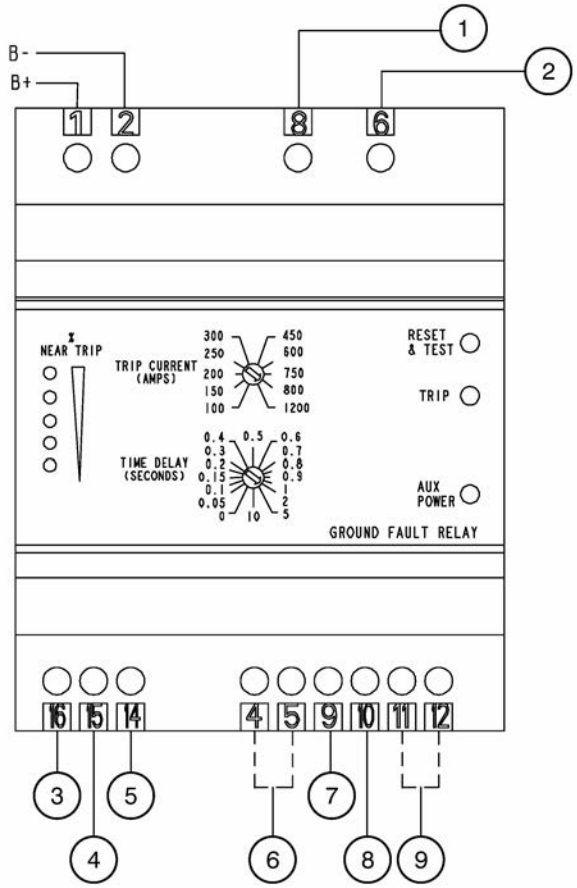
The connection points on the ground fault relay that are used are listed in the following table.

TABLE 10. GROUND FAULT RELAY CONNECTIONS

Relay Connection	Terminal Block Connection	Harness
GFR-1	CTB B+	Relay
GFR-2	CTB B–	
GFR-14	CI-14	
GFR-15	CI-15	
GFR-6	CI-6	AC
GFR-8	CI-8	

The two leads connected from GFR-14 and GFR-15 to CI-14 and 15 are configurable inputs.

Refer to the following figure when making wiring connections.

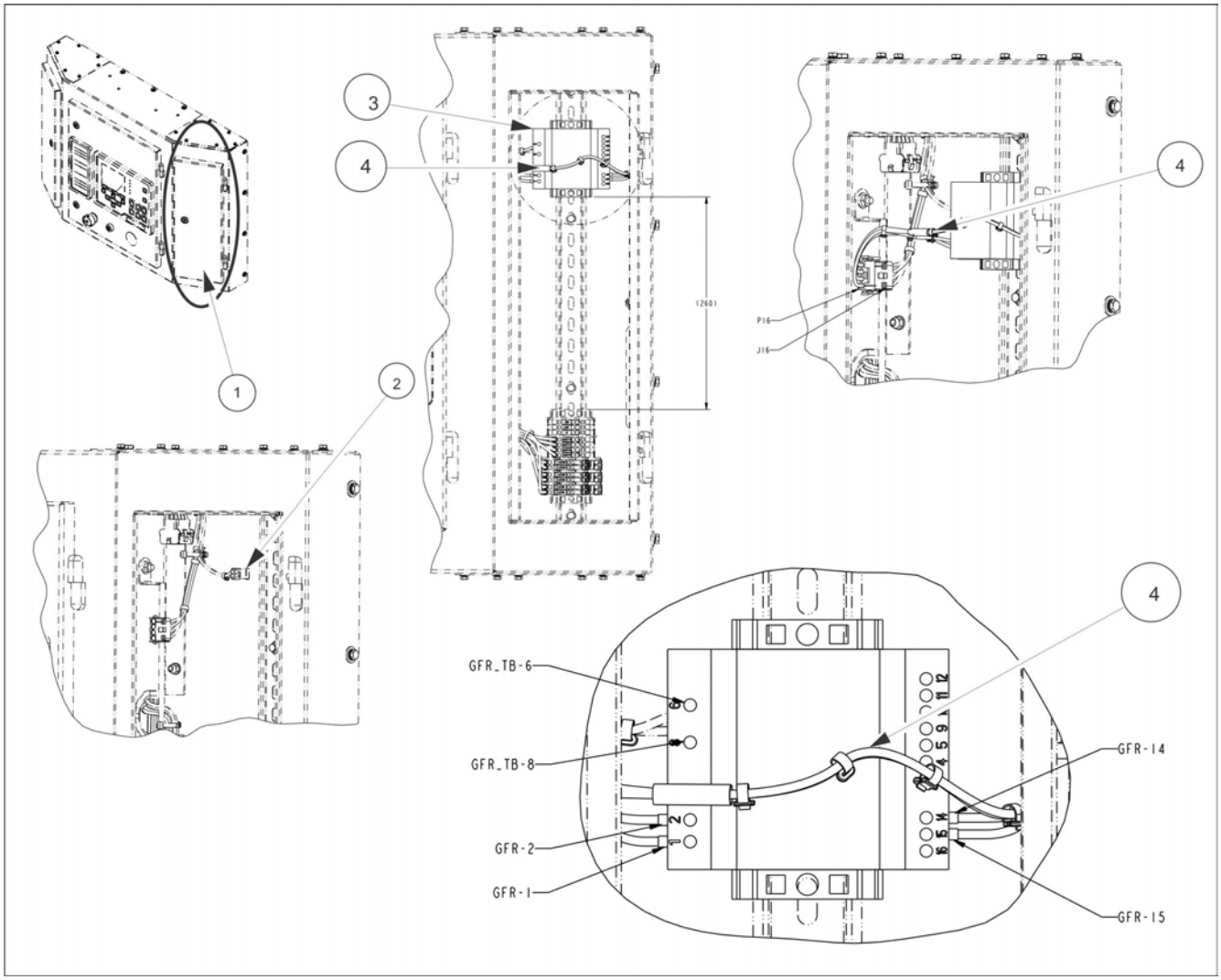


No.	Description	No.	Description
1	Signal Return	6	Link for Latching Relay
2	Signal Ground	7	Analogue +
3	Normally Closed	8	Output –
4	Com.	9	Link for 200µ Shunt
5	Normally Open		

FIGURE 56. GROUND FAULT RELAY WIRING CONNECTIONS

1. Remove the bottom panel from the control box.
2. Remove the cover from the side terminal box.
3. Install the ground fault relay and the two terminal end brackets on the terminal DIN rail, as shown in the following figure.
4. Remove the tape from the end of the two wires exiting the convoluted sleeving from the AC harness.
5. Install the two AC wires to the ground fault relay.
6. Secure the AC wires by tightening the sealing nut in the side terminal box.
7. Install the ground fault relay harness.
8. Torque all screws securing wires on the ground fault relay to 0.6 - 0.8 Nm (5.3 - 7.1 in-lb).

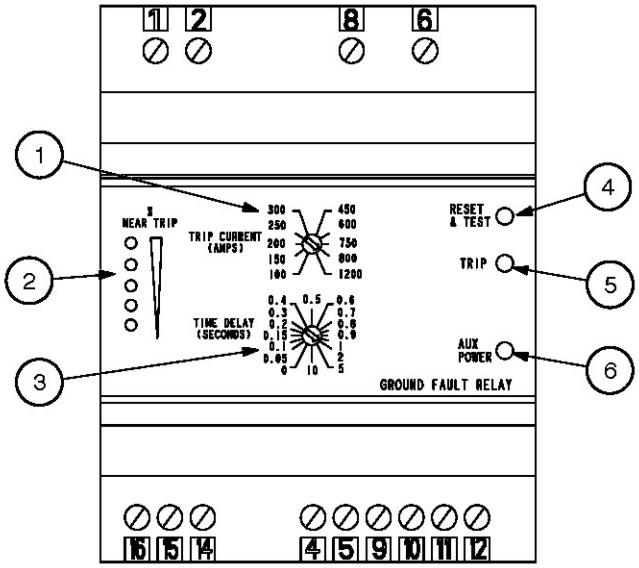
9. Reinstall the side terminal box cover. Torque the three large bolts to 24 - 29 Nm (17.6 - 21.3 ft-lb). Torque the small bolt to 5.8 - 7.0 Nm (4.3 - 5.2 ft-lb).
10. Reinstall the bottom panel on the control box. Torque the bolts to 24 - 29 Nm (17.6 – 21.3 ft-lb).



No.	Description	No.	Description
1	Ground Fault Location	3	Ground Fault Relay
2	Terminal Connector	4	Relay Harness

FIGURE 57. GROUND FAULT RELAY INSTALLATION

The relay has a time delay setting of 0–10 seconds and a current setting of 100–1200 amperes. Adjust the Current and Time Delay controls on the ground fault relay to the customer's specifications.



No.	Description	No.	Description
1	Trip Current Control	4	Reset and Test Button
2	Percent Near Trip Indicators	5	Test Button
3	Time Delay Control	6	Auxiliary Power Indicator

FIGURE 58. GROUND FAULT RELAY

10 AC Electrical Connections

⚠ WARNING

Arc Flash and Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. The AC sensing harness and other cabling will become energized when the generator set is in operation.

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Avoid contact with the voltage sense and bus sense leads; voltages of up to 600 VAC may still be present. These voltages could be live even when the generator set is switched off.

This section provides the procedure that is used to connect the AC electrical system of the generator set.

Before making any AC electrical connections, make certain the generator set cannot be accidentally started. Make sure the Operator Panel is in OFF mode. Turn off or remove AC power from the battery charger and then remove the negative (–) battery cable from the set starting battery using an insulated wrench.

If the generator set is being installed in an application where it may parallel with other generators or utility sources, the generator set control system may be energized from an external source. Lock out tag out any external source that can provide AC power to the generator set.

NOTICE

Ventilate the battery area before working on or near battery. Wear goggles. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Disconnect negative (–) cable first and reconnect last using an insulated wrench.

Connecting the generator set AC electrical system involves:

- Installation of transfer switch
- Installation or verification of paralleling switchboard
- Generator output voltage selection
- Load cable connection
- Standard and optional AC equipment connections (e.g., control box heater, coolant heater, etc.).

For all output connections, including when field connection is made at the alternator terminations, installation should be completed with conductors of appropriate size, type, and rating specified in local codes (or UL). For UL compliant installations, use conductor size, X AWG, 75 °C or 90 °C copper wire, 600V. Where X AWG is the conductor size specified by the local electrical code for 75 °C at the rated output current for the generator set. For non-UL compliant installations, use cable sizes, composition, and rating per local codes. Strain relief, bending space, raceway, and other installation features should be completed in compliance with local code.

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of electrical codes in effect at the installation site.

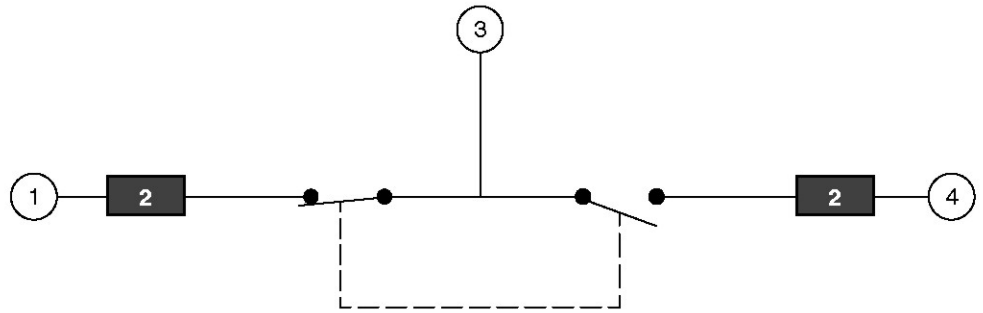
Before starting the generator set, check to make sure that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the generator set are properly connected.

NOTICE

Backfeed to a utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after the building main switch is opened.

10.1 Transfer Switch

A transfer switch must be used for switching the load from the normal power source to the generator set (see **Figure 59**). Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.



No.	Description	No.	Description
1	Normal Power Source	3	Load
2	Overcurrent Protective Device	4	Emergency Power Source

FIGURE 59. TYPICAL LOAD TRANSFER FUNCTION

10.2 Alternator Voltage Connections

These alternators can be configured to the nameplate voltages as shown on the Reconnection Diagram decal, attached to the backside of the control box cover. Many of the voltages listed will require reconfiguration of the alternator output leads on the connection terminal block. This reconfiguration must only be done by service personnel that are trained and experienced to perform electrical installation. The generator set was adjusted to produce a specified voltage during production verification testing prior to shipment. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage required.

Some generator sets are capable of producing a wide range of voltages and connection configurations; others have specific limited capabilities. Refer to wiring diagram and generator voltages (from the nameplate) when reviewing the voltage connection information and use the wiring diagram supplied with your generator set when actually performing load connections.

NOTICE

Reconfiguring generator sets to higher voltages can exceed the voltage capability of the specific generator windings and damage the generator and also decrease line current, rendering line circuit breakers too large. Consult with your authorized distributor before performing reconnection for a different voltage.

NOTICE

Reconfiguring generator sets to lower voltages can reduce generator set ratings, and also increase line current, rendering line circuit breakers too small. Consult with your authorized distributor before performing reconnection for a different voltage.

10.3 Load Connections

NOTICE
Flexible conduit and stranded conductors must be used for connections to take up movement of the generator set.

All loads are connected to the alternator by bolting stranded load wires to the appropriate terminals on the alternator reconnection terminal block or circuit breaker lugs. The terminals are marked U, V, W, and N to indicate the line and neutral connections. (Reference: U, V, and W correspond with L1, L2 and L3; and N with L0 respectively). See **Appendix D on page 169** for details about the following:

- Load connections
- Conduit
- Cable Size

10.3.1 Generator Set Load Cable Installation

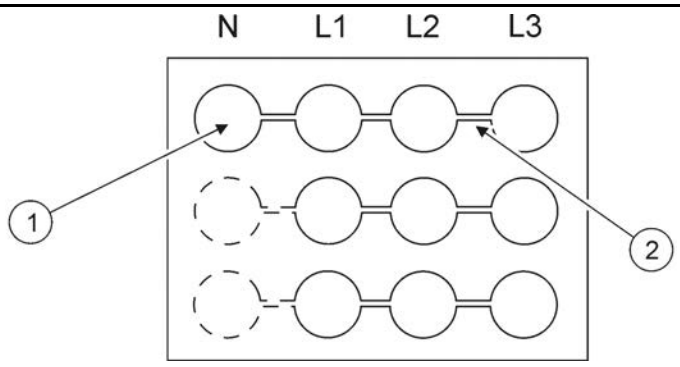
To ensure optimum performance of the generator set, load cables passing through cable gland plates must be adequately protected and secured.

10.3.2 Cabling through Non-Ferrous Gland Plates

Single core load cables must be secured using non-ferrous cable glands.

10.3.3 Cabling through Ferrous Gland Plates

Single core load cables must pass through the same hole, or slotted cable gland holes as illustrated (see **Figure 60**). Cable glands must be made from non-ferrous material.



No.	Description	No.	Description
1	Cable Gland Holes	2	Slot > 0.5 mm (0.02 in)

FIGURE 60. FERROUS GLAND PLATES

10.3.4 Distribution Cables

Single core power distribution cables should be grouped in a trefoil formation as illustrated (See **Figure 61**). (Trefoil grouping provides optimum cable loading and reduces electrical emissions). To minimize cable temperature rise and reduce cable de-rate factors, cable groups where possible, should be spaced to provide ventilation. Cable groups must be secured with non-ferrous material.

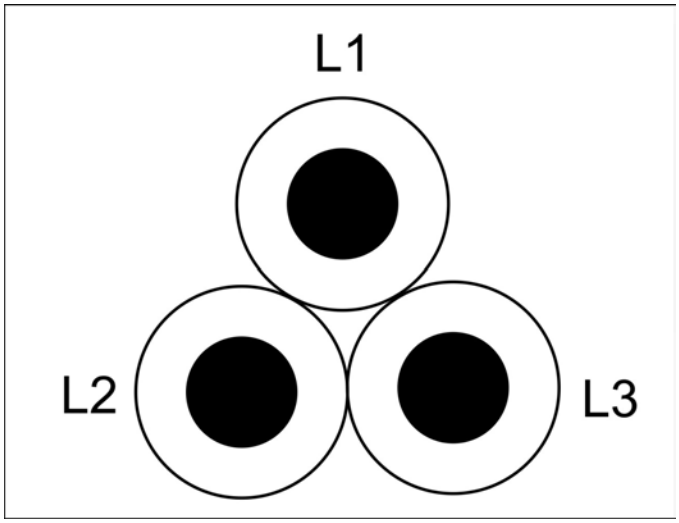


FIGURE 61. TREFOIL FORMATION

10.4 Load Balancing

When connecting loads to the generator set, balance the loads so that the current flow from each line terminal (L1, L2, and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value and no line current exceeds the name plate rating of the generator. Check the current flow from each line after connections by observing the Operator Panel ammeter.

10.5 Current Transformers

Current transformers (CTs) reduce high voltage currents (AC) to enable safe monitoring.

10.5.1 Current Transformer Installation Requirements

Current transformers (CTs) reduce high voltage currents (AC) to enable safe monitoring.

The CT has a dot on one side. This dot must be facing toward the alternator reconnection terminal block (conventional current flowing into the dot). A dot is also used to indicate pin 1 of the CT.

Route the load lead through the appropriate CT. See the Alternator Reconnection Drawing section.

The CTs have dual secondaries (3 pins):

- The CT secondary wire marked 1 is connected to pin 1 of the CT.
- The CT secondary wire marked 2/3 is connected to pin 3 for low voltage generator sets.

10.6 Coolant Heater

The coolant heaters are designed to allow the generator set to start and pick up load within 10 seconds in a 4.4 °C (40 °F) environment. In colder ambient temperature environments the starting time may be longer.

10.6.1 Coolant Heater Connection

NOTICE

The coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.

A coolant heater keeps the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces start-up time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

Refer to **Appendix A** for electrical connections.

10.6.2 Coolant Heater Specifications

The coolant heaters are designed to allow the generator set to start and pick up load within 10 seconds in a 40 °F (4.4 °C) environment. In colder ambient temperature environments the starting time may be longer.

An installation may include one of two types of coolant heaters.

- 4990 watt at nominal voltage - This coolant heater is used in an environment where the minimum temperature is 40 °F (4 °C).
- 6420 watt at nominal voltage - This coolant heater is used in an environment where the temperature is less than 40 °F (4 °C).

A coolant heater can be set up for 240 or 480 Volt configurations.

10.7 Alternator Heaters

10.7.1 Alternator Heater Connection

⚠ WARNING

Electric Shock Hazard

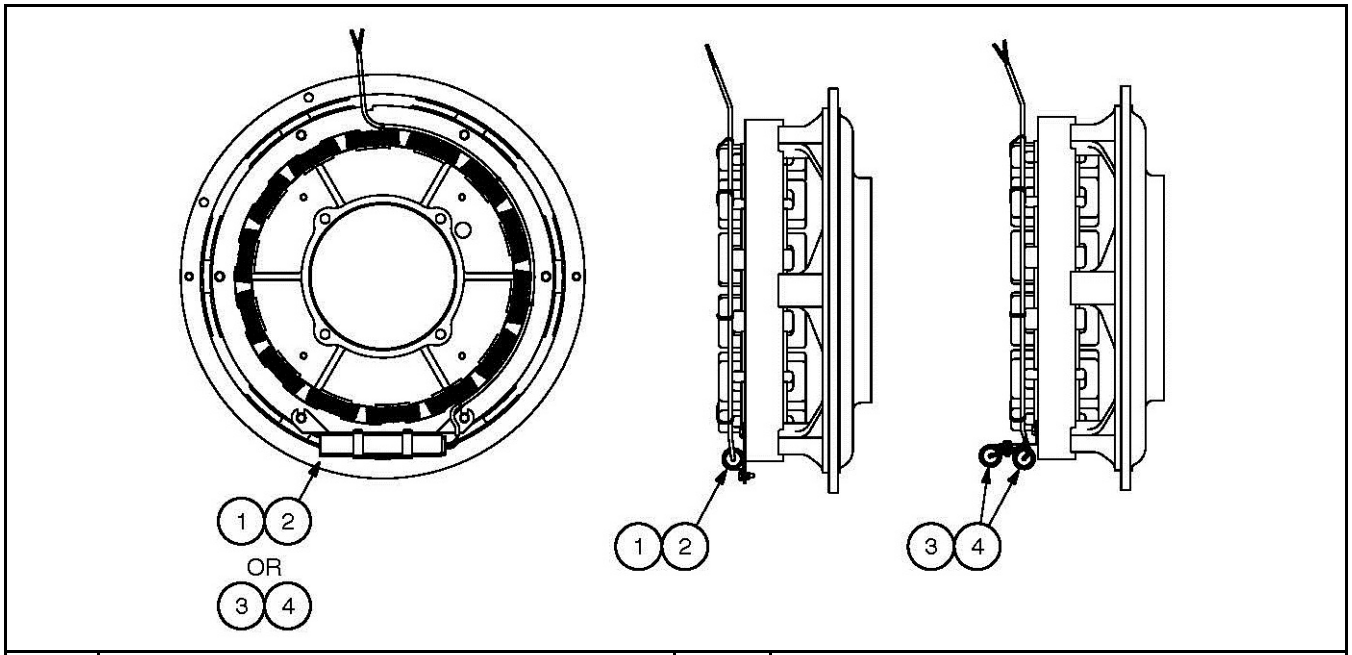
Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Water or moisture inside an alternator increases the possibility of flashing and electrical shock. Do not use an alternator which is not dry inside and out.

An alternator heater(s) is used to help keep the alternator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within an alternator, creating flashing and shock hazards.

Connect the heater(s) terminals to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

10.7.2 Installed Alternator Heaters



No.	Description	No.	Description
1	Alternator Heater - 240 V	3	Alternator Heater Cartridge - 120 V
2	Alternator Heater - 120 V	4	Alternator Heater Cartridge - 240 V

FIGURE 62. INSTALLED ALERNATOR HEATERS

10.8 Control Box Heater

10.8.1 Control Cabinet Heater Installation

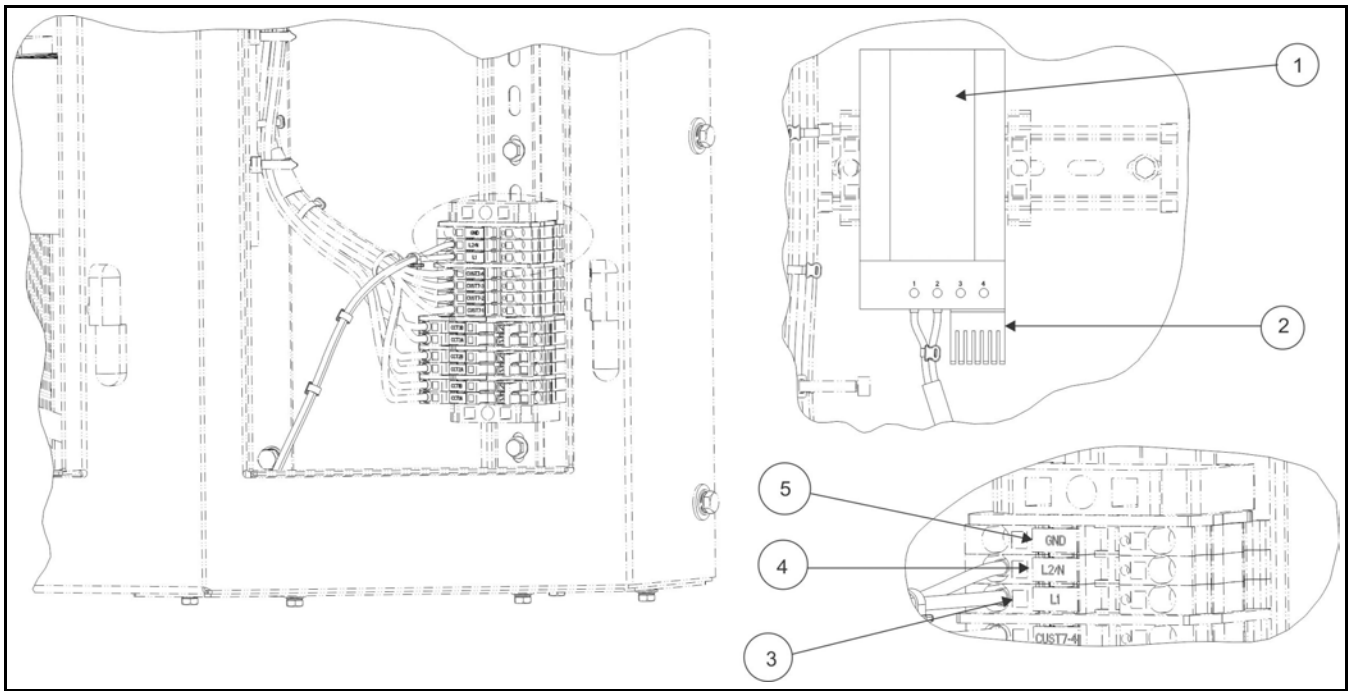
A thermostat controlled heater is installed inside the control cabinet. The heater pad is attached to the bottom of the upper control box compartment and the heater terminal blocks are installed on the terminal rail in the lower control box compartment.

Both 120V and 240V heaters are available.

Figure 63 shows an installed heater. The hex nuts used to install the thermostat are to be torqued to 5.8 - 7.2 Nm (51 - 64 in-lb). The screws used to secure the terminal bocks to the terminal rail are to be torqued to 0.58 - 0.78 Nm (5.1-6.9 in-lb).

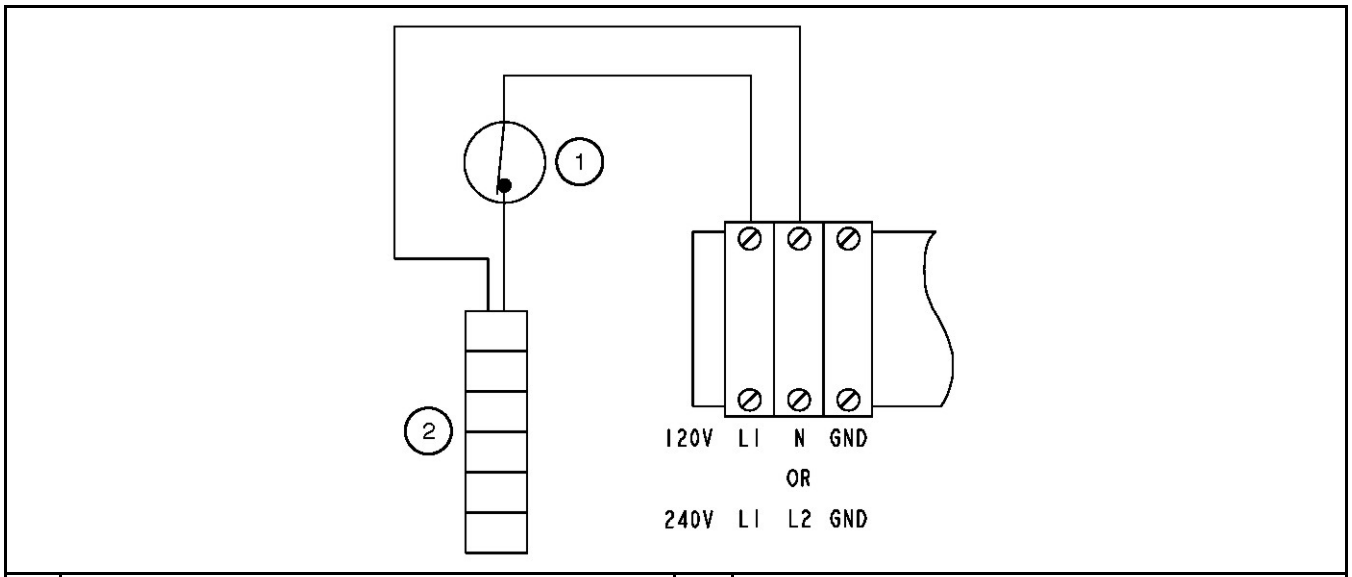
Figure 64 shows heater wiring. Connect the heater wires to the top side of the gray terminal blocks.

The heater power cord must be connected to a grounded outlet.



No.	Description	No	Description
1	Flexible Heater Pad	4	Terminal Block
2	Thermostat	5	Terminal Block
3	Terminal Block	6	Terminal Block (Ground)

FIGURE 63. TYPICAL CONTROL CABINET HEATER



No.	Description	No.	Description
1	Thermostat	2	Heater

FIGURE 64. CONTROL CABINET HEATER WIRING

10.9 Oil Heaters

10.9.1 Oil Pan Heater Installation

Oil pan heaters require an external power source.

The oil pan heater used in 120 V or 208/240 V applications is shown below.

NOTICE
For 120 V applications, the optional location is shown. The primary location is on the left hand side of the oil pan.

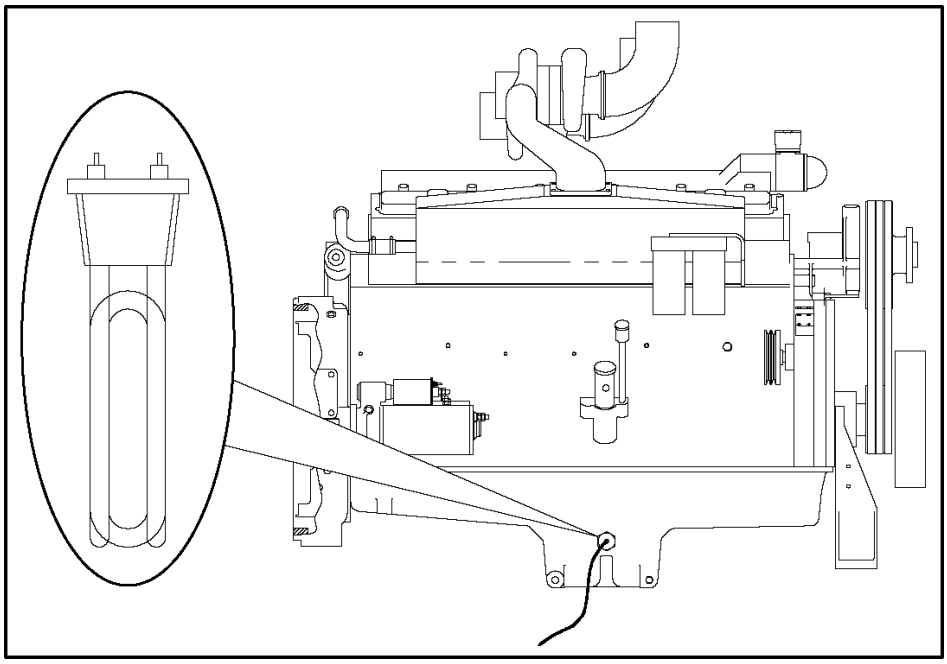


FIGURE 65. 300 W OIL PAN HEATER USED IN 120 V AND 208/240 V APPLICATIONS

The oil pan heater used in 480 V applications is shown below.

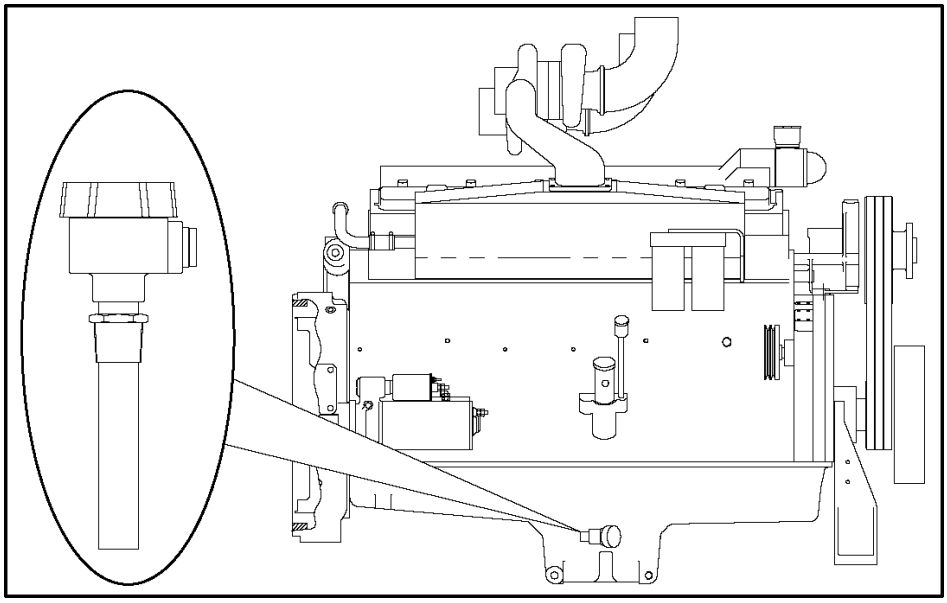


FIGURE 66. 300 W OIL PAN HEATER USED IN 480 V APPLICATIONS

10.10 Annunciators

10.10.1 PowerCommand Universal Annunciator

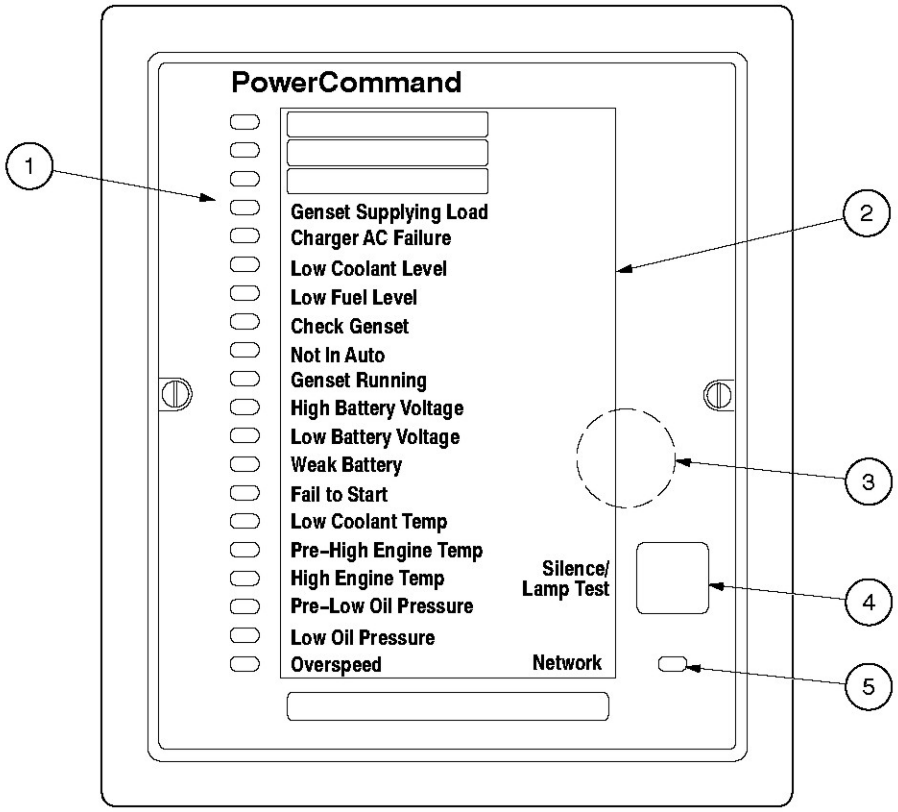
A universal annunciator provides lamps and a horn to annunciate the operating status and fault conditions of an emergency power system. It is designed for connection to either a 12 VDC or a 24 VDC control system. It can be configured to be either a positive or negative signal device.

Two versions of the PowerCommand universal annunciator are available.

- Panel Mounted
- Panel with Enclosure

The universal annunciator can communicate using either a PCCNet or a Modbus network.

Refer to the annunciator owner's manual for more information.



No.	Description	No.	Description
1	System Status Lamps	4	Silence/Lamp Test Button
2	Insert Card	5	Network Status Lamp
3	Horn		

FIGURE 67. ANNUNCIATOR COMPONENTS

10.11 Battery Commissioning

NOTICE
Commissioning is to be undertaken by suitably trained and qualified service personnel only.

Lead-acid batteries supplied in dry-charged form are commissioned as follows:

- Pre-Commissioning Procedure
- Filling the Battery with Electrolyte
- Charging
- Fitting the Battery to the Generator Set

10.11.1 Safety Precautions

Servicing of batteries are to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

10.11.1.1 General Precautions

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Laying tools or metal objects across the battery can cause arcing. Never lay tools or metal objects across the top of the battery.

⚠ CAUTION

Electrical Shock

A battery presents a risk of electrical shock and high short circuit current which can cause minor or moderate injury.

Observe the following precautions when working on batteries.

- Use proper PPE. Remove jewelry such as watches, rings, or other metal objects. Remove any conductive items from pockets. These items can fall into equipment and result in a short circuit, which can cause shock or burning. Refer to local standards for PPE details (in the U.S: see NFPA 70).
- Keep batteries upright to prevent spillage. Electrolyte is a dilute sulphuric acid that is harmful to the skin and eyes.
- Use tools with insulated handles to prevent the risk of electric shock.

10.11.1.2 Fire Hazard

NOTICE

During the charging of a battery, explosive gases are given off. Keep the battery area well ventilated and away from naked flames and sparks. Do not smoke.

- Before disconnecting a battery, isolate the utility powered battery charger (where fitted).
- To disconnect the battery, use an insulated wrench to disconnect the negative cable first.
- To connect the battery, use an insulated wrench to connect the negative cable last.

10.11.1.3 Fluid Hazard

⚠ WARNING

Toxic Hazard

Contact with electrolyte can cause severe personal injury.

Wear appropriate PPE when handling electrolyte: acid-proof protective apron, goggles, rubber gloves and boots. If electrolyte is splashed on the skin or in the eyes, flush the affected areas immediately with water and seek medical attention.

⚠ WARNING

Hazardous Liquid

Uncontrolled chemical reactions can cause severe chemical burns or death.

Never add undiluted sulfuric acid to a battery.

10.11.2 Pre-Commissioning Procedure

1. Check for any damage to the battery case or terminals, and make sure that the battery is clean and dry.
2. Remove the vent plugs and break any seals (if present), taking care not to damage the plates or separators. The broken seal will fall into the bottom of the chamber and do no harm.

10.11.3 Filling the Battery with Electrolyte

1. Fill each cell of the battery with dilute sulphuric acid (electrolyte) of the correct specific gravity (SG) according to the levels on the battery label.
2. Filling must be completed in one step.
3. Allow the battery to soak for ten to fifteen minutes. If the electrolyte level has fallen, it should be restored by adding electrolyte of the correct SG to the levels given on the battery label.
4. After filling, place the battery on a commissioning charge within one hour. Charging must take place before any load is placed on the battery.

NOTICE
Failure to give a commissioning charge may impair the charge capacity and life of the battery.

10.11.4 Charging - Commissioning

1. Charge the battery for a minimum of four hours to ensure the acid is sufficiently mixed within the battery. If the battery has been in storage, check the manufacturer's instructions; the charging period may need extending.
2. When the generator set is running, check the charge alternator output using an induction ammeter.

10.11.5 Connecting the Battery to the Generator Set

NOTICE
A battery must not be fitted to a generator set without charge if the specific charge of the electrolyte has fallen below 1.240 during storage.

1. Secure the battery. Battery hold-down bolts must be tight, but not over-tight.
2. Smear the terminals with petroleum jelly, if necessary.
3. Fit the vents firmly in position and ensure that the battery is clean and dry.
4. Verify correct polarity when connecting the battery to the set. Even momentary incorrect connection can cause damage to the electrical system.
5. Use an insulated wrench connect the positive generator cable first, followed by the negative cable. Terminal connections must be tight, but not over-tight.

10.11.6 Electrolyte - Specific Gravity and Temperature

Maintenance-free batteries are sealed and do not require the addition of electrolyte. Some manufacturers of maintenance-free batteries provide an ‘eye’ or other visible means of telling when the battery is discharged or approaching the end of its useful life.

10.11.6.1 Checking Electrolyte Level

NOTICE
Never add tap or well water and never allow the battery electrolyte to drop below the top of the plates, otherwise damage will occur.

NOTICE
Do not add water in freezing weather unless the engine will run long enough (2 to 3 hours) to make sure that water and electrolyte are thoroughly mixed.

Check the level of the electrolyte (acid and water solution) in the batteries at least every month or 100 hours of operation, whichever occurs first. Maintain the electrolyte to the levels indicated on the battery label. Add distilled water only and recharge. Replace the vent plugs once filling is completed.

If a cell level is low, check the case for leaks.

Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

10.11.6.2 Checking Specific Gravity Using a Hydrometer

Use a hydrometer to check the specific gravity (SG) of the electrolyte in each battery cell.

Hold the hydrometer vertically and take the reading.

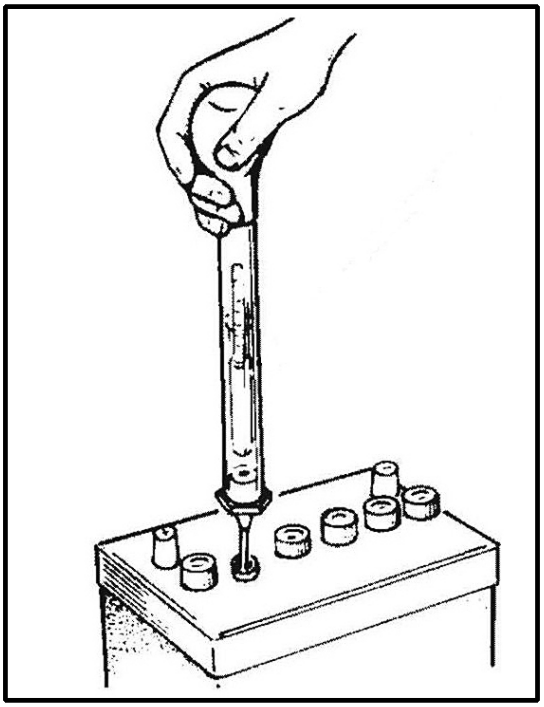


FIGURE 68. CHECKING SPECIFIC GRAVITY

10.11.6.3 Checking Specific Gravity Using an Acid Refractometer

Follow the instructions included with the refractometer. Obtain a small drop of liquid and place it under the clear plastic cover to check the specific gravity (SG) of the electrolyte in each battery cell.

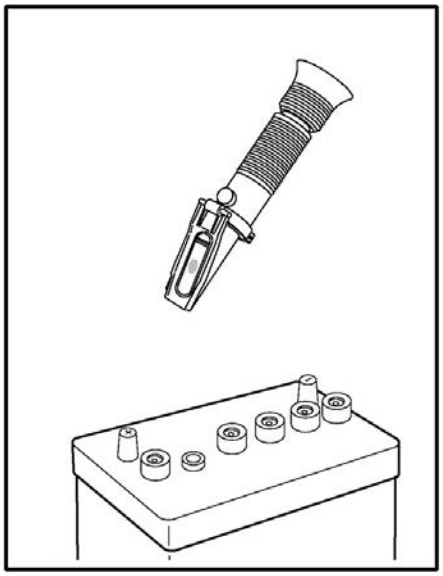


FIGURE 69. TYPICAL BATTERY ACID REFRACTOMETER

10.11.6.4 Specific Gravity Values for Batteries

A fully charged battery will have a corrected specific gravity (SG) of 1.260 at 25 °C (77 °F). Hold the hydrometer vertically and take the reading. Charge the battery if the reading is below 1.215. The table below shows the specific gravity of electrolyte, corrected to 25 °C (77 °F).

TABLE 11. SPECIFIC GRAVITY

Temperature	For Filling New Cells	At End of Charge
Ambient temperature normally below 32 °C (90 °F)	1.270	1.270 – 1.290
Ambient temperature frequently above 32 °C (90 °F)	1.240	1.240 – 1.260
Maximum permissible temperature of electrolyte during charge	45 °C (113 °F)	45 °C (113 °F)

Correct the specific gravity reading for other temperatures by subtracting seven gravity points (0.007) for every 10 °C (18 °F) when the electrolyte temperature is above 27 °C (80 °F). Apply the correction formula as follows:

- For every 10 °C (18 °F) above 25 °C (77 °F), subtract 0.007 (7 points)
- For every 10 °C (18 °F) below 25 °C (77 °F), add 0.007 (7 points)

For example: if the specific gravity at 25 °C (77 °F) is 1.260, then the specific gravity at 15 °C (59 °F) is 1.267.

10.11.7 Electrolyte Levels and Bench Charging Rates

The following table shows the electrolyte level expected at a range of bench charging rates.

TABLE 12. ELECTROLYTE LEVELS

Battery Type	Electrolyte Level above Plates (mm)	Bench Charging Rate (A/hour)		Battery Type	Electrolyte Level above Plates (mm)	Bench Charging Rate (A/hour)
1	8	3		325	8	20
7	8	3.5		327	8	11
15	8	4		328	8	20
16	8	4		329	8	20
17	8	9		332	8	25
35	8	3.5		333	8	11
36	8	3.5		386	8	6
37	8	4		404	8	7
38	8	4		414	8	20
46	8	6		415	8	20
47	8	3		471	8	15
48	8	4		484	8	25
49	8	4		501	8	9
63	8	4		511	8	10
65	8	5		521	8	12
67	8	7		531	8	13
68	8	7		541	8	15
69	8	7		543	8	15
70	8	7		591	8	14
71	8	6		602	8	8
72	8	8		612	8	9
73	8	6		635	16	12
74	8	7		643	16	9
75	8	7		644	16	12
77	8	4		645	16	9
78	12	5		646	16	8
83	8	3.5		647	16	12
84	8	4		648	16	12
85	8	5		649	16	9
90	12	7		655	16	12
91	8	6		656	16	12
92	12	5		663	16	9

Battery Type	Electrolyte Level above Plates (mm)	Bench Charging Rate (A/hour)		Battery Type	Electrolyte Level above Plates (mm)	Bench Charging Rate (A/hour)
93	8	6		664	16	9
97	8	6		665	16	9
154	4	3.5		678	8	6
175	8	7		679	16	9
191	6	6		701	8	16
221	8	8		702	8	20
222	8	12		703	8	25
279	8	6		711	8	16
312	8	14		712	8	20
313	8	14		713	8	25
315	8	14		721	8	15
319	8	14		722	8	20
320	8	14		732	8	15
321	8	14		733	8	20
322	8	14		769	8	45
324	8	20				

NOTICE

If not listed in the above table use the bench rate given in the catalog, or charge at a current equal to 10% of the nominal capacity at the twenty hour rate (Amperes/hour), or 5% of the reserve capacity in minutes.

NOTICE

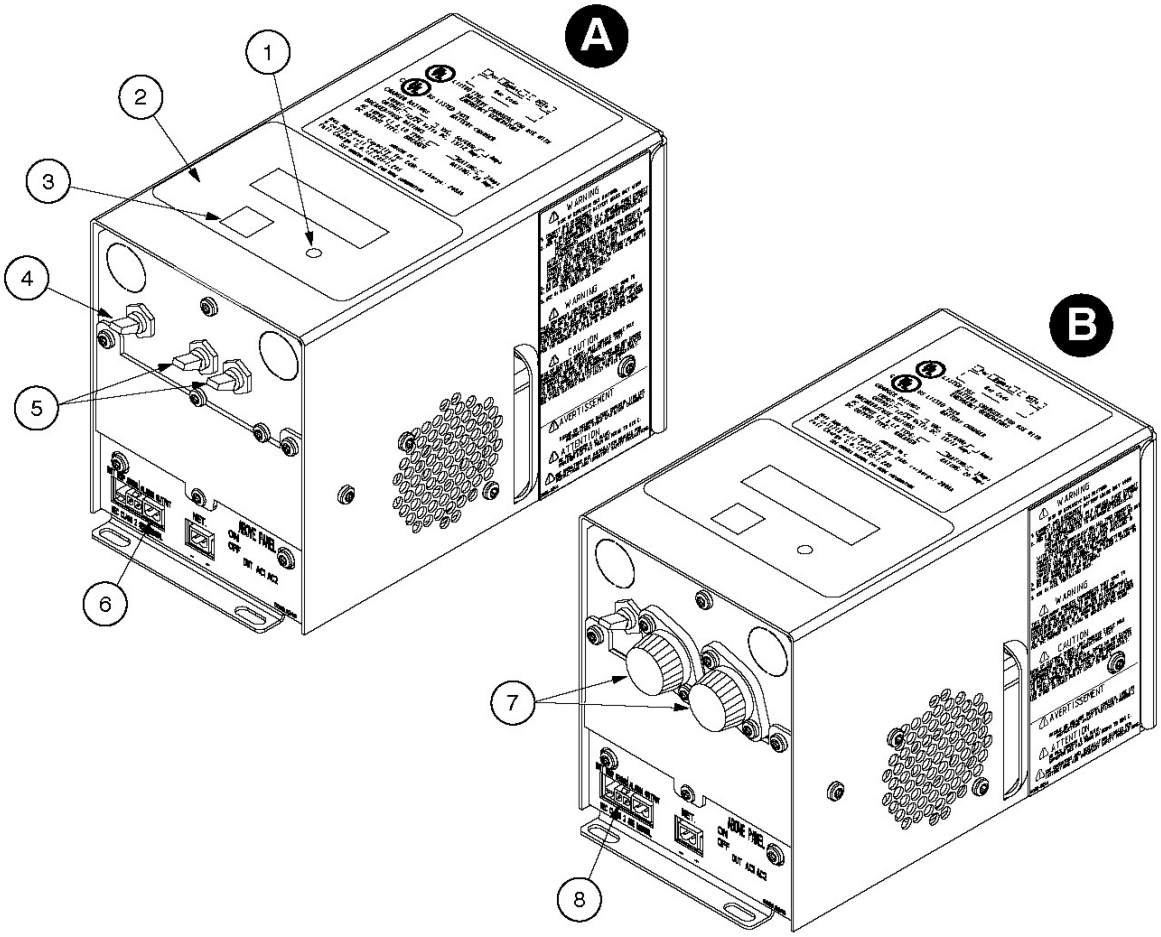
Batteries of the 800 series should be prepared in accordance with the instructions supplied with each battery.

10.12 Battery Charger

10.12.1 Battery Charger - 15 Amp/12 Volt and 12 Amp/24 Volt

There are two types of 15/12-Amp PowerCommand battery chargers. All 15/12-Amp battery chargers have a 20 Amp DC circuit breaker switch on the front of the battery charger. The 120, 208, and 240 VAC battery chargers include two 10 Amp AC circuit breaker switches, all other models include two AC fuse holders.

Refer to the battery charger Owner Manual (901-0107) for more information.



No.	Description	No.	Description
A	120, 208, and 240 VAC Battery Charger	4	20 Amp DC Circuit Breaker Switch (Shown in the "On" position)
B	Battery Charger with Fuse Holders	5	10 Amp AC Circuit Breaker Switches (Shown in the "On" position)
1	Status LED	6	Fault Alarm Output Connector
2	Control Panel	7	10 Amp AC Fuse Holders
3	Reset Button	8	Connector for Optional Battery Temperature Sensor

FIGURE 70. 15/12-AMP POWERCOMMAND BATTERY CHARGERS

10.13 Grounding

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. Bonding and grounding must be done properly. All metallic parts that could become energized under abnormal conditions must be properly grounded.

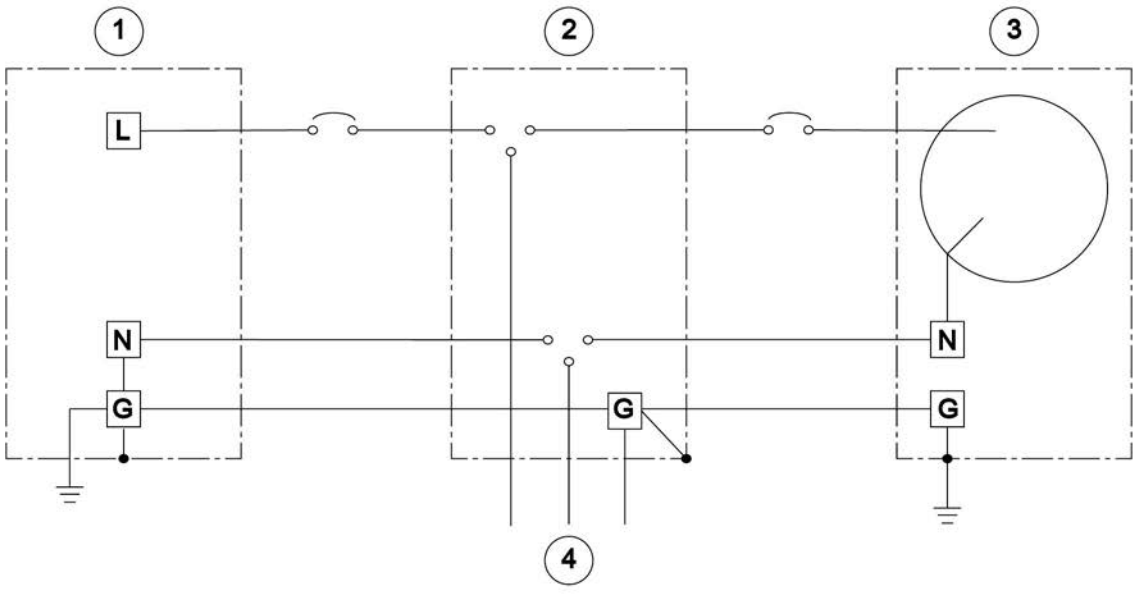
The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system.

NOTICE

It is important to follow the requirements of the local electrical code.

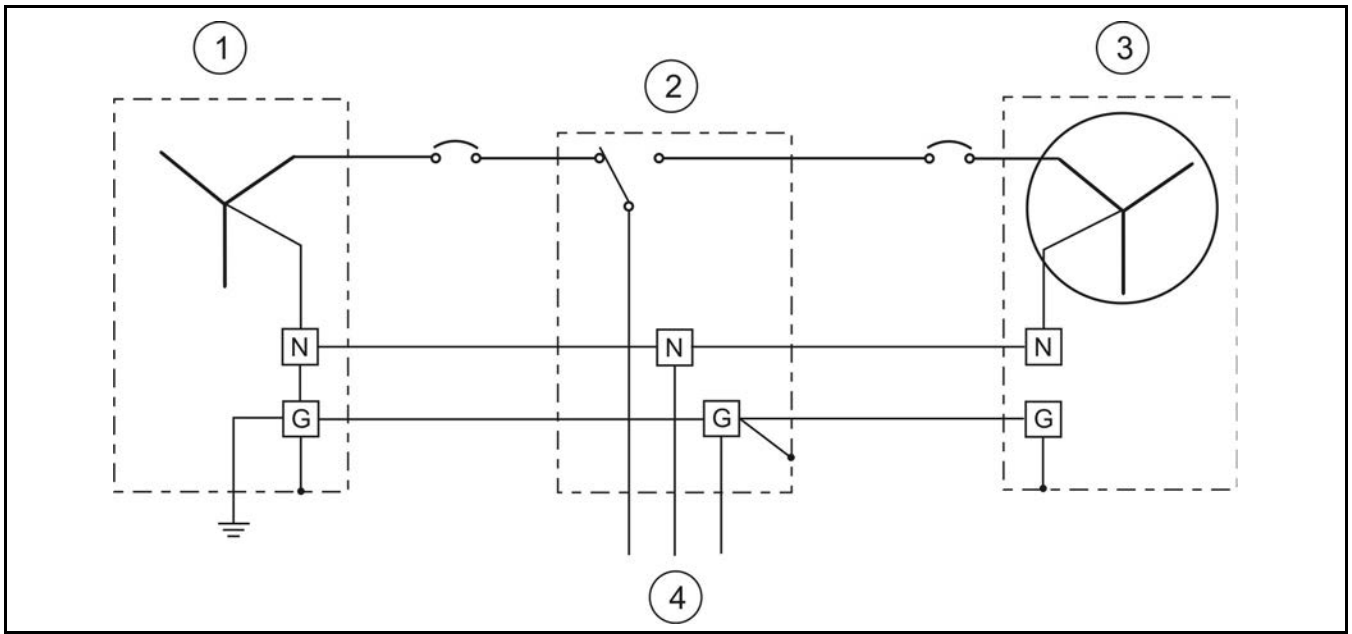
Figure 71, Figure 72 and Figure 73 illustrate typical system grounding for a 2-pole, 3-pole, and 4-pole Automatic Transfer Switch (ATS). In the 2-pole and 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding electrode conductor and a bonding jumper are used to connect the generator neutral to ground.

Make sure the generator set is grounded to earth in one location only. On generator sets without a circuit breaker, ground to the point indicated on the top of the generator. On generator sets with circuit breakers, use the ground lug provided in the circuit breaker box.



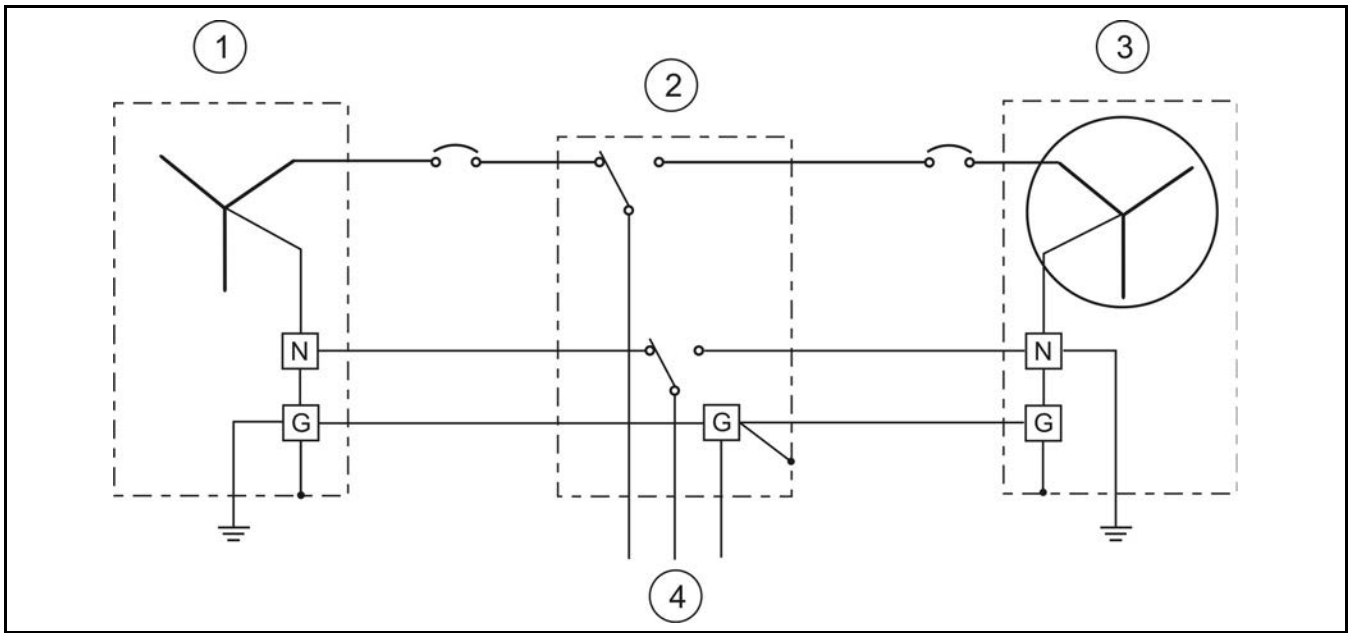
No.	Description	No.	Description
1	Service Entrance	3	Generator Set
2	2-Pole ATS	4	Load

FIGURE 71. TYPICAL SYSTEM - ONE-PHASE, THREE WIRE UTILITY, TWO-POLE ATS



No.	Description	No.	Description
1	Service Entrance	3	Generator Set
2	3-Pole ATS	4	Load

FIGURE 72. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, THREE-POLE ATS



No.	Description	No.	Description
1	Service Entrance	3	Generator Set
2	4-Pole ATS	4	Load

FIGURE 73. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, FOUR-POLE ATS

11 Pre-Start Preparation

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

Before an initial start of the generator set, complete the Installation Checklist, see **Chapter 12 on page 129**.

11.1 Electrical System

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

11.2 Battery Connections

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Make sure that the generator set cannot be started accidentally or remotely before starting work on the generator.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

Starting the unit requires one or more batteries. For more information on batteries, refer to the Mpdel Specifications section. To prevent arcing, use an insulated wrench to connect the positive battery cable, then connect the negative battery cable.

If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger. Proper selection and maintenance of batteries and battery chargers is essential for system reliability.

11.3 Site-Specific Configuration

NOTICE
Site-specific configuration is to be undertaken by suitably trained and qualified service personnel only.

The generator set is configured at the factory. Before starting the generator set, any site-specific configuration should be completed by qualified service personnel.

11.4 Starting

Refer to the generator set Operator manual for important safety precautions and recommended procedures for starting the generator set and verifying proper operation. Start the generator set and verify all engine and generator set menus are displaying the correct values.

12 Installation Checklist

12.1 Checklist

Tick	General Items
	Generator set wattage capacity is sufficient to handle maximum anticipated load.
	At least 3 feet (914.4 mm) of clearance (or greater for housing door) is provided around the entire generator set for service and ventilation.
	The generator set is located in an area not subject to flooding.
	All operating personnel have read and are familiar with the generator set Operator manual, all health and safety procedures, warnings, cautions, precautions, and the other documentation supplied with the generator set.
	All operators have been thoroughly briefed on preventative maintenance procedures.
	All operators have read and understand all important safety instructions.
	Generator Set Support
	The floor, roof, or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
	The generator set is properly supported and retained to an approved base
	The supporting base is large enough and is of non-combustible material, extending 6 inches (152.4 mm) all around the generator set.
	Cooling Air Flow
	Generator set air inlet is faced into direction of strongest, prevailing winds.
	Air inlet openings are unrestricted and are at least 1 to 1½ times larger than air outlet area.
	Cooling air outlet is on downwind side of building (if not, wind barrier is constructed).
	Proper ducting material (sheet metal, canvas) is used between radiator and air outlet.
	Diesel Fuel System
	Fuel tanks meet or exceed all local, state, or national codes (if applicable).
	Fuel lines are properly installed, supported, and protected against damage.
	The fuel filters have been installed.
	Approved flexible fuel line is installed between the main fuel supply and the generator set's fuel system near the generator set, to protect it against damage caused by vibration, expansion, and contraction.
	Strainer or fuel screen (100 to 200 mesh) is installed in the fuel supply line to protect the fuel lift pump, day tank transfer pump, or float valve seat from fuel tank debris (if applicable).
	The fuel filter assembly shipped with the generator set is installed and operational (if applicable).
	Fuel supply shutoff valves are installed to prevent fuel flow in case of leaks.
	No shutoff valves are installed on engine fuel return line (if applicable).
	External fuel pumps are connected and operational at all times - generator set started or shut down (if applicable).

Tick	General Items
	Fuel tanks are filled with the correct grade / type of fuel (if applicable).
	Fuel system is properly primed.
	No fuel leaks are found in supply line or engine fuel system.
	Exhaust System
	The breather tube routing is set up to blow the fumes away from the generator set (if applicable)
	Operators are thoroughly briefed on the dangers of carbon monoxide gas.
	If the installation includes a heavy duty air cleaner, it has been installed.
	Areas around generator set are well ventilated. No possibility of exhaust fumes entering building doors, windows, or intake fans.
	Exhaust gases are piped safely outside and away from building.
	The correct length of approved rigid pipe is connected to the generator set flexible pipe using approved securing methods with no weight resting on engine exhaust components. There are no bends in flex section.
	Condensation drain is provided in lowest section of exhaust piping.
	Exhaust piping is insulated to guard against burns to personnel.
	Exhaust piping passing through walls or ceilings have approved fire-proof materials and are in compliance with all codes.
	Exhaust piping is large enough in diameter to prevent excessive back pressure on engine.
	Verify that the pyrometer meters are functioning.
	AC and DC Wiring
	For bottom entry circuit breaker installations, the cable chute has been installed (if applicable).
	Wire sizes, insulation, conduits and connection methods all meet applicable codes.
	AC and DC wires are separated in their own conduit to prevent electrical induction.
	All load, line and generator connections are well made and correct.
	Flexible conduit is used between the generator and the building or surrounding structure.
	Check phase rotation.
	Generator Set Pre-Start
	Generator set engine is properly serviced with oil and coolant.
	Battery charger is installed using the appropriate cable size and is operational.
	Battery charger is configured for the proper DC battery voltage, battery type, and float voltage.
	Batteries are properly installed, serviced and charged.
	Battery temperature sensor is connected and operational (if applicable).
	Engine coolant heater is connected and operational.
	All generator set covers and safety shields are installed correctly.
	All fuel and coolant shutoff valves are operational.
	Radiator fan and other external moving parts including drive belts are unrestricted.

13 Manufacturing Facilities

U.S. and CANADA	EMEA, CIS	EMEA, CIS
Cummins Inc. 1400 73rd Ave. NE Minneapolis, MN 55432 USA	Cummins Inc. Columbus Avenue Manston Park Manston, Ramsgate Kent CT12 5BF United Kingdom	Cummins Inc. Royal Oak Way South Daventry Northamptonshire NN11 8NU United Kingdom
Toll Free 1-800-CUMMINS™ (1-800-286-6467) Phone +1 763-574-5000 Fax +1 763-574-5298	Phone +44 1843 255000 Fax +44 1843 255902	Phone +44 1327 88-6453 Fax +44 1327 88-6125
BRAZIL	**CHINA**	**INDIA**
Rua Jati, 310, Cumbica Guarulhos, SP 07180-900 CNPJ: 43.2201.151/0001-10 Brazil	Cummins Inc. No.118 South Quanli Road , Wuhan Economic& Technological Development Zone , Hubei, P.R.China 430058	Cummins Inc. Plot No B-2, SEZ Industrial Area, Village-Nandal & Surwadi, Taluka-Phaltan Dist- Satara, Maharashtra 415523 India
Phone 0800 286 6467	Phone + 86 (27) 8421 4008 Fax + 86 (27) 8421 4804	Phone +91 021 66305514
LATIN AMERICA	**MEXICO**	**ASIA PACIFIC**
3350 Southwest 148th Ave. Suite 205 Miramar, FL 33027 USA	Eje 122 No. 200 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico	Cummins Inc. 10 Toh Guan Road #07-01 TT International Tradepark Singapore 608838
Phone +1 954 431 551 Fax +1 954 433 5797	Phone +52 444 870 6700 Fax +52 444 824 0082	Phone +65 6417 2388 Fax +65 6417 2399

13.1 How to Obtain Service

When a product requires servicing, contact the nearest Cummins service provider. To locate the distributor, go to **www.cummins.com/support** and select Sales and Service Locator. When contacting the service provider, always supply the complete model, specification, and serial number as shown on the nameplate.

13.1.1 Locating a Distributor

In the U.S. and Canada

To easily locate the nearest certified distributor/dealer for Cummins generator sets in your area, or for more information, contact us at 1-800-CUMMINS™ (1-800-286-6467) or visit **www.cummins.com/support**.

If unable to contact a distributor using the automated service, consult the Internet.

If unable to arrange a service or resolve an issue, contact the Service Manager at the nearest Cummins distributor for assistance.

When contacting the distributor, always supply the complete Model, Specification, and Serial Number as shown on the product nameplate.

Outside the U.S. and Canada

Refer to **www.cummins.com/support** and select Sales and Service Locator, or send an email to ask.powergen@cummins.com.

Appendix A. Wiring Diagrams

Table of Contents

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

A.1 Schematic Diagram (A054B161)

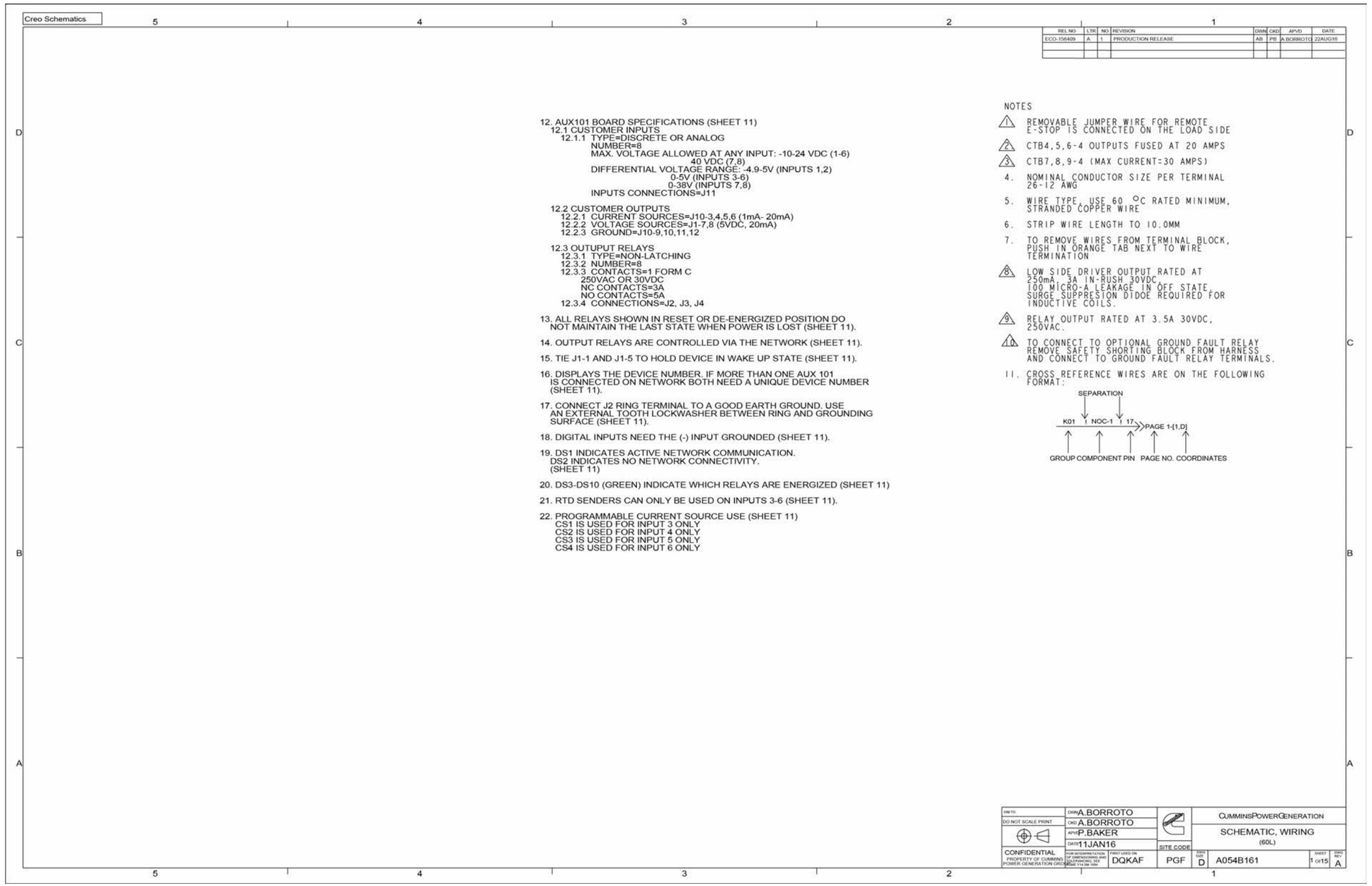


FIGURE 74. SCHEMATIC DIAGRAM (SHEET 1)

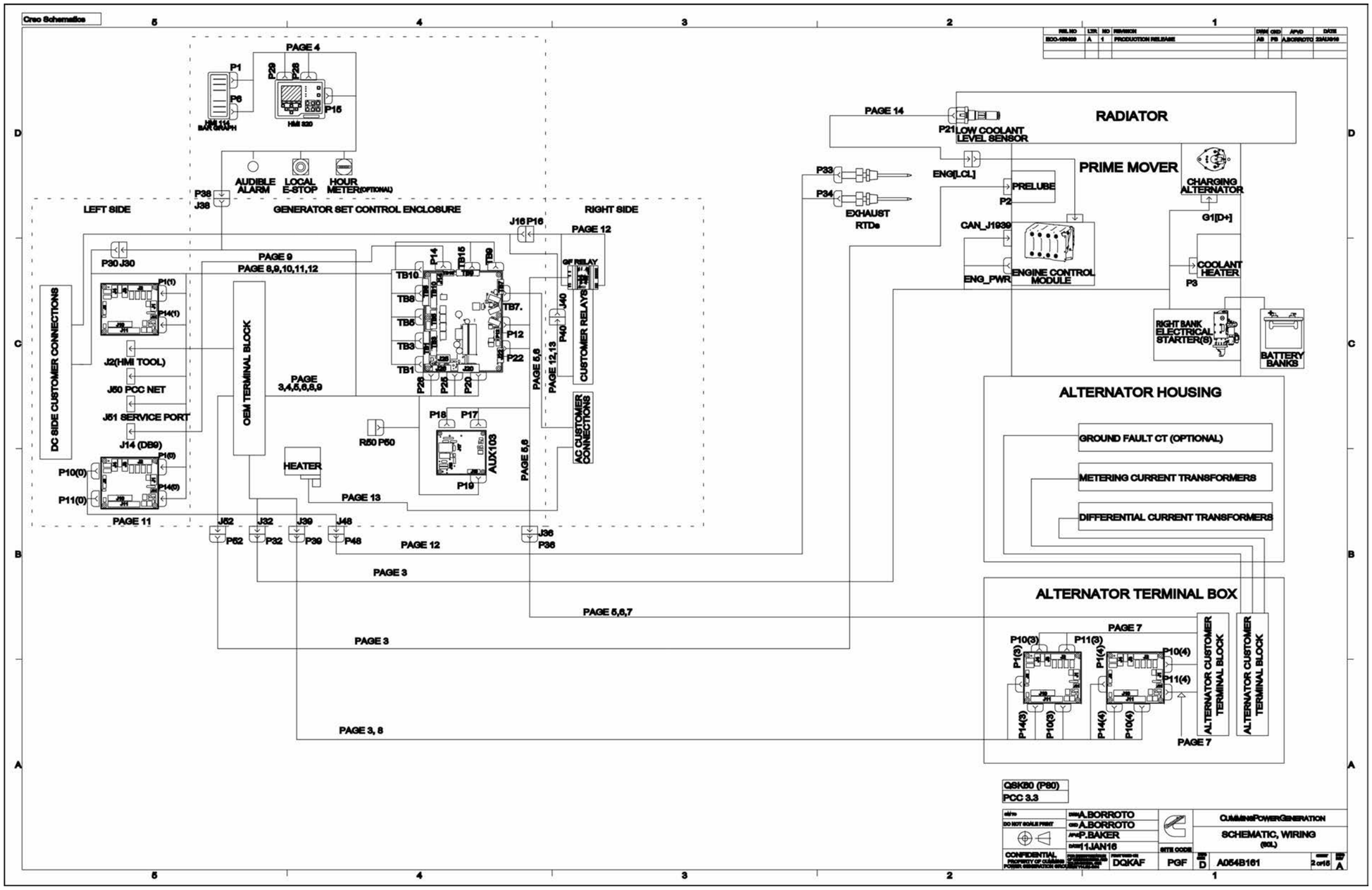


FIGURE 75. SCHEMATIC DIAGRAM (SHEET 2)

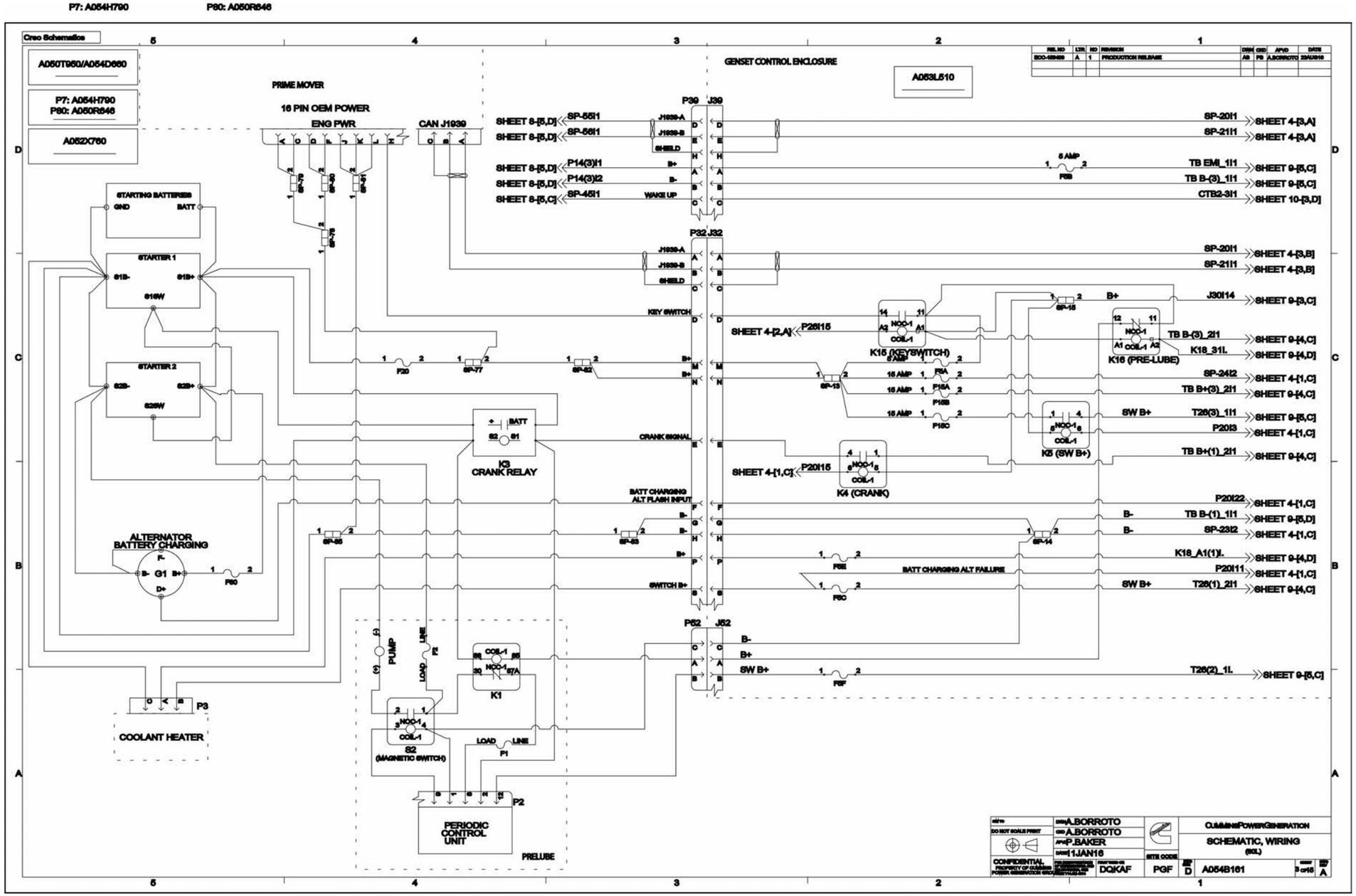


FIGURE 76. SCHEMATIC DIAGRAM (SHEET 3)

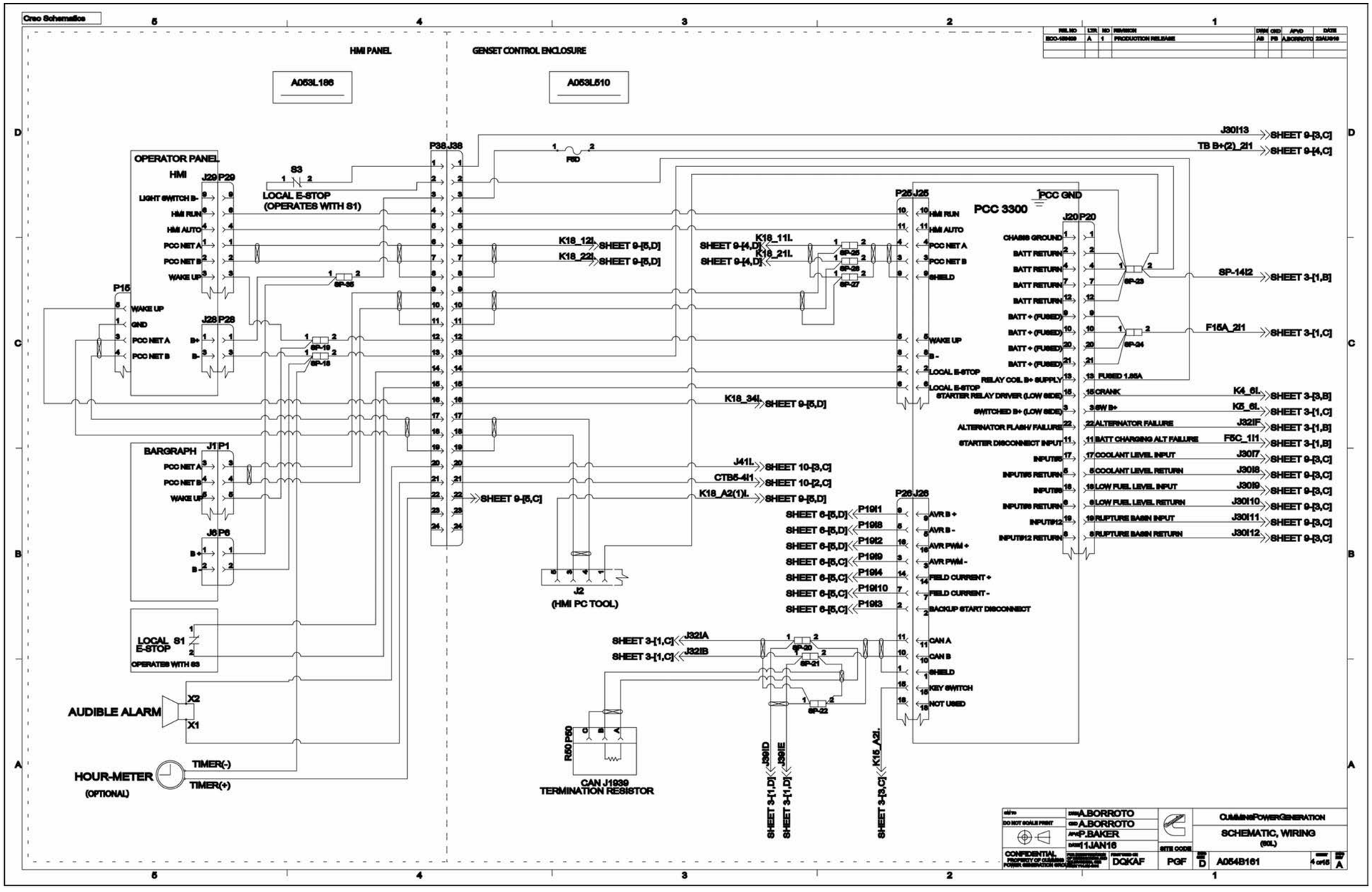


FIGURE 77. SCHEMATIC DIAGRAM (SHEET 4)

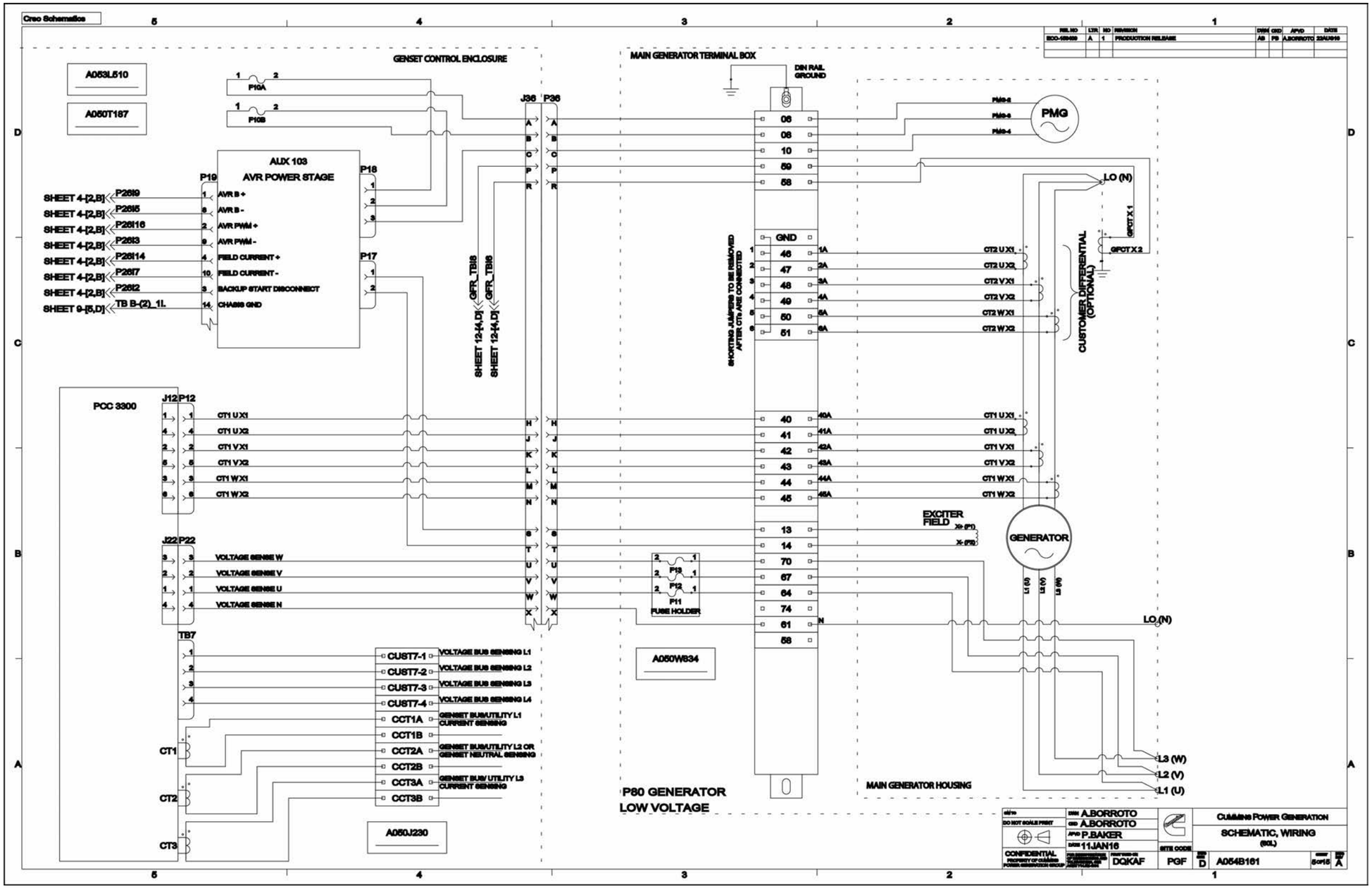


FIGURE 78. SCHEMATIC DIAGRAM (SHEET 5)

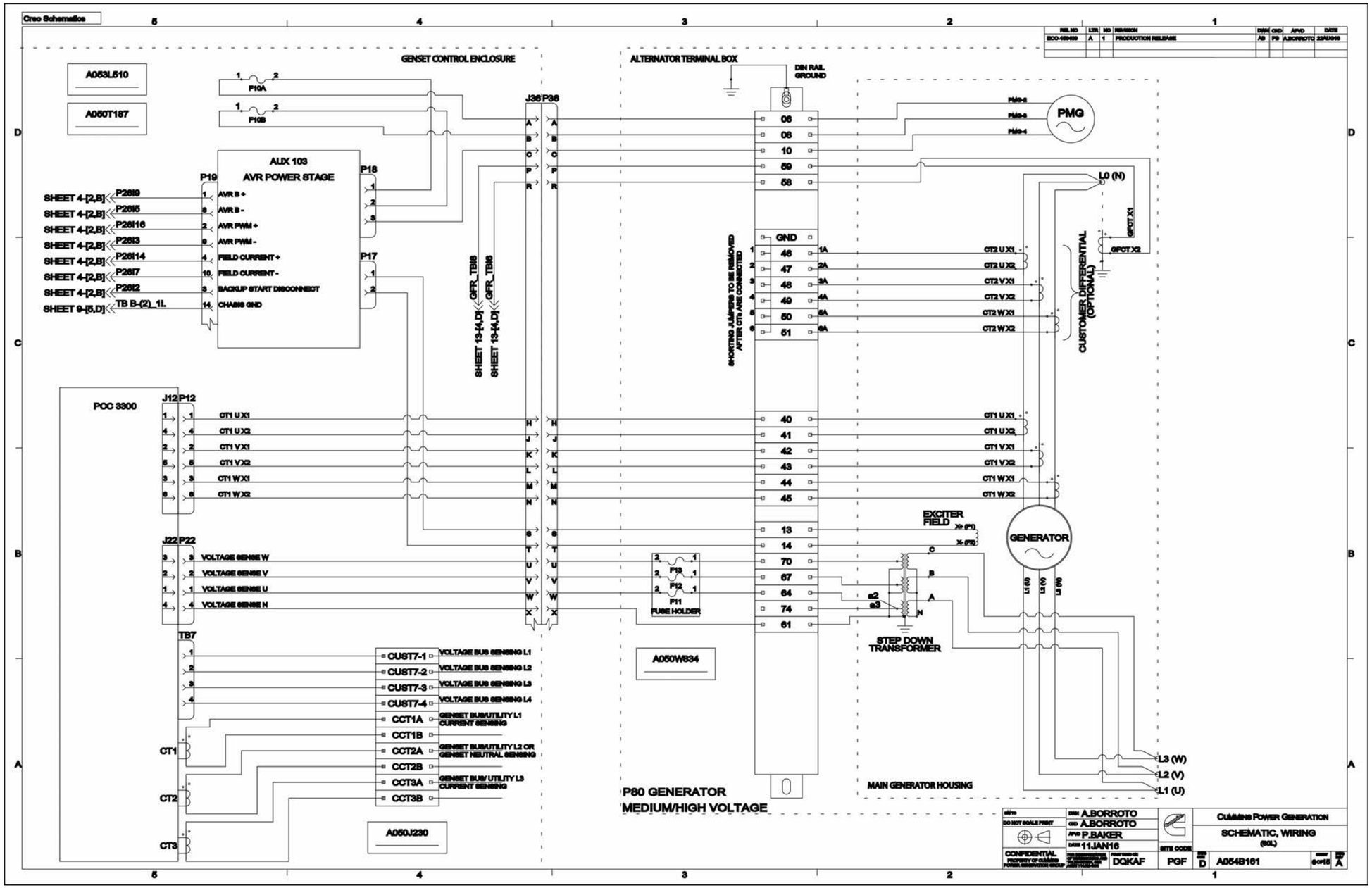


FIGURE 79. SCHEMATIC DIAGRAM (SHEET 6)

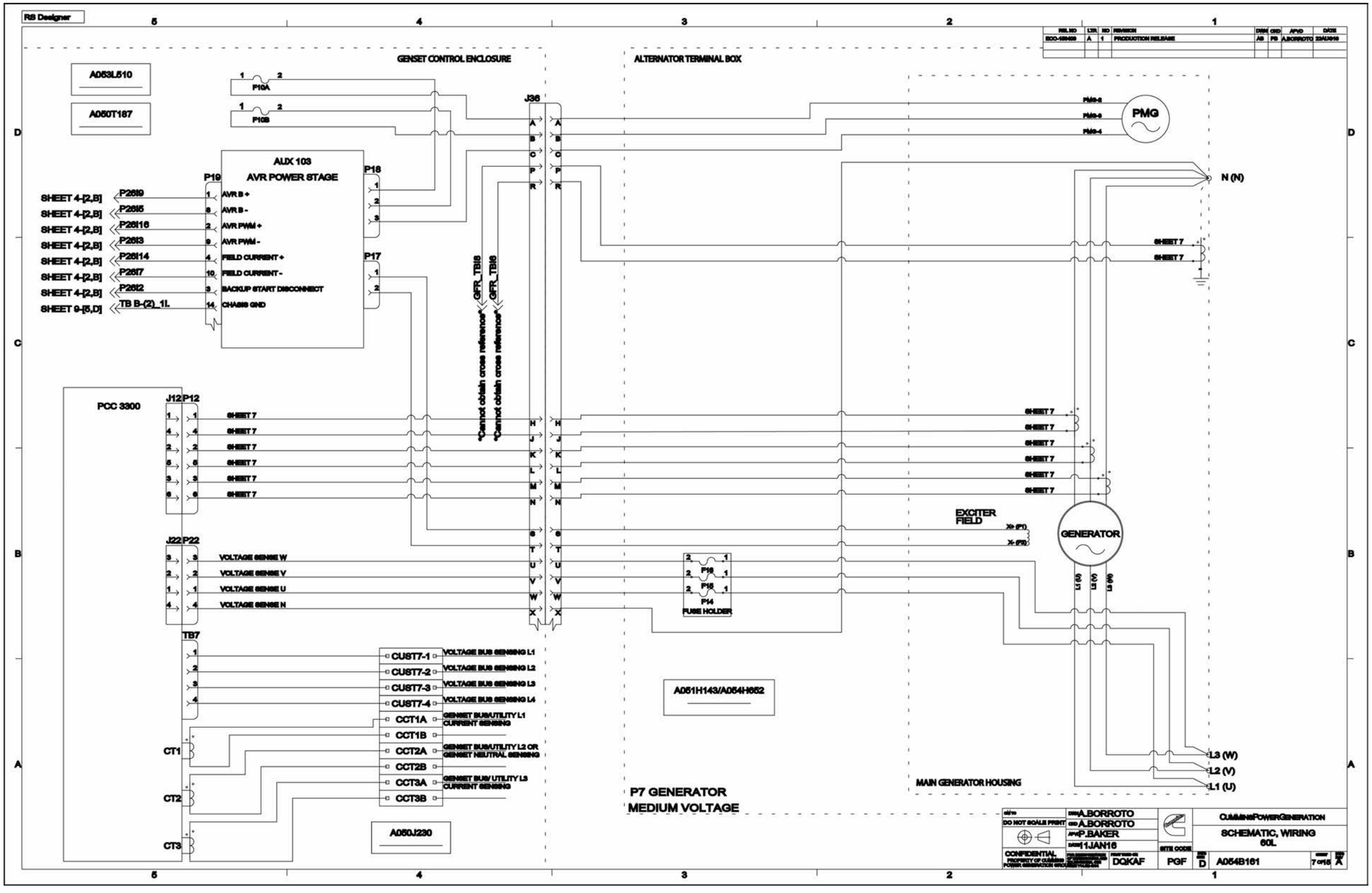


FIGURE 80. SCHEMATIC DIAGRAM (SHEET 7)

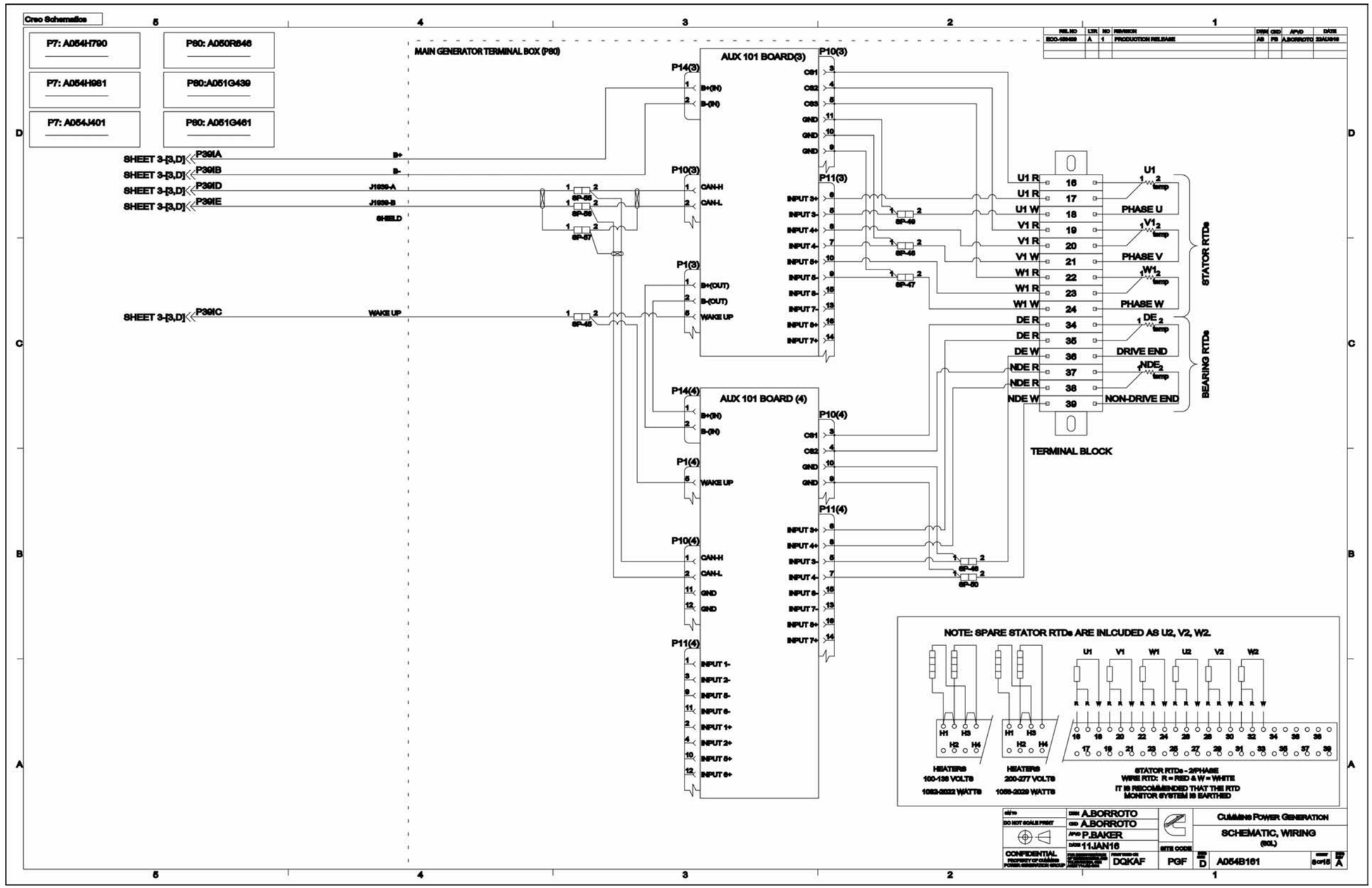


FIGURE 81. SCHEMATIC DIAGRAM (SHEET 8)

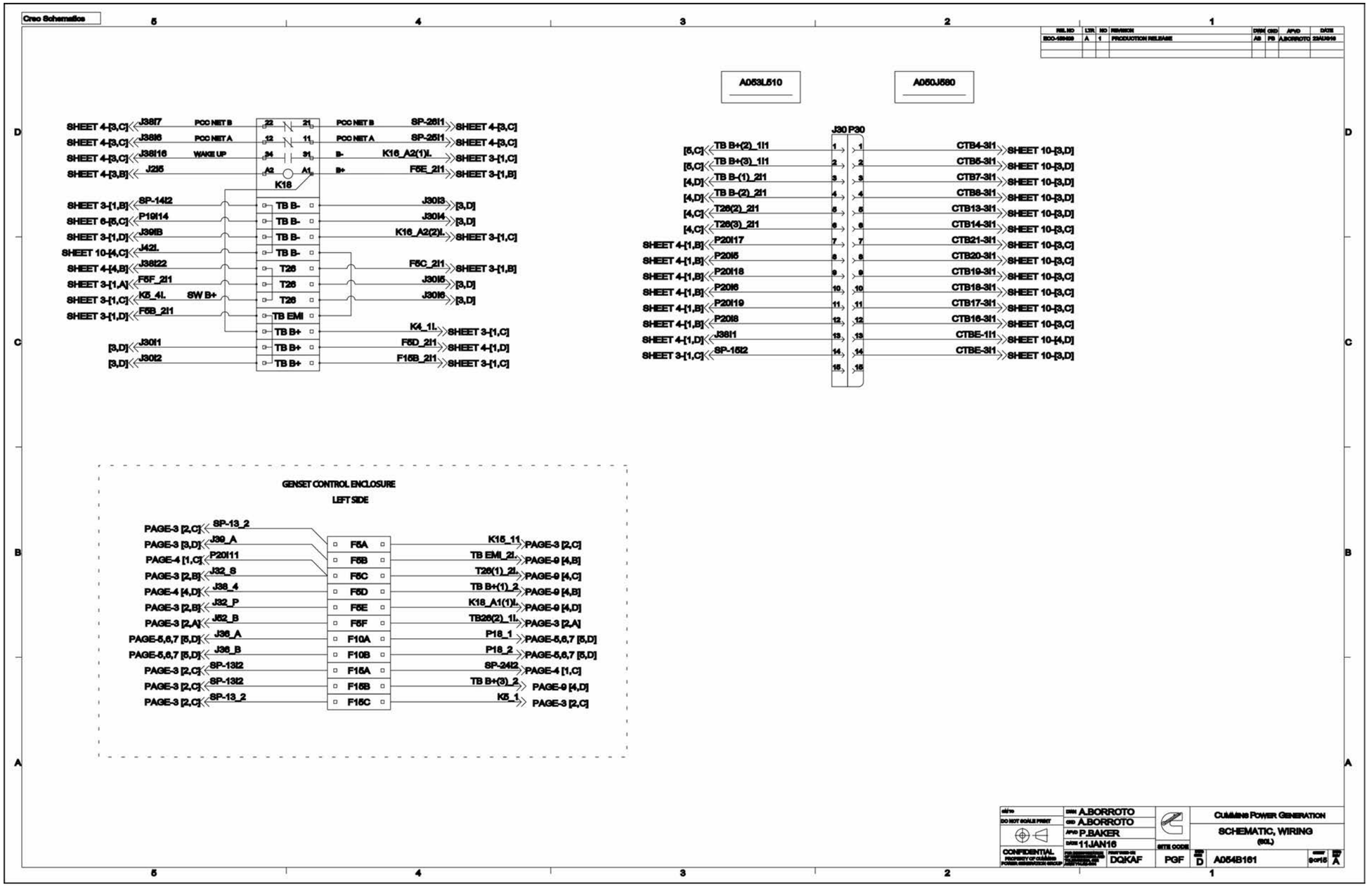


FIGURE 82. SCHEMATIC DIAGRAM (SHEET 9)

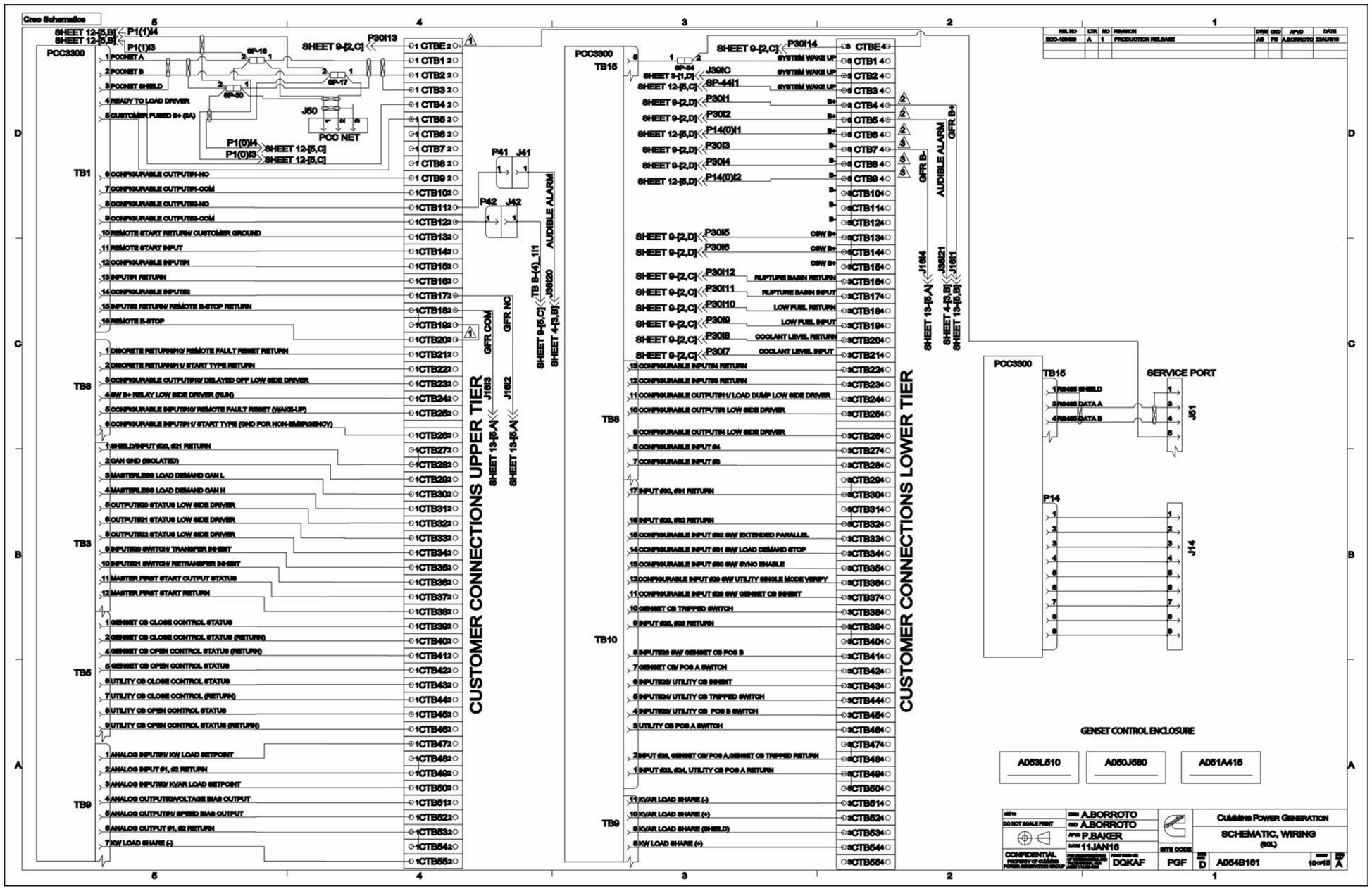


FIGURE 83. SCHEMATIC DIAGRAM (SHEET 10)

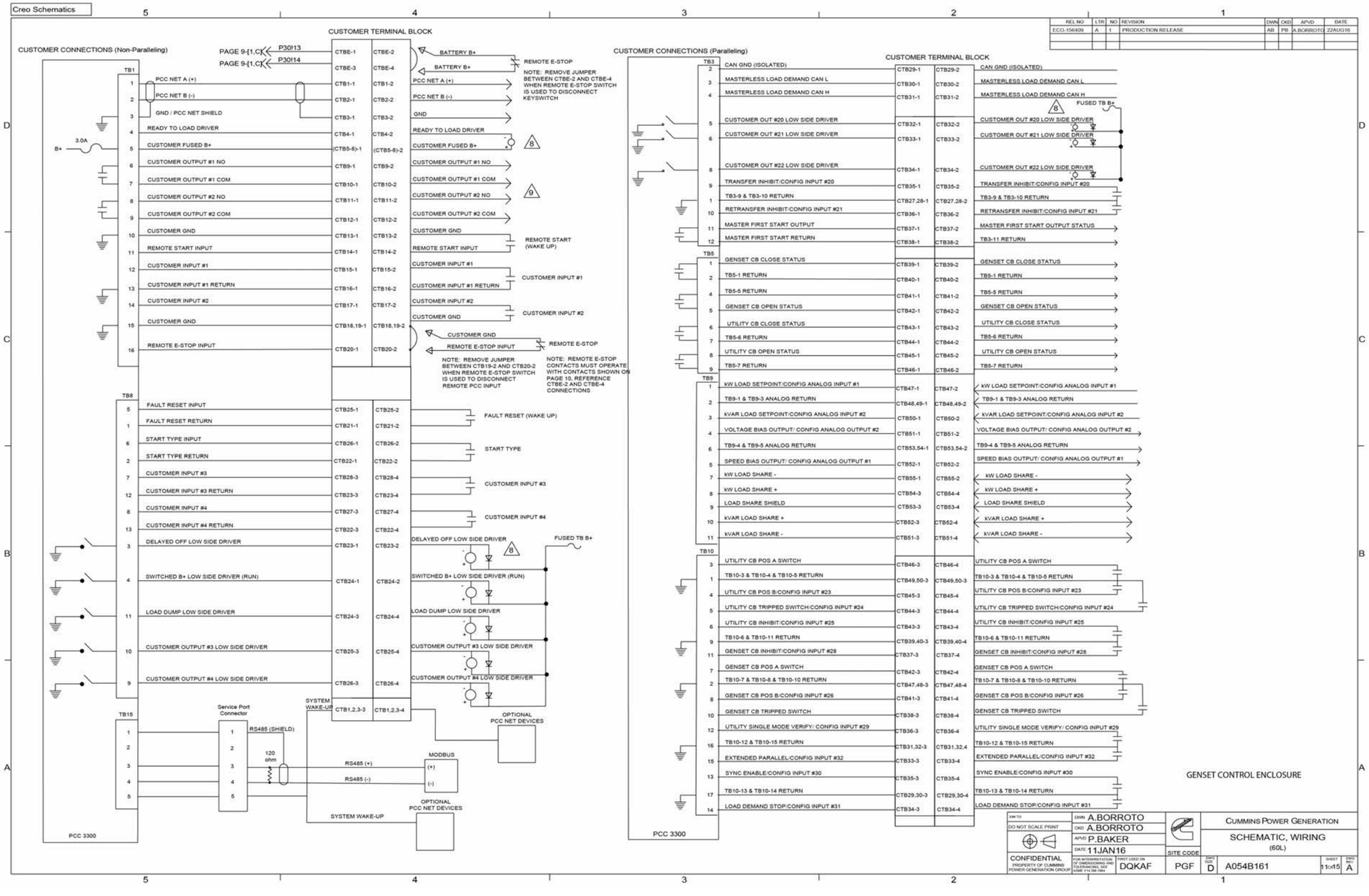


FIGURE 84. SCHEMATIC DIAGRAM (SHEET 11)

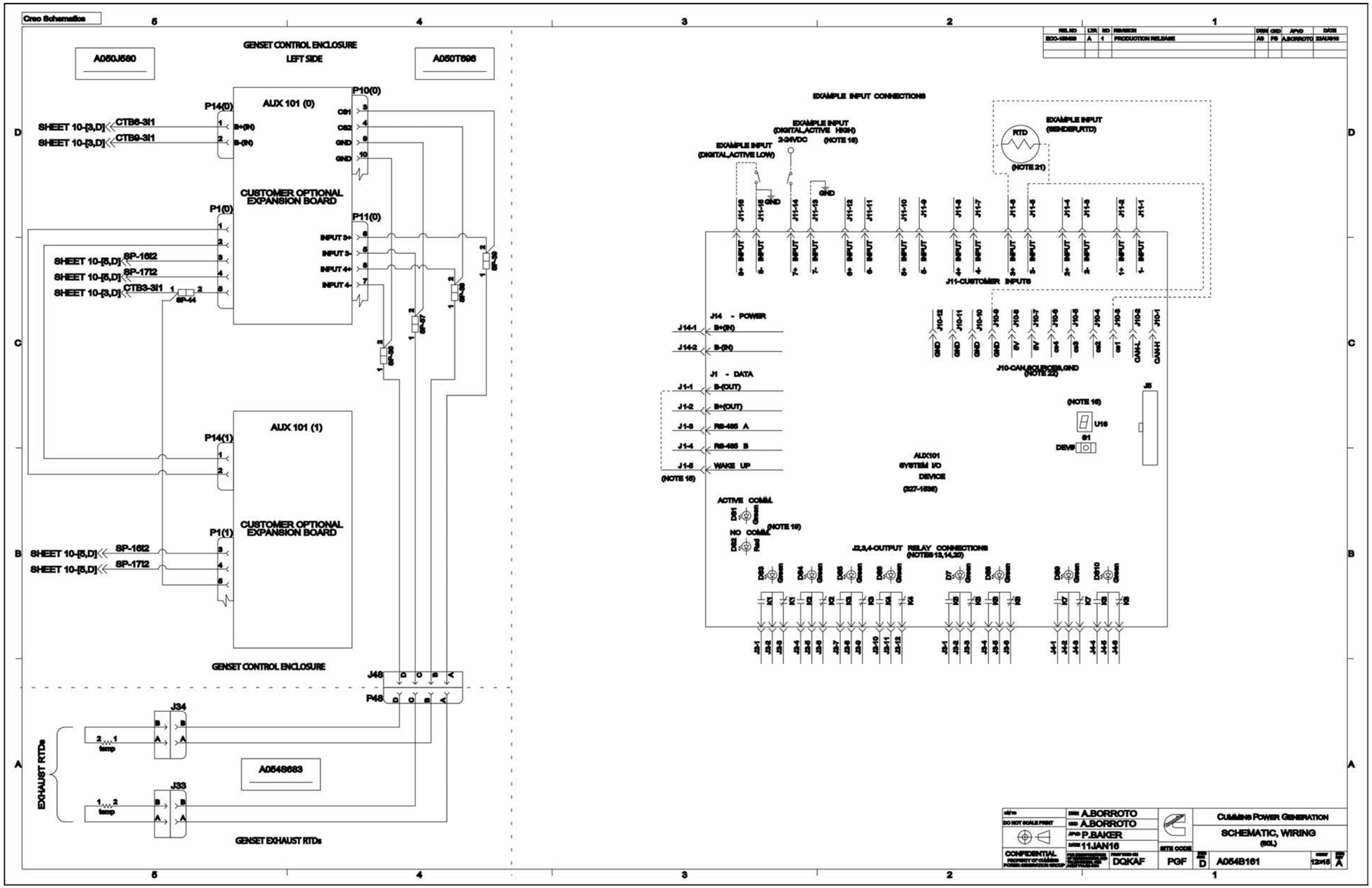


FIGURE 85. SCHEMATIC DIAGRAM (SHEET 12)

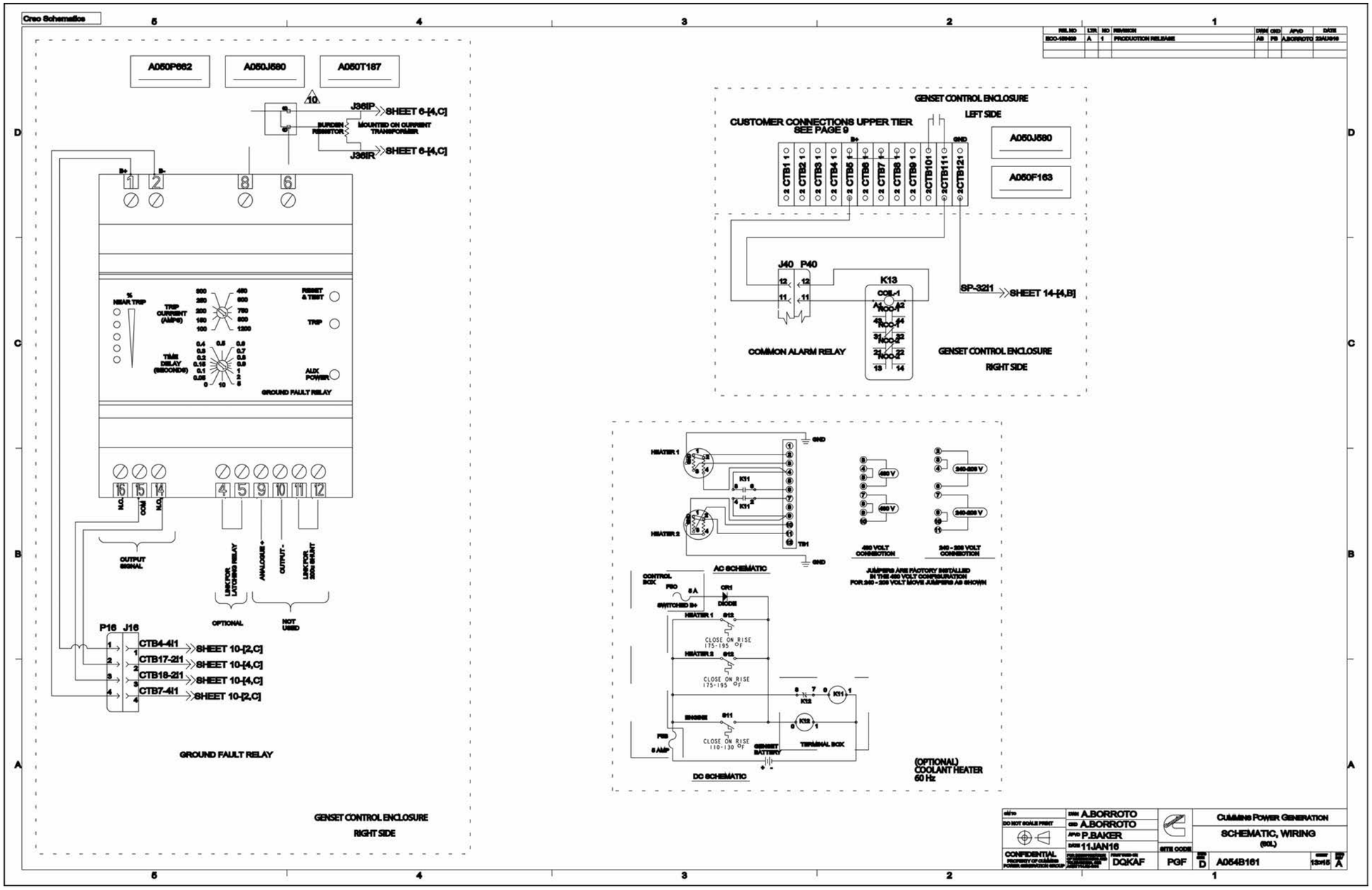


FIGURE 86. SCHEMATIC DIAGRAM (SHEET 13)

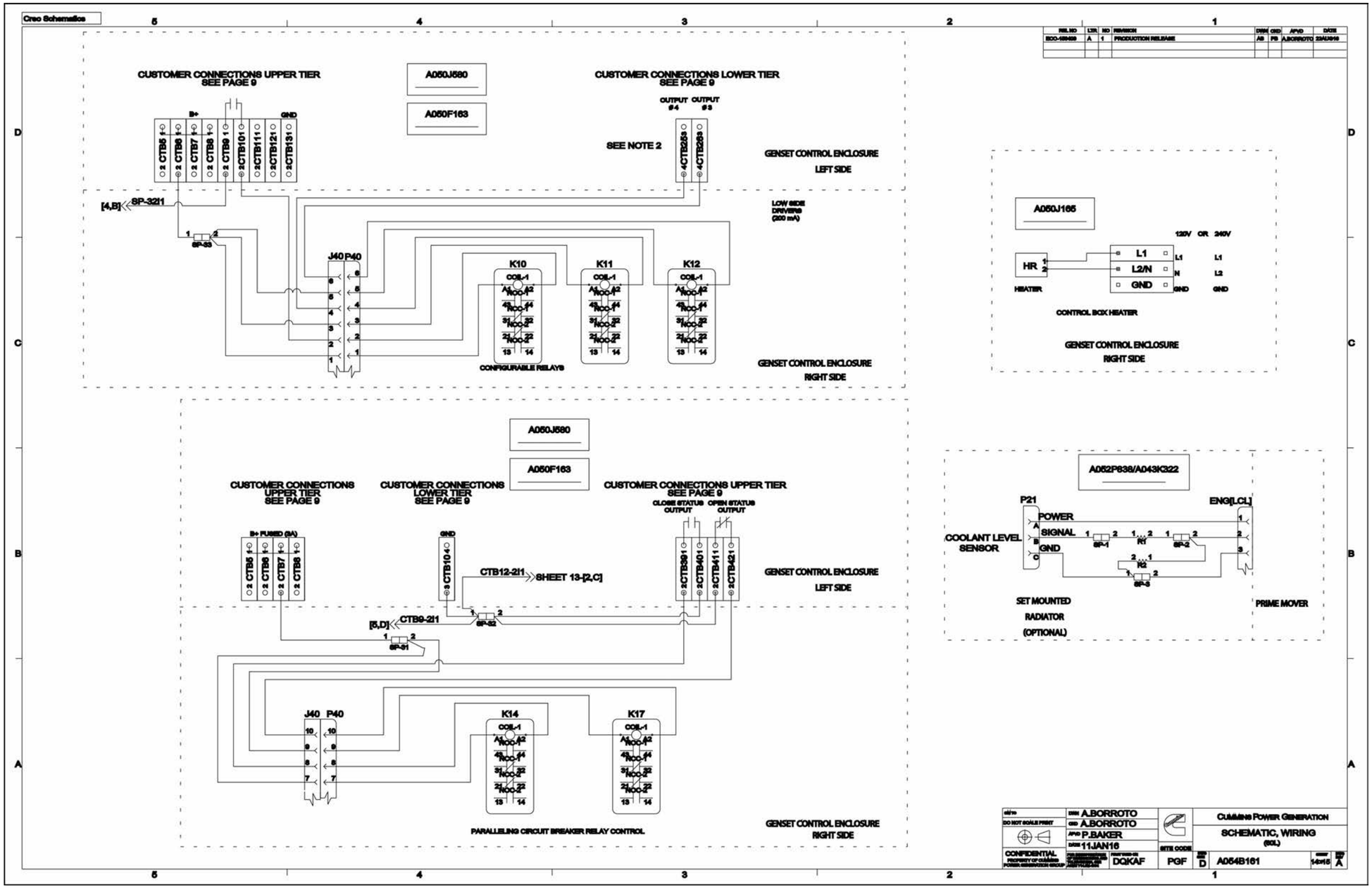
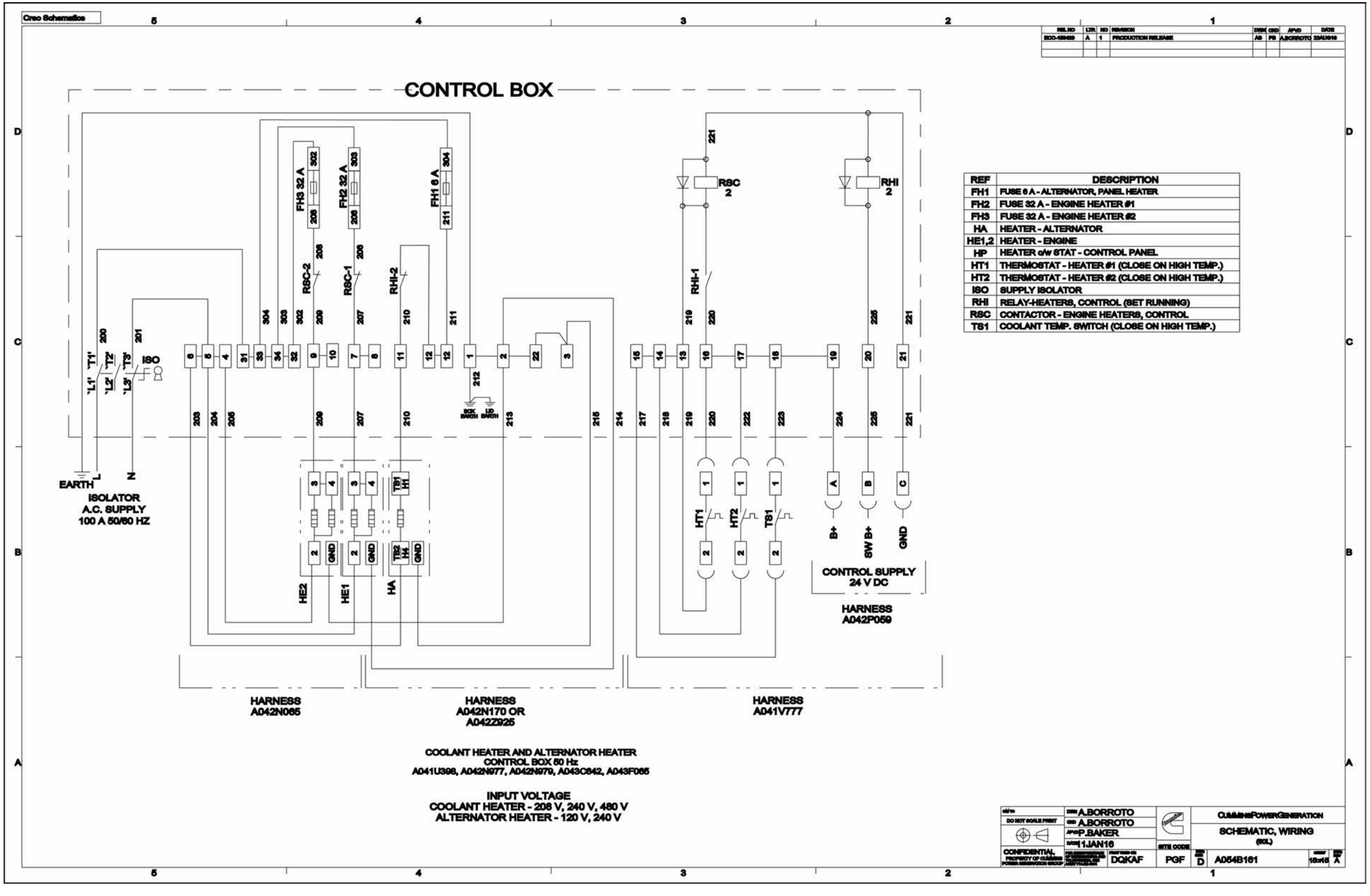


FIGURE 87. SCHEMATIC DIAGRAM (SHEET 14)



REF	DESCRIPTION
FH1	FUSE 6 A - ALTERNATOR, PANEL HEATER
FH2	FUSE 32 A - ENGINE HEATER #1
FH3	FUSE 32 A - ENGINE HEATER #2
HA	HEATER - ALTERNATOR
HE1,2	HEATER - ENGINE
HP	HEATER c/w STAT - CONTROL PANEL
HT1	THERMOSTAT - HEATER #1 (CLOSE ON HIGH TEMP.)
HT2	THERMOSTAT - HEATER #2 (CLOSE ON HIGH TEMP.)
ISO	SUPPLY ISOLATOR
RHI	RELAY-HEATERS, CONTROL (SET RUNNING)
RSC	CONTACTOR - ENGINE HEATERS, CONTROL
TS1	COOLANT TEMP. SWITCH (CLOSE ON HIGH TEMP.)

FIGURE 88. SCHEMATIC DIAGRAM (SHEET 15)

A.2 Wiring Diagram with PowerCommand 3.3 or PowerCommand 3.3MLD Control

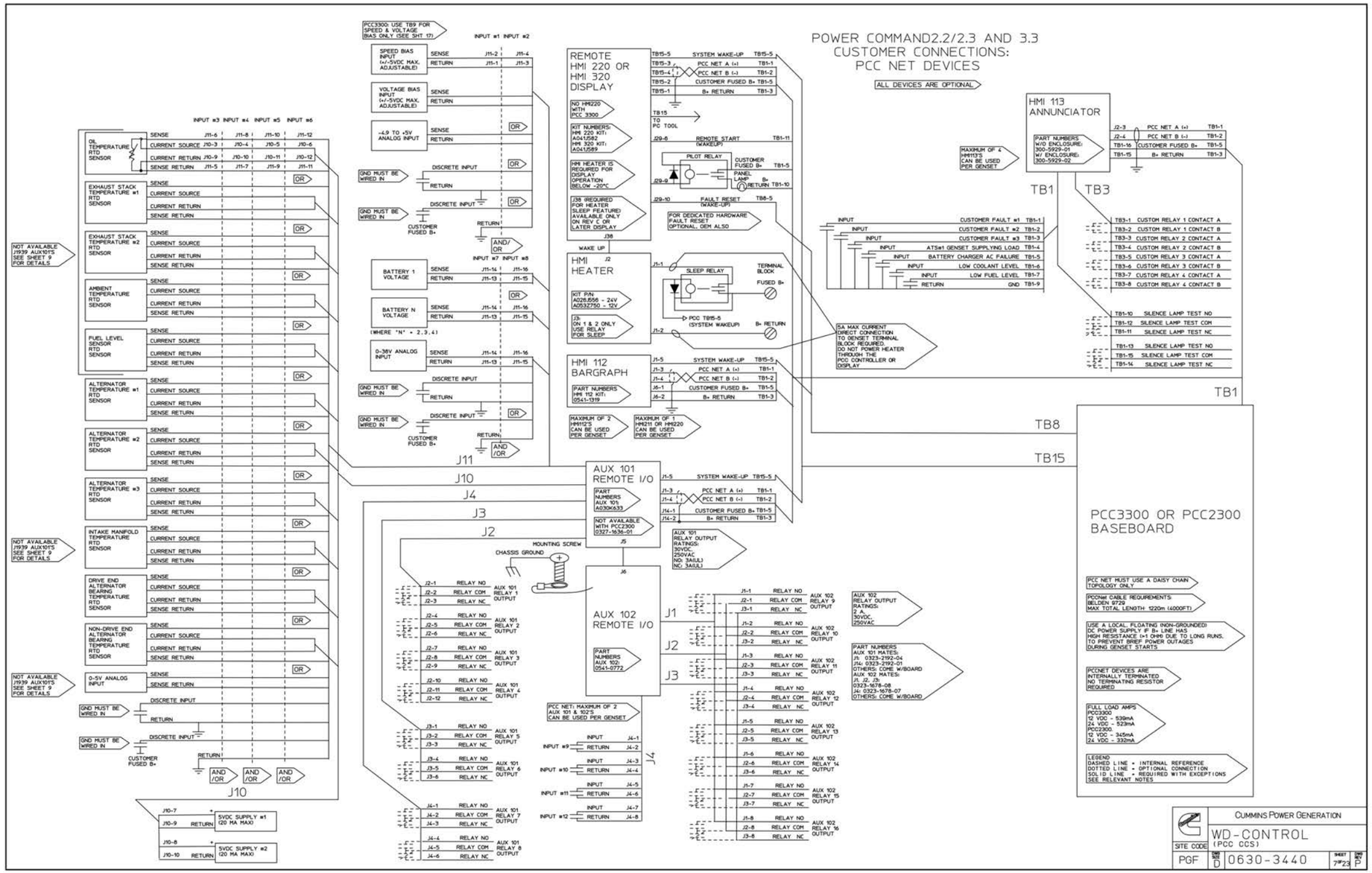


FIGURE 89. WIRING DIAGRAM (SHEET 1)

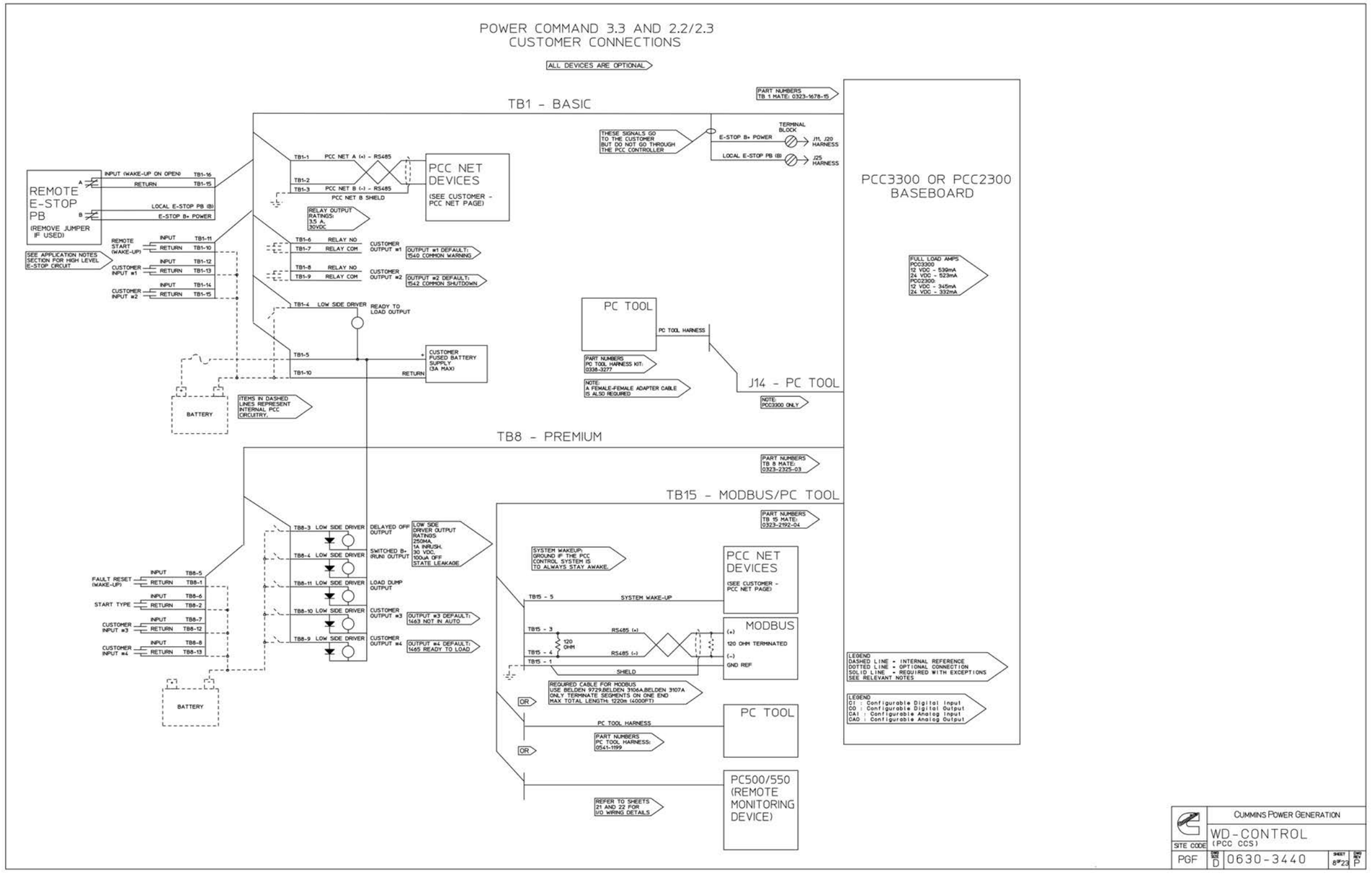


FIGURE 90. WIRING DIAGRAM (SHEET 2)

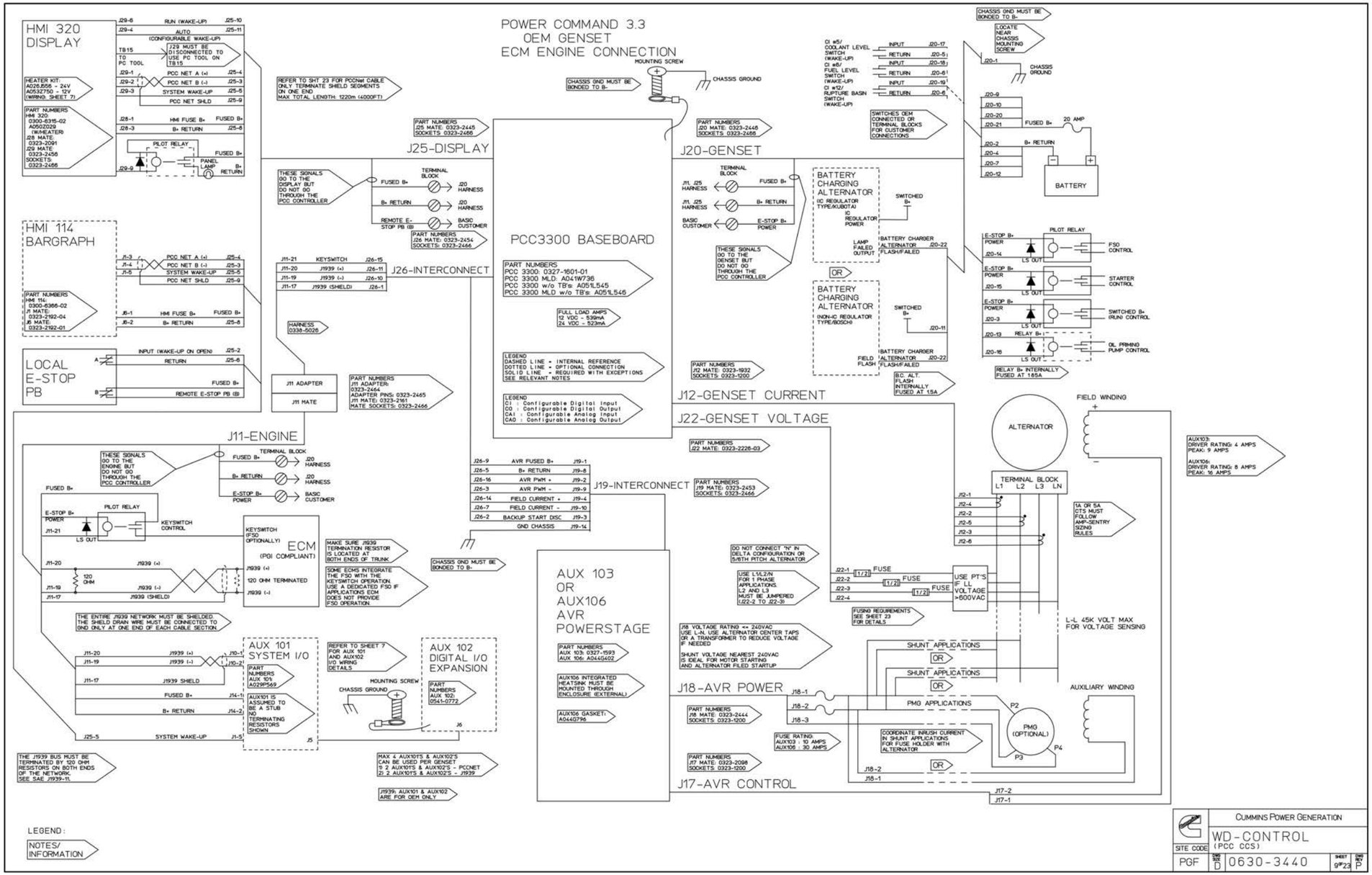


FIGURE 91. WIRING DIAGRAM (SHEET 3)

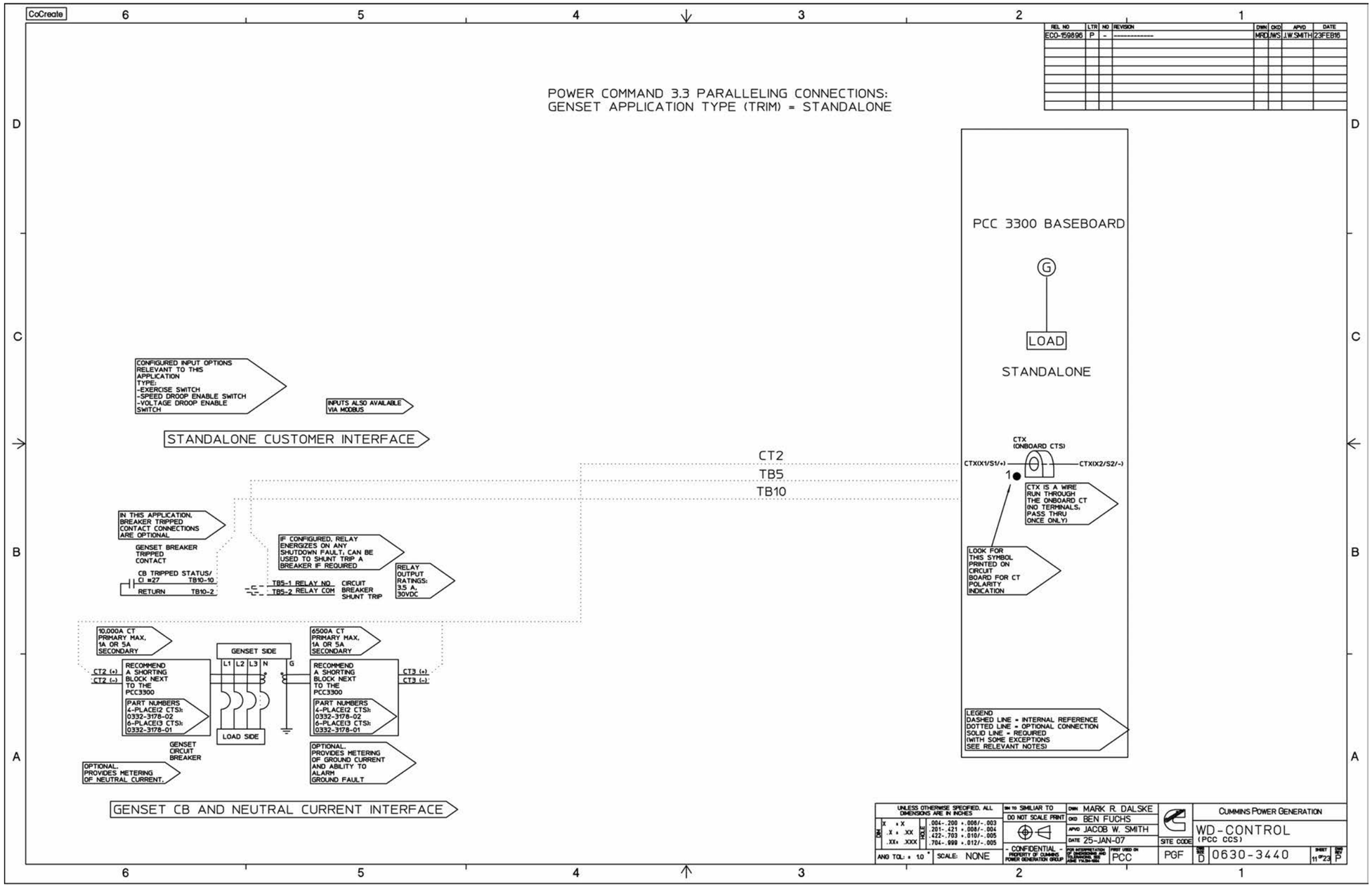


FIGURE 92. WIRING DIAGRAM (SHEET 4)

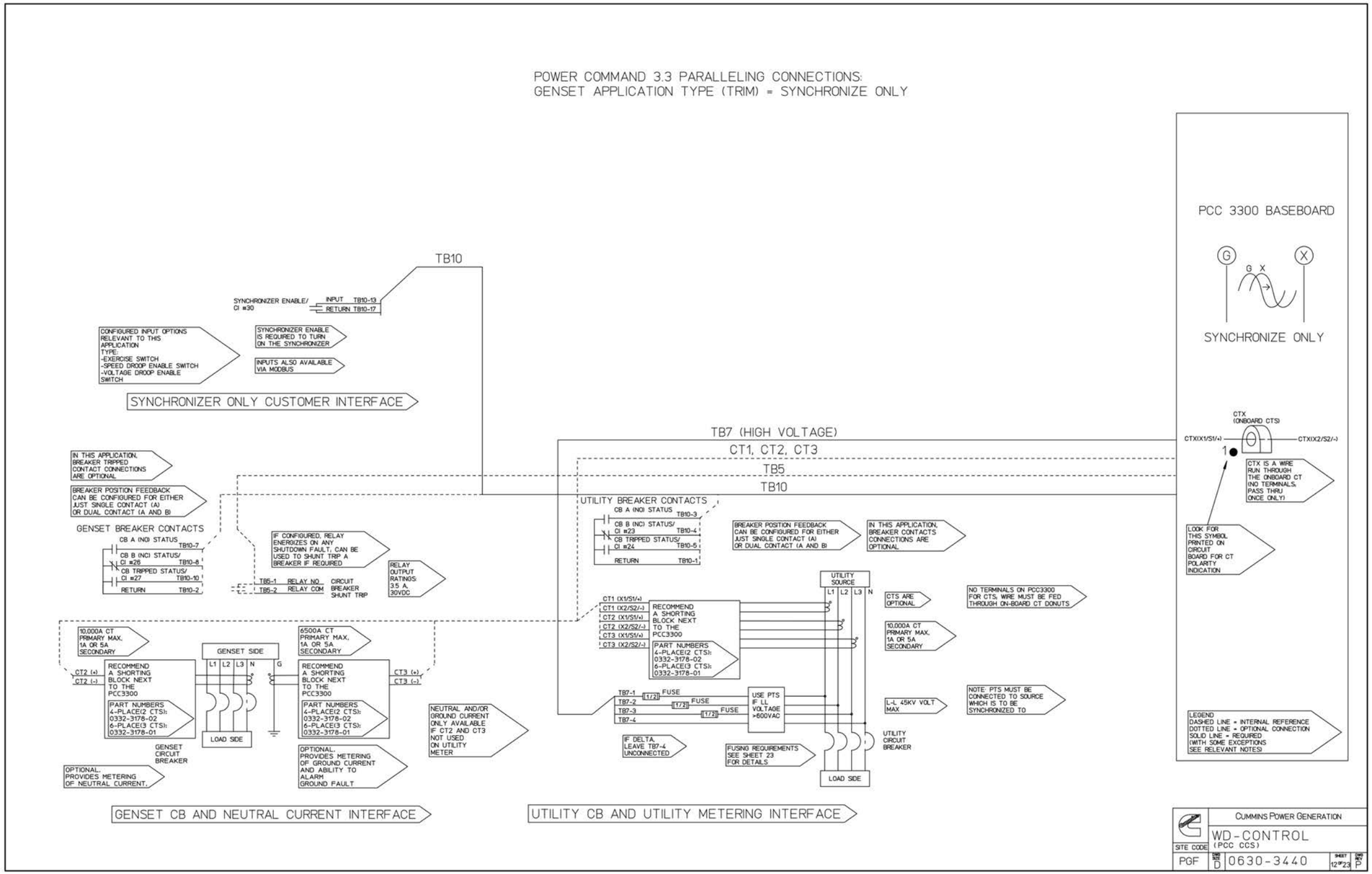


FIGURE 93. WIRING DIAGRAM (SHEET 5)

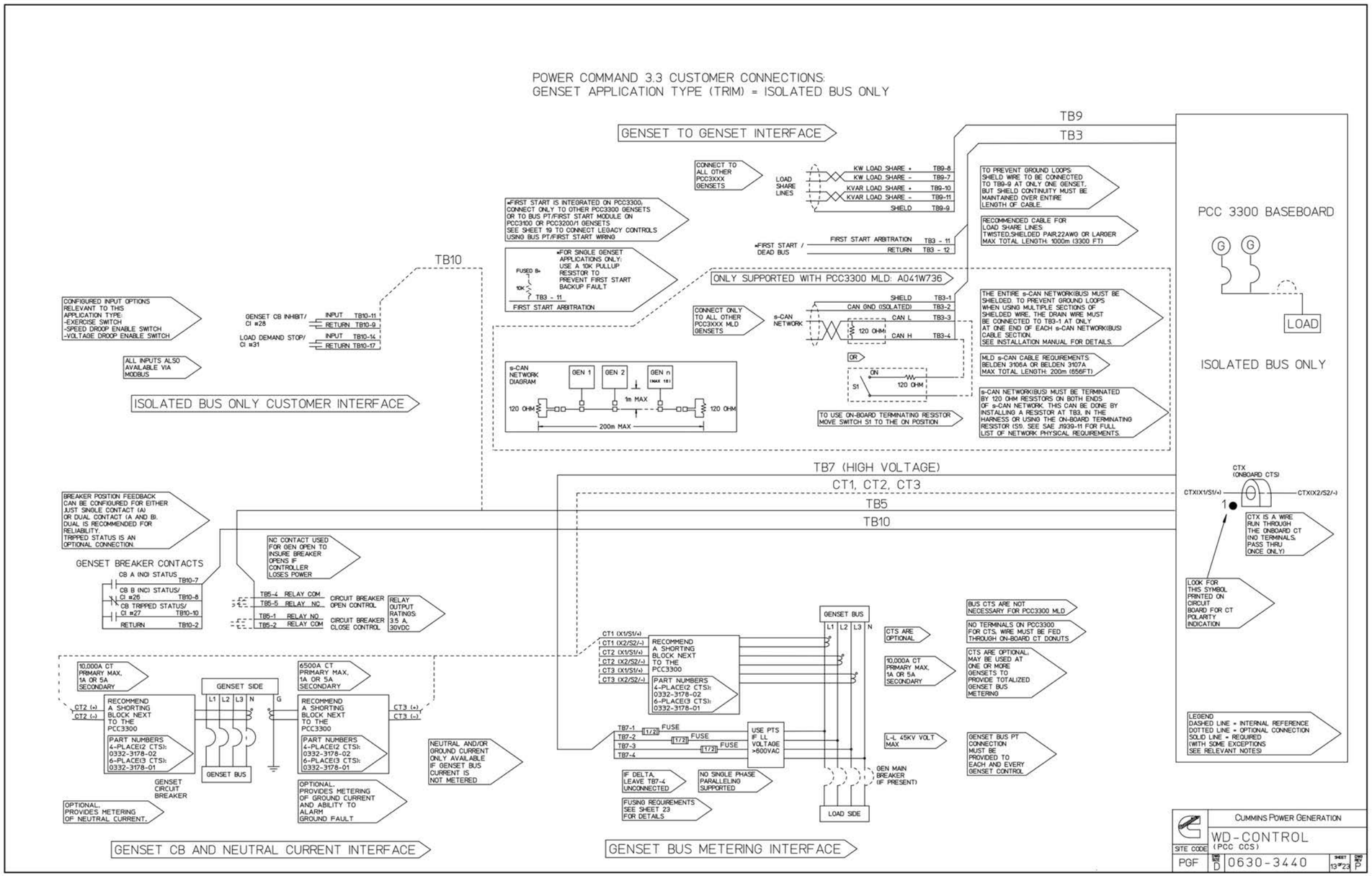


FIGURE 94. WIRING DIAGRAM (SHEET 6)

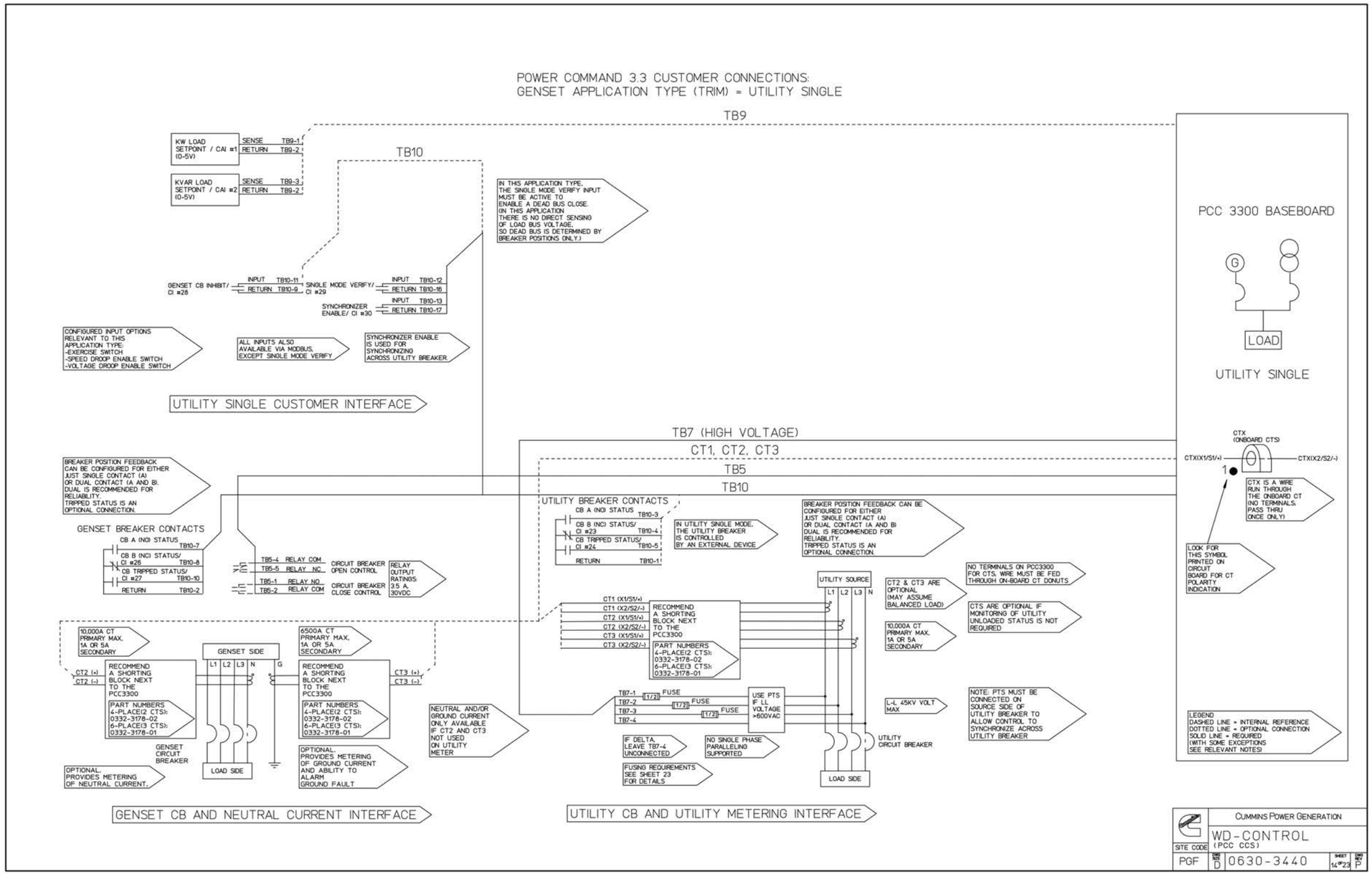


FIGURE 95. WIRING DIAGRAM (SHEET 7)

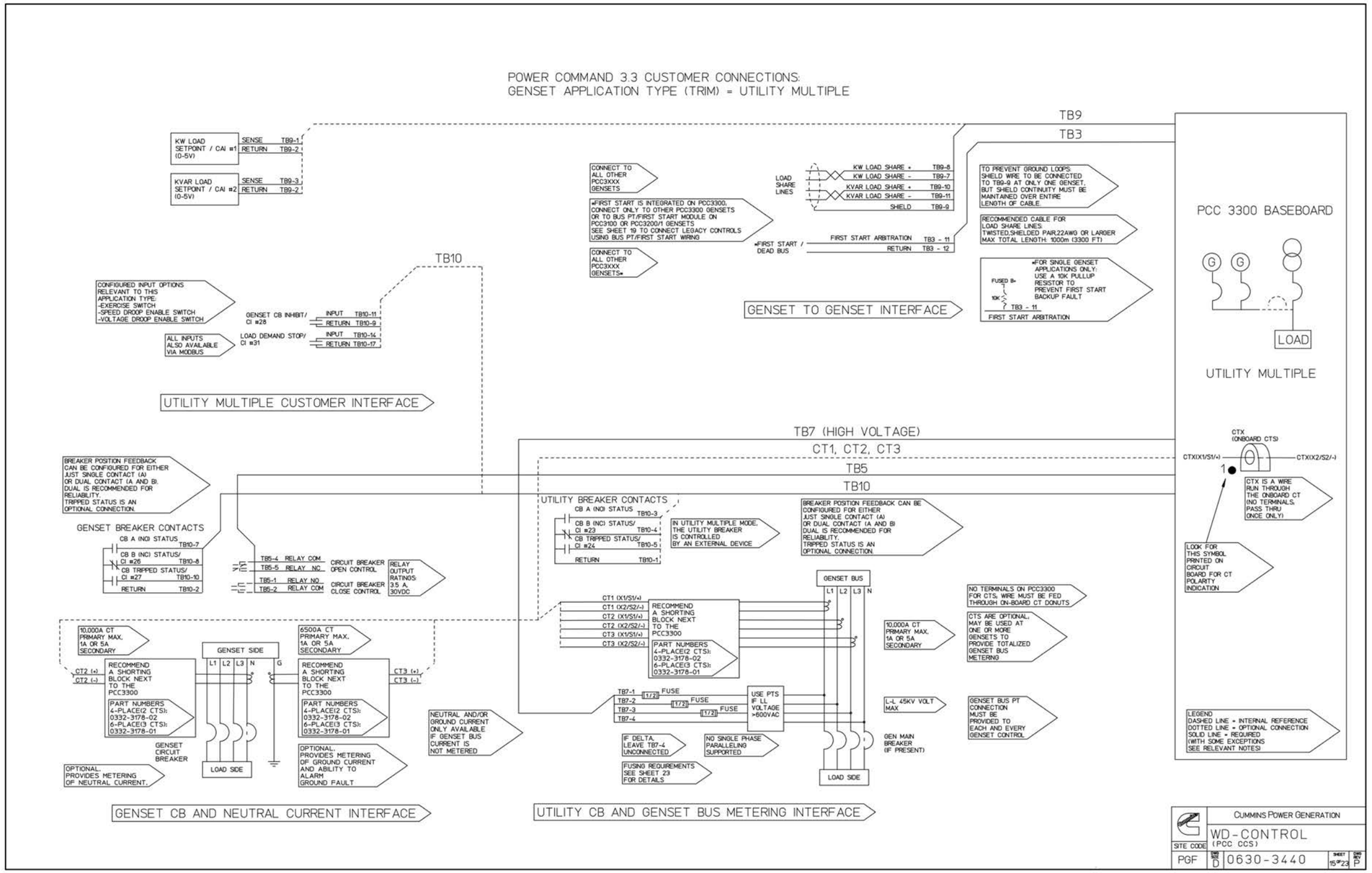


FIGURE 96. WIRING DIAGRAM (SHEET 8)

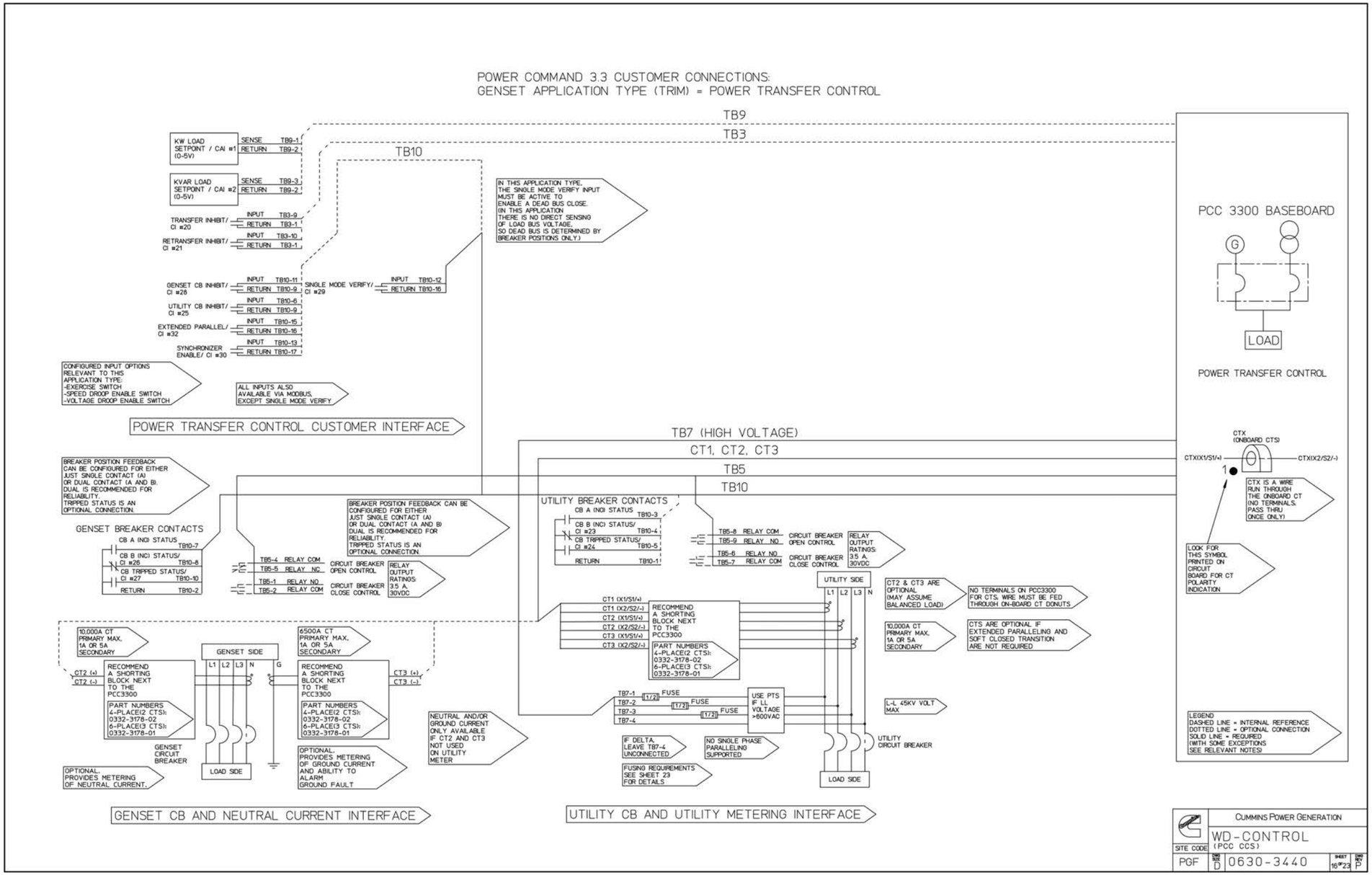


FIGURE 97. WIRING DIAGRAM (SHEET 9)

Rules for Configurable Paralleling IO - When Can IO be configured for non-default functionality?

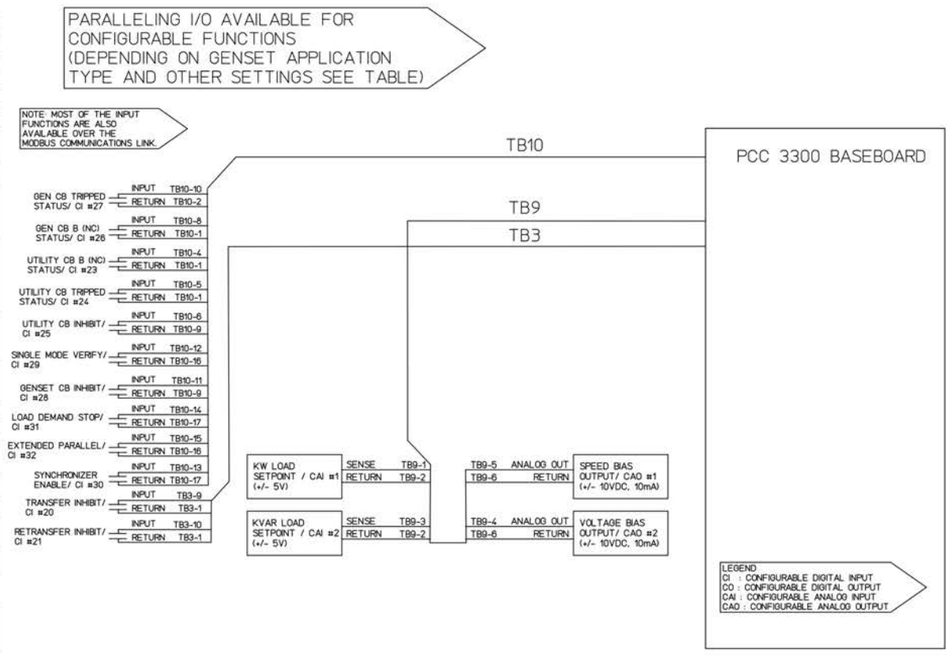
Signal	Can be Configured for non-default function if:
SWITCH INPUTS	
Genset CB B (NC) Status / CI#26	Only 'a' contact feedback will be used to monitor Genset breaker position.
Genset CB Tripped Status / CI #27	Genset breaker tripped indication will not be used.
Genset CB Inhibit / CI #28	Genset breaker inhibit control will not be used.
Utility CB B (NC) Status / CI#23	Only 'a' contact feedback will be used to monitor Utility breaker position.
Utility CB Tripped Status / CI #24	Utility breaker tripped indication will not be used.
Utility CB Inhibit / CI #25	Utility breaker inhibit control will not be used.
Single Mode Verify / CI #29	Genset Application Type (trim) is NOT Utility Single, or Power Transfer Control.
Load Demand Stop / CI #31	External control of load demand will not be needed, or if MLD is used for load demand control
Extended Parallel/ CI#32	This input default function is applicable only for "PTC" application. Thus in most applications (Non-PTC) this input can be configured for a non-default function.
Synchronizer Enable / CI #30	Genset Application Type (trim) is NOT Synchronize Only. Or Genset Application Type (trim) is Utility Single, but control system never needs to synchronize across utility breaker. Or Genset Application Type (trim) is Power Transfer Control and synchronizing when genset control is in Manual running mode is not required.
Transfer Inhibit / CI #20	Genset Application Type (trim) is NOT Power Transfer Control. Or Genset Application Type is Power Transfer Control, but transfer inhibit function is not needed.
Retransfer Inhhibit / CI #21	Genset Application Type (trim) is NOT Power Transfer Control. Or Genset Application Type is Power Transfer Control, but retransfer inhibit function is not needed.
LOW SIDE DRIVER OUTPUTS	NO CONFIGURABLE LOW SIDE DRIVER PARALLELING IO.
RELAY OUTPUTS	NO CONFIGURABLE RELAY OUTPUT PARALLELING IO.
ANALOG INPUTS	
kW Load Setpoint / CAI #1	Can be reconfigured when input is not needed for controlling genset kW output when utility paralleled.
kVAR Load Setpoint / CAI #2	Can be reconfigured when input is not needed for controlling genset kVAR output when utility paralleled.
ANALOG OUTPUTS	
Speed Bias Output / CAO #1	Can be reconfigured when input is not needed for speed bias interface to 3rd party speed governor.
Voltage Bias Output / CAO #2	Can be reconfigured when input is not needed for voltage bias interface to 3rd party voltage regulator.

Switch Input Functions (for Paralleling) only available by Configuring a Switch Input

Configurable Switch Input Paralleling Functions (functions only available by configuring an input to one of these)	Description / when used:
Exercise Switch	Will cause genset to start and run for a trimmable amount of fixed time. Control will function just as if the Remote Start input had been turned on for this fixed amount of time. For example, can be used when Genset Application Type = Power Transfer Control to cause genset to start and transfer load and after fixed time will automatically retransfer to utility and stop.
PTC Mode Switch	When Genset Application Type (trim) is Power Transfer Control, this will allow putting the breaker pair into a Manual operation mode, thereby causing the control to relinquish operation of the breakers.
Extended Parallel Switch	When Genset Application Type (trim) is Power Transfer Control, this input acts like Remote Start except instead of doing a load transfer it will parallel to the utility source and remain paralleled and control the kW and kVAR as programmed.
Speed Droop Enable Switch	Use to put genset into Speed Droop operation.
Voltage Droop Enable Switch	Use to put genset into Voltage Droop operation.
Load Demand Inhibit Switch	3300MLD systems ONLY. When LD system enable (trim) is enabled, and input is ACTIVE: Load Demand System Enable is inhibited. All the gensets will start.
Load Demand Spare Capacity Request	3300MLD systems ONLY. When LD system enable (trim) is enabled, and input is ACTIVE: Additional spare capacity (set by Load Demand Spare Capacity Request Value) is requested on the Genset Bus.

Switch Output Functions (for Paralleling) only available by Configuring a Switch Output

Configurable Switch Output Paralleling Functions (functions only available by configuring an output to one of these)	Description / when used:
Load Demand Spare Capacity Available	3300MLD systems ONLY. When LD system enable (trim) is enabled, and output is ACTIVE: Current load and spare capacity requirements are satisfied.



Analog Input Functions only available by Configuring an Analog Input

Configurable Analog Input Paralleling Functions (functions only available by configuring an input to one of these)	Description / when used:
External Speed Bias Input	Use when external biasing of engine speed is required.
External Voltage Bias Input	Use when external biasing of voltage is required.

Analog Output Functions only available by Configuring an Analog Output

Configurable Analog Output Paralleling Functions (functions only available by configuring an input to one of these)	Description / when used:
Genset Average Voltage	
Genset Average Current	
Genset Total Power Factor	
Genset Frequency	
Genset Total kW	
Genset Total kVAR	
Engine Speed	
Coolant Temperature	
Oil Pressure	
Oil Temperature	
Intake Manifold Temperature	

CUMMINS POWER GENERATION
WD-CONTROL (PCC CCS)
SITE CODE PGF
DWG NO. 0630-3440
SHEET 17 OF 23
DWG REV P

FIGURE 98. WIRING DIAGRAM (SHEET 10)

This page is intentionally blank.

Appendix B. Customer Connections

Table of Contents

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 Customer Connections

Power Generation

Termination	Customer Terminal Block	Signal Description
P30-13	CTBE-1	Remote Stop Circuit
TB1-1	CTB1-1	PCC Net A-Rs485
TB1-2	CTB2-1	PCC Net B-Rs485
TB1-3	CTB3-1	PCC Net Shield
TB1-4	CTB4-1	Ready To Load Output
TB1-5	CTB5-1	Configurable Fused B+ (3A)
	CTB6-1	**Open Port (TB1-5)**
	CTB7-1	**Open Port (TB1-5)**
	CTB8-1	**Open Port (TB1-5)**
TB1-6	CTB9-1	Configurable Output#1 NO
TB1-7	CTB10-1	Configurable Output#1 COM
TB1-8	CTB11-1	Configurable Output#2 NO
TB1-9	CTB12-1	Configurable Output#2 COM
TB1-10	CTB13-1	Remote Start (Wake-up) Return/Configurable Ground
TB1-11	CTB14-1	Remote Start (Wake-up) Input
TB1-12	CTB15-1	Configurable Input #1
TB1-13	CTB16-1	Configurable Return #1/Configurable Ground
TB1-14	CTB17-1	Configurable Input #2
TB1-15	CTB18-1	Configurable Input #2 Return/Remote E-Stop Return
	CTB19-1	**Open Port (TB1-15)**
TB1-16	CTB20-1	Remote E-Stop Input (Wake-Up On Open)
TB8-1	CTB21-1	Discrete Return#10/Fault Reset(Wake-Up) Return
TB8-2	CTB22-1	Discrete Return#11/Start Type Return
TB8-3	CTB23-1	Configurable Output#10/Delayed Off Low Side Driver
TB8-4	CTB24-1	SW B+ Relay Low Side Driver(Run)
TB8-5	CTB25-1	Discrete Input #10/Fault Reset(Wake-Up) Input
TB8-6	CTB26-1	Discrete Input #11/Start Type Input
	CTB27-1	**Open Port (TB3-1)**
TB3-1	CTB28-1	Shield/Input #20,#21 Return
TB3-2	CTB29-1	CAN Ground (Isolated)
TB3-3	CTB30-1	Masterless Load Demand CAN L
TB3-4	CTB31-1	Masterless Load Demand CAN H
TB3-5	CTB32-1	Configurable Output #20 Low Side Driver
TB3-6	CTB33-1	Configurable Output #21 Low Side Driver
TB3-8	CTB34-1	Configurable Output #22 Low Side Driver
TB3-9	CTB35-1	Input #20 Switch/ Transfer Inhibit
TB3-10	CTB36-1	Input #21 Switch/ Retransfer Inhibit
TB3-11	CTB37-1	Master First Start Output
TB3-12	CTB38-1	Master First Start Return
TB5-1	CTB39-1	Genset CB Close Control
TB5-2	CTB40-1	Genset CB Close Control Return
TB5-4	CTB41-1	Genset CB Open Control Return
TB5-5	CTB42-1	Genset CB Open Control
TB5-6	CTB43-1	Utility CB Close Control
TB5-7	CTB44-1	Utility CB Close Control Return
TB5-8	CTB45-1	Utility CB Open Control
TB5-9	CTB46-1	Utility CB Open Control Return
	CTB47-1	Analog Input #1/KW Load Setpoint
	CTB48-1	**Open Port (TB9-2)**
TB9-2	CTB49-1	Analog Input #1, #2 Return
TB9-3	CTB50-1	Analog Input #2/KVAR Load Setpoint
TB9-4	CTB51-1	Analog Output#2/Voltage Bias Output
TB9-5	CTB52-1	Analog Output#1/Speed Bias Output
TB9-6	CTB53-1	Analog Output#1, #2 Return
	CTB54-1	**Open Port (TB9-6)**
TB9-7	CTB55-1	KW Load Share (-)

Termination	Customer Terminal Block	Signal Description
P30-14	CTBE-3	Remote Stop Circuit
TB15-5	CTB1-3	System Wake-Up
	CTB2-3	**Open Port (TB15-5)**
	CTB3-3	**Open Port (TB15-5)**
P30-1	CTB4-3	B+
P30-2	CTB5-3	B+
P14(0)-1	CTB6-3	B+
P30-3	CTB7-3	B-
P30-4	CTB8-3	B-
P14(0)-2	CTB9-3	B-
	CTB10-3	B-
	CTB11-3	B-
	CTB12-3	B-
P30-5	CTB13-3	CSW B+
P30-6	CTB14-3	CSW B+
	CTB15-3	CSW B+
P30-12	CTB16-3	Rupture Basin Return
P30-11	CTB17-3	Rupture Basin Input
P30-10	CTB18-3	Low Fuel Return
P30-9	CTB19-3	Low Fuel Input
P30-8	CTB20-3	Coolant Level Return
P30-7	CTB21-3	Coolant Level Input
TB8-13	CTB22-3	Configurable Input #4 Return
TB8-12	CTB23-3	Configurable Input #3 Return
TB8-11	CTB24-3	Configurable Output #11/Load Dump Low Side Driver
TB8-10	CTB25-3	Configurable Output #3 Low Side Driver
TB8-9	CTB26-3	Configurable Output #4 Low Side Driver
TB8-8	CTB27-3	Configurable Input #4
TB8-7	CTB28-3	Configurable Input #3
	CTB29-3	**Open Port (TB10-17)**
TB10-17	CTB30-3	Configurable Input #30, #31 Return
	CTB31-3	**Open Port (TB10-16)**
TB10-16	CTB32-3	Configurable Input #29, #32 Return
TB10-15	CTB33-3	Configurable Input #32/ Extended Parallel
TB10-14	CTB34-3	Configurable Input #31/Load Demand Stop
TB10-13	CTB35-3	Configurable Input #30/Sync Enable
TB10-12	CTB36-3	Configurable Input #29/Utility Single Mode Verify
TB10-11	CTB37-3	Configurable Input #28/Genset CB Inhibit
TB10-10	CTB38-3	Configurable Input#27/Genset CB Tripped
TB10-9	CTB39-3	Configurable Input#25, #28 Return
	CTB40-3	**Open Port (TB10-9)**
TB10-8	CTB41-3	Configurable Input #26/Genset CB Position B (NC)
TB10-7	CTB42-3	Genset CB Position A (NO)
TB10-6	CTB43-3	Configurable Input #25/Utility CB Inhibit
TB10-5	CTB44-3	Configurable Input #24/Utility CB Tripped
TB10-4	CTB45-3	Configurable Input #23/Utility CB Position B (NC)
TB10-3	CTB46-3	Utility CB Position A (NO)
	CTB47-3	**Open Port (TB10-2)**
TB10-2	CTB48-3	Configurable Input #26, #27, Genset CB Position A Return
TB10-1	CTB49-3	Configurable Input #23, #24, Utility CB Position A Return
	CTB50-3	**Open Port (TB10-1)**
TB9-11	CTB51-3	KVAR Load Share (-)
TB9-10	CTB52-3	KVAR Load Share (+)
TB9-9	CTB53-3	KVAR Load Share (Shield)
TB9-8	CTB54-3	KW Load Share (+)
	CTB55-3	

= Terminal Block Jumper

Factory connections (excluding options) terminate in terminals CTBxx-1 and CTBxx-3
Customer connections terminate in terminals CTBxx-2 and CTBxx-4

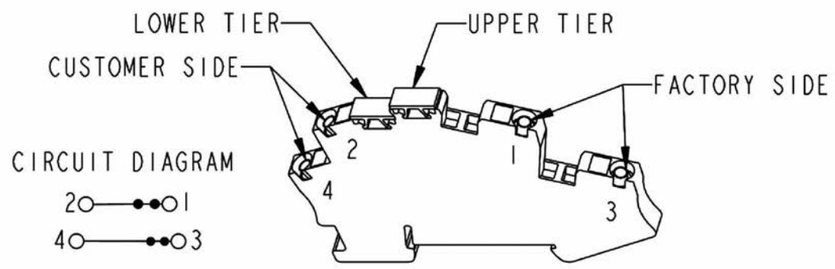
A052Z040 A

FIGURE 99. CUSTOMER CONNECTIONS (SHEET 1)

Power Generation

Fuse Left Connection	Fuse Name	Fuse Right Connection
Batt B +	F5A	Key-switch, pre-lube B+ contact
Alt Aux101	F5B	TB B+
Coolant heater, Batt alt failure	F5C	T26 (SW B+)
HMI Panel	F5D	TB B+
Coolant heater	F5E	TB B+
Pre-lube	F5F	T26 (SW B+)
PMG 2	F10A	Aux 103
PMG 3	F10B	Aux 103
Batt B +	F15A	PCC 3300
Batt B +	F15B	TB B+
Batt B +	F15C	K5 (SW B+), T26

Cummins Part Number	Description
A049S817	Fuse Holder
0321-0321-04	Fuse 5A
0321-0321-06	Fuse 10A
0321-0321-07	Fuse 15A
A050L067	OEM Terminal & Fuse Tags
A050E781	OEM Terminal Capacitor Holder
0355-0315	OEM Terminal Capacitor
A049S801	1PDT Relay Module (miniature)
A049S834	3PDT Relay Module
A049S839	Double Level Terminal Block
A050K512	Lower Level Terminal Tags
A050K510	Upper Level Terminal Tags
A030V501	Terminal Block Jumper 4 Position
A030V471	Terminal Block Jumper 3 Position
A040K491	Terminal Block Jumper 2 Position
0332-4320	Terminal Block End Clamp
A049S842	Double Level Terminal Block End Cover
A050B150	Terminal Block End Cover
0305-1009	24VDC Relay Suppressor
A049U039	24VCD Relay 2NO, 2NC



A052Z040 A

FIGURE 100. CUSTOMER CONNECTIONS (SHEET 2)

Appendix C. Alternator Reconnect Drawing

Table of Contents

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 Reconnect Drawing for P7 Alternator

Pro/ENGINEER

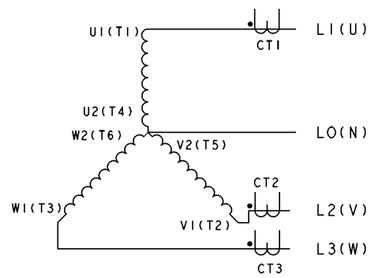
REL NO	LTR	NO	REVISION	DRN	CKD	APPD	DATE
ECO-100669	A	1	PRODUCTION RELEASE	LJK	PPL	PPL	30JUL08

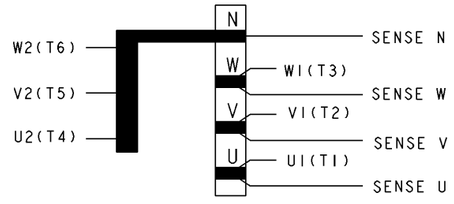
P7 GENERATOR

3 PHASE NON-RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONNECTION X1, X2

220/380V, 50,60 HZ (RO99)
230/400V, 50 HZ (RO29)
240/416V, 50, 60 HZ (RO03)
255/440V, 50,60 HZ (RO23)
266/460V, 60 HZ (RO27)
277/480V, 60 HZ (RO02)
347/600V, 60 HZ (R114)





NOTES:

1. UVW PHASE SEQUENCE WITH CLOCKWISE ROTATION FACING DRIVE END.
2. CHECK GENERATOR SET NAMEPLATE FOR ALLOWABLE VOLTAGE SELECTIONS.
3. VOLTAGE SENSING LEADS MUST BE CONNECTED AS SHOWN FOR PROPER METERING AND VOLTAGE REGULATION OPERATION.
4. CURRENT TRANSFORMER POLARITY/LEADS MUST BE CONNECTED AS SHOWN FOR PROPER METERING.

-THIS IS A CONTROLLED PRODUCT-
PER QMAR PROCEDURE PRE-1002

TO MAINTAIN CONFORMANCE WITH REQUIREMENTS OF THE CODES, STANDARDS, OR AGENCIES LISTED BELOW

☐ CSA ☒ UL ☐ EC ☐ MTA ☐ ABYC
☐ OTHER _____ ☐ OTHER _____
AND/OR ASSIGN INTERNAL QMAR DESIGN CONTROL FACILITIES ☐

CHANGES, DEVIATIONS, OR SUBSTITUTIONS OF MATERIAL, PROCESS, OR PERFORMANCE FOR THIS PRODUCT MUST BE APPROVED BY THE FOLLOWING DESIGN CONTROL FACILITIES

DESIGN CONTROL FACILITY FARKEY
DESIGN CONTROL FACILITY _____

POWER COMMAND 2.2 2.3 3.3

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1, .X ±0.8, .XX± 0.38
HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13
ANG TOL: ± 1.0° SCALE: 1/1
DIM NO .
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DRN L. KAPLAN
CKD P. LARSON
APVD P. LARSON
DATE 30JUL08
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, REF. ASME Y14.5M-1994 . FIRST USED ON .
SITE CODE PGF
CUMMINS POWER GENERATION
DIAGRAM, WIRING RECONNECT
SIZE D A026F378 SHEET 1 OF 1 REV A

FIGURE 101. P7 GENERATOR 3-PHASE NON-RECONNECTABLE WIRING DIAGRAM

This page is intentionally blank.

Appendix D. Outline Drawings

Table of Contents

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

This page is intentionally blank.

D.1 Generator Set with Enhanced High Ambient Radiator Outline Drawing

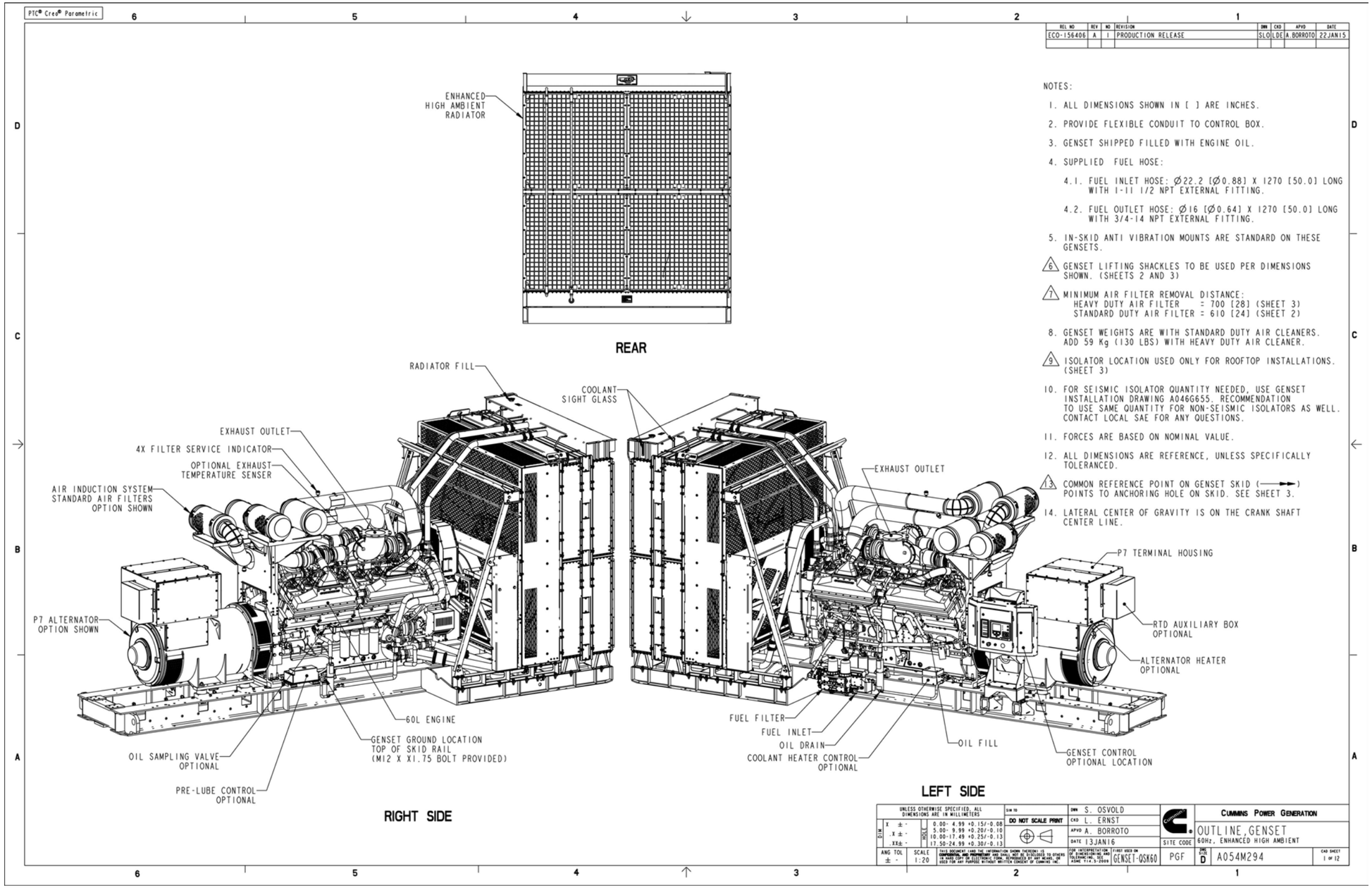


FIGURE 102. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 1)

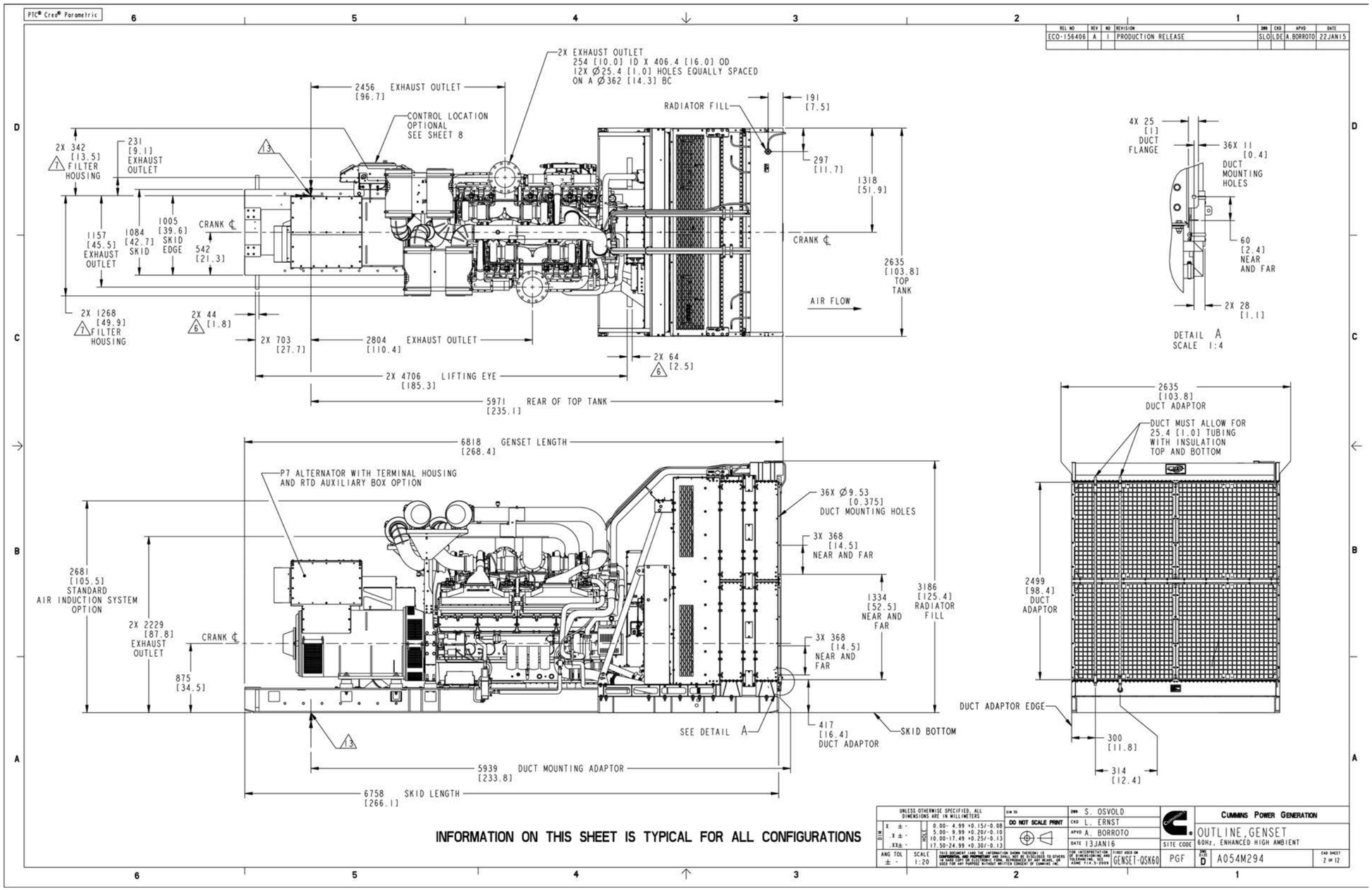
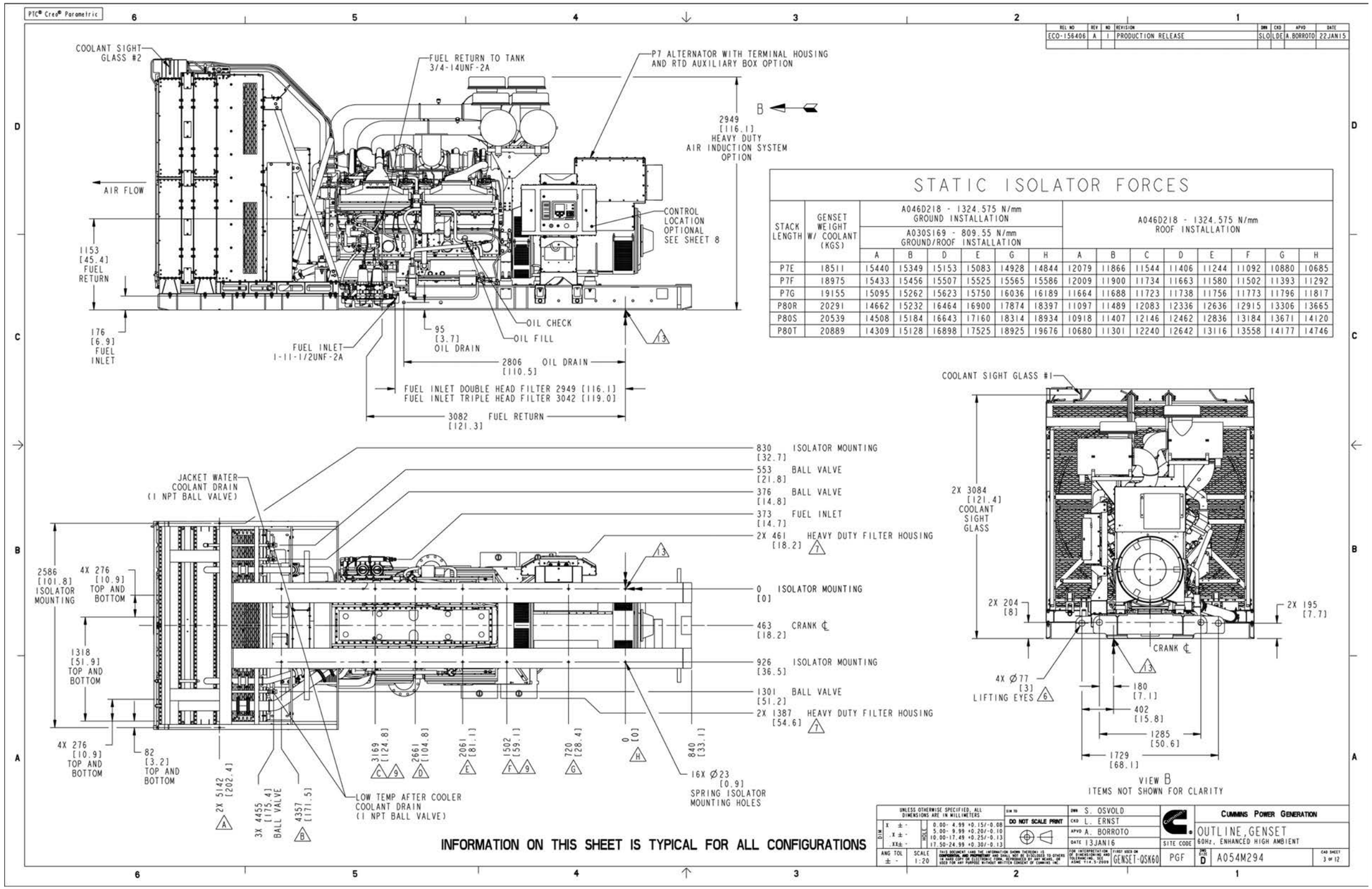


FIGURE 103. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 2)



STATIC ISOLATOR FORCES

STACK LENGTH	GENSET WEIGHT W/ COOLANT (KGS)	A046D218 - 1324.575 N/mm GROUND INSTALLATION / A030S169 - 809.55 N/mm GROUND/ROOF INSTALLATION						A046D218 - 1324.575 N/mm ROOF INSTALLATION							
		A	B	D	E	G	H	A	B	C	D	E	F	G	H
P7E	18511	15440	15349	15153	15083	14928	14844	12079	11866	11544	11406	11244	11092	10880	10685
P7F	18975	15433	15456	15507	15525	15565	15586	12009	11900	11734	11663	11580	11502	11393	11292
P7G	19155	15095	15262	15623	15750	16036	16189	11664	11688	11723	11738	11756	11773	11796	11817
P80R	20291	14662	15232	16464	16900	17874	18397	11097	11489	12083	12336	12636	12915	13306	13665
P80S	20539	14508	15184	16643	17160	18314	18934	10918	11407	12146	12462	12836	13184	13671	14120
P80T	20889	14309	15128	16898	17525	18925	19676	10680	11301	12240	12642	13116	13558	14177	14746

FIGURE 104. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 3)

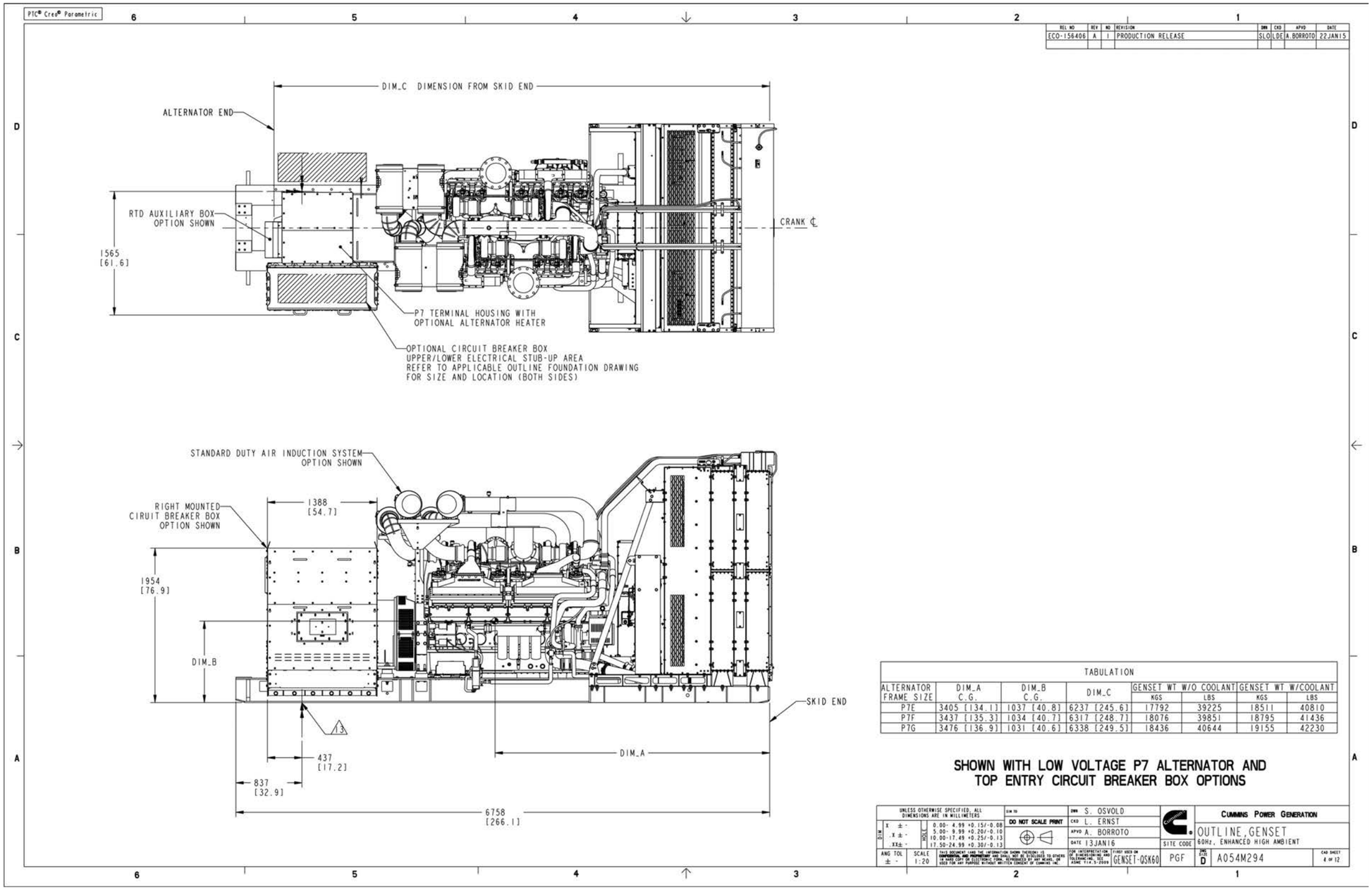
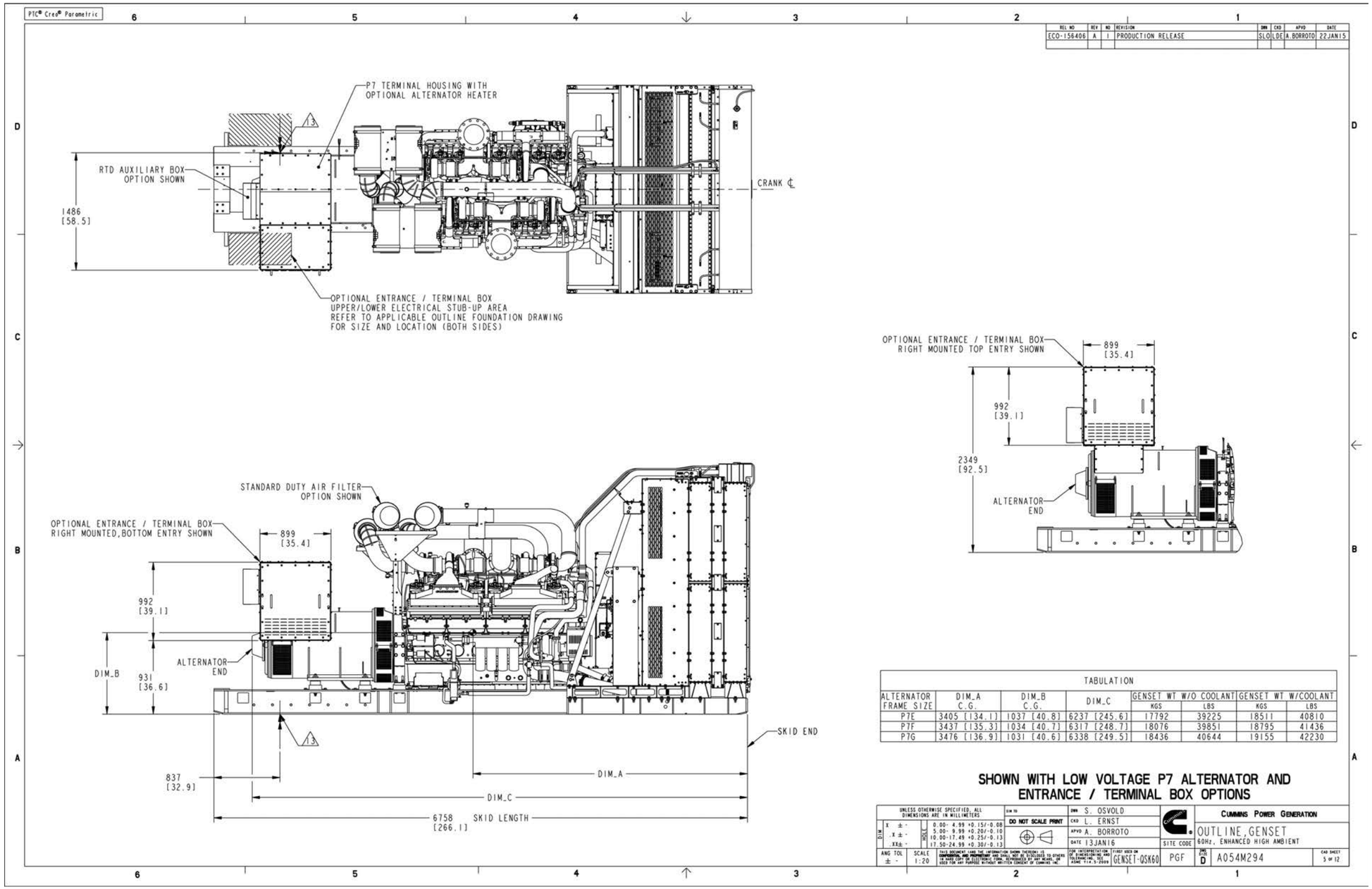


FIGURE 105. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 4)



REL NO	REV	NO	REVISION	DRN	CKD	APVD	DATE
ECO-156406	A	1	PRODUCTION RELEASE	SLO	LDE	A.BORROTO	22JAN15

TABULATION

ALTERNATOR FRAME SIZE	DIM_A C.G.	DIM_B C.G.	DIM_C	GENSET WT W/O COOLANT KGS	GENSET WT W/O COOLANT LBS	GENSET WT W/COOLANT KGS	GENSET WT W/COOLANT LBS
P7E	3405 [134.1]	1037 [40.8]	6237 [245.6]	17792	39225	18511	40810
P7F	3437 [135.3]	1034 [40.7]	6317 [248.7]	18076	39851	18795	41436
P7G	3476 [136.9]	1031 [40.6]	6338 [249.5]	18436	40644	19155	42230

DRN	S. OSVOLD
CKD	L. ERNST
APVD	A. BORROTO
DATE	13JAN16
SITE CODE	PGF
SIZE	D
DWG NO	A054M294
CAD SHEET	5 OF 12

FIGURE 106. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 5)

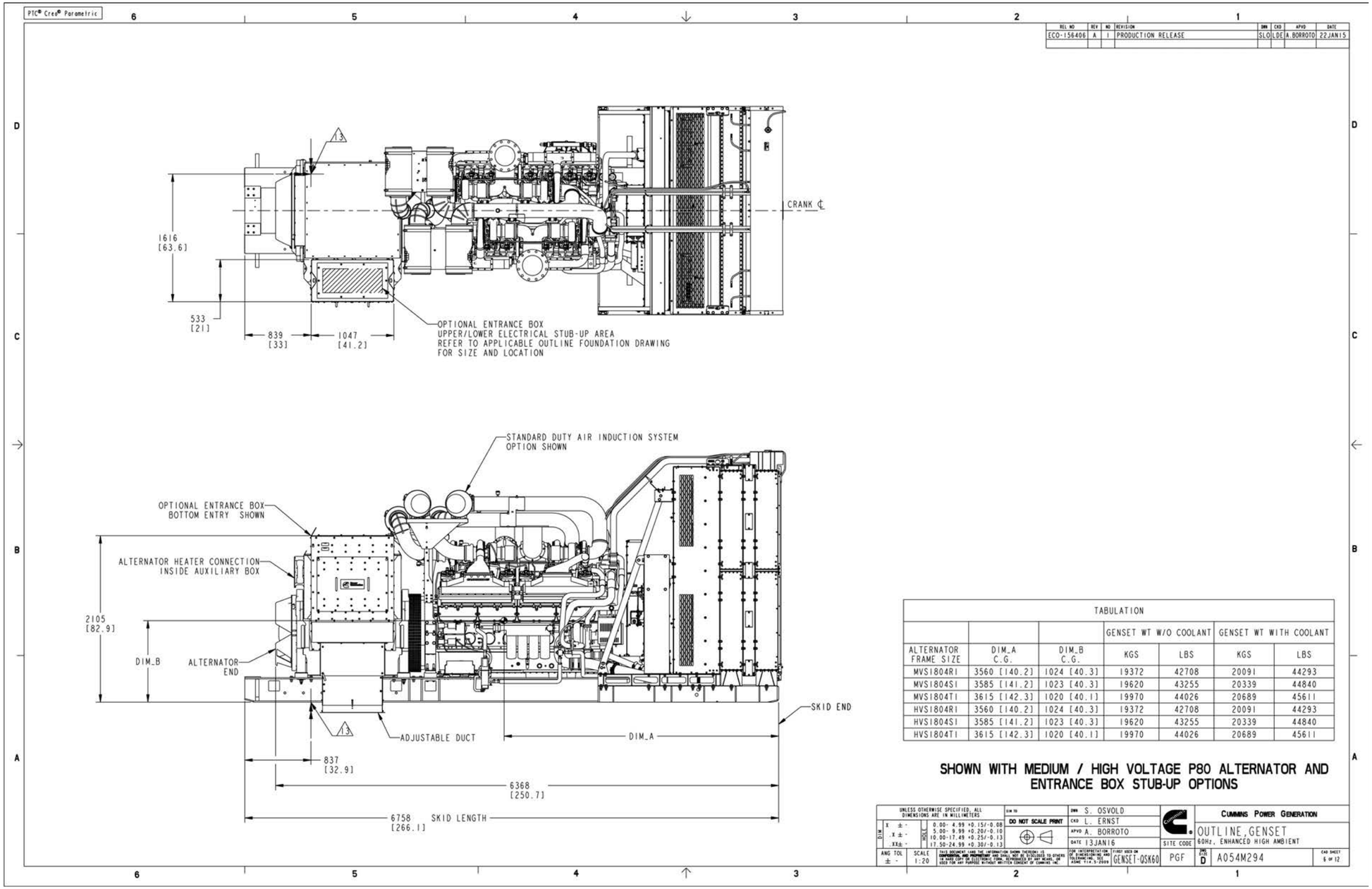


FIGURE 107. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 6)

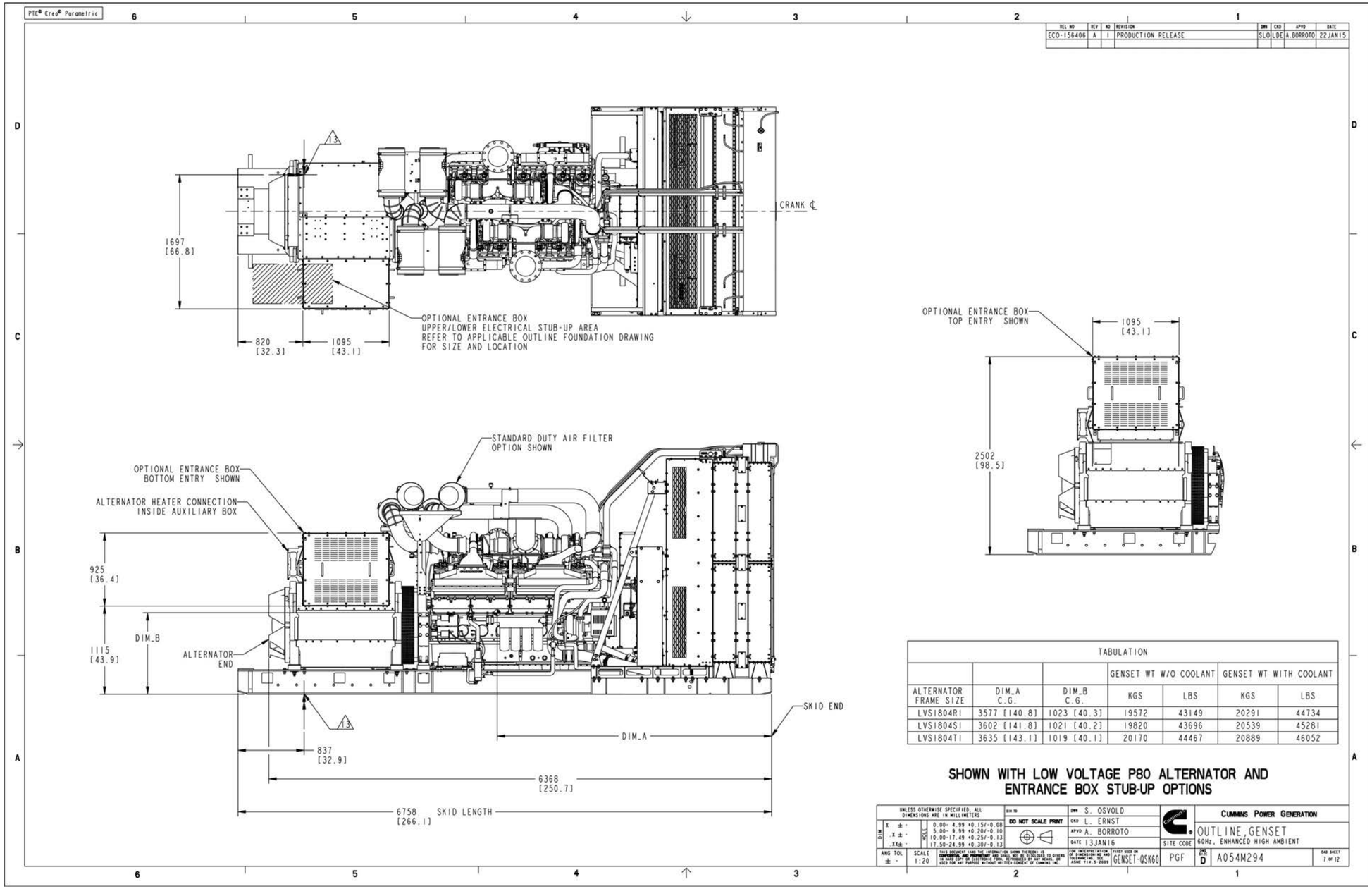


FIGURE 108. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 7)

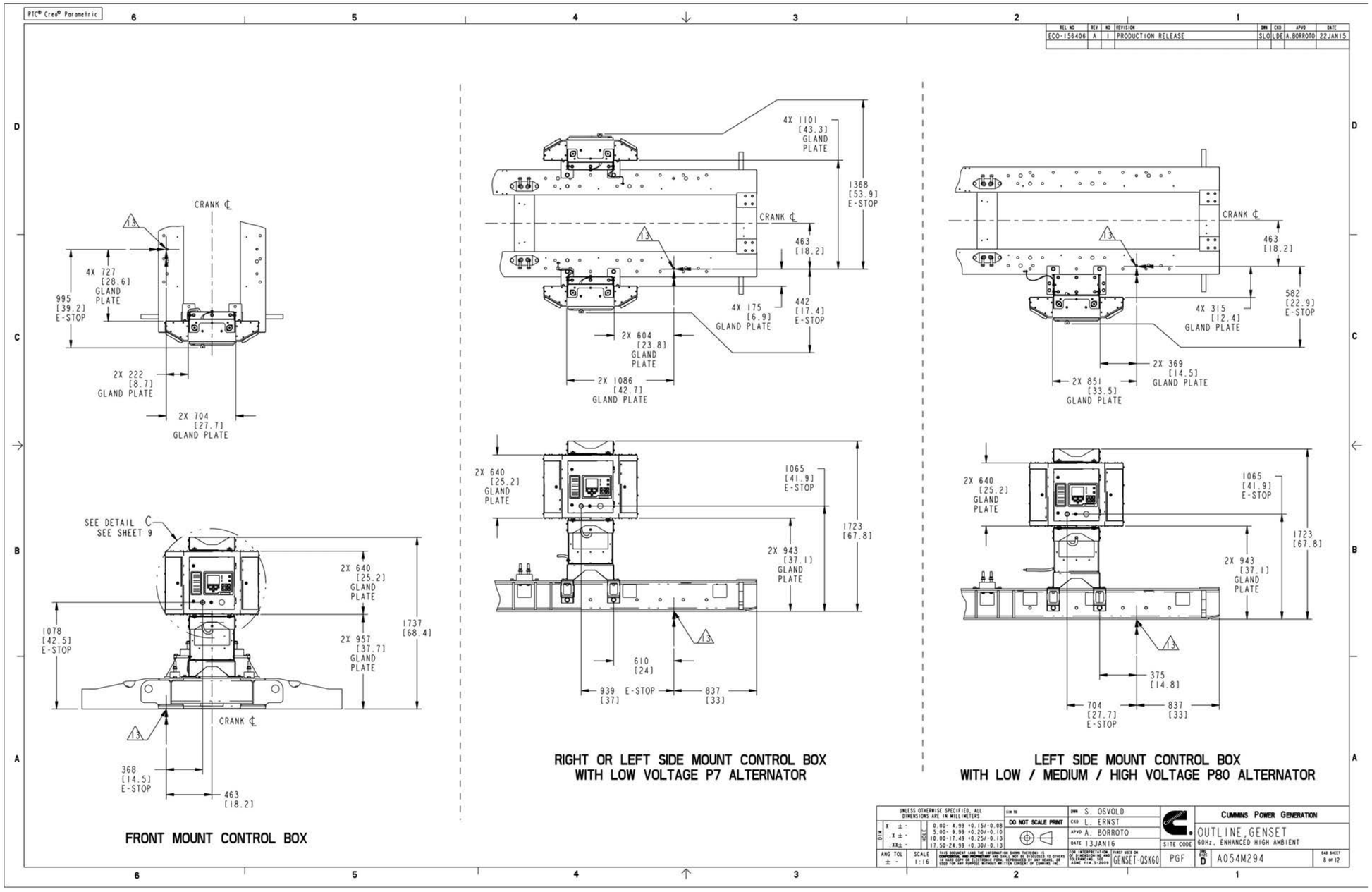


FIGURE 109. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 8)

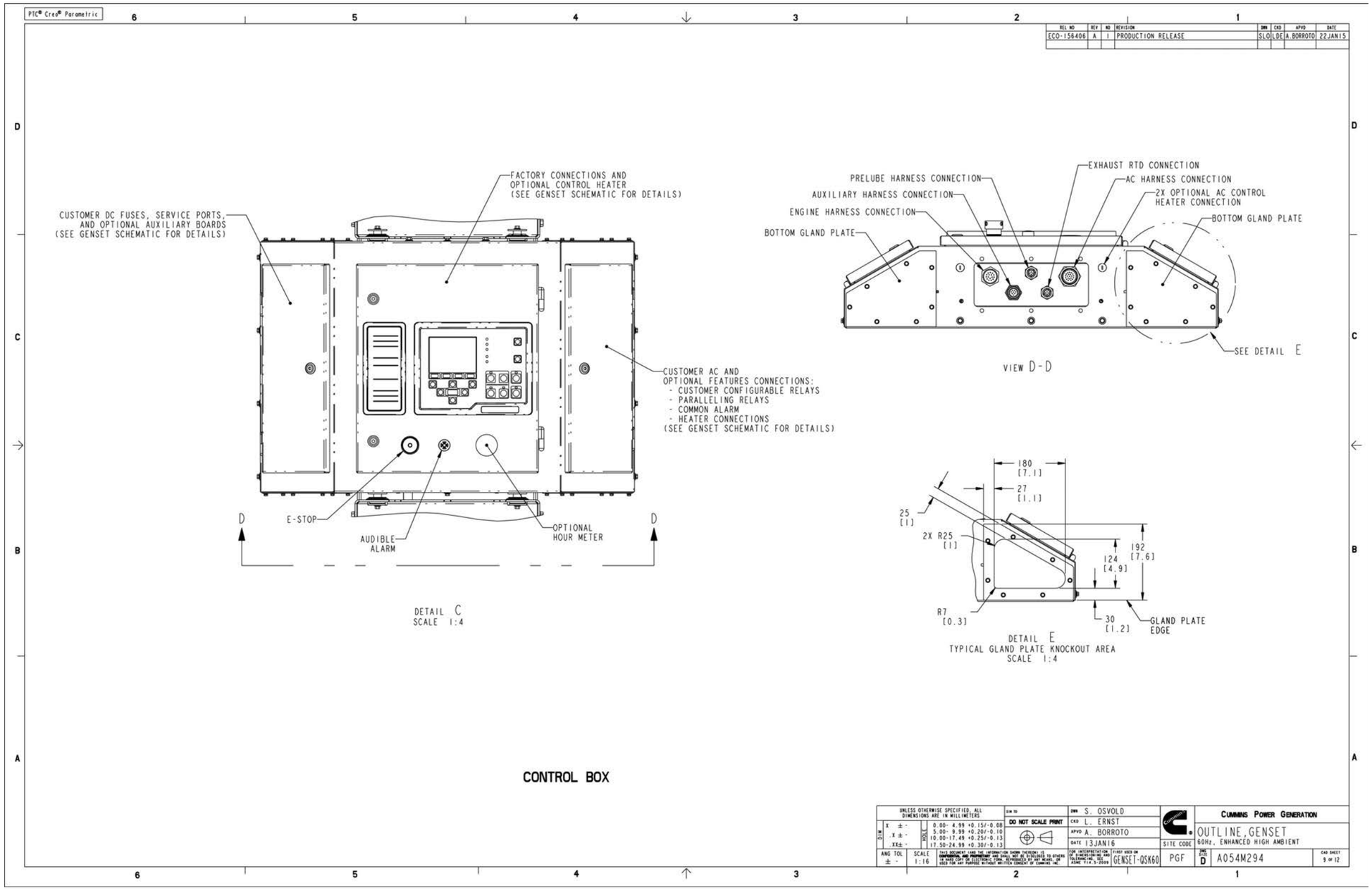


FIGURE 110. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 9)

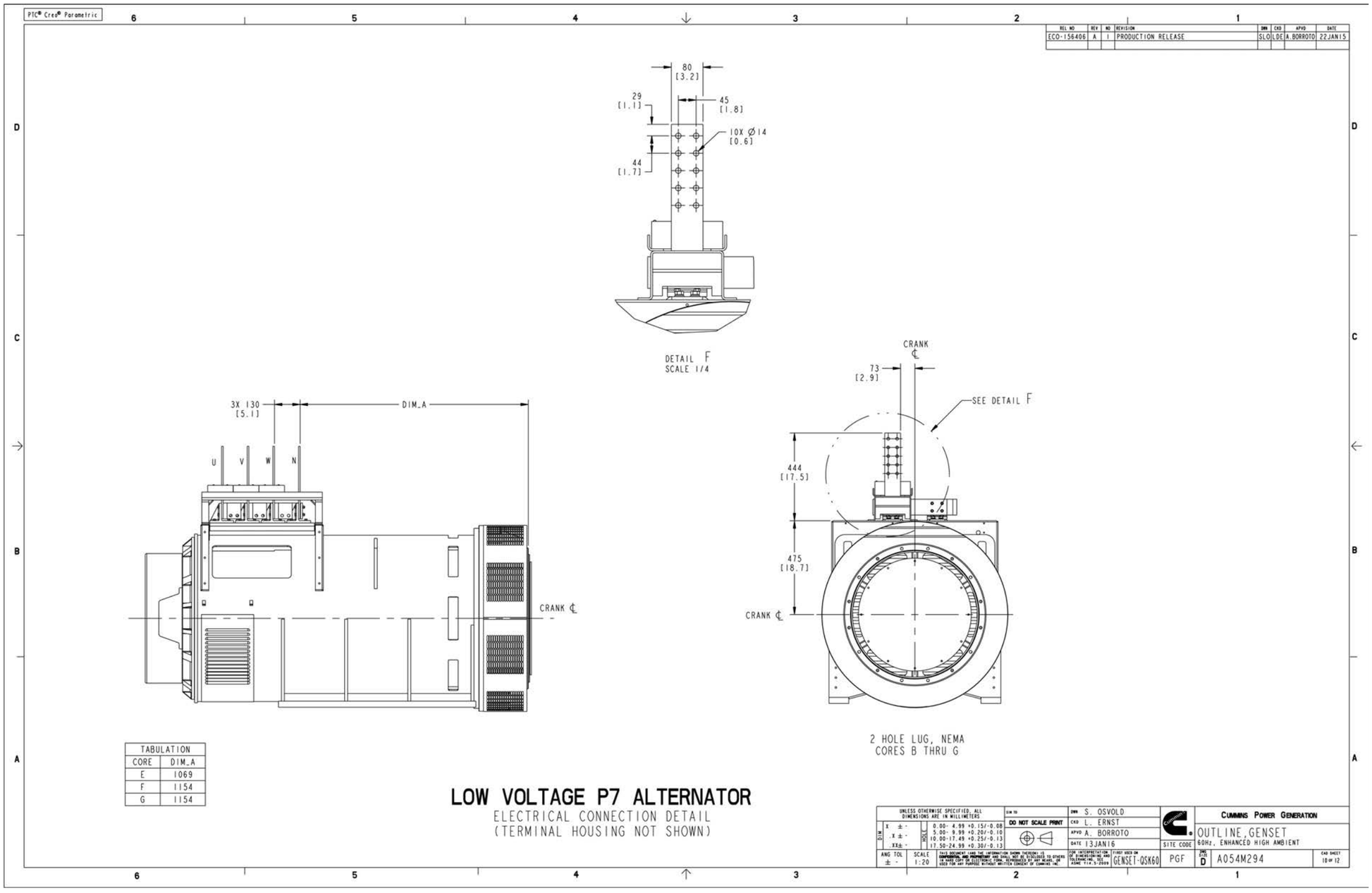


FIGURE 111. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 10)

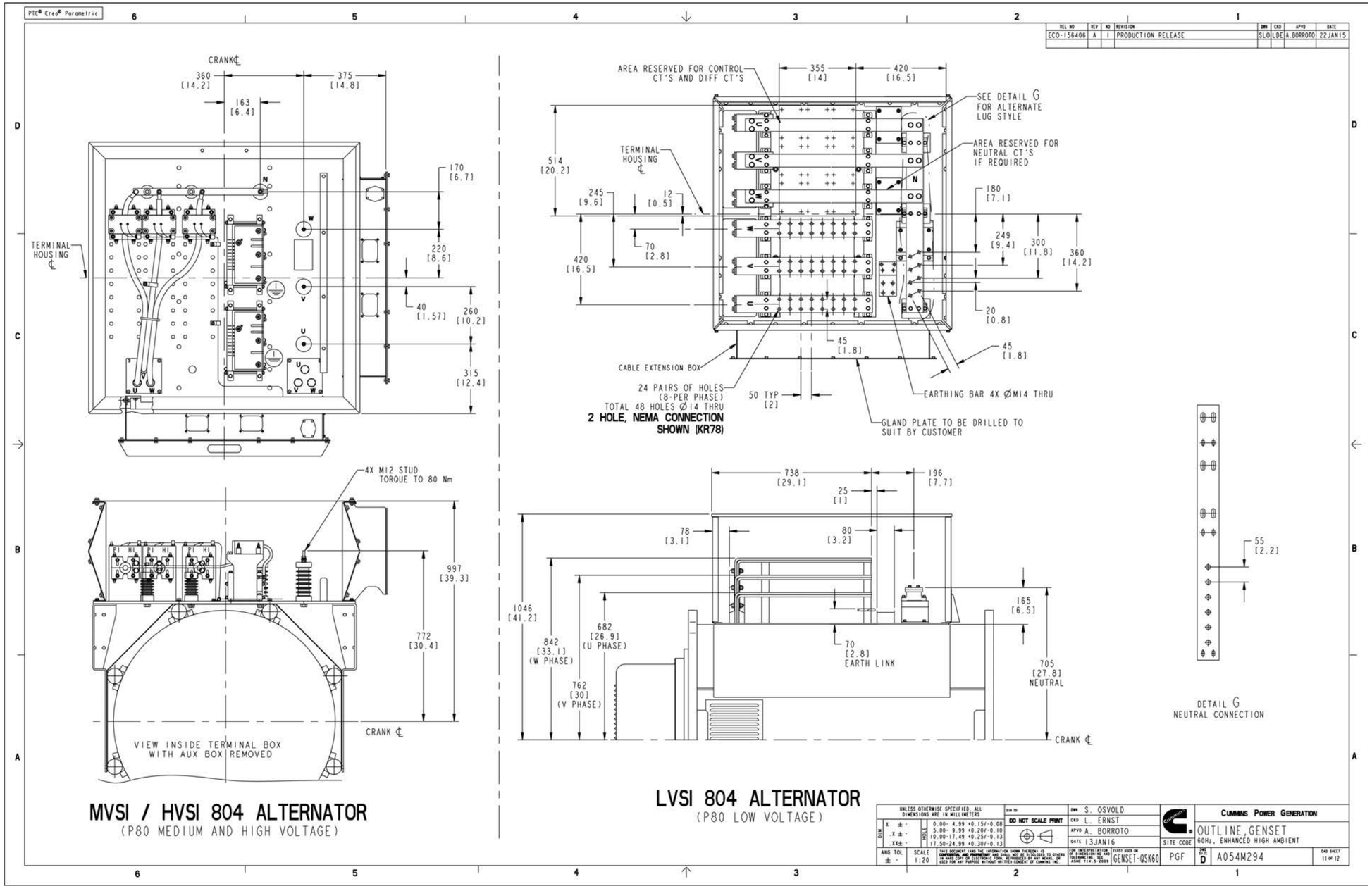


FIGURE 112. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 11)

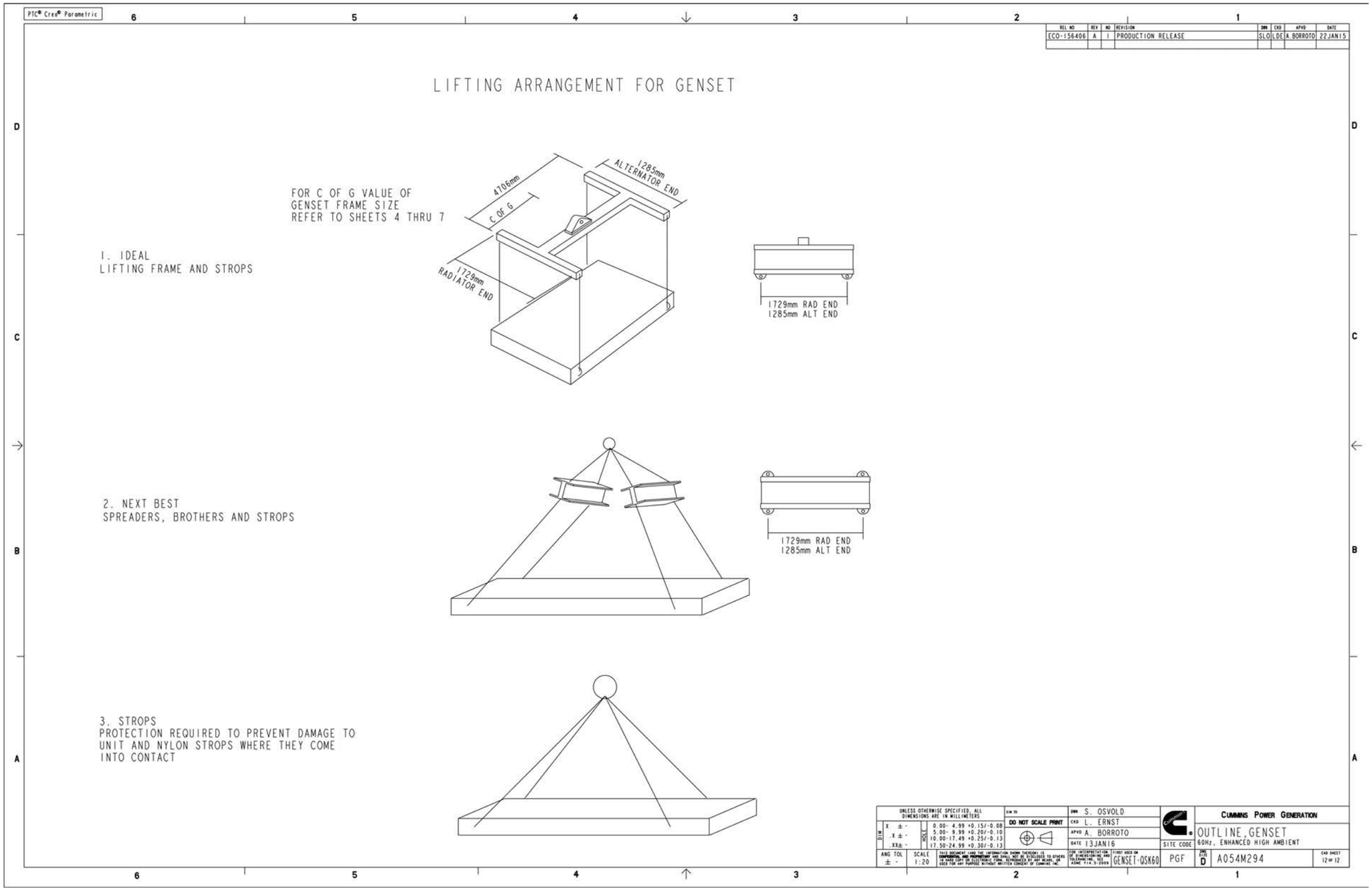


FIGURE 113. GENERATOR SET WITH ENHANCED HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 12)

D.2 Generator Set with Remote Cooling Outline Drawing

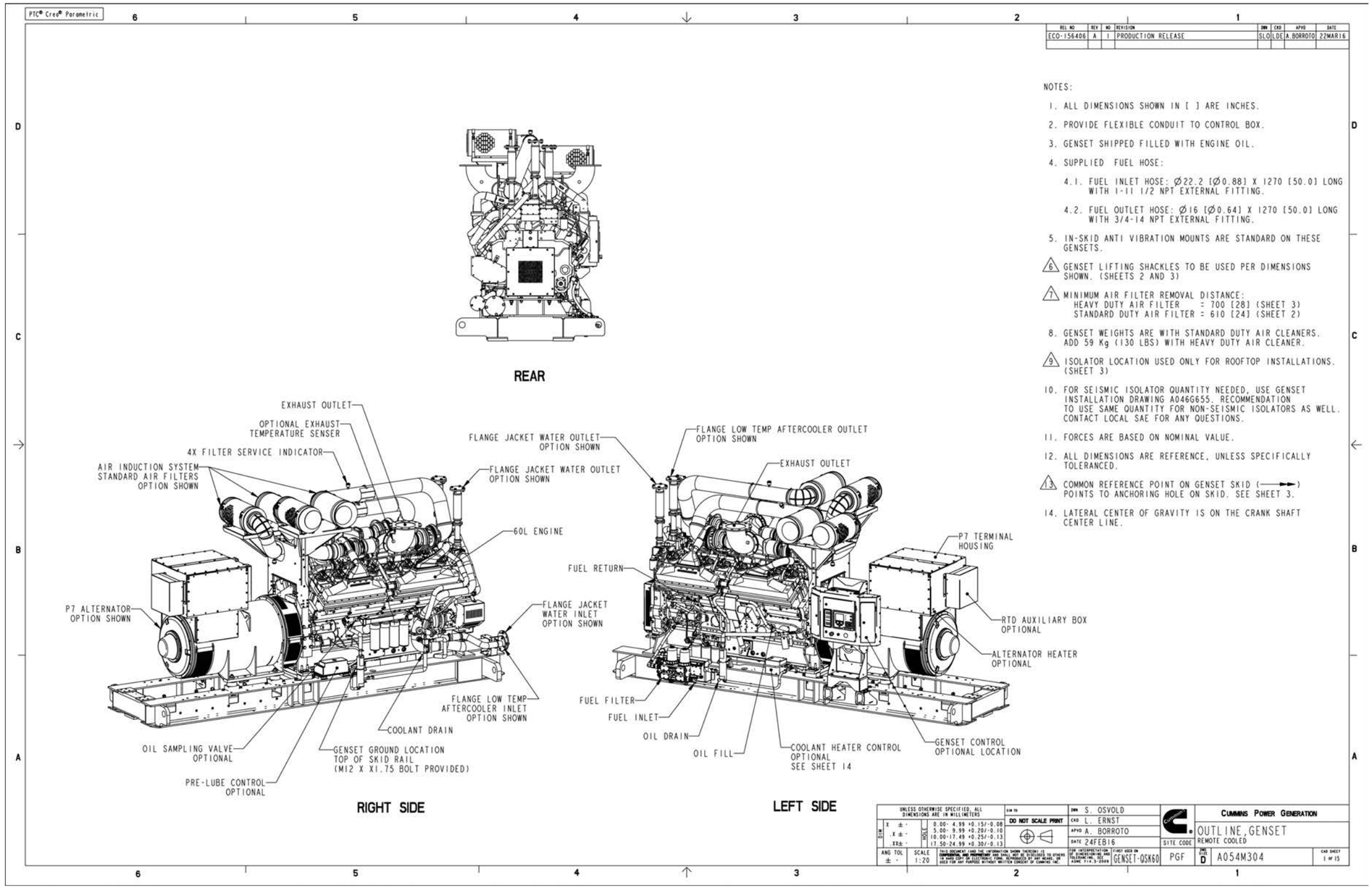


FIGURE 114. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 1)

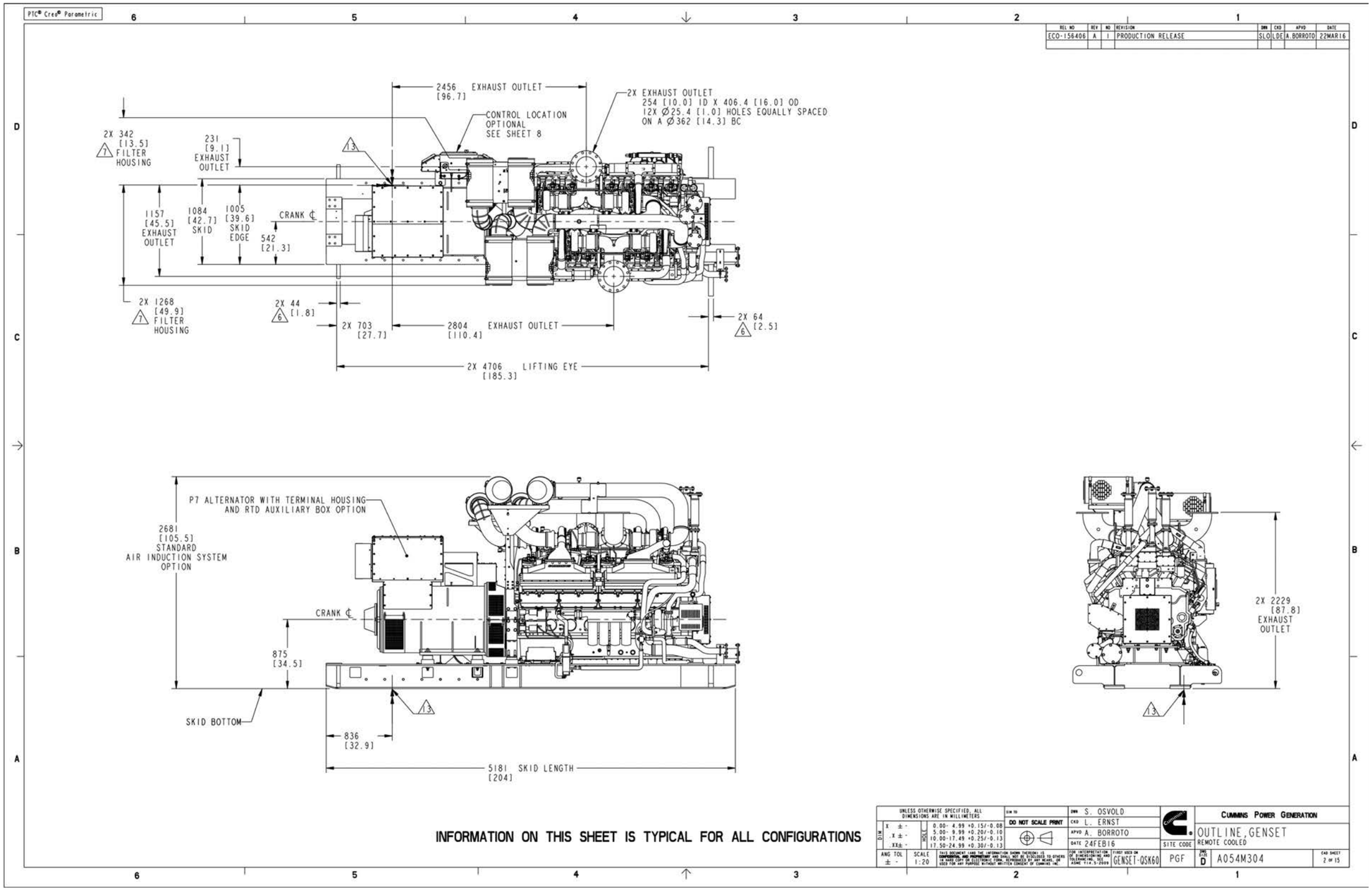
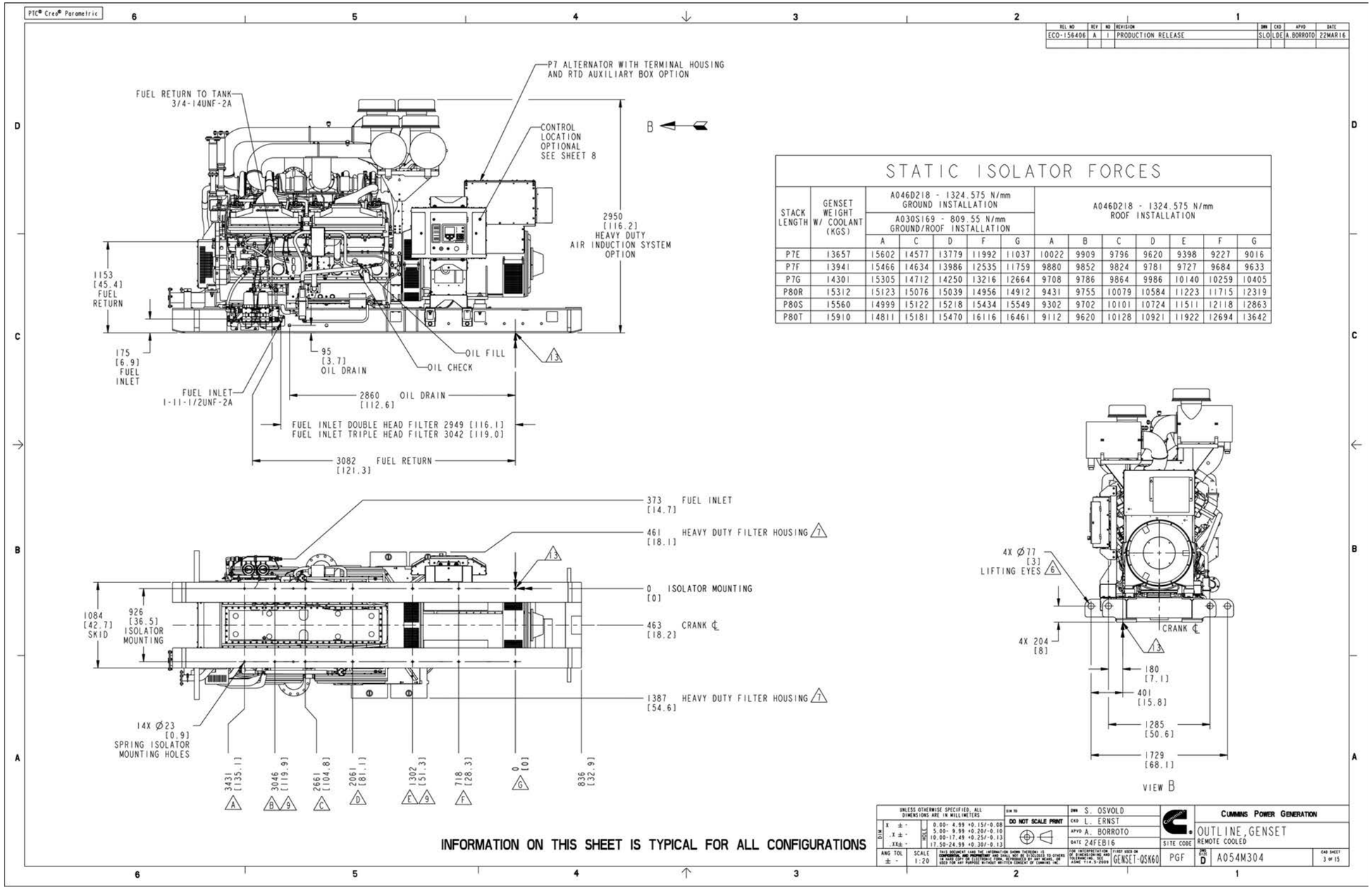


FIGURE 115. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 2)



STATIC ISOLATOR FORCES

STACK LENGTH	GENSET WEIGHT W/ COOLANT (KGS)	A046D218 - 1324.575 N/mm GROUND INSTALLATION / A030S169 - 809.55 N/mm GROUND/ROOF INSTALLATION					A046D218 - 1324.575 N/mm ROOF INSTALLATION						
		A	C	D	F	G	A	B	C	D	E	F	G
P7E	13657	15602	14577	13779	11992	11037	10022	9909	9796	9620	9398	9227	9016
P7F	13941	15466	14634	13986	12535	11759	9880	9852	9824	9781	9727	9684	9633
P7G	14301	15305	14712	14250	13216	12664	9708	9786	9864	9986	10140	10259	10405
P80R	15312	15123	15076	15039	14956	14912	9431	9755	10079	10584	11223	11715	12319
P80S	15560	14999	15122	15218	15434	15549	9302	9702	10101	10724	11511	12118	12863
P80T	15910	14811	15181	15470	16116	16461	9112	9620	10128	10921	11922	12694	13642

FIGURE 116. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 3)

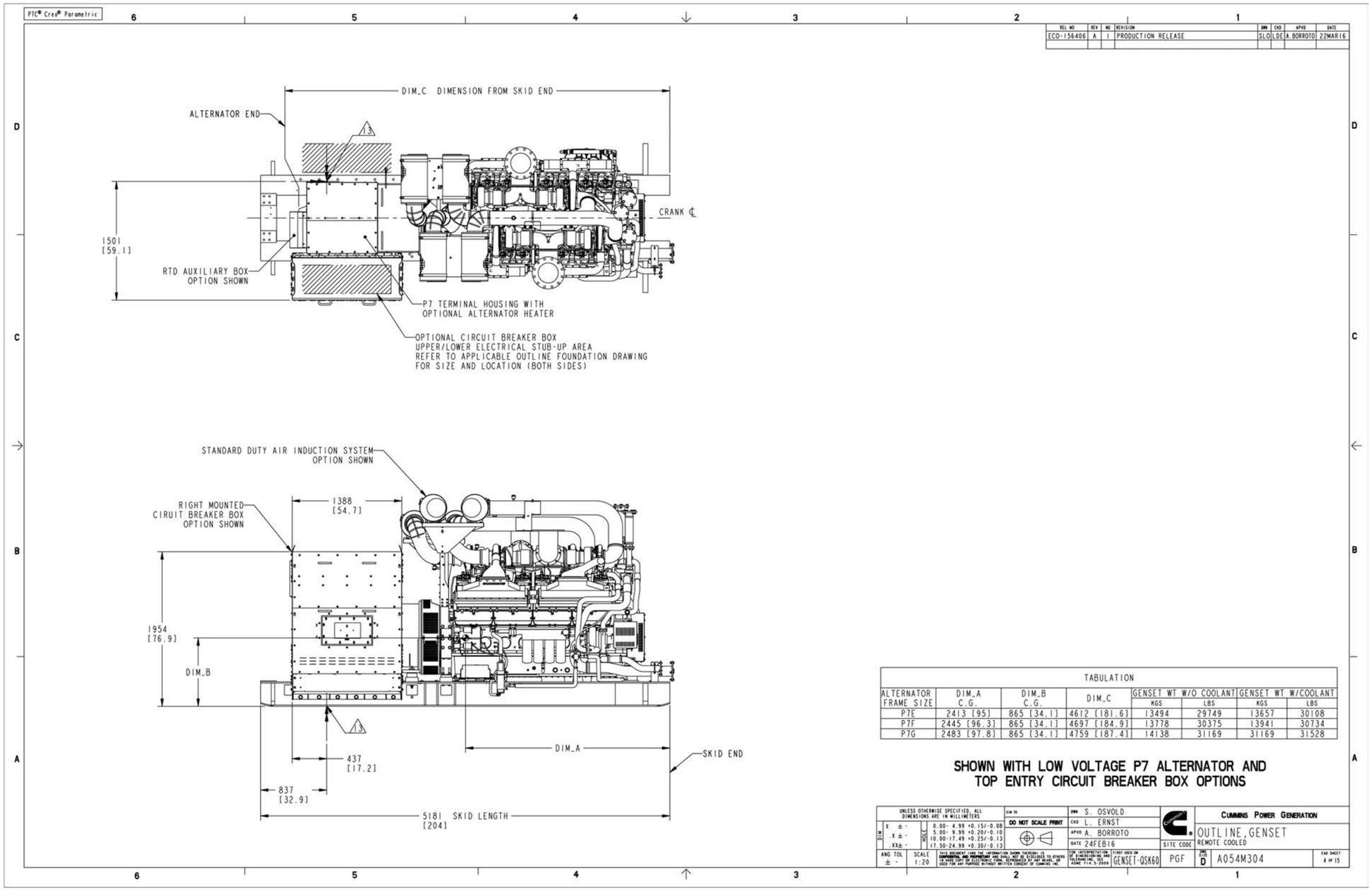


FIGURE 117. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 4)

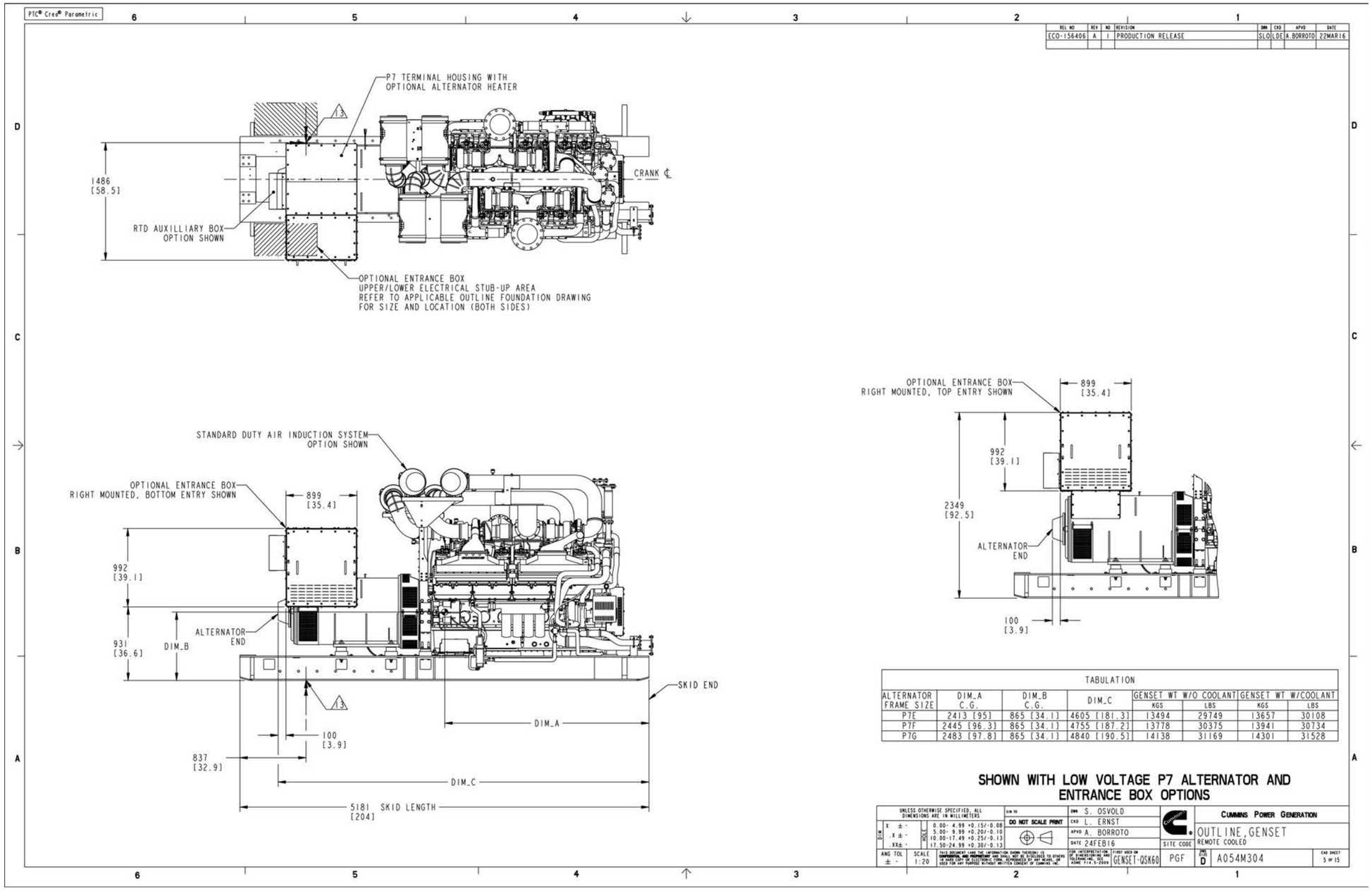


FIGURE 118. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 5)

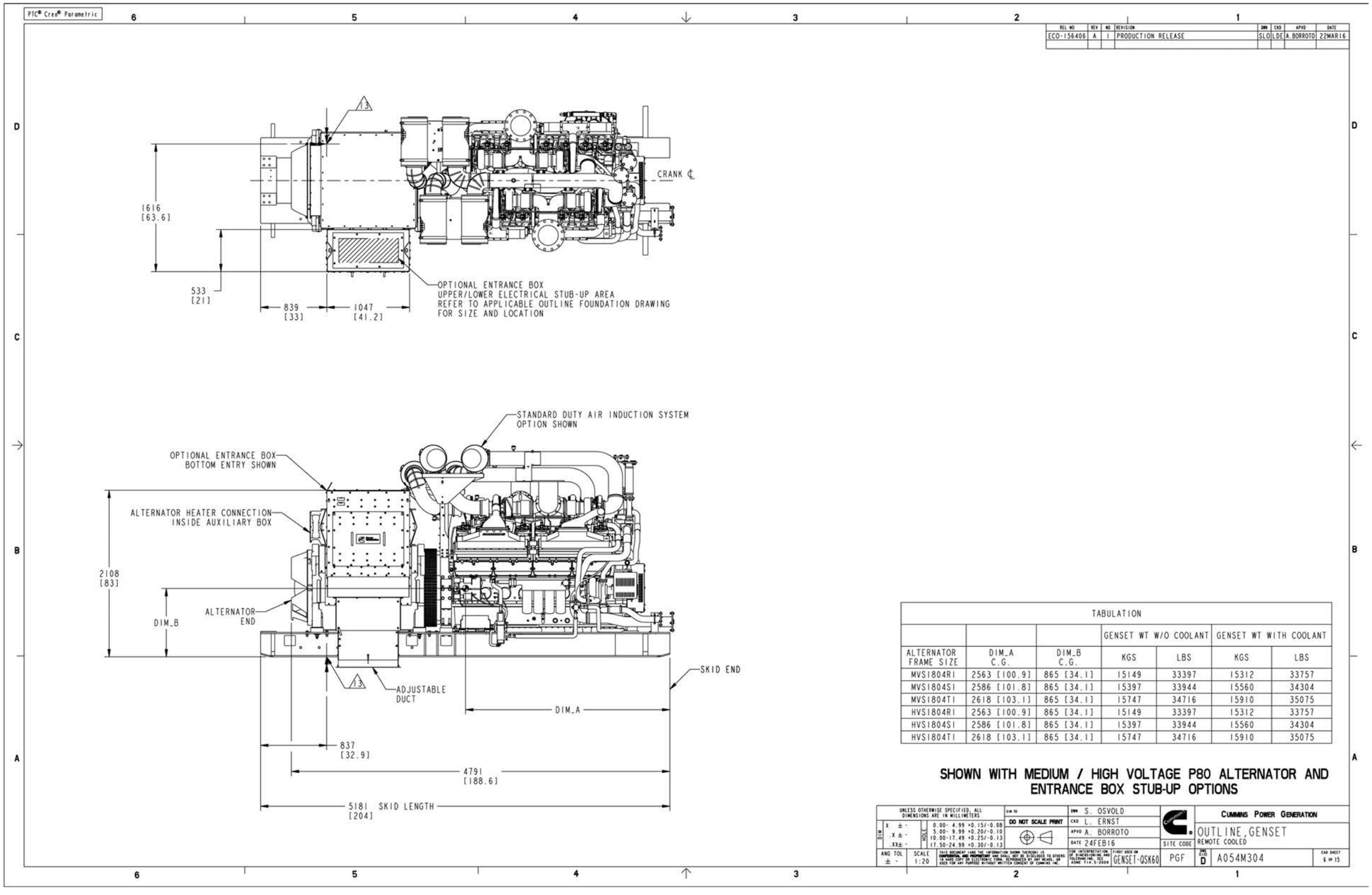


FIGURE 119. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 6)

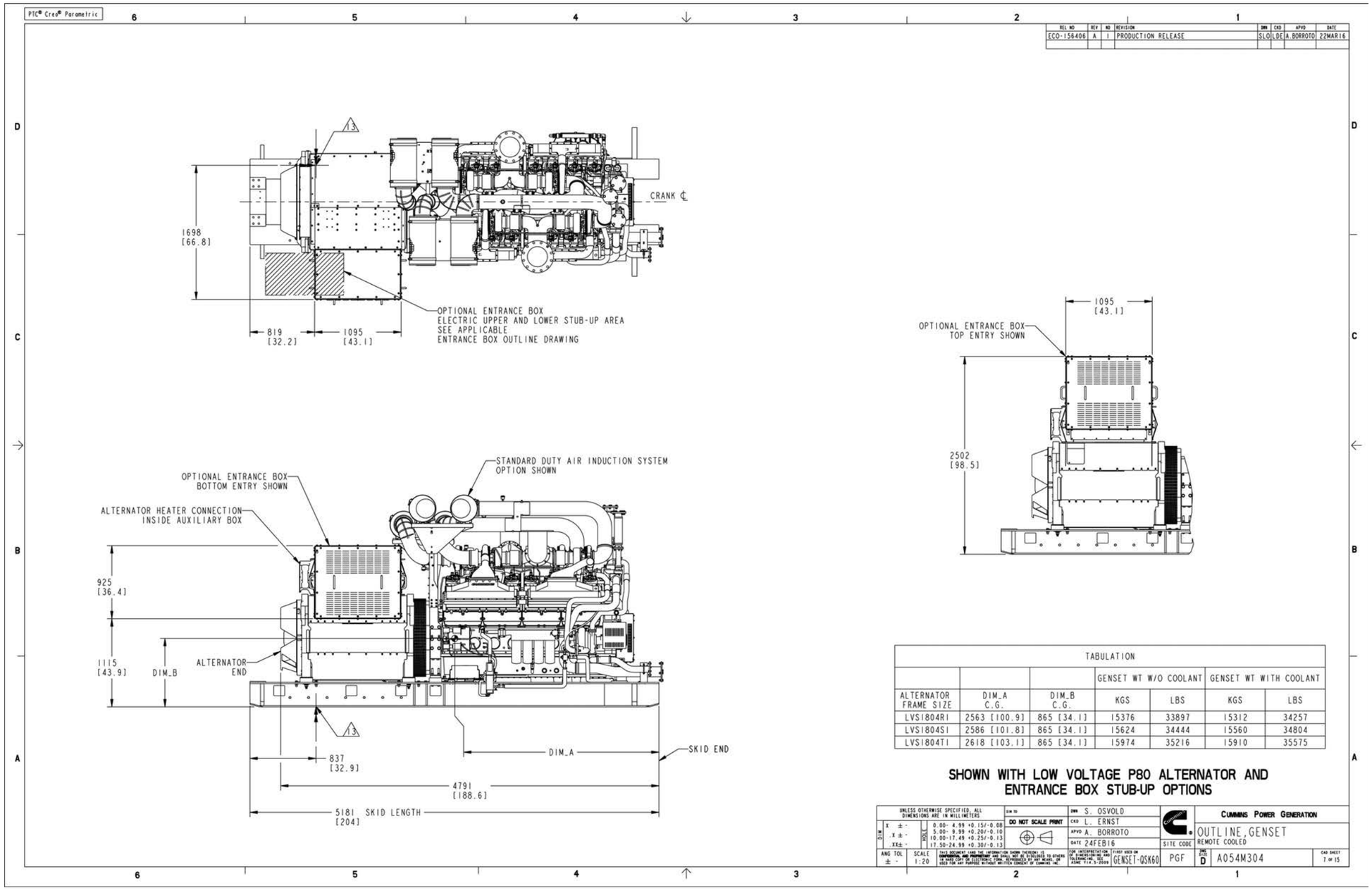


FIGURE 120. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 7)

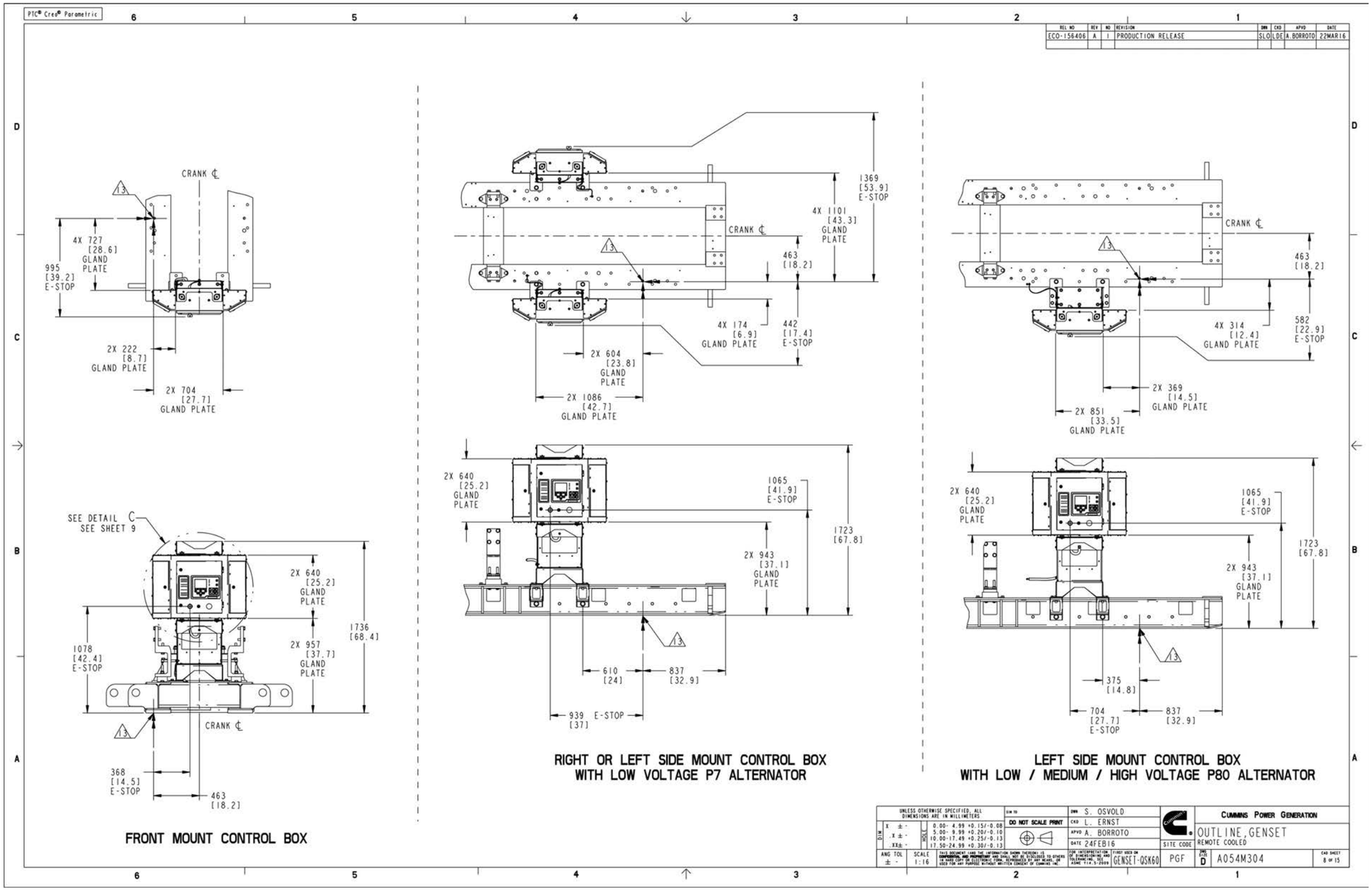


FIGURE 121. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 8)

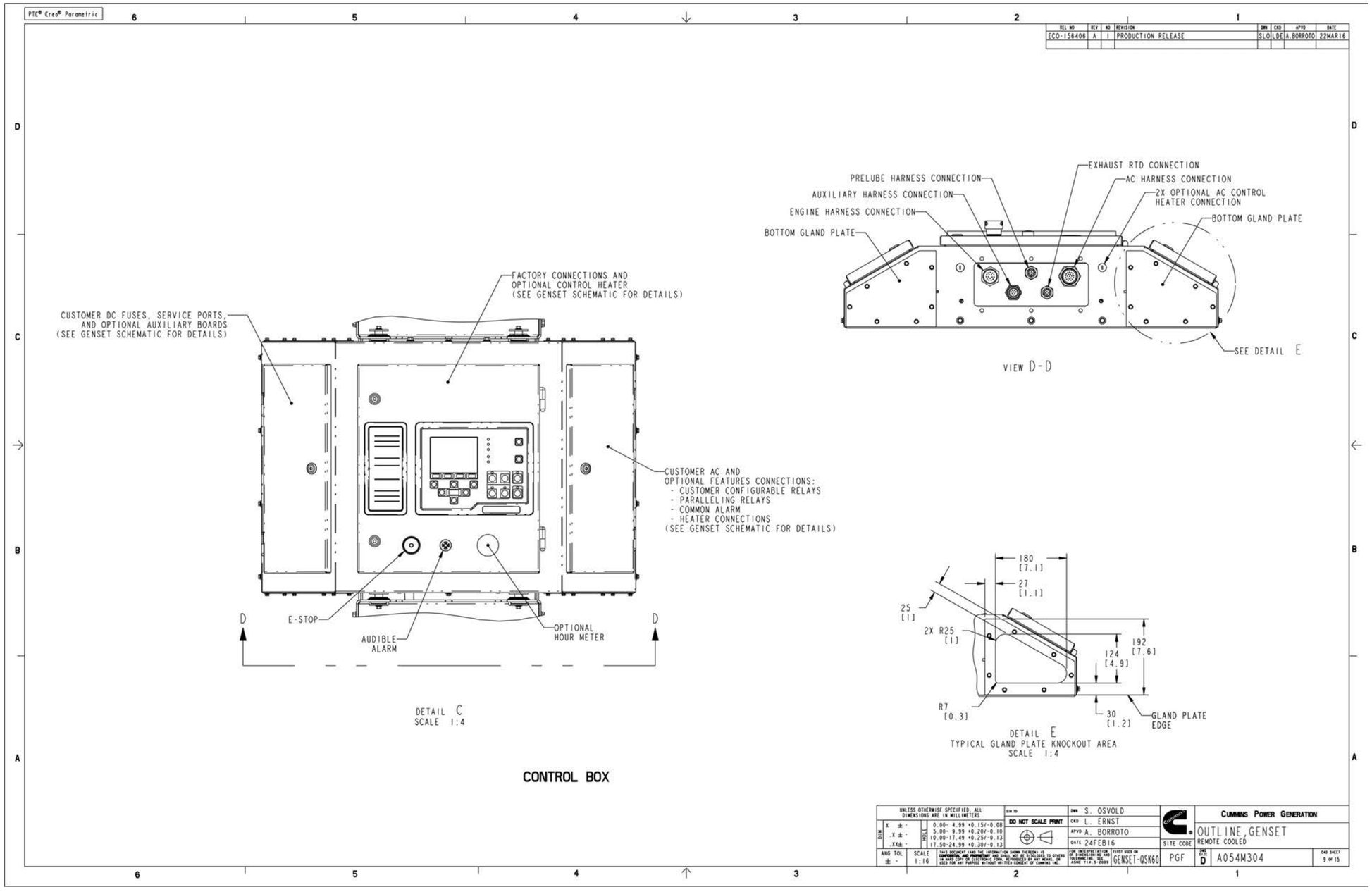


FIGURE 122. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 9)

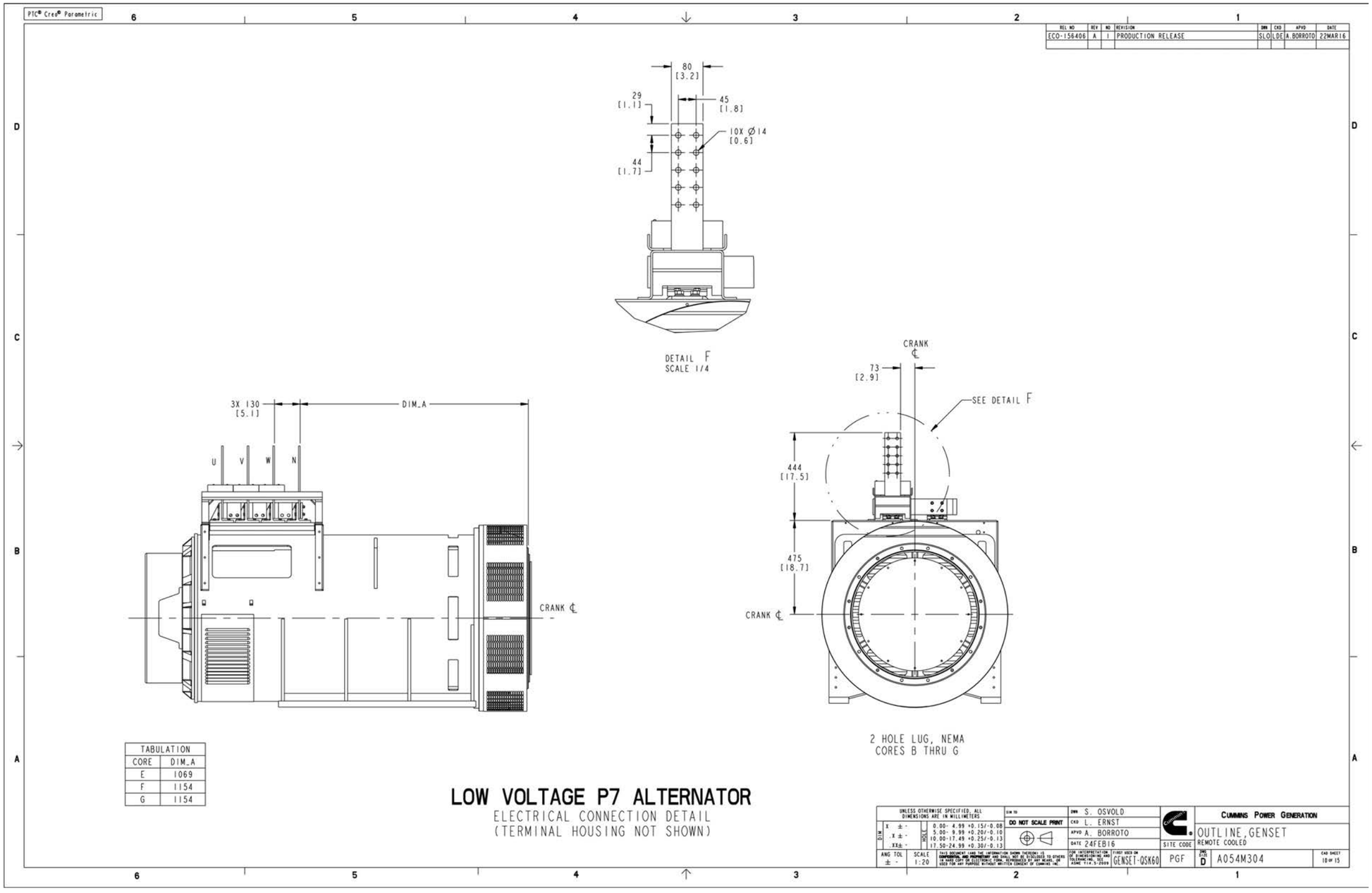


FIGURE 123. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 10)

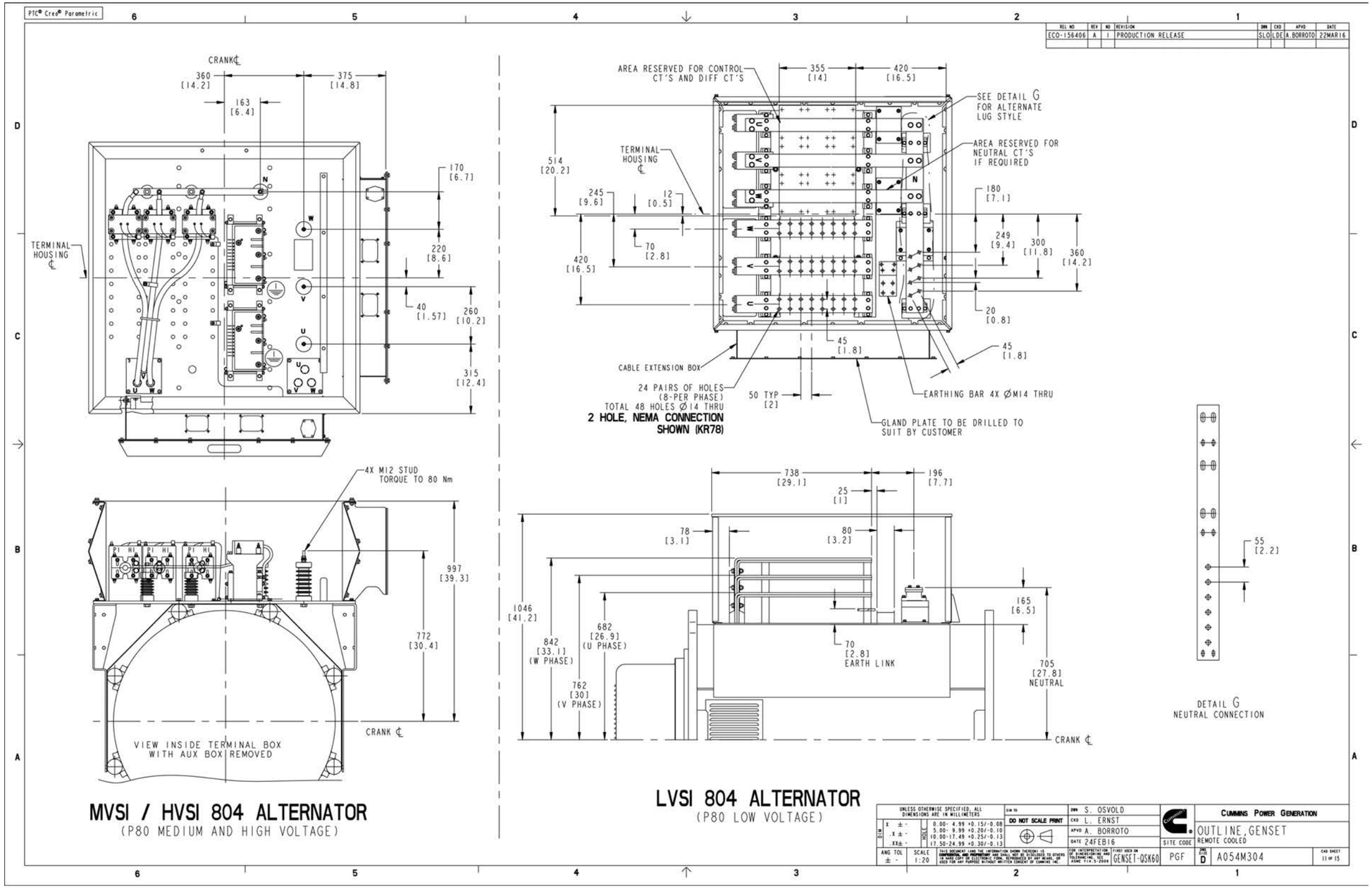


FIGURE 124. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 11)

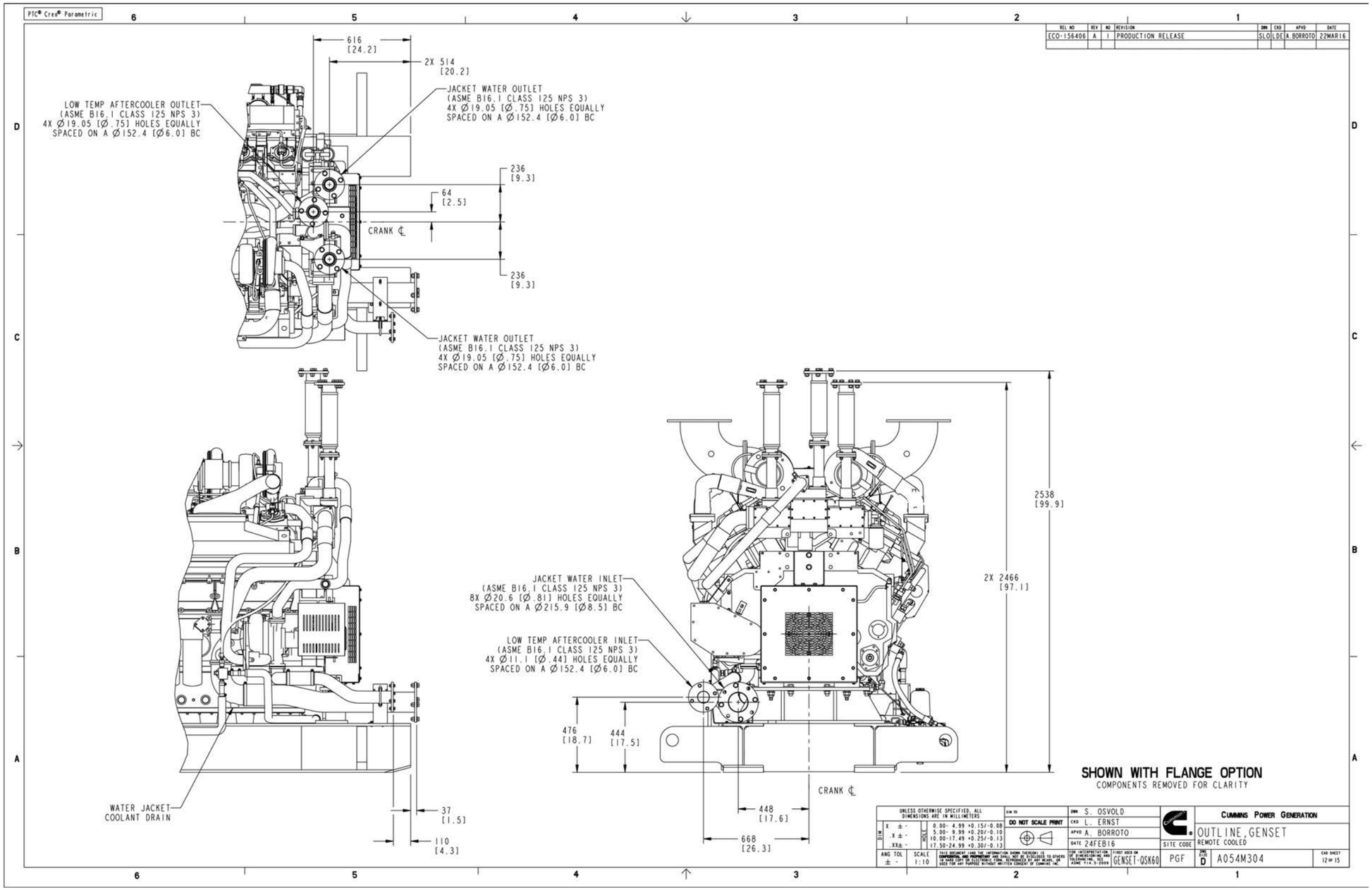


FIGURE 125. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 12)

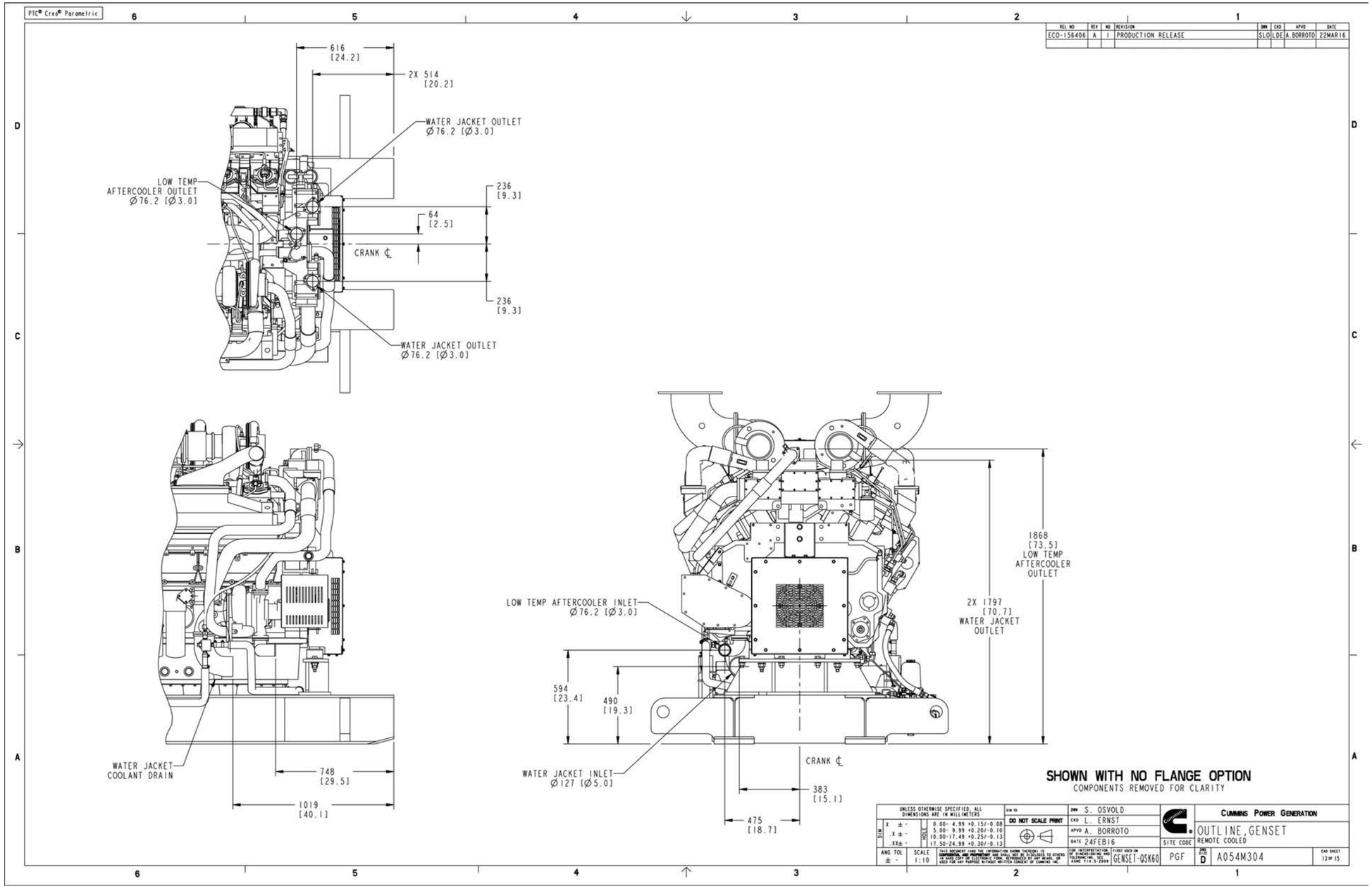


FIGURE 126. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 13)

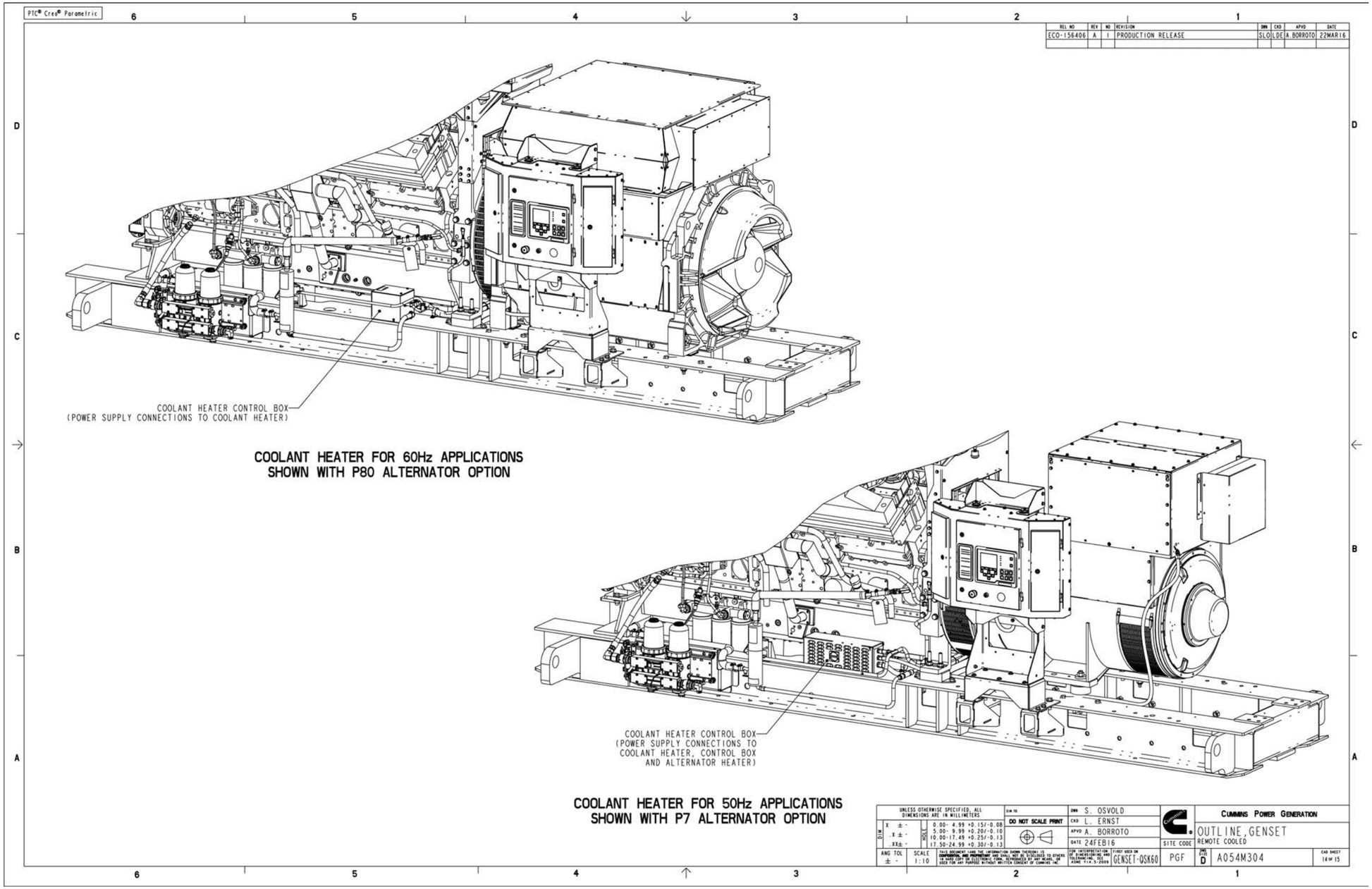


FIGURE 127. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 14)

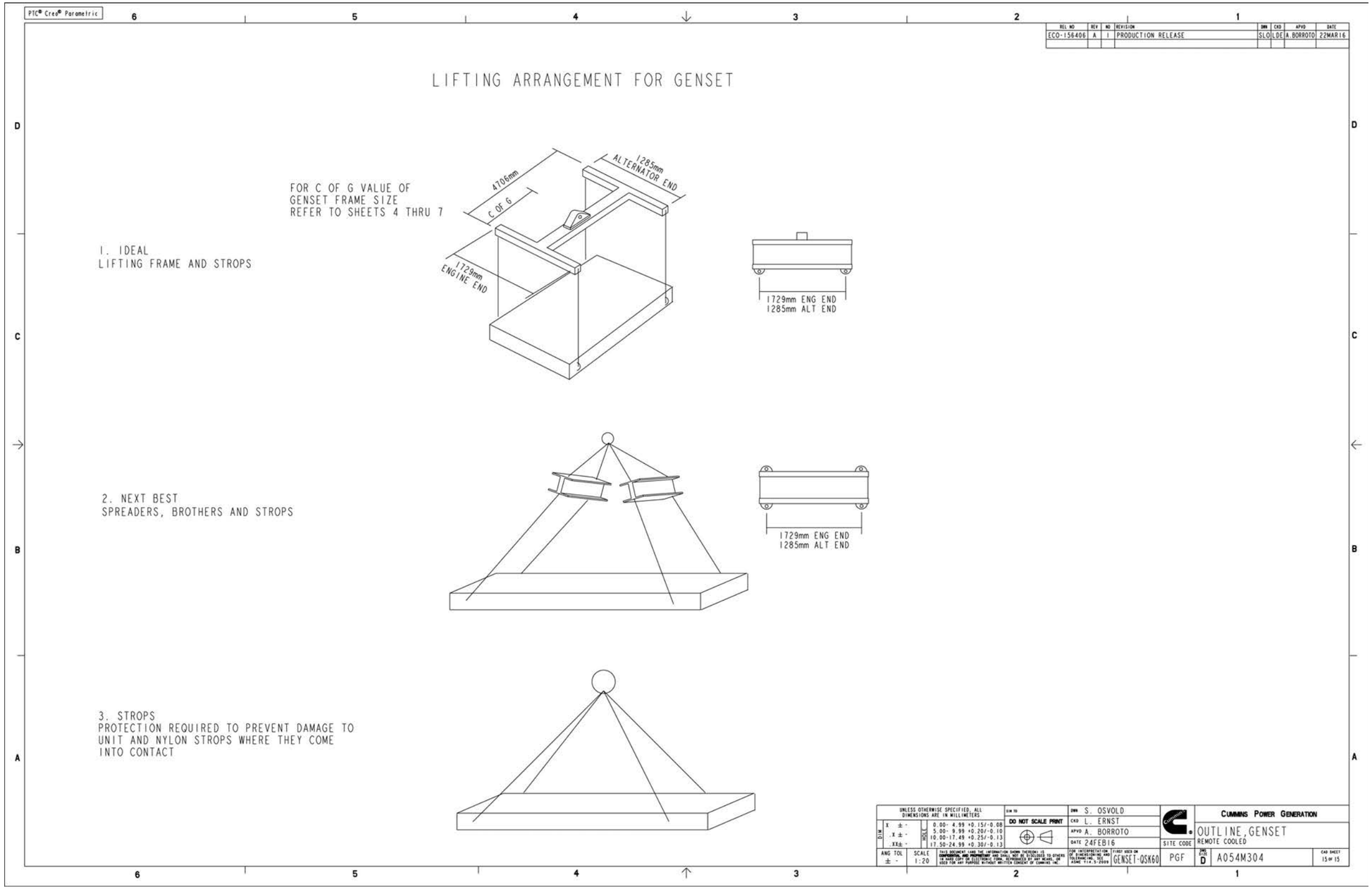


FIGURE 128. GENERATOR SET WITH REMOTE COOLING OUTLINE DRAWING (SHEET 15)

D.3 Generator Set with High Ambient Radiator Outline Drawing

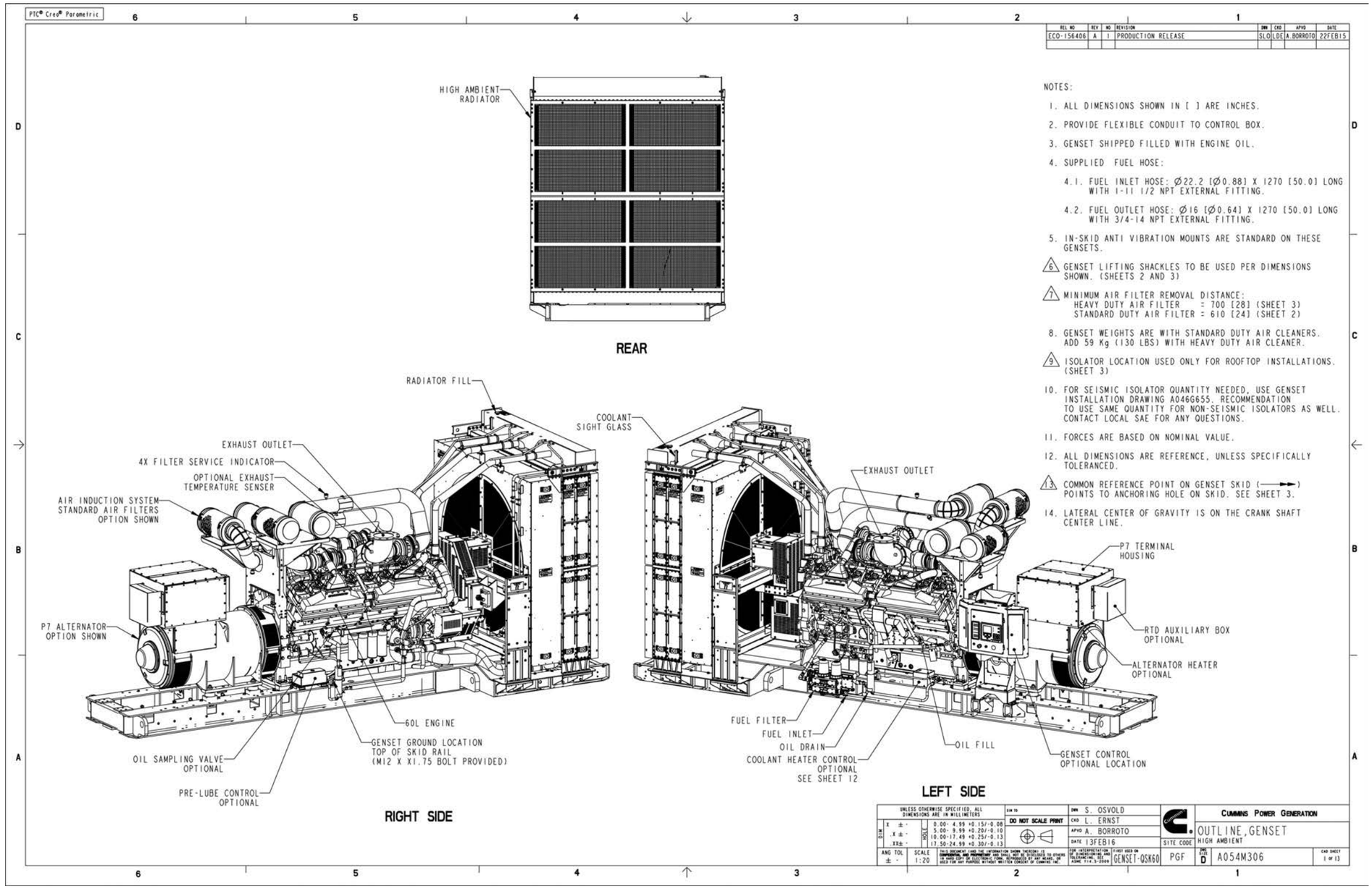


FIGURE 129. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 1)

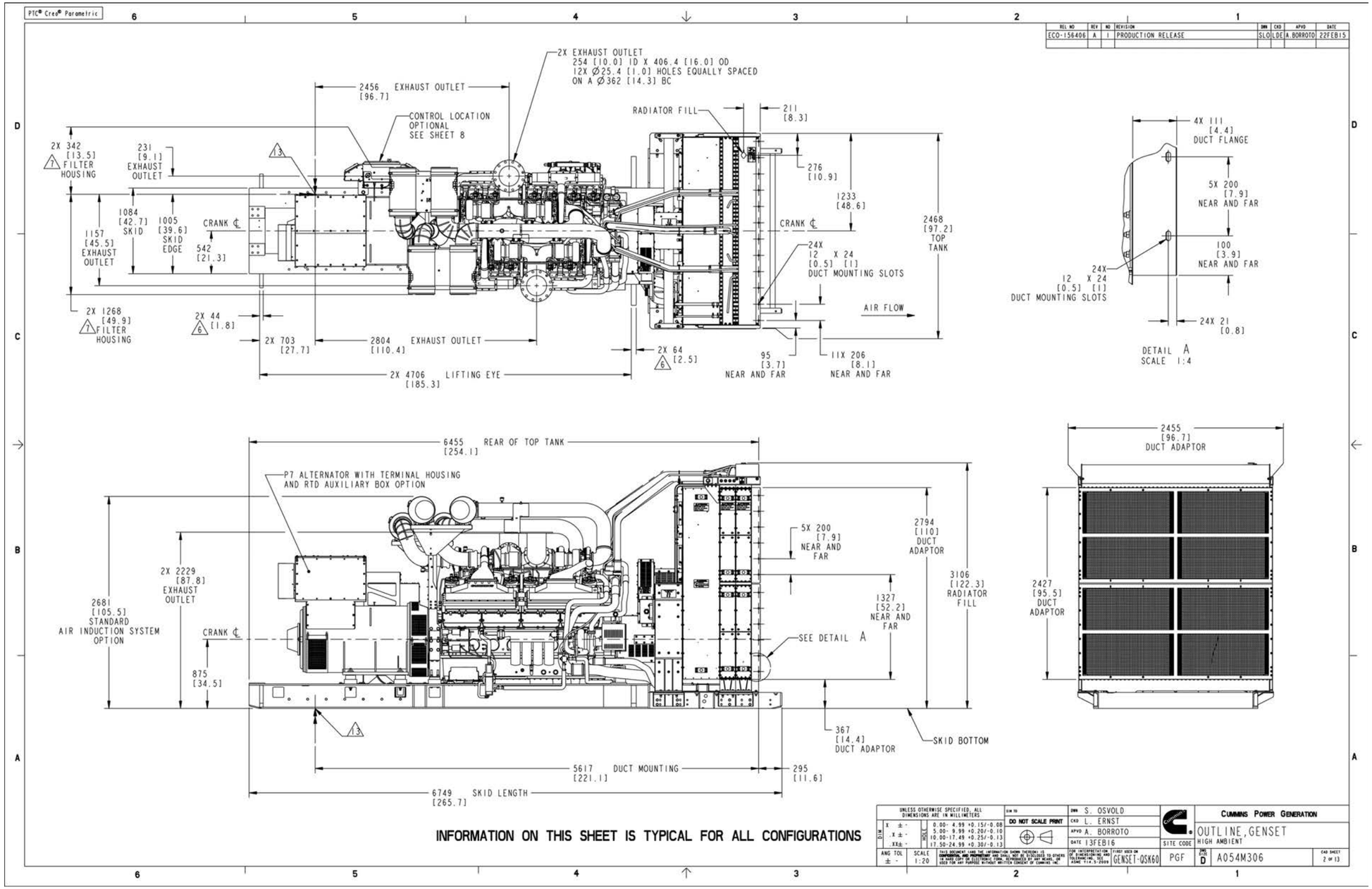
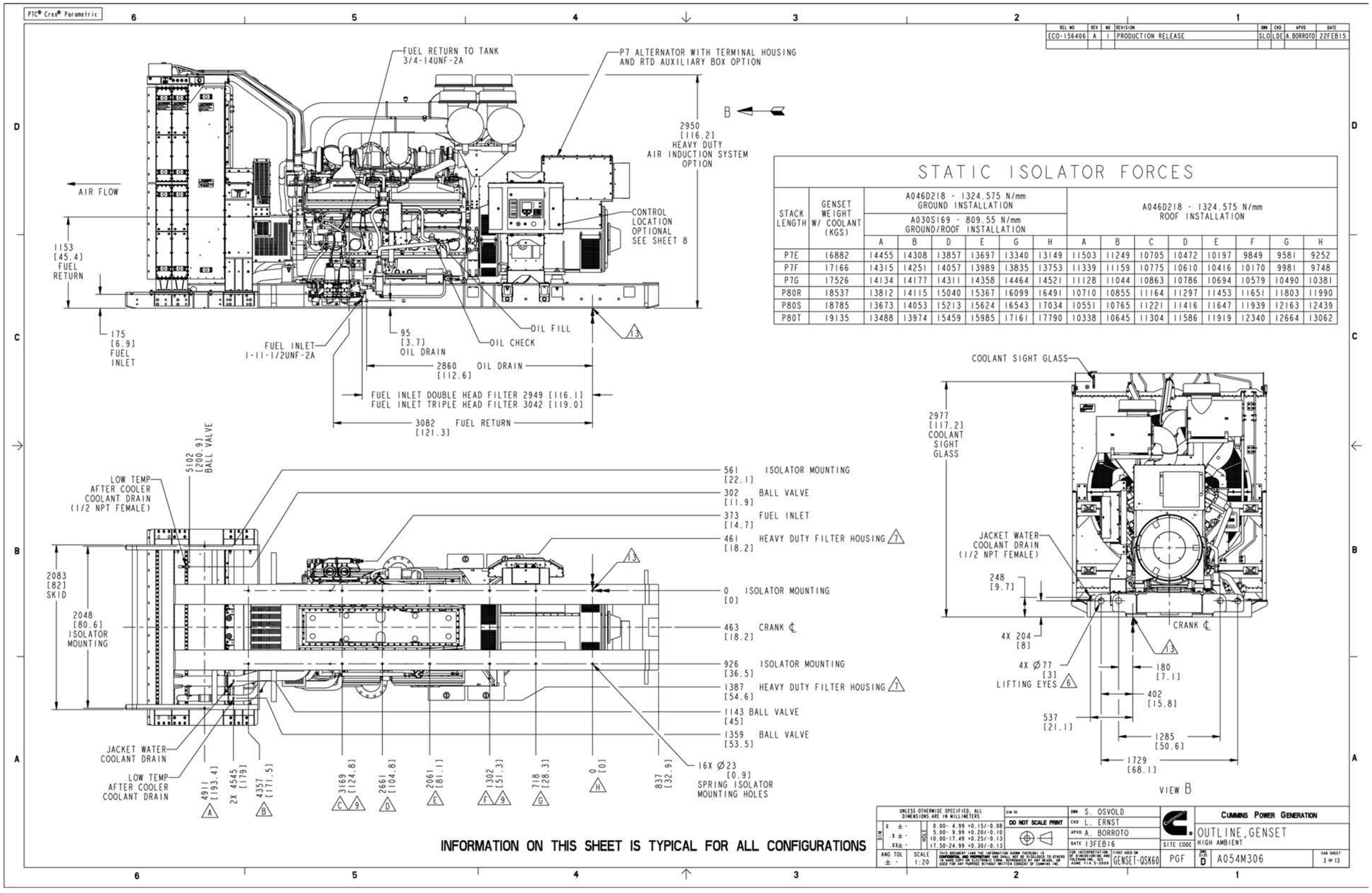


FIGURE 130. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 2)



REL NO	REV	NO	REVISION	DRN	CKD	APVD	DATE
ECO-156406	A	1	PRODUCTION RELEASE	SLO	LDE	A.BORROTO	22FEB15

STATIC ISOLATOR FORCES

STACK LENGTH	GENSET WEIGHT W/ COOLANT (KGS)	A046D218 - 1324.575 N/mm GROUND INSTALLATION / A030S169 - 809.55 N/mm GROUND/ROOF INSTALLATION						A046D218 - 1324.575 N/mm ROOF INSTALLATION							
		A	B	D	E	G	H	A	B	C	D	E	F	G	H
P7E	16882	14455	14308	13857	13697	13340	13149	11503	11249	10705	10472	10197	9849	9581	9252
P7F	17166	14315	14251	14057	13989	13835	13753	11339	11159	10775	10610	10416	10170	9981	9748
P7G	17526	14134	14177	14311	14358	14464	14521	11128	11044	10863	10786	10694	10579	10490	10381
P80R	18537	13812	14115	15040	15367	16099	16491	10710	10855	11164	11297	11453	11651	11803	11990
P80S	18785	13673	14053	15213	15624	16543	17034	10551	10765	11221	11416	11647	11939	12163	12439
P80T	19135	13488	13974	15459	15985	17161	17790	10338	10645	11304	11586	11919	12340	12664	13062

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DO NOT SCALE PRINT
DWN S. OSVOLD
CKD L. ERNST
APVD A. BORROTO
DATE 13FEB16
CUMMINS POWER GENERATION
OUTLINE, GENSET HIGH AMBIENT
SITE CODE PGF
SIZE D
A054M306
CAD SHEET 3 OF 13
ANG TOL ± -
SCALE 1:20
FIRST USED ON GENSET-QSK60

FIGURE 131. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 3)

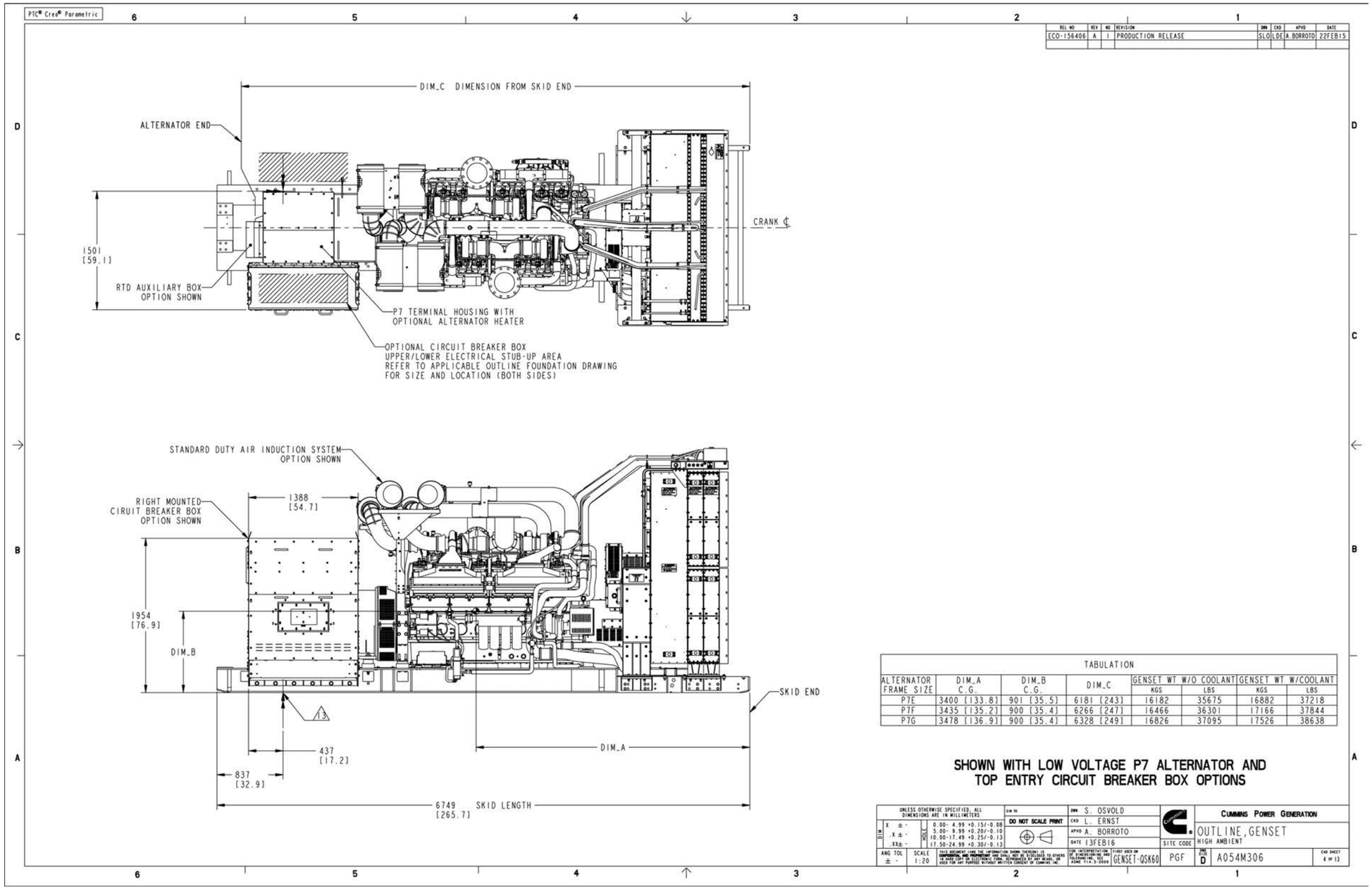


FIGURE 132. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 4)

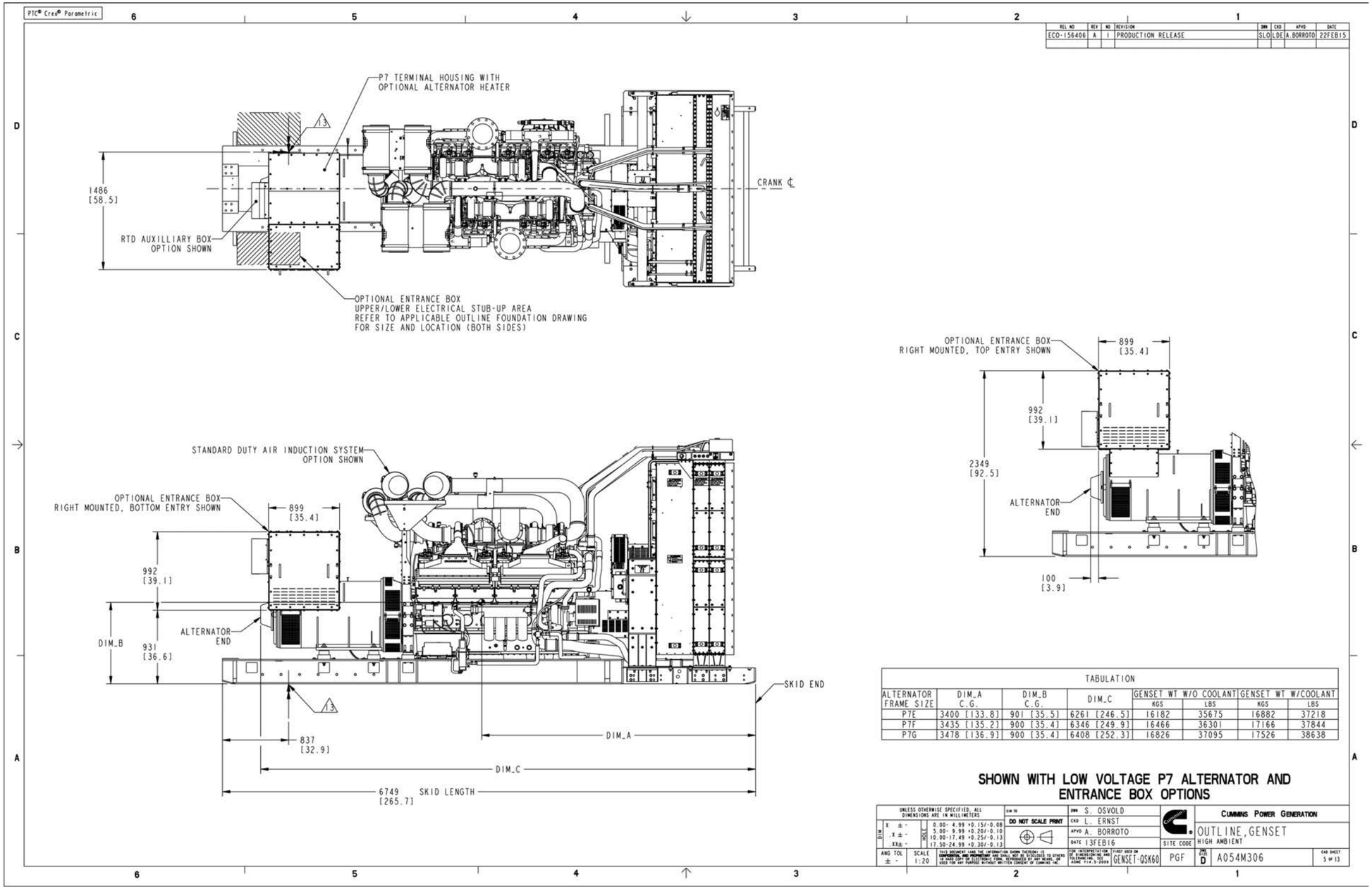


FIGURE 133. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 5)

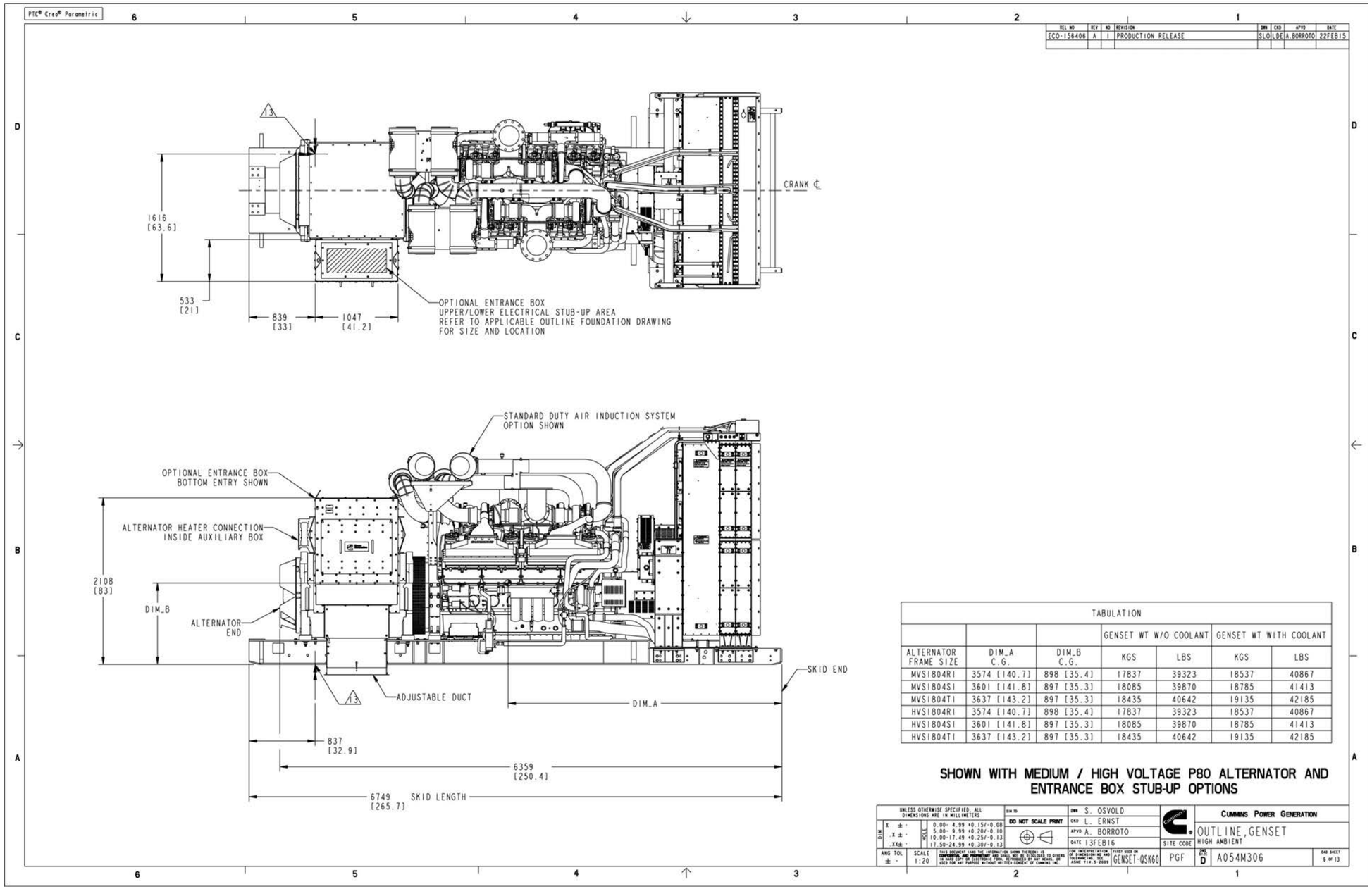


FIGURE 134. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 6)

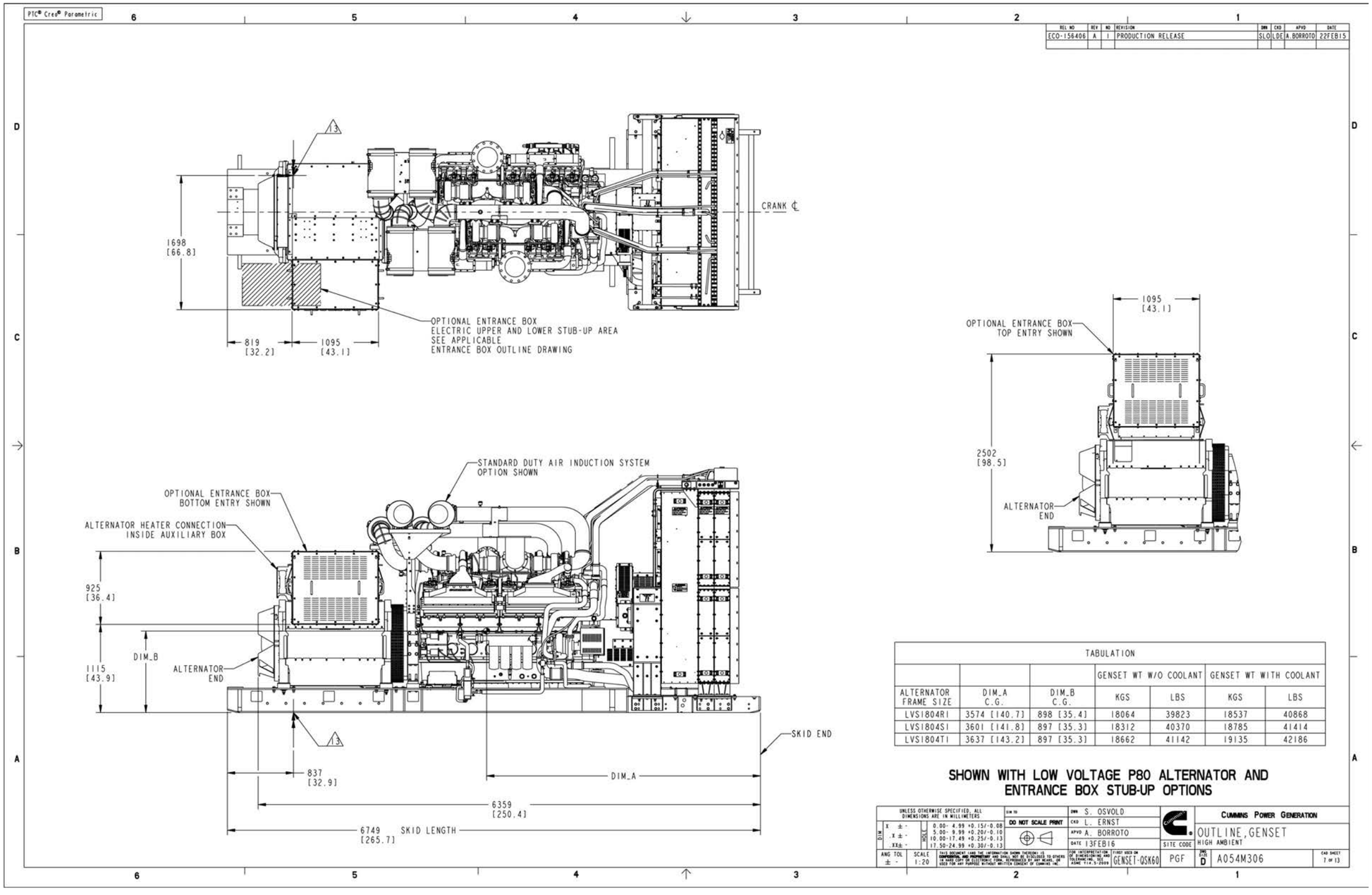


FIGURE 135. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 7)

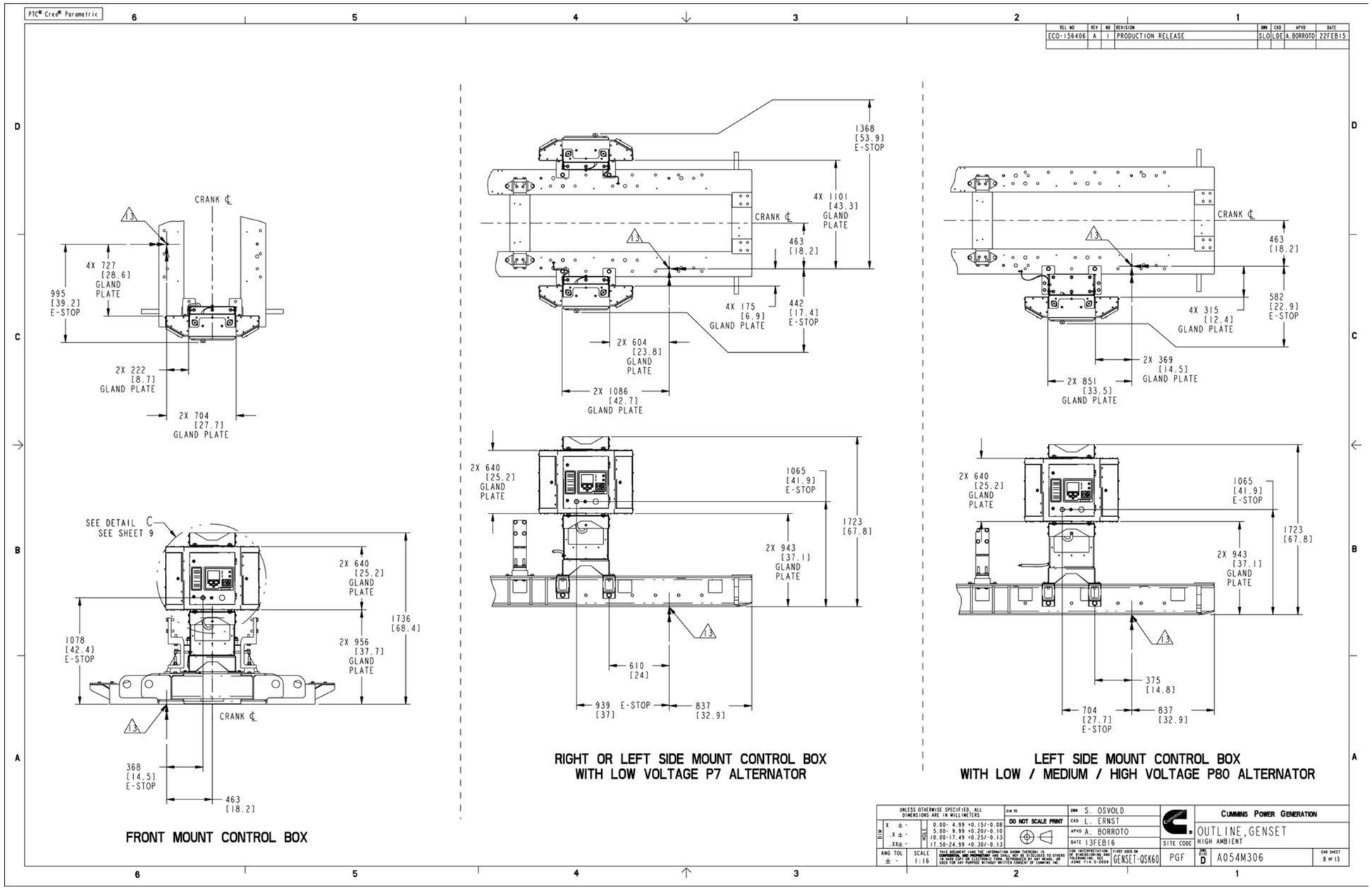


FIGURE 136. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 8)

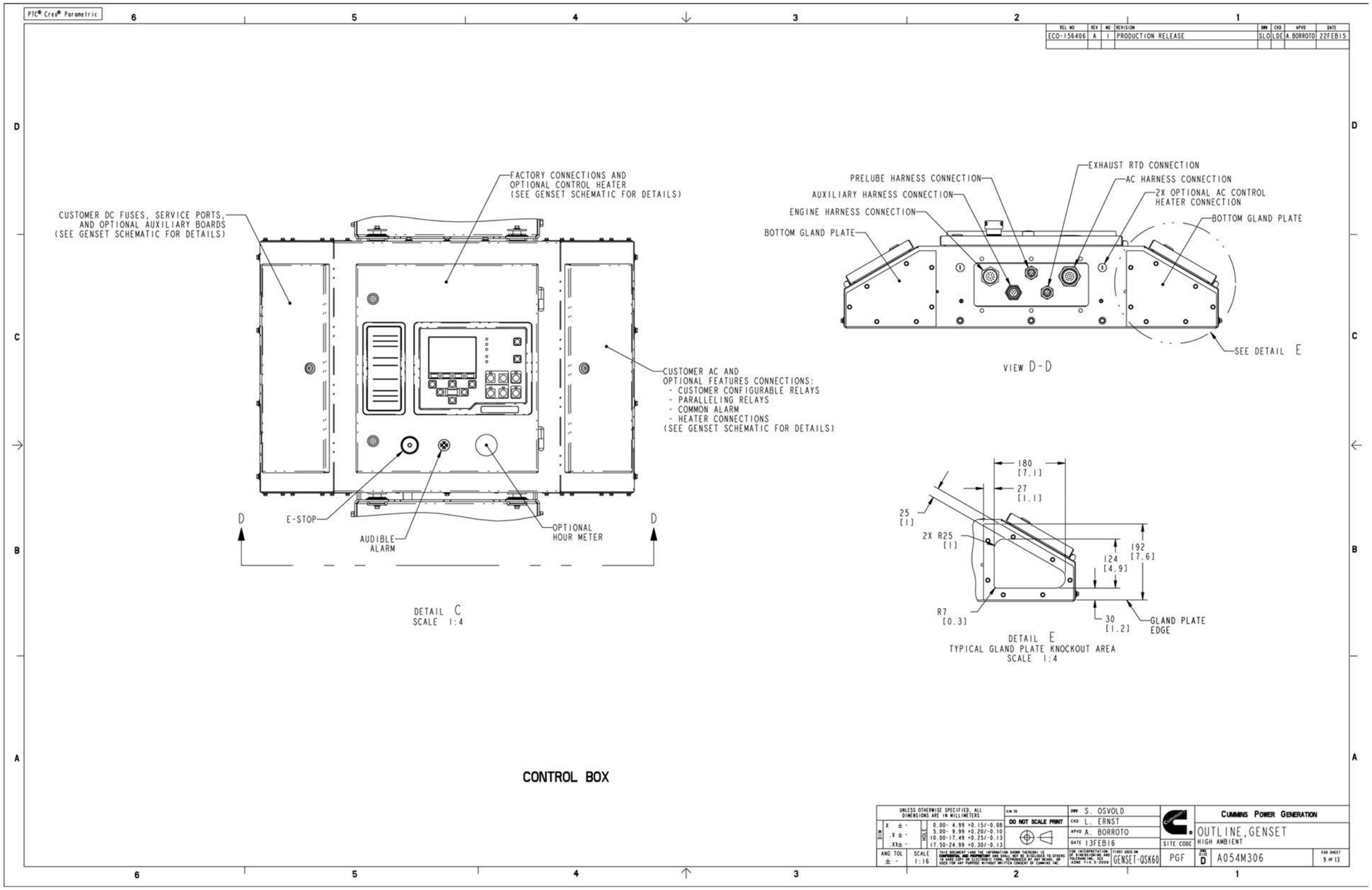


FIGURE 137. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 9)

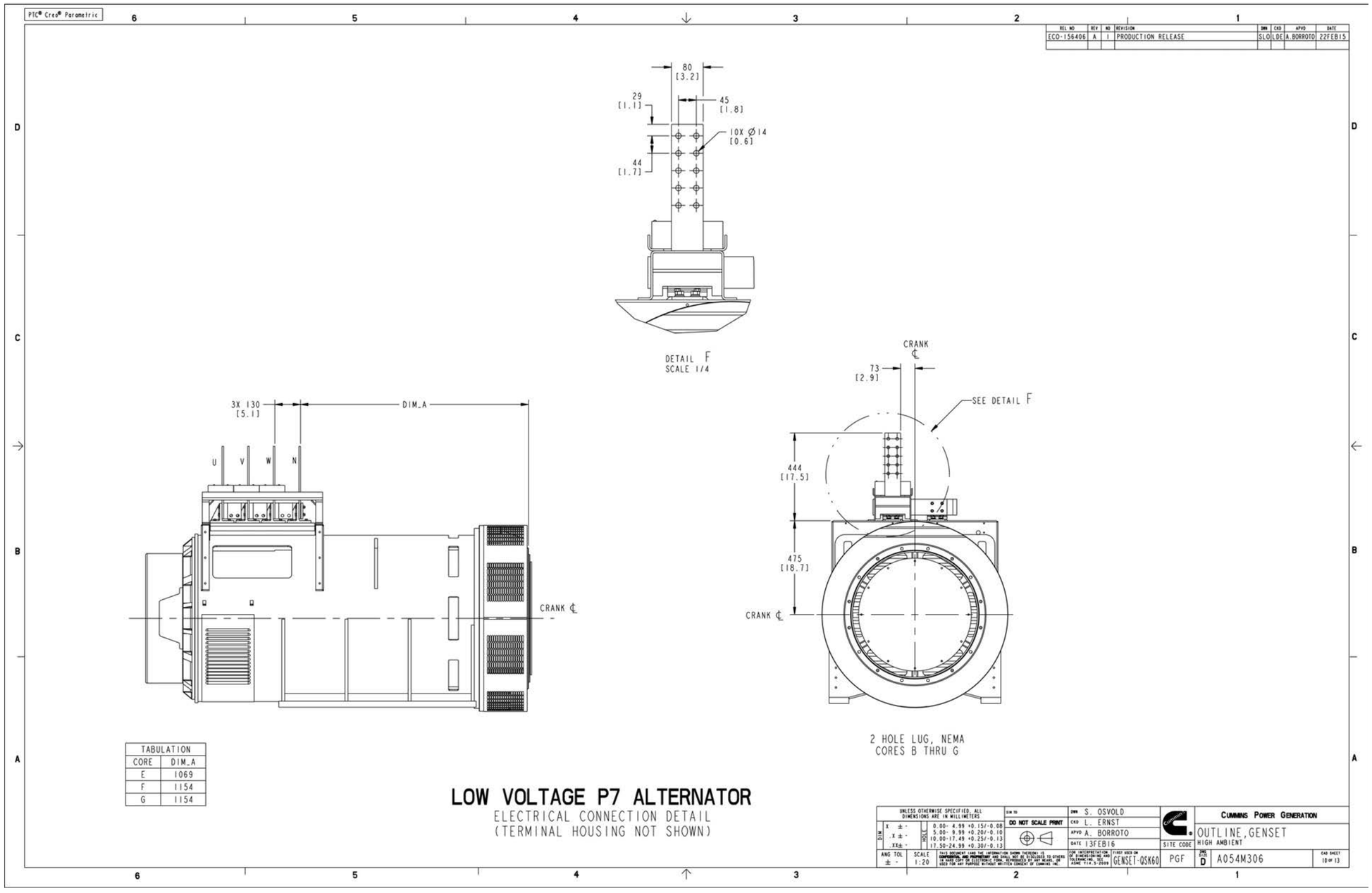


FIGURE 138. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 10)

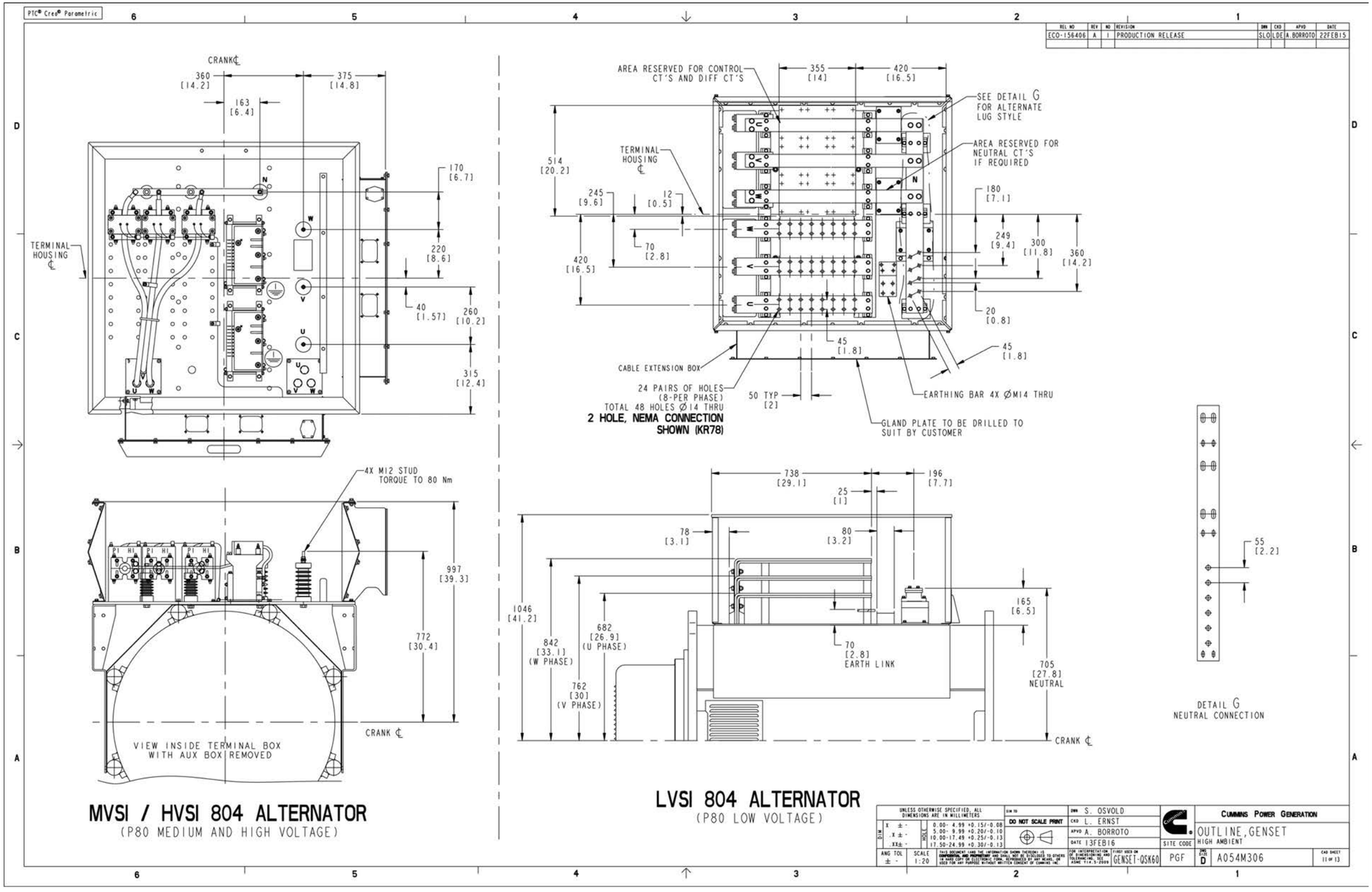


FIGURE 139. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 11)

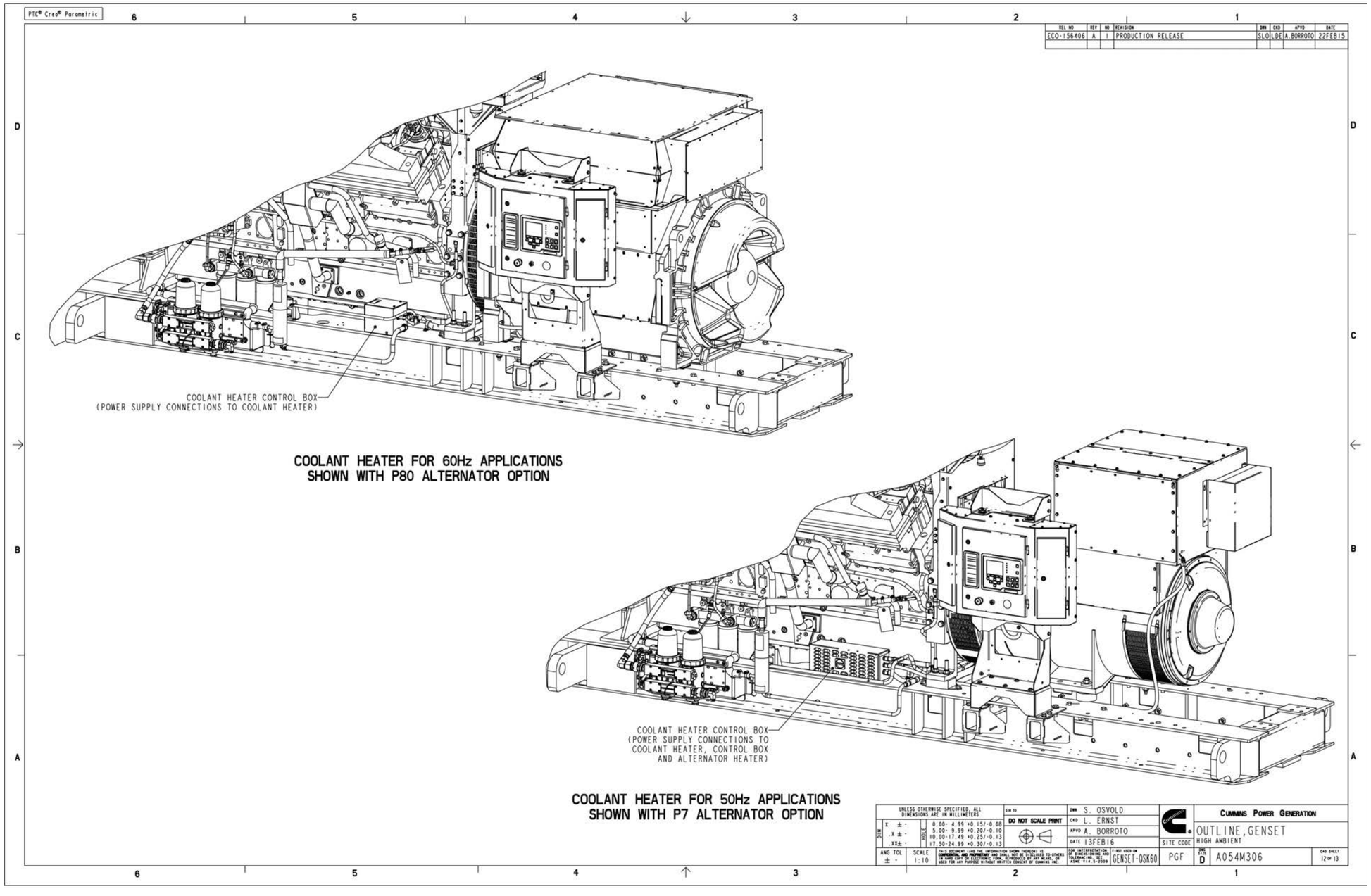


FIGURE 140. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 12)

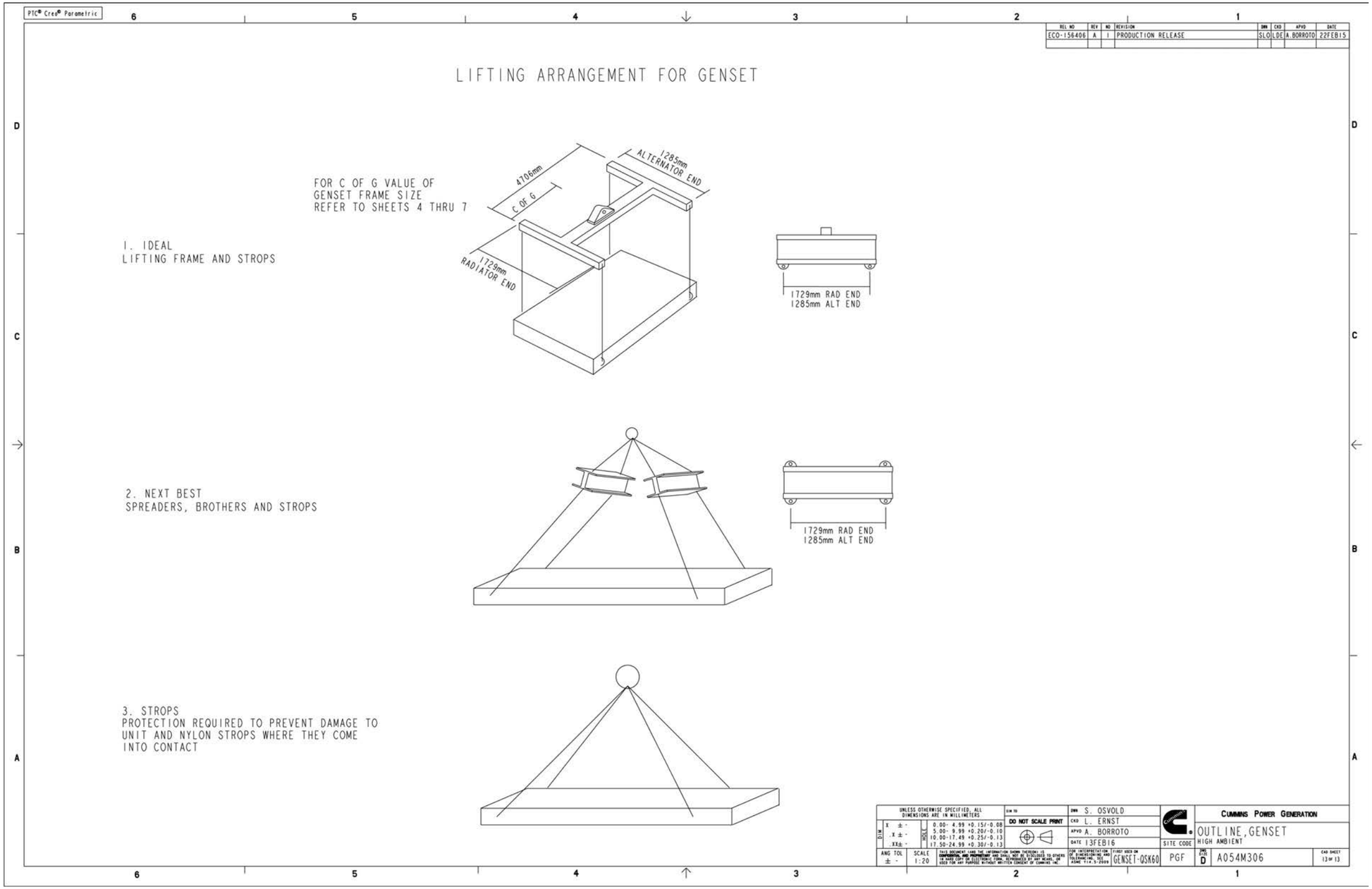


FIGURE 141. GENERATOR SET WITH HIGH AMBIENT RADIATOR OUTLINE DRAWING (SHEET 13)

D.4 Foundation Drawing for Remote Cooled Generator Set

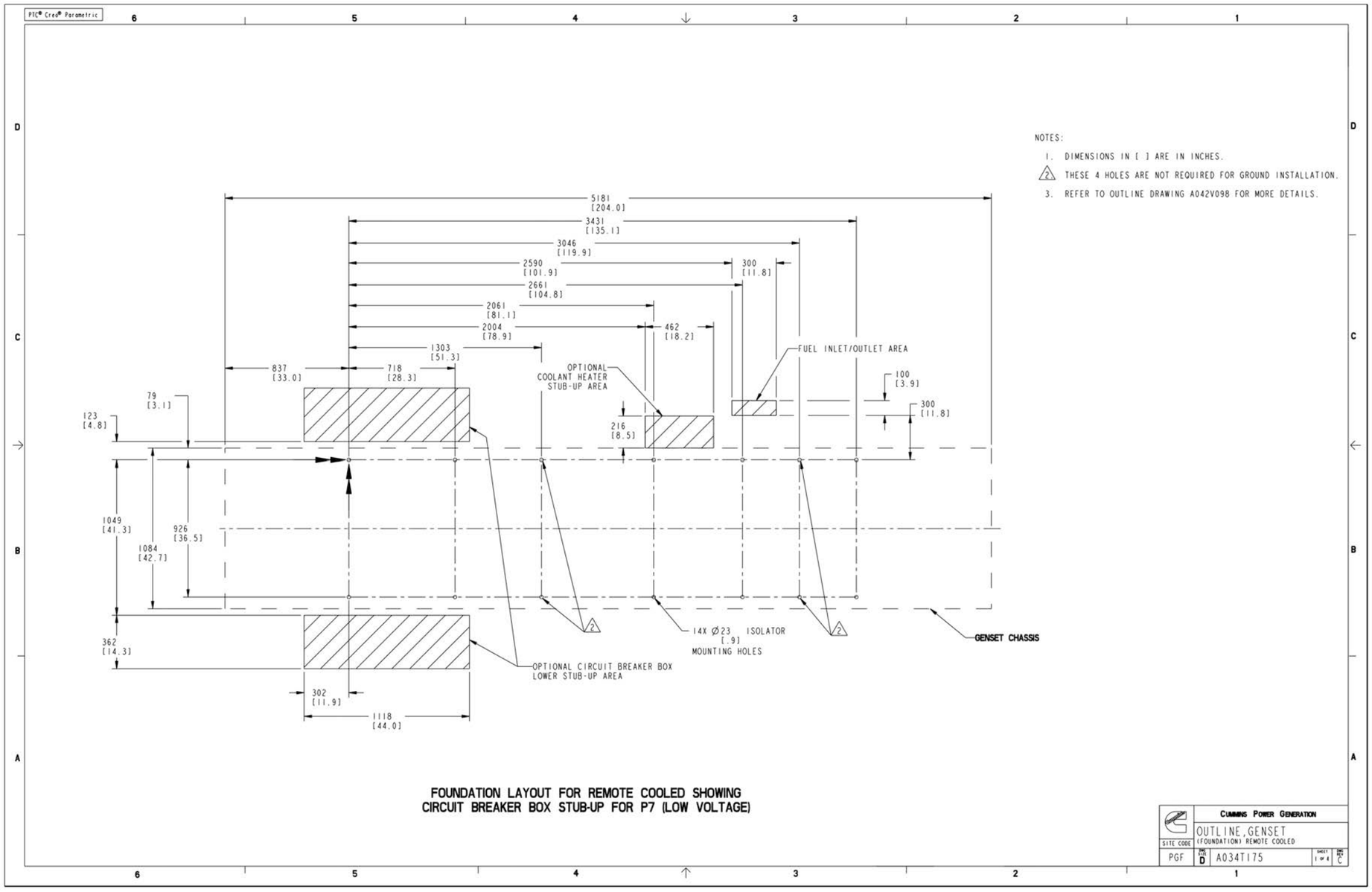


FIGURE 142. FOUNDATION DRAWING FOR REMOTE COOLED GENERATOR SET (SHEET 1)

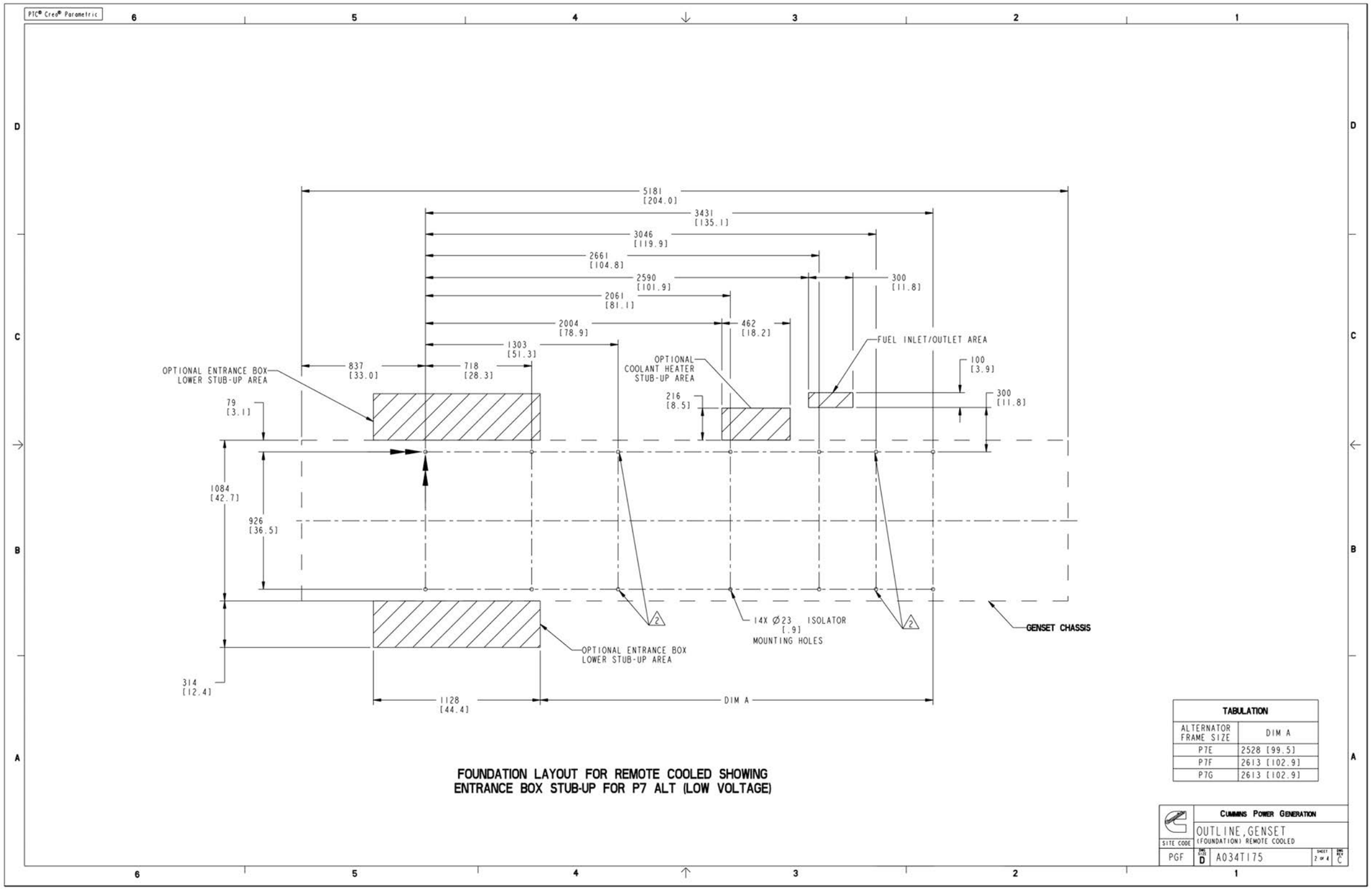


FIGURE 143. FOUNDATION DRAWING FOR REMOTE COOLED GENERATOR SET (SHEET 2)

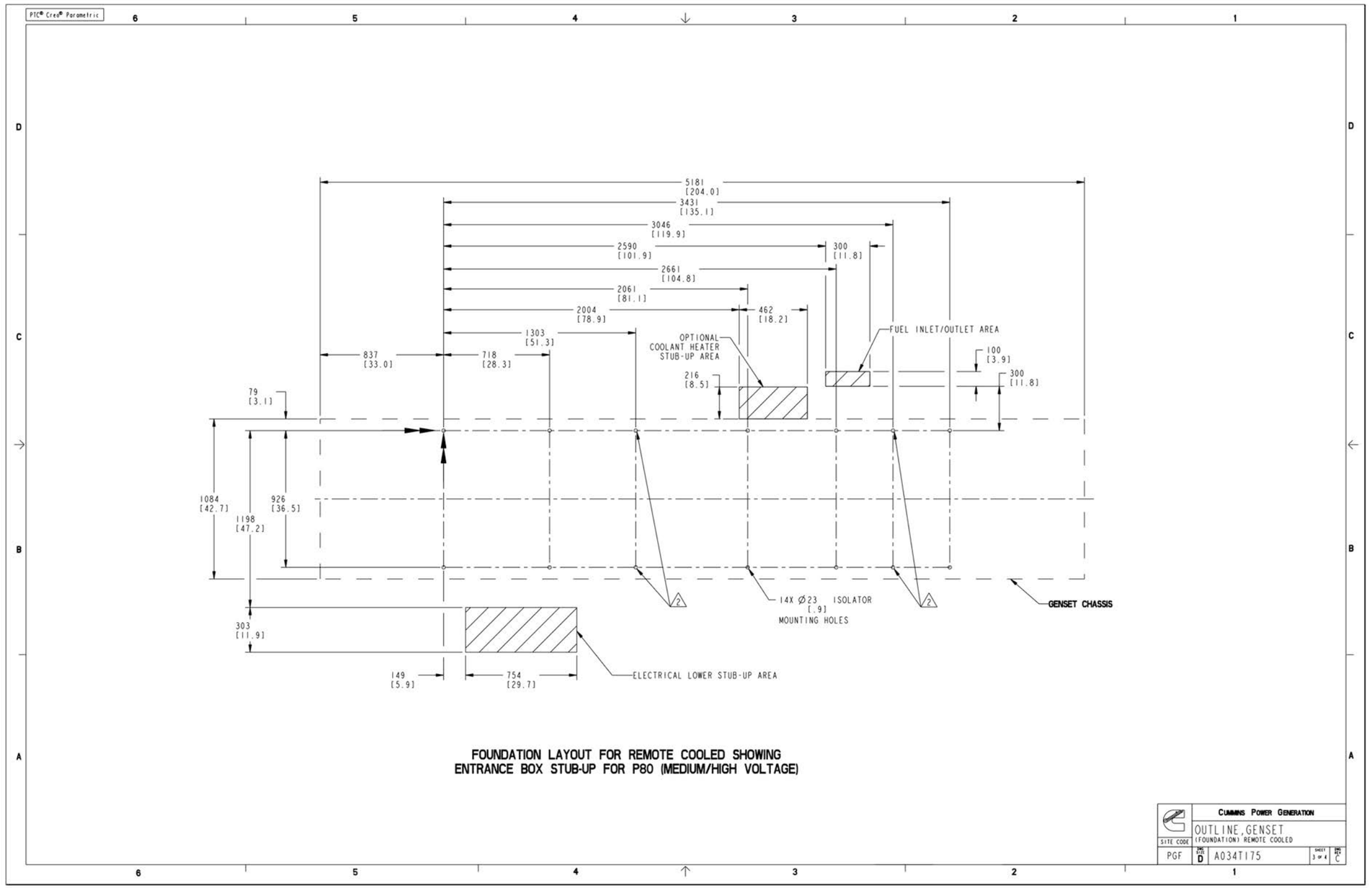


FIGURE 144. FOUNDATION DRAWING FOR REMOTE COOLED GENERATOR SET (SHEET 3)

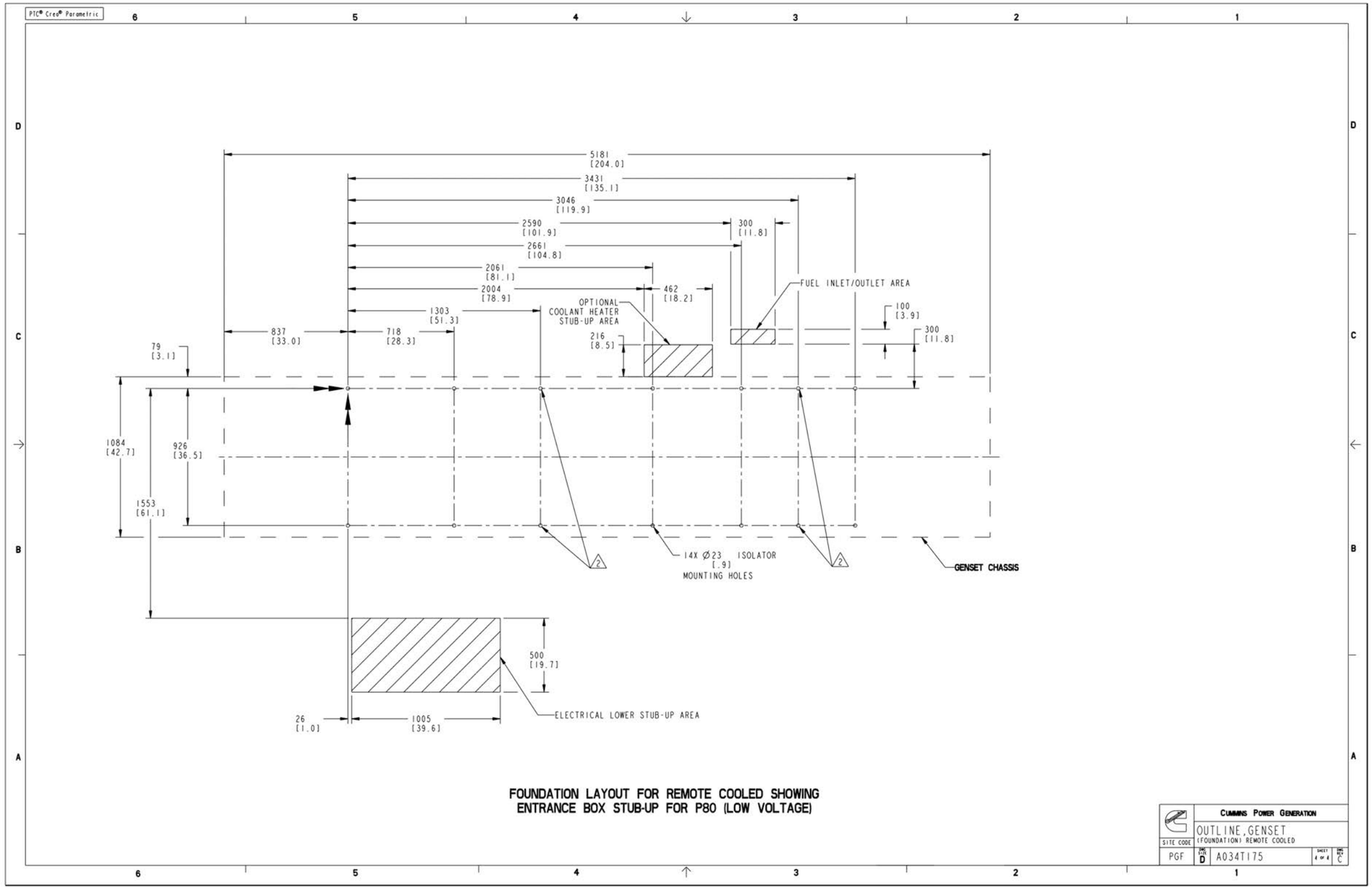


FIGURE 145. FOUNDATION DRAWING FOR REMOTE COOLED GENERATOR SET (SHEET 4)

D.5 Foundation Outline Drawing, High Ambient and Enhanced High Ambient Radiators

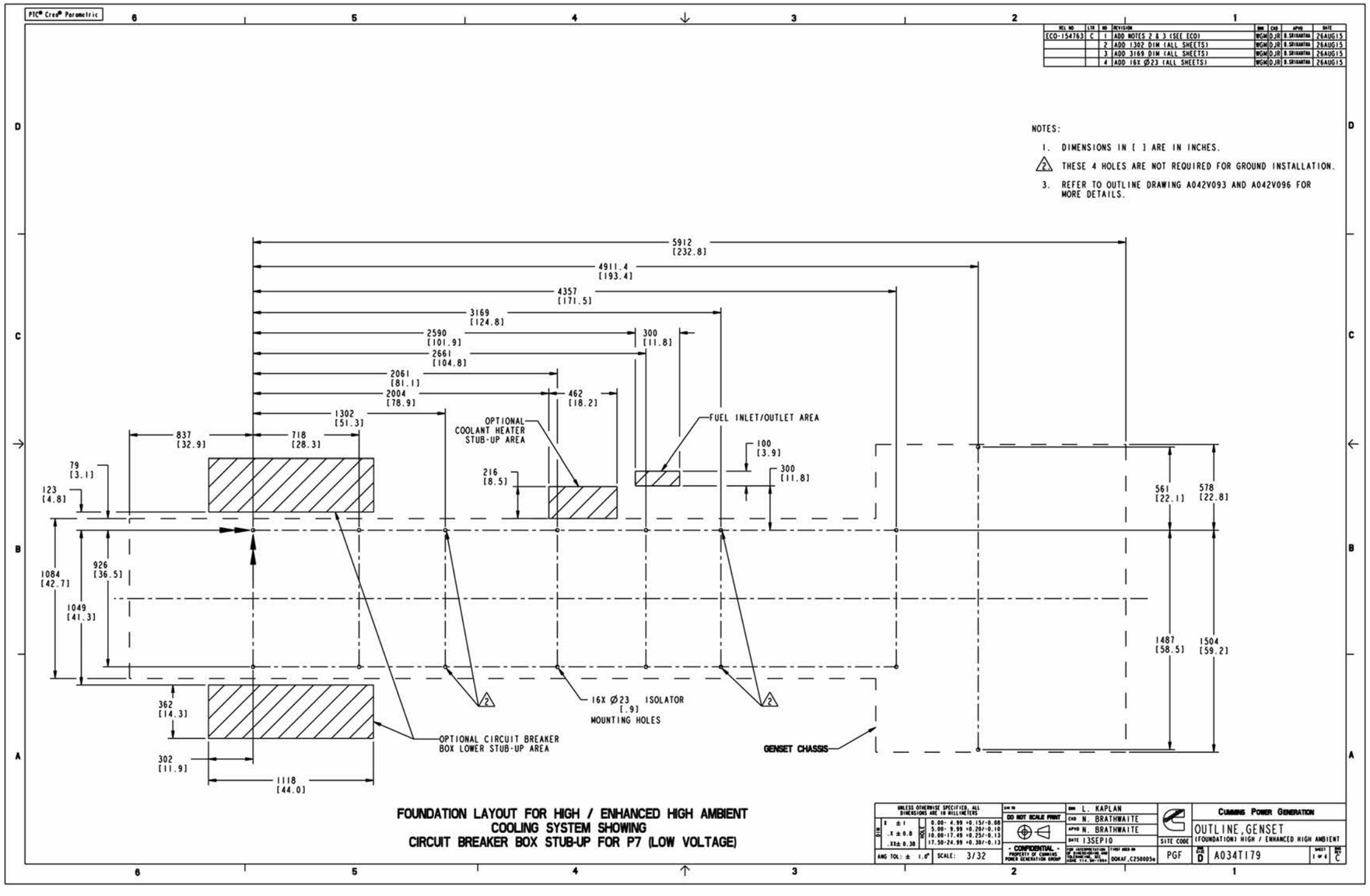


FIGURE 146. FOUNDATION OUTLINE DRAWING, HIGH AMBIENT AND ENHANCED HIGH AMBIENT RADIATORS (SHEET 1)

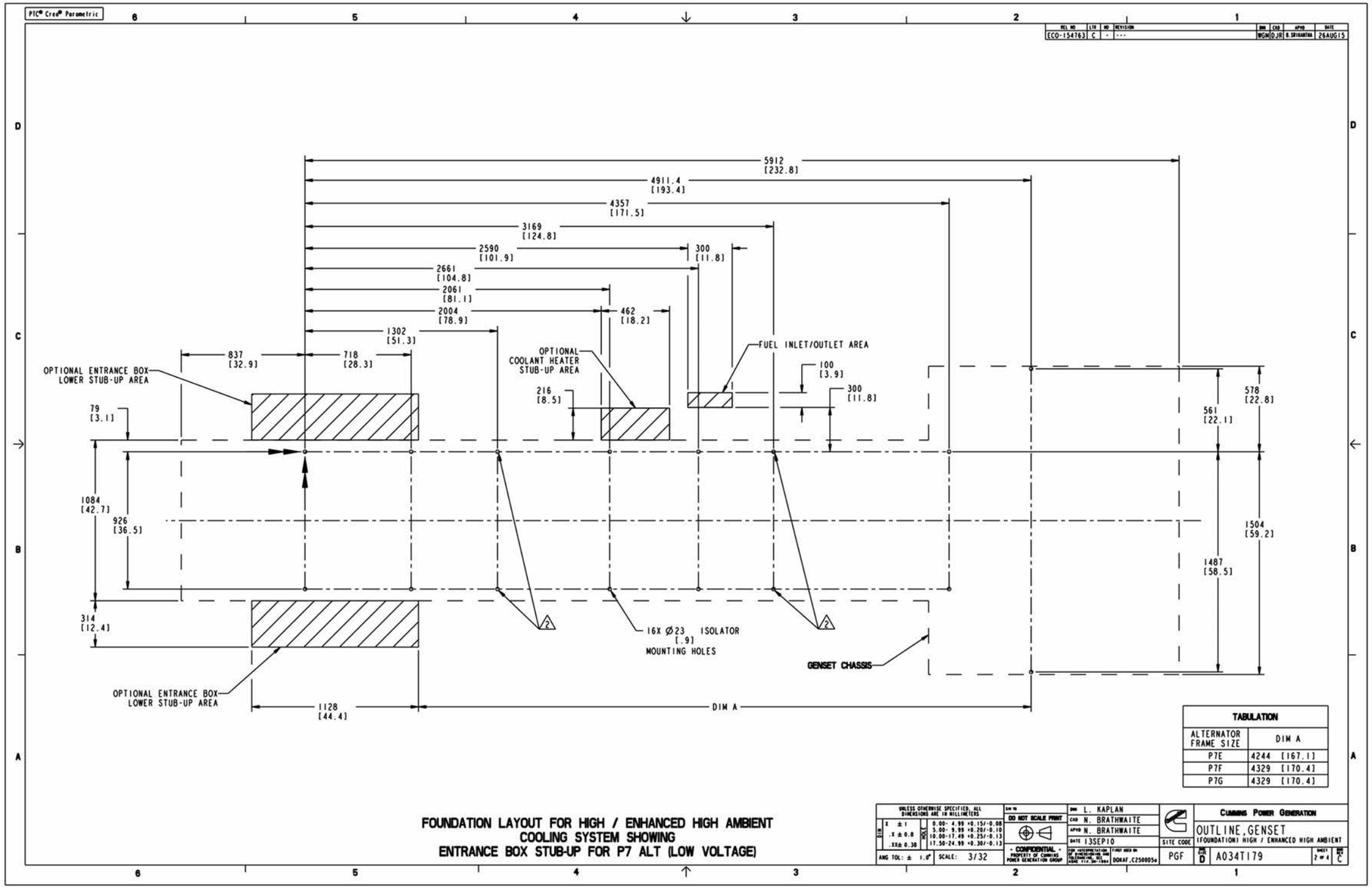


FIGURE 147. FOUNDATION OUTLINE DRAWING, HIGH AMBIENT AND ENHANCED HIGH AMBIENT RADIATORS (SHEET 2)

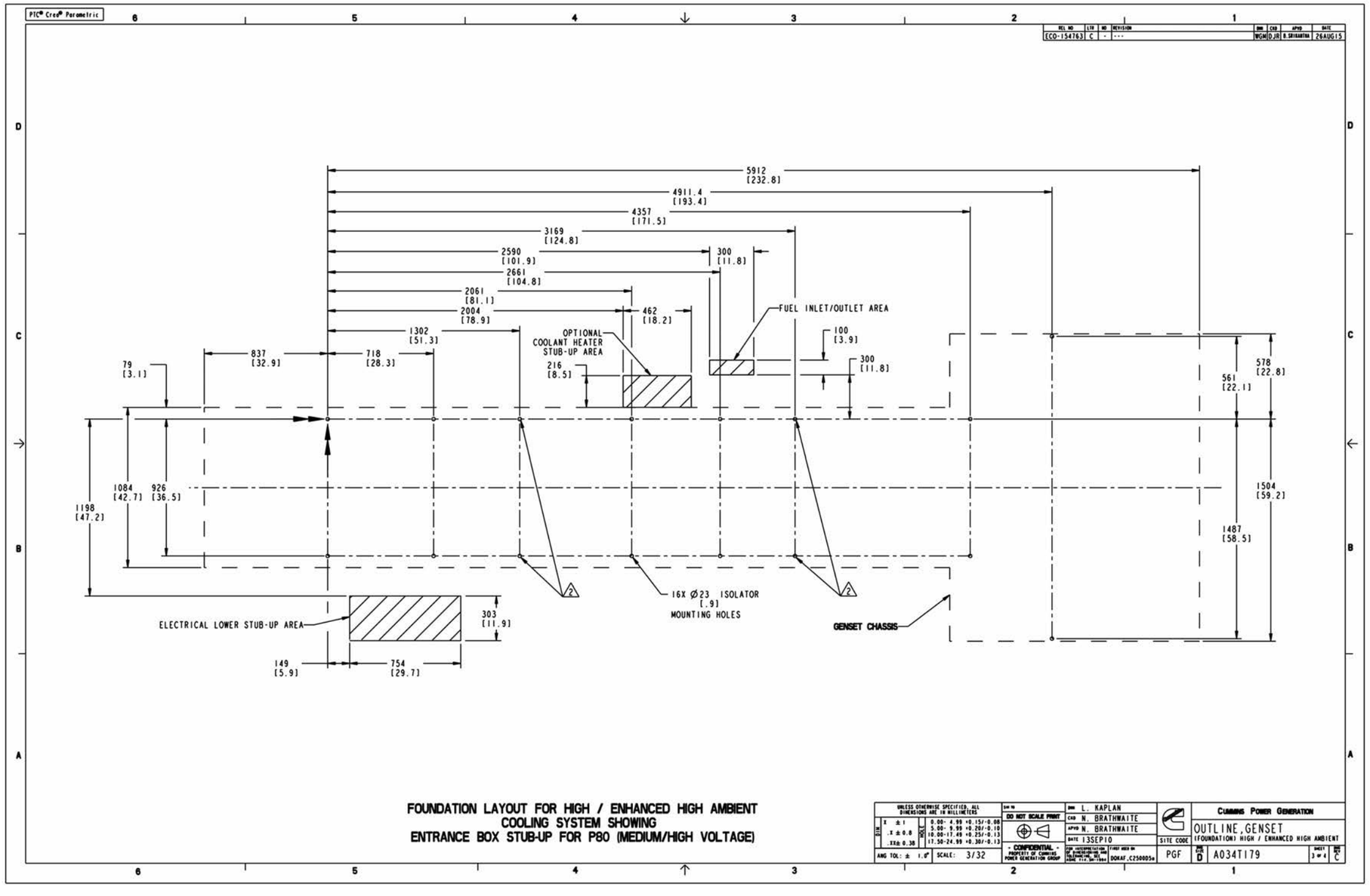


FIGURE 148. FOUNDATION OUTLINE DRAWING, HIGH AMBIENT AND ENHANCED HIGH AMBIENT RADIATORS (SHEET 3)

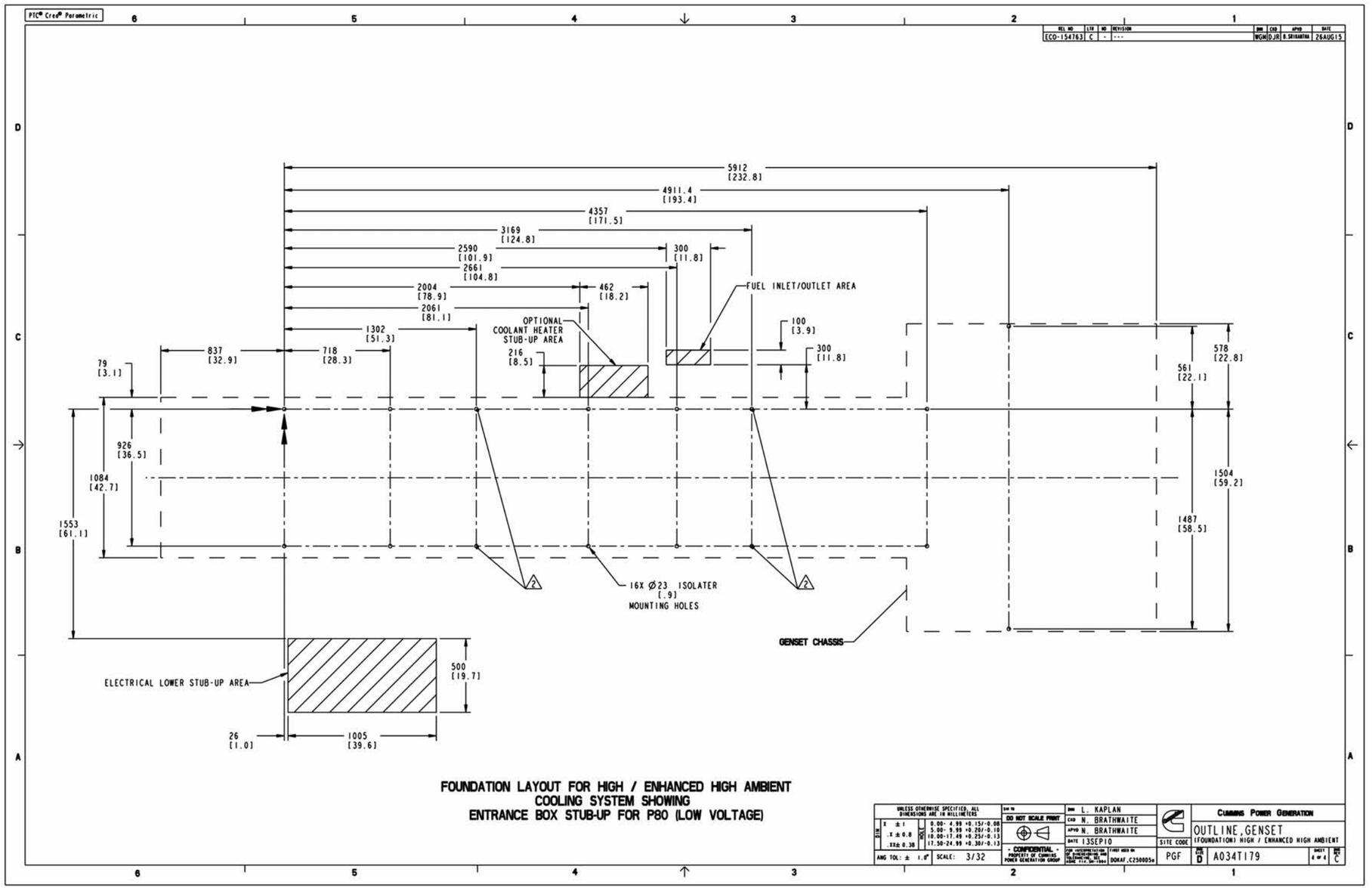


FIGURE 149. FOUNDATION OUTLINE DRAWING, HIGH AMBIENT AND ENHANCED HIGH AMBIENT RADIATORS (SHEET 4)

Appendix E. Seismic Requirements

Table of Contents

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

E.1 Requirements for Set Mount Radiators and Remote Cooling

Creo Parametric

SPRING-ISOLATED GENERATOR SETS: GROUND LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQGAE, DQGAR DQGAF, DQGAS DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	A046D218 (RJJEQ-D-5880)	12	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	4.0" MIN.	6.0" MIN.	3000 PSI N.W.C.	6.0" MIN.
						SDS<=2.1 Z/H=0.0		10.0" MIN.	12.0" MIN.		12.0" MIN
	REMOTELY COOLED		10	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	4.0" MIN.	6.0" MIN	3000 PSI N.W.C.	6.0" MIN
						SDS<=2.1 Z/H=0.0		10.0" MIN.	12.0" MIN		12.0" MIN.
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	A046D218 (RJJEQ-D-5880)	12	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	4.0" MIN.	6.0" MIN.	3000 PSI N.W.C.	6.0" MIN.
						SDS<=2.1 Z/H=0.0		12.0" MIN.	14.0" MIN.		14.0" MIN.
	REMOTELY COOLED		10	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	4.0" MIN.	6.0" MIN.	3000 PSI N.W.C.	6.0" MIN.
						SDS<=2.1 Z/H=0.0		12.0" MIN.	14.0" MIN.		14.0" MIN.

SPRING-ISOLATED GENERATOR SETS: ROOF LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQGAE, DQGAR DQGAF, DQGAS DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	A046D218 (RJJEQ-D-5880)	14	SDS<=1.94 Z/H=1.0	4 PER ISOLATOR (56 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=1.0	4 PER ISOLATOR (56 TOTAL) HILTI HIT-HY 150 MAX-SD+HAS Ø3/4"	10.0" MIN.	12.0" MIN.	3000 PSI N.W.C.	12.0" MIN
	REMOTELY COOLED		12	SDS<=1.94 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	10.0" MIN.	12.0" MIN.	3000 PSI N.W.C.	12.0" MIN
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	A046D218 (RJJEQ-D-5880)	16	SDS<=1.94 Z/H=1.0	4 PER ISOLATOR (64 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	10.0" MIN.	12.0" MIN.	3000 PSI N.W.C.	12.0" MIN
	REMOTELY COOLED		14	SDS<=1.94 Z/H=1.0	4 PER ISOLATOR (56 TOTAL) Ø3/4" GRADE 8 BOLTS	SDS<=1.0 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) HILTI-HY 150 MAX-SD + HAS Ø3/4"	10.0" MIN.	12.0" MIN.	3000 PSI N.W.C.	12.0" MIN

-THIS IS A CONTROLLED ITEM-
PER CPG PROCEDURE PRE-1002

TO MAINTAIN COMPLIANCE WITH REQUIREMENTS OF THE CODES, STANDARDS, OR AGENCIES LISTED BELOW

☐ CSA ☐ UL ☐ CE ☐ NVIA ☐ ABYC
☑ IBC ☐ OTHER _____ ☐ OTHER _____

CHANGES, DEVIATIONS, OR SUBSTITUTIONS OF MATERIAL, PROCESS OR PERFORMANCE OF THIS ITEM MUST BE APPROVED BY THE FOLLOWING CONTROLLED ITEM APPROVER.

RESPONSIBLE C/A ROLE STATIONARY GENSET C/A
RESPONSIBLE C/A ROLE _____
RESPONSIBLE C/A ROLE _____

CUMMINS POWER GENERATION
INSTALLATION, GENSET
SEISMIC REQUIREMENTS
SITE CODE PGF | DWG SIZE D | A046G655 | SHEET 1 OF 6 | DWG REV C

FIGURE 150. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 1)

Creo Parametric

SPRING-ISOLATED GENERATOR SETS: GROUND LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	A030S169 (M2SSH-1E-5150N)	12	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	14.0" MIN.	14.0" MIN.	4000 PSI MIN.	16.0" MIN.
						SDS<=1.20 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN.		12.0" MIN.
	REMOTELY COOLED	A030S169 (M2SSH-1E-5150N)	10	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (40 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	12.0" MIN.	10.0" MIN	4000 PSI MIN.	14.0" MIN.
						SDS<=1.40 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN		12.0" MIN.
DQGAE, DQGAR DQGAF, DQGAS	SET-MOUNTED COOLING	A046D208 (M2SSH-1E-4000N)	14	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (56 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS <= 2.10 z/h = 0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	10.0" MIN.	9.0" MIN.	4000 PSI MIN.	12.0" MIN.
						SDS<=1.60 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN.		12.0" MIN.
	REMOTELY COOLED	A046D208 (M2SSH-1E-4000N)	12	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	9.0" MIN.	8.0" MIN.	4000 PSI MIN.	11.0" MIN.
						SDS<=1.90 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN.		12.0" MIN.
DQGAG DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	A046D208 (M2SSH-1E-4000N)	14	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (56 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	10.0" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.
						SDS<=1.60 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN.		12.0" MIN.
	REMOTELY COOLED	A046D208 (M2SSH-1E-4000N)	12	SDS<=2.10 Z/H=0.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	9.0" MIN.	8.0" MIN.	4000 PSI MIN.	11.0" MIN.
						SDS<=1.90 Z/H=0.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	4.75" MIN.	12.0" MIN.		12.0" MIN.

CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SITE CODE PGF | DWG SIZE D | A046G655 | SHEET 2 OF 6 | DWG REV C

FIGURE 151. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 2)

Creo Parametric

SPRING-ISOLATED GENERATOR SETS: ROOF LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	A030S169 (M2SSH-1E-5150N)	12	SDS<=1.40 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS<=0.85 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN.	5000 PSI MIN.	18.0" MIN.
						SDS<=1.15 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.
	REMOTELY COOLED	A030S169 (M2SSH-1E-5150N)	10	SDS<=1.60 Z/H=1.0	4 PER ISOLATOR (40 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS<=1.15 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN	5000 PSI MIN.	18.0" MIN.
						SDS<=0.50 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN	4000 PSI MIN.	12.0" MIN.
DQGAE, DQGAR DQGAF, DQGAS	SET-MOUNTED COOLING	A046D208 (M2SSH-1E-4000N)	14	SDS<=2.10 Z/H=1.0	4 PER ISOLATOR (56 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS <= 1.30 z/h = 1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN.	5000 PSI MIN.	18.0" MIN.
						SDS<=0.55 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.
	REMOTELY COOLED	A046D208 (M2SSH-1E-4000N)	12	SDS<=2.05 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS<=1.50 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN.	5000 PSI MIN.	18.0" MIN.
						SDS<=0.65 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.
DQGAG DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	A046D208 (M2SSH-1E-4000N)	14	SDS<=2.00 Z/H=1.0	4 PER ISOLATOR (56 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS<=1.20 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN.	5000 PSI MIN.	18.0" MIN.
						SDS<=0.55 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.
	REMOTELY COOLED	A046D208 (M2SSH-1E-4000N)	12	SDS<=2.10 Z/H=1.0	4 PER ISOLATOR (48 TOTAL) Ø5/8" ASTM A490 BOLTS	SDS<=1.50 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) ADHESIVE ANCHORS HIT-RE 500-SD + HAS Ø3/4"	15.0" MIN.	16.0" MIN.	5000 PSI MIN.	18.0" MIN.
						SDS<=0.65 Z/H=1.0	6 PER ISOLOATOR (72 TOTAL) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	12.0" MIN.

CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SITE CODE PGF | SIZE D | A046G655 | SHEET 3 OF 6 | REV C

FIGURE 152. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 3)

Creo Parametric

HARD-MOUNTED GENERATOR SETS: GROUND LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	SDS<=2.10 Z/H=0.0	QTY (12) Ø3/4" ASTM A325 BOLTS	SDS<=2.03 Z/H=0.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	7000 PSI MIN.	14.0" MIN.
				SDS<=1.70 Z/H=0.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	4000 PSI MIN.	14.0" MIN.
				SDS<=0.75 Z/H=0.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
	REMOTELY COOLED	SDS<=2.10 Z/H=0.0	QTY (10) Ø3/4" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	QTY (10) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN	4000 PSI MIN.	14.0" MIN.
				SDS<=1.00 Z/H=0.0	QTY (10) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN	4000 PSI MIN.	10.0" MIN.
DQGAE, DQGAR DQGAF, DQGAS	SET-MOUNTED COOLING	SDS<=2.10 Z/H=0.0	QTY (14) Ø3/4" ASTM A325 BOLTS	SDS <= 2.10 z/h = 0.0	QTY (14) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	12.0" MIN.	4000 PSI MIN.	14.0" MIN.
				SDS<=1.00 Z/H=0.0	QTY (14) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
	REMOTELY COOLED	SDS<=2.10 Z/H=0.0	QTY (12) Ø3/4" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	12.0" MIN.	4000 PSI MIN.	14.0" MIN.
				SDS<=1.20 Z/H=0.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
DQGAG DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	SDS<=2.10 Z/H=0.0	QTY (14) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	QTY (14) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	14.0" MIN.	4000 PSI MIN.	14.0" MIN.
				SDS<=0.90 Z/H=0.0	QTY (14) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
	REMOTELY COOLED	SDS<=2.10 Z/H=0.0	QTY (12) Ø5/8" ASTM A325 BOLTS	SDS<=2.10 Z/H=0.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	12.0" MIN.	4000 PSI MIN.	14.0" MIN.
				SDS<=1.20 Z/H=0.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.

CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SITE CODE PGF | DWG SIZE D | A046G655 | SHEET 4 OF 6 | DWG REV C

FIGURE 153. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 4)

Creo Parametric

HARD-MOUNTED GENERATOR SETS: ROOF LEVEL INSTALLATIONS

CUMMINS GENSET MODEL	CONFIGURATION	ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	SLAB THICKNESS
DQKAD, DQKAK DQKAE, DQKAL DQKAF, DQKAM DQKAG DQKAH DQKAJ	SET-MOUNTED COOLING	SDS<=1.25 Z/H=1.0	QTY (12) Ø3/4" ASTM A490 BOLTS	SDS<=0.60 Z/H=1.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	5000 PSI MIN.	14.0" MIN.
				SDS<=0.25 Z/H=1.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	8.0" MIN.
	REMOTELY COOLED	SDS<=1.50 Z/H=1.0	QTY (10) Ø3/4" ASTM A490 BOLTS	SDS<=0.80 Z/H=1.0	QTY (10) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN	5000 PSI MIN.	14.0" MIN.
				SDS<=0.35 Z/H=1.0	QTY (10) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN	4000 PSI MIN.	10.0" MIN.
DQGAE, DQGAR DQGAF, DQGAS	SET-MOUNTED COOLING	SDS<=1.90 Z/H=1.0	QTY (14) Ø3/4" ASTM A490 BOLTS	SDS <= 0.90 z/h = 1.0	QTY (14) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	5000 PSI MIN.	14.0" MIN.
				SDS<=0.35 Z/H=1.0	QTY (14) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
	REMOTELY COOLED	SDS<=2.10 Z/H=1.0	QTY (12) Ø3/4" ASTM A490 BOLTS	SDS<=1.00 Z/H=1.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	5000 PSI MIN.	14.0" MIN.
				SDS<=0.40 Z/H=1.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
DQGAG DQGAH DQGAJ DQGAK DQGAM DQGAN	SET-MOUNTED COOLING	SDS<=1.75 Z/H=1.0	QTY (14) Ø3/4" ASTM A490 BOLTS	SDS<=0.85 Z/H=1.0	QTY (14) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	5000 PSI MIN.	14.0" MIN.
				SDS<=0.30 Z/H=1.0	QTY (14) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.
	REMOTELY COOLED	SDS<=2.10 Z/H=1.0	QTY (12) Ø3/4" ASTM A490 BOLTS	SDS<=1.00 Z/H=1.0	QTY (12) UNDERCUT ANCHORS HDA-P M20x250/50 Ø0.79"	9.843" (20 MM) MIN.	16.0" MIN.	5000 PSI MIN.	14.0" MIN.
				SDS<=0.40 Z/H=1.0	QTY (12) EXPANSION ANCHORS HILTI KWIK BOLT TZ - CS Ø3/4"	4.75" MIN.	12.0" MIN.	4000 PSI MIN.	10.0" MIN.

CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SITE CODE PGF DWG NO D A046G655 SHEET 5 OF 6 REV C

FIGURE 154. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 5)

Creo Parametric

SEISMIC INSTALLATIONS NOTES:

1. THE INSTALLATION GUIDELINES IN THIS DRAWING ARE RECOMMENDATIONS FROM THE ISOLATOR SUPPLIER AND SHOULD BE CONTACTED IF IN DOUBT.

2. THE DESIGN OF POST-INSTALLED ANCHORS IN CONCRETE USED FOR THE COMPONENT ANCHORAGE IS PRE-QUALIFIED FOR SEISMIC APPLICATIONS IN ACCORDANCE WITH "ACI 355.2" AND DOCUMENTED IN A REPORT BY A REPUTABLE TESTING AGENCY. (EX. THE EVALUATION SERVICE REPORT ISSUED BY THE INTERNATIONAL CODE COUNCIL)

3. EQUIPMENT ANCHORAGE MUST BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS.

4. ANCHORS MUST BE INSTALLED IN MINIMUM 4000 PSI COMPRESSIVE STRENGTH NORMAL WEIGHT CONCRETE EXCEPT WHERE OTHERWISE INDICATED. CONCRETE AGGREGATE MUST COMPLY WITH "ASTM C33". INSTALLATION IN STRUCTURAL LIGHTWEIGHT CONCRETE IS NOT PERMITTED UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.

5. ANCHORS MUST BE INSTALLED TO THE TORQUE SPECIFICATION AS RECOMMENDED BY THE ANCHOR MANUFACTURER TO OBTAIN MAXIMUM LOADING.

6. ANCHORS MUST BE INSTALLED IN LOCATIONS SPECIFIED ON THIS INSTALLATION DRAWING.

7. WIDE WASHERS MUST BE INSTALLED AT EACH ANCHOR LOCATION BETWEEN THE ANCHOR HEAD AND EQUIPMENT FOR TENSION LOAD DISTRIBUTION. WIDE WASHERS MUST BE SERIES "W" OF AMERICAN NATIONAL STANDARD TYPE "A" PLAIN WASHERS (ANSI B18.22.1-1965, R1975) WITH THE NOMINAL WASHER SIZE SELECTED TO MATCH THE SPECIFIED NOMINAL ANCHOR DIAMETER.

8. CONCRETE FLOOR SLAB AND CONCRETE HOUSEKEEPING PADS MUST BE DESIGNED AND REBAR REINFORCED FOR SEISMIC APPLICATIONS IN ACCORDANCE WITH "ACI 318".

9. ALL HOUSEKEEPING PAD THICKNESSES MUST BE DESIGNED IN ACCORDANCE WITH THE PRE-QUALIFICATION TEST REPORT AS DEFINED IN NOTE 1 OR A MINIMUM OF 1.5X THE ANCHOR EMBEDMENT DEPTH, WHICHEVER IS LARGEST.

10. ALL HOUSEKEEPING PADS MUST BE DOWELLED OR CAST INTO THE BUILDING STRUCTURAL FLOOR SLAB AND DESIGNED FOR SEISMIC APPLICATION PER "ACI 318" AND AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.

11. FLOOR MOUNTED EQUIPMENT (WITH OR WITHOUT A HOUSEKEEPING PAD) MUST BE INSTALLED TO A REBAR REINFORCED STRUCTURAL CONCRETE FLOOR THAT IS SEISMICALLY DESIGNED AND APPROVED BY THE ENGINEER OF RECORD TO RESIST THE ADDED SEISMIC LOADS FROM COMPONENTS BEING ANCHORED TO THE FLOOR.

12. WHEN INSTALLING TO A FLOOR, REBAR INTERFERENCE MUST BE CONSIDERED.

13. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY FLOOR OR WALL OTHER THAN THOSE CONSTRUCTED OF STRUCTURAL CONCRETE AND DESIGNED TO ACCEPT THE SEISMIC LOADS FROM SAID EQUIPMENT IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION.

14. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY FLOOR CONSTRUCTED OF LIGHT WEIGHT CONCRETE OVER STEEL DECKING IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION.

15. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY CONCRETE BLOCK WALLS OR CINDER BLOCK WALLS IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION.

16. INSTALLATION UPON ANY STEEL DUNNAGE SHALL BE COORDINATED WITH THE STRUCTURAL ENGINEER OF RECORD. STEEL DUNNAGE MUST BE CERTIFIED BY OTHERS AS IS BEYOND THE SCOPE OF THIS REPORT.

17. INSTALLATION UPON ANY ROOFTOP CURB SHALL BE COORDINATED WITH THE CURB MANUFACTURER AND THE STRUCTURAL ENGINEER OF RECORD. ANY CURB OR CONCRETE PAD THAT SUPPORTS THE GENSET UNIT IS BEYOND THE SCOPE OF THIS CERTIFICATION.

18. ALL ACCESSORY ATTACHMENTS (PIPE, CONDUIT, ETC.) TO THE EQUIPMENT SHALL BE ATTACHED IN A MANNER THAT ALLOWS RELATIVE MOTION (FLEX, SWING, JOIN/ELBOW, ETC.) TO PREVENT FAILURE DUE TO DIFFERENTIAL MOVEMENT BETWEEN THE EQUIPMENT AND ATTACHED ACCESSORY CAUSED BY SEISMIC LOADING ON THE SYSTEM.

19. REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR ANCHOR REQUIREMENTS AND MOUNTING CONSIDERATIONS FOR SEISMIC APPLICATIONS. MOUNTING REQUIREMENT DETAILS SUCH AS BRAND, TYPE, EMBEDMENT DEPTH, EDGE SPACING, ANCHOR SPACING, CONCRETE STRENGTH, WALL BRACING, AND SPECIAL INSPECTION MUST BE OUTLINED AND APPROVED BY THE PROJECT STRUCTURAL ENGINEER OF RECORD. THE INSTALLING CONTRACTOR IS RESPONSIBLE FOR THE PROPER INSTALLATION OF ALL ANCHORS AND MOUNTING HARDWARE, OBSERVING THE MOUNTING REQUIREMENT DETAILS OUTLINED BY THE ENGINEER OF RECORD. CONTACT THE MANUFACTURE'S REPRESENTATIVE IF A DETAILED SEISMIC INSTALLATION CALCULATION PACKAGE IS REQUIRED.

CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SITE CODE PGF | SIZE D | A046G655 | SHEET 6 OF 6 | REV C

FIGURE 155. REQUIREMENTS FOR SET MOUNT RADIATORS AND REMOTE COOLING (SHEET 6)

power.cummins.com