Installation Manual

Generator Set

QSX15-G8 or QSX15-G9 Engine with PowerCommand® 3201 Controller

DFEG (Spec K-L)
DFEH (Spec K-L)
DFEJ (Spec K-M)
DFEK (Spec K-M)

English
Original Instructions
8-2014
A040Z648 (Issue 4)

California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Table of Contents

1 Important Safety Instructions

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

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

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

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

⚠ DANGER
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 Power Generation with specific generator sets. In the event that this manual has been supplied in isolation please contact your authorized distributor.

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

1.2.1 General Safety Precautions

⚠ WARNING

Coolant under pressure.
Hot coolants under pressure can cause severe scalding.
Do not open a radiator or heat exchanger pressure cap while the engine is running. Let the engine cool down before removing the coolant pressure 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 or death.
Make sure all protective guards are properly in place before starting the generator set.

⚠ WARNING

Toxicity.
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

Operation of equipment.
Operation of equipment is unsafe when mentally or physically fatigued.
Do not operate equipment in this condition, or after consuming any alcohol or drug.

⚠ WARNING

Exhaust 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

Fire or explosion.
Flammable liquids can cause fire or explosion leading to severe personal injury or death.
Do not store fuel, cleaners, oil, etc. near the generator set.

⚠ WARNING

Noise.
Generator sets in operation mode emit noise, which can cause hearing damage.
Wear appropriate ear protection at all times.

⚠ WARNING

Hot metal parts.
Exposed skin can suffer serious and permanent burns, depending on the temperature and contact time.
Avoid contact or wear protective gloves.

⚠ WARNING

Maintaining or installing a generator set.

Failure to carry out the correct procedures when maintaining or installing a generator set can cause severe personal injury or equipment damage.

Wear personal protective equipment such as safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing when working on equipment.

⚠ WARNING

Toxicity.

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

Clean up coolant spills and dispose of used antifreeze in accordance with local environmental regulations.

⚠ WARNING

Starting fluids, such as ether.

Starting fluids, such as ether, may cause explosion, which can result in severe personal injury and generator set engine damage.

Do not use.

⚠ WARNING

Accidental or remote starting.

Accidental or remote starting of the generator set while working on it can cause severe personal injury or death.

Prevent accidental or remote starting by disconnecting the starting battery cables (negative [–] first), using an insulated wrench and isolating all auxiliary supplies.

⚠ CAUTION

Fire hazard.

Loose cleaning materials can become entangled in moving parts, which may result in equipment damage or a fire hazard.

Make sure that all cleaning materials are removed from the generator set before operating the generator.

⚠ CAUTION

Fire hazard.

A build up of combustible materials under the generator set can present a fire hazard.

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

⚠ CAUTION

Fire hazard.

Accumulated grease and oil can cause overheating and engine damage presenting a potential fire hazard.

Keep the generator set clean and makes sure oil leaks are repaired promptly.

NOTICE

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

⚠ CAUTION

Fire hazard.

Articles left against or close by the generator set may obstruct and restrict the air flow causing over heating or a fire hazard.

Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.

NOTICE

Keep multi-class ABC fire extinguishers handy. 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 applicable region.)

NOTICE

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

Improper operation and maintenance.

Improper operation and maintenance can lead to severe personal injury, or loss of life and property, by fire, electrocution, mechanical breakdown, or exhaust gas asphyxiation.

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

⚠ WARNING

Lifting .

Incorrect lifting and repositioning of the generator set, can result in severe personal injury, death, and/or equipment damage.

Lifting must only be carried out using suitable lifting equipment, shackles, and spreader bars, in accordance with local guidelines and legislation, by suitably trained and experienced personnel. For more information, contact your authorized distributor.

1.3.1 Moving Parts Can Cause Severe Personal Injury Or Death

- Keep your 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

The generator set should be placed on level ground with adequate open space around it. The immediate area around the generator set should be free of any flammable material.

NOTICE
On an enclosed generator set, the canopy doors must be locked before repositioning, and they must remain locked during transportation and siting.

NOTICE
The generator set is capable of operating at inclines of up to +/– 20 degrees, however, for optimal performance and reliability, any incline should be +/– 5 degrees.

1.3.3 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. ***Any work with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher poses a significant risk of electrical shock and electrical arc flash. These silent hazards can cause severe injuries or death.*** ***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 jewelry 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 jewelry 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. Safety*) may require the installation of a disconnect means for the generator set, either on the generator set or where the generator set conductors enter a facility.

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

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

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

1.4.1.1 AmpSentry

Generator sets with AmpSentry™ protective relay include 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.

The equipment may have more than one source of electrical energy. Disconnecting one source without disconnecting the others presents a shock hazard that can result in severe personal injury or death.

Before working on the equipment, disconnect and verify that all sources of electrical energy have been removed.

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 or during 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 Power Generation 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 pipes.
Hot exhaust pipes and charge air pipes can cause severe personal injury or death from direct contact, or from fire hazard.
Wear appropriate PPE when working on hot equipment and avoid physical contact where possible.

⚠ WARNING

Exhaust gases.
Hot exhaust gases can cause burns resulting in severe personal injury.
Wear personal protective equipment when working on equipment.

⚠ WARNING

Exhaust gases.
Inhalation of exhaust fumes can result in serious personal injury or death.
Be sure deadly exhaust gas is piped outside and away from windows, doors, or other inlets to buildings. Do not allow to accumulate in habitable areas.

⚠ WARNING

Fire hazard.
Contaminated insulation is a fire risk which can result in severe personal injury and equipment damage.
Remove any contaminated insulation and dispose of 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.

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2 Introduction

⚠ WARNING

Hazardous voltage.

Hazardous voltages can cause severe personal injury or death and equipment damage.

Generator electrical output connections must be made by a trained and experienced electrician in accordance with the installation instructions and all applicable codes.

⚠ WARNING

Electrical generating equipment.

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 Power Generation (CPG) 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 Power Generation 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://qsol.cummins.com/info/index.html).

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 Power Generation 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 **www.cumminspower.com**
2. Click on "Application Engineering" under heading, Technical Information.
3. 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	LCT	Low Coolant Temperature
AMP	AMP, Inc., part of Tyco Electronics	LED	Light-emitting Diode
ANSI	American National Standards Institute	MFM	Multifunction Monitor
ASOV	Automatic Shut Off Valve	Mil Std	Military Standard
ASTM	American Society for Testing and Materials (ASTM International)	NC	Normally Closed
ATS	Automatic Transfer Switch	NC	Not Connected
AVR	Automatic Voltage Regulator	NFPA	National Fire Protection Agency
AWG	American Wire Gauge	NO	Normally Open
CAN	Controlled Area Network	NWF	Network Failure
CB	Circuit Breaker	OEM	Original Equipment Manufacturer
CE	Conformité Européenne	OOR	Out of Range
CFM	Cubic Feet per Minute	OORH / ORH	Out of Range High
CGT	Cummins Generator Technologies	OORL / ORL	Out of Range Low
CMM	Cubic Meters per Minute	PB	Push Button
CT	Current Transformer	PCC	PowerCommand® Control
DC	Direct Current	PGI	Power Generation Interface
DEF	Diesel Exhaust Fluid	PGN	Parameter Group Number
DPF	Diesel Particulate Filter	PI	Proportional/Integral
ECM	Engine Control Module	PID	Proportional/Integral/Derivative

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
ECS	Engine Control System	PLC	Programmable Logic Controller
EMI	Electromagnetic interference	PMG	Permanent Magnet Generator
EN	European Standard	PPE	Personal Protective Equipment
EPS	Engine Protection System	PT	Potential Transformer
E-Stop	Emergency Stop	PTC	Power Transfer Control
FAE	Full Authority Electronic	PWM	Pulse-width Modulation
FMI	Failure Mode Identifier	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
HMI	Human-machine Interface	SCR	Selective Catalytic Reduction
IC	Integrated Circuit	SPN	Suspect Parameter Number
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

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 to familiarize themselves with the warnings and operating procedures .

⚠ CAUTION

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

- Operator Manual for DFEG, DFEH, DFEJ, and DFEK Generator Set with PowerCommand® 3201 Controller (A040Z650)
- Installation Manual for DFEG, DFEH, DFEJ, and DFEK Generator Set with PowerCommand® 3201 Controller (A040Z648)
- Service Manual for DFEG, DFEH, DFEJ, and DFEK Generator Set with PowerCommand® 3201 Controller (A040Z652)
- Controller Service Manual for PowerCommand® 3201 Controller (A034T572)
- Engine Operation & Maintenance Manual for QSX15 Engine (3666423)
- Alternator Service Manual for HC Alternator (0900-9904)
- *Specification* and *Data Sheet* (For engineering data specific to the generator set)

- Application Manual T-030, *Liquid Cooled Generator Sets* (For application information)
- Parts Manual for DFEG, DFEH, DFEJ, and DFEK Generator Set with QSX15 engine, PowerCommand® 2100 Controller or PowerCommand® 3201 Controller (A040G238)
- Standard Repair Times - CH Family (A034H045)
- Warranty Manual (F1117-0005)
- 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 Power Generation offers a full range of maintenance and warranty services.

2.4.1 Maintenance

⚠ WARNING

Electrical generating equipment.
Incorrect 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/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 *Global Commercial Warranty Statement* listed in the Related Literature section.

Extended warranty coverage is also available. 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.

For further warranty details, contact your authorized distributor.

NOTICE

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

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.

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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

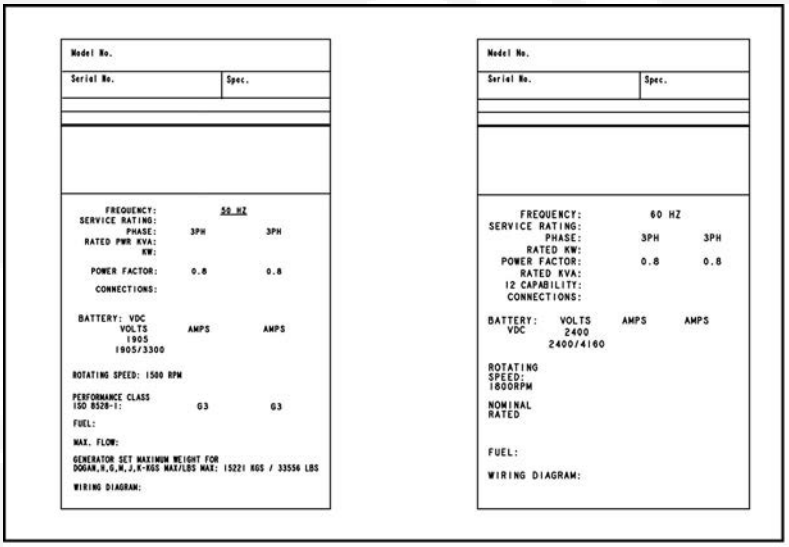
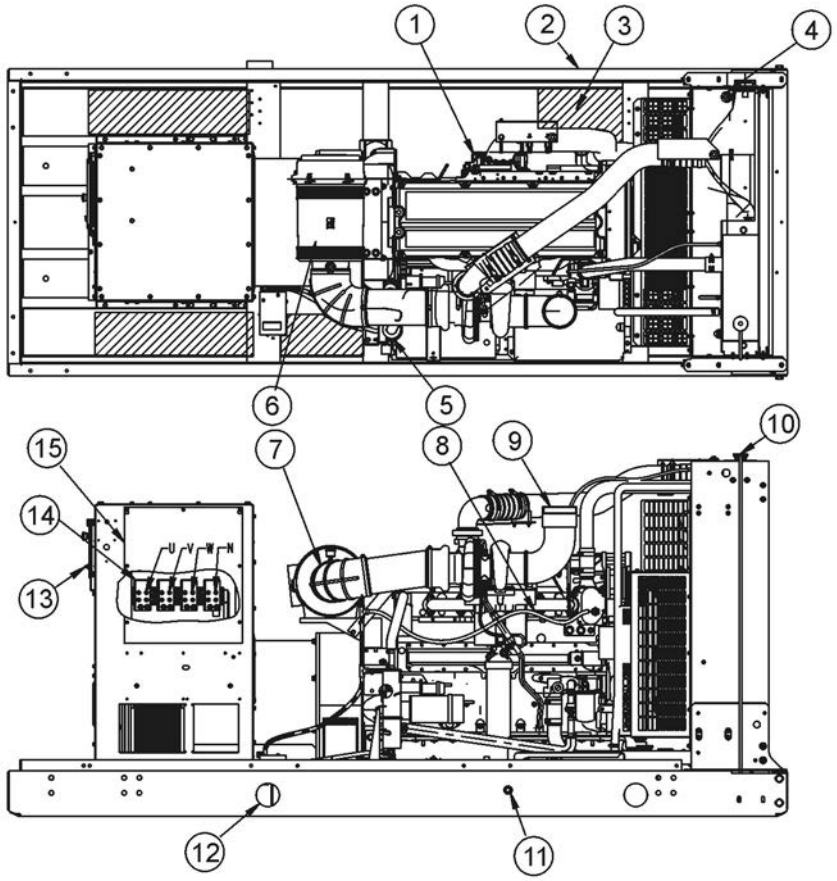


FIGURE 1. TYPICAL GENERATOR SET NAMEPLATE

3.2 DFEG, DFEH, DFEJ, and DFEK Generator Set Components

The main components of a DFEG, DFEH, DFEJ, and DFEK 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
1	Fuel Connections	9	Exhaust Connector
2	Fuel Stub Up Area A	10	Radiator Fill
3	Oil Fill	11	Oil Drain Extension Access Hole
4	Fuel Return	12	Lifting Holes
5	Optional Coolant Heater	13	Control Interface
6	Fuel Stub Up Area B	14	Generator Electrical Load Connections
7	Air Cleaner	15	Electrical Connection Access Removable Panel (Both Sides)
8	Fuel Supply		

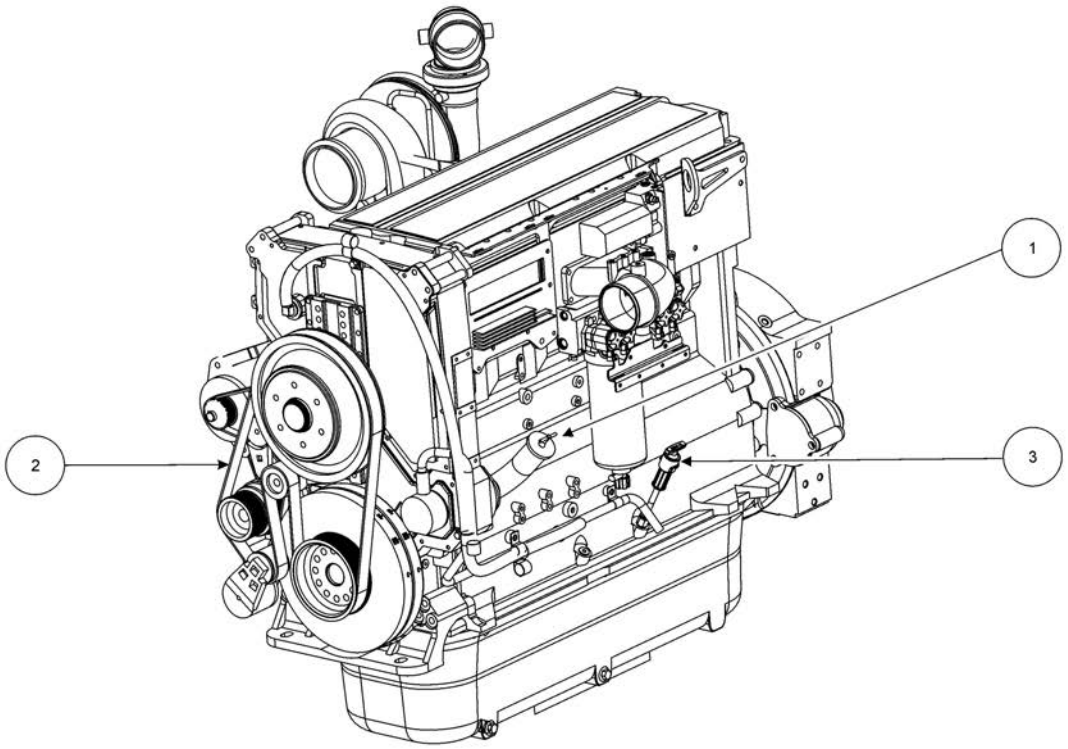
FIGURE 2. 0500-4227 REVISION C GENERATOR SET

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 de-rate may be necessary.

3.4 Engine

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



No.	Description
1	Oil filler cap
2	Fan belt
3	Dipstick

FIGURE 3. TYPICAL ENGINE COMPONENTS

3.5 Sensors

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

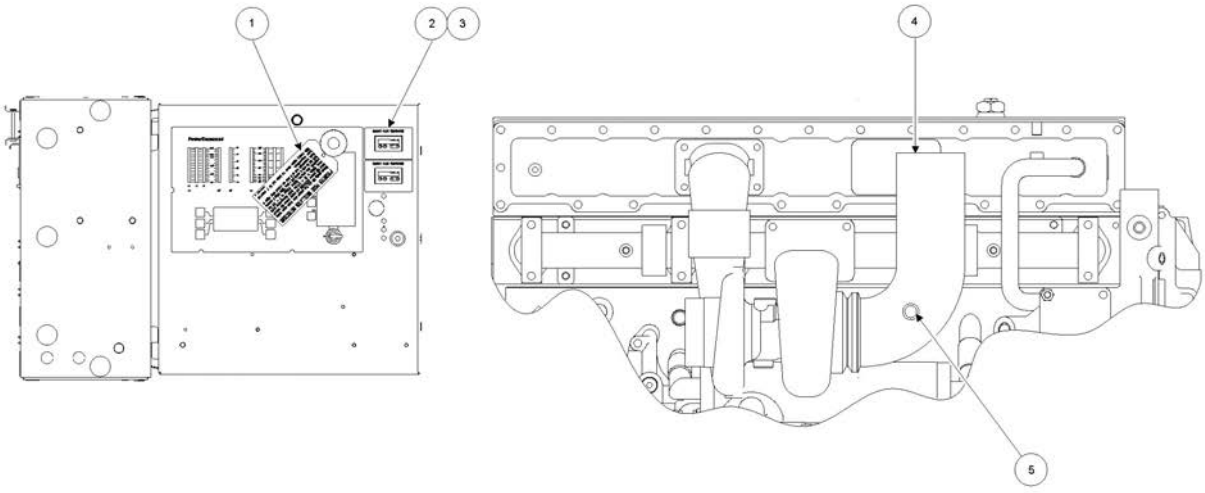
Engine-mounted sensors monitor a number of different systems, such as:

- 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	Instruction Label	4	Exhaust Outlet Elbow
2	Exhaust Pyrometer Label	5	Temperature Sender Location
3	Temperature Meter		

FIGURE 4. PYROMETER LOCATION AND METER(S)

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 9.11 on page 80**.

3.7.2 Battery Charger

Battery chargers can be wall, bench, or skid mounted. For more information, see **Section 9.12 on page 81**.

3.7.3 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 51**.

3.7.4 Day Tank

Some generator set installations include a fuel day tank. For more information, refer to **Section 7.1.6 on page 42**.

3.7.4.1 Fuel Transfer Pump

A fuel transfer pump and control can be installed when a sub-base or an in-skid day tank is provided. For more information, see **Section 7.1.7 on page 43** and **Section 9.5.1 on page 72**.

3.7.5 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 53**.

3.7.6 Heaters

3.7.6.1 Heater Supply and Isolation

An external power supply is required for the operation of the engine heaters and alternator heaters (if fitted).

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 Power Generation accepts no responsibility for providing the means of isolation.

NOTICE
This disconnecting device is not provided as part of the generator set.

3.7.6.2 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 9.8 on page 77**.

3.7.6.3 Coolant Heater

A coolant heater keeps the engine coolant warm when the engine is shut down. For more information on coolant heater components and specifications, see **Section 9.7 on page 74**.

3.7.6.4 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 9.9 on page 77**.

3.7.6.5 Oil Heaters

An engine oil heater keeps the oil warm which improves cold weather starting. For more information on oil pan heaters, refer to **Section 9.10 on page 79**.

3.7.7 Relays

3.7.7.1 Customer Relays

These relays are used for customer-specific applications. For more information, see **Section 8.1 on page 64**.

3.7.7.2 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 8.3 on page 67**.

3.7.7.3 Paralleling Circuit Breaker Control Relays

Paralleling circuit breaker control relays can be installed on generator sets that may be used in paralleling applications. For more information on relay components and wiring, see **Section 8.2 on page 65**.

3.7.8 Seismic Installation Requirements

Seismically certified generator set installations have special requirements. For more information, refer to **Section 4.3 on page 23** and **Appendix F on page 167**.

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.

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 F on page 167**.

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 Power Generation 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 Power Generation is rated to provide the above requirements in ambient temperatures as low as 40 °F (4 °C). Although most Cummins Power Generation generator sets will start in temperatures down to –25 °F (–32 °C) 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 40 °F (4 °C).

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 70 °F (21 °C). In applications where the ambient temperature falls below 40 °F (4 °C), 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 Power Generation 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.

5 Specifications

5.1 Generator Set Specifications

TABLE 1. DFEG, DFEH, DFEJ, AND DFEK SPECIFICATIONS

MODELS	DFEG	DFEH	DFEH	DFEJ	DFEJ	DFEK	DFEK
Engine							
Cummins Diesel Series	QSX15 (60 Hz)	QSX15 (50 Hz)	QSX15 (60 Hz)	QSX15 (50 Hz)	QSX15 (60 Hz)	QSX15 (50 Hz)	QSX15 (60 Hz)
Generator kW Rating (Standby)	350	352	400	400	450	440	500
Generator kW Rating (Prime)	320	320	350	364	410	400	455
Engine Fuel Connection							
Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied						
Maximum Weight (Wet)	8800 lbs (3992 kgs)	8800 lbs (3992 kgs)		9300 lbs (4218 kgs)		9800 lbs (4445 kgs)	
Fuel							
Fuel Pump Flow Rate	112 Gal/hr (423.9 L/hr)	100 Gal/hr (378.5 L/hr)	112 Gal/hr (423.9 L/hr)	100 Gal/hr (378.5 L/hr)	112 Gal/hr (423.9 L/hr)	100 Gal/hr (378.5 L/hr)	112 Gal/hr (423.9 L/hr)
Maximum Fuel Inlet Restriction	5 in Hg (127 mm Hg)						
Maximum Fuel Return Restriction	6.5 in Hg (165.1 mm Hg)						
Air							
Maximum Air Cleaner Restriction	25 cfm (6.2 kPa)						
Exhaust							
Outlet Size	6 in. NPT Male STD (A299)/ASA Flange (A355) or Slip-on (A298) Optional						
Exhaust Flow at Rated Load (Standby)	2600 cfm	2680 cfm	2875 cfm	2935 cfm	3105 cfm	3130 cfm	3625 cfm
Exhaust Flow at Rated Load (Standby)	73.6 m^3/min	75.8 m^3/min	81.4 m^3/min	83.1 m^3/min	87.9 m^3/min	88.6 m^3/min	102.6 m^3/min

Exhaust Flow at Rated Load (Prime)	2505 cfm	2470 cfm	2685 cfm	2720 cfm	2910 cfm	2935 cfm	3135 cfm
Exhaust Flow at Rated Load (Prime)	70.9 m^3/min	69.9 m^3/min	76 m^3/min	77 m^3/min	82.4 m^3/min	83.1 m^3/min	88.7 m^3/min
Exhaust Temperature (Standby)	810 °F	856 °F	825 °F	880 °F	865 °F	925 °F	901 °F
Exhaust Temperature (Standby)	432.2 °C	457.8 °C	440.6 °C	471.1 °C	462.8 °C	496.1 °C	482.8 °C
Exhaust Temperature (Prime)	805 °F	852 °F	815 °F	858 °F	825 °F	880 °F	872 °F
Exhaust Temperature (Prime)	429.4 °C	455.6 °C	435 °C	458.9 °C	440.6 °C	471.1 °C	466.7 °C
Maximum Allowable Back Pressure	41 in H2O (10.2 kPa)						
Electrical System							
Starting Voltage	24 Volts DC						
Battery(s)	Two 12 Volt						
Battery Group Number	8D						
CCA (minimum) Cold Soak @ 0 °F (-18 °C)	1400A at 0 °F to 32 °F (-18 °C to 0 °C)						
Cooling System							
Ambient design	104 °F (40 °C)						
Coolant Capacity with Standard Set-mounted Radiator	15.3 Gal (57.9 L)						
Lubricating System							
Oil Capacity with Filters	88 qt (83.3 L)						

5.2 Engine Fuel Consumption

TABLE 2. FUEL CONSUMPTION (L/HR) AT 1500 RPM (50 HZ)

Model	DFEH	DFEJ	DFEK
Engine	**QSX15-G8**	**QSX15-G8**	**QSX15-G8**
Engine Performance Data at 50Hz[1]	91	101	115

1. Standby/Full Load
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.

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

Model	DFEG	DFEH	DFEJ	DFEK
Engine	**QSX15-G9**	**QSX15-G9**	**QSX15-G9**	**QSX15-G9**
Engine Performance Data at 60Hz[1]	91	103	114	130

1. Standby/Full Load
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.

TABLE 4. FUEL CONSUMPTION (GAL/HR) AT 1500 RPM (50 HZ)

Model	DFEH	DFEJ	DFEK
Engine	**QSX15-G8**	**QSX15-G8**	**QSX15-G8**
Engine Performance Data at 50Hz[1]	24.1	26.8	30.5

1. Standby/Full Load
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.

TABLE 5. FUEL CONSUMPTION (GAL/HR) AT 1800 RPM (60 HZ)

Model	DFEG	DFEH	DFEJ	DFEK
Engine	**QSX15-G9**	**QSX15-G9**	**QSX15-G9**	**QSX15-G9**
Engine Performance Data at 60Hz[1]	24.1	27.3	30.1	34.4

1. Standby/Full Load
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.

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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 your 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 your construction plans.

6.1 Location

⚠ 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.

6.2 Mounting

Generator sets are mounted on a steel skid that provides proper support, which is sited on mechanical spring isolators to provide adequate vibration isolation per application.

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.

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

6.3 Access to Set

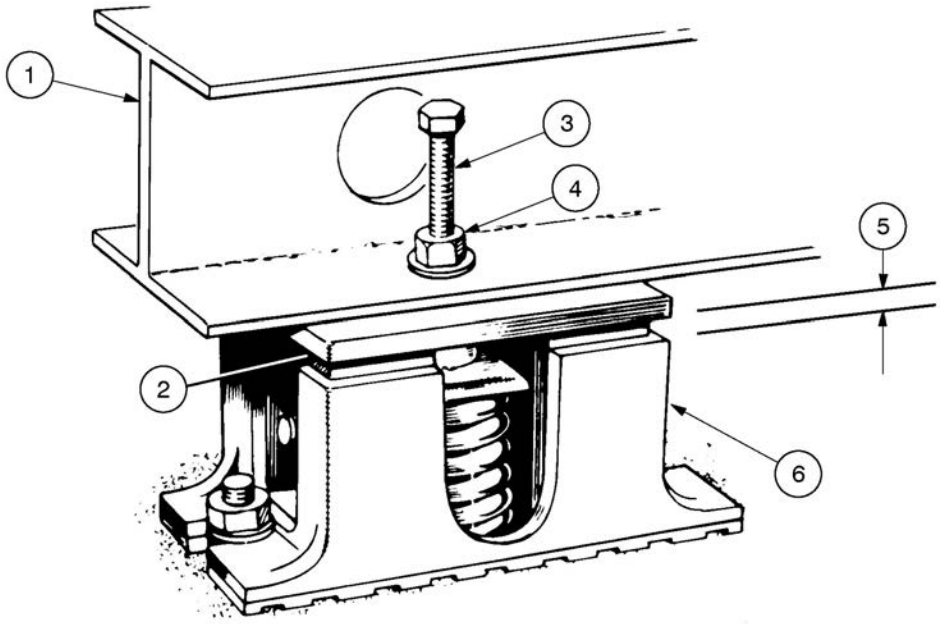
Generally, at least 1 meter (3.3 feet) of clearance should be provided on all sides of the generator set for maintenance and service access. (Increase clearance by width of door if optional housing is used.) A raised foundation or slab of 152 mm (6 inches) or more above floor level will make servicing 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.

6.4 Vibration Isolator Installation and Adjustment Procedure

1. Place the vibration isolators (see **Figure 5**) 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 5. VIBRATION ISOLATOR INSTALLATION

6.5 Rigging Instructions

⚠ WARNING

Lifting.
Improper lifting this can result in severe personal injury or death.
Never lift the generator set by the engine lifting points, use the indicated lifting points and do not stand under or near the generator set when lifting.

⚠ WARNING

Lifting.
Improper lifting this can result in severe personal injury or death.
Personnel must be trained and experienced in rigging and hoisting.

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.

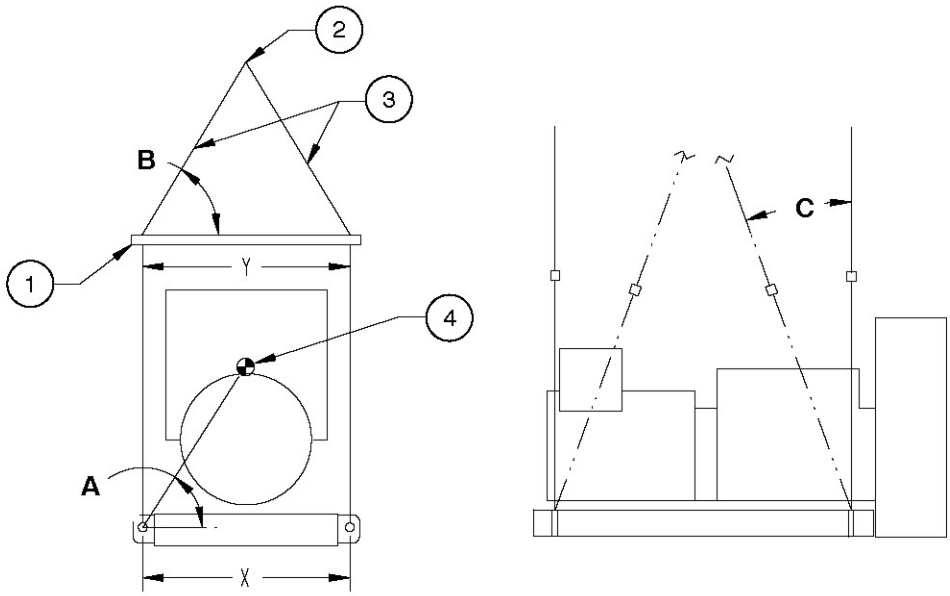
NOTICE

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 degrees from vertical.



Item	Description	Item	Description
A	Angle A	1	Spreader Bar
B	Angle B	2	Lifting Point
C	Angle C (20 Degrees 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 6. RIGGING

6.6 Moving the Generator Set

⚠ WARNING

Improper handling.

Improper handling of the generator set may cause serious damage to the generator set and its components and can result in personal injury or death.

Transportation and handling of generator sets must only be undertaken by suitably trained and experienced personnel.

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.

⚠ WARNING

Lifting.

Improper handling of the generator set may cause serious damage to the generator set and its components and can result in severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points.

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.

⚠ WARNING

Access.
Using the generator set as a means of access when attaching lifting shackles, chains, or other lifting aids, may damage the generator set, causing severe personal injury or death
Do not use the skid (bedframe) or any part of the generator set as a means of access.

NOTICE

On an enclosed generator set, the canopy doors must be locked before repositioning, and they must remain locked during transportation and siting.

- 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.

⚠ DANGER

Raised Load.
Contact with a lifted generator set can result in severe personal injury or death.
Never stand underneath a lifted generator set.

- 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.

6.7 Transportation

⚠ WARNING

Improper handling.
Improper handling of the generator set may cause serious damage to the generator set and its components and can result in personal injury or death.
Transportation and handling of generator sets must only be undertaken by suitably trained and experienced personnel.

⚠ WARNING

Lifting.

Improper handling of the generator set may cause serious damage to the generator set and its components and can result in severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points.

NOTICE

On an enclosed generator set, the canopy 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.
- For lifting procedures, see **Section 6.5 on page 33**.
- 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.

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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 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 Lines Connections

⚠ WARNING

Explosive hazard.
Fuel leaks create fire and explosion hazards which can result in 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

Sparks.
Sparks can ignite fuel, leading to severe personal injury or death.
Do not route fuel lines near electrical wiring.

⚠ WARNING

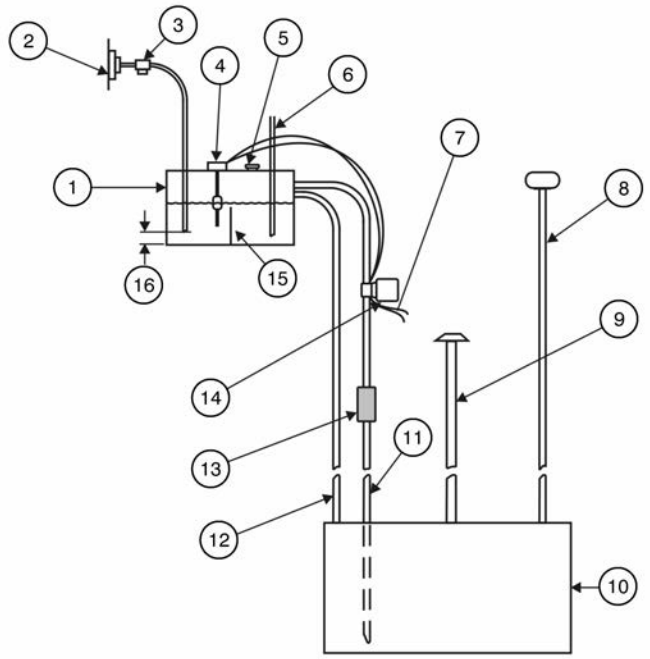
Hot surfaces.
Hot surfaces can ignite fuel, leading to severe personal injury or death.
Do not route fuel lines near hot exhaust parts.

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 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.



No.	Description	No.	Description
1	Day 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 7. 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

NOTICE
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 6 inches (150 mm) 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.

NOTICE

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 6 inches (150 mm) 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 **Chapter 5 on page 27** 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 Day Tank

Some generator set installations may include a fuel day tank. They are used when fuel inlet restriction limits cannot be met, or the supply tank is overhead and presents problems of high fuel head pressure for the fuel inlet and return lines.

7.1.6.1 Supply Tank Lower Than Engine

⚠ WARNING

Fire hazard.

Spilled fuel presents the hazard of fire or explosion which can result in severe personal injury or death.

Provide an overflow line to the supply tank from the day tank.

NOTICE

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply to the day tank.

With this installation, the day tank is installed near the generator set, below the fuel injection system and within the fuel inlet restriction limit. Install a fuel transfer pump, to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

Provide a return line from the engine injection system return connection to the day tank. Plumb the return line to the bottom of day tank as shown in **Figure 7 on page 41**. Provide a day tank overflow line to the supply tank in case the float switch fails to shut off the fuel transfer pump.

7.1.6.2 Supply Tank Higher Than Engine

With this installation, the day tank is installed near the generator set, above the fuel injection system and within the fuel return restriction limit. Include an automatic fuel shutoff valve in the fuel line between the fuel supply tank and the day tank to stop fuel flow when the generator set is off.

Provide a return line from the engine injection system return connection to the day tank. Plumb the return line to the bottom of day tank as shown in **Figure 7 on page 41**.

NOTICE
Spilled fuel can create environmental hazards. Check local requirements for containment and prevention of diagraining to sewer and ground water.

7.1.7 Fuel Transfer Pump

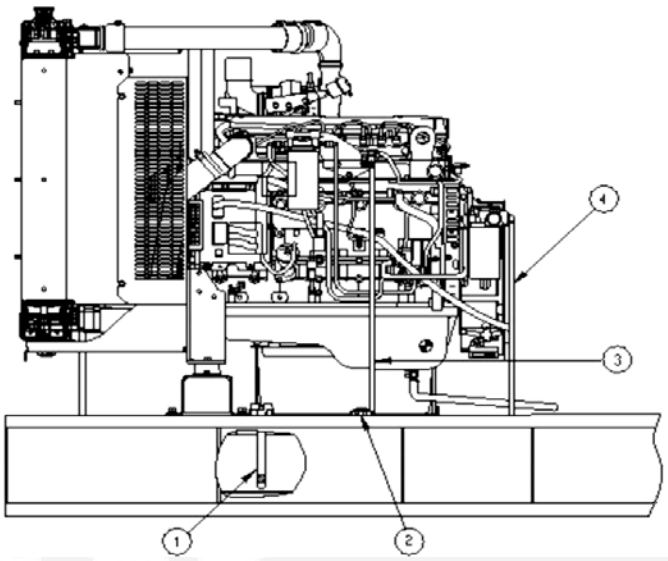
7.1.7.1 Fuel Transfer Pump Installation

⚠ **WARNING**
Combustible fuels. ***Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited.*** ***Installation and service must be performed by trained and experienced persons in accordance with the applicable codes.***

NOTICE
Do not smoke near fuel and keep flames, sparks, pilot lights, arcing switches and equipment, and other sources of ignition well away.

A fuel transfer pump and control are available as an option when a sub-base or an in-skid day tank is provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

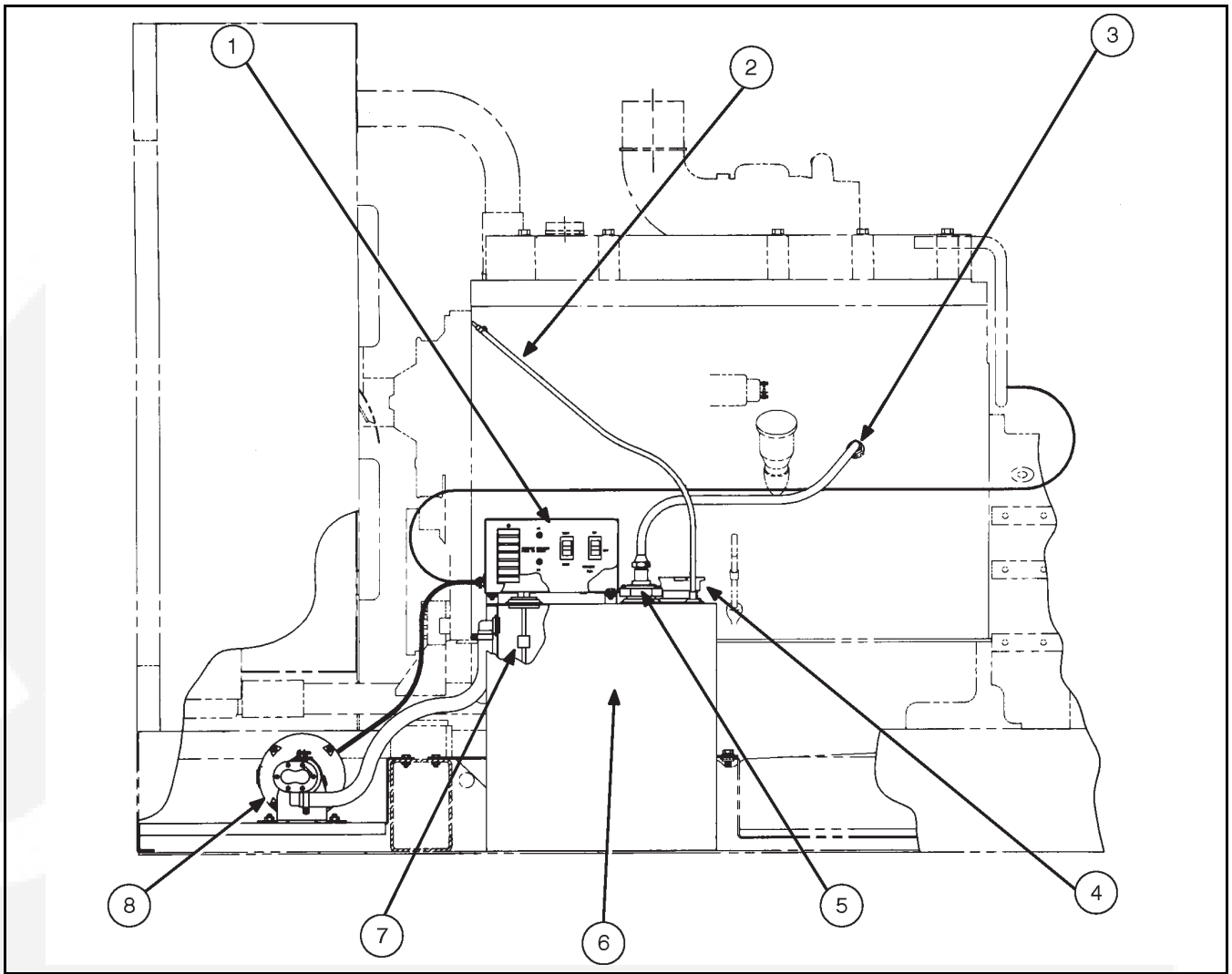
7.1.7.1.1 Sub-Base Installation



1	Float Switch Assembly	3	Fuel Supply Line
2	Fuel Fill Cap	4	Fuel Flexible Return Line

FIGURE 8. TYPICAL SUB-BASE INSTALLATION

7.1.7.1.2 In-Skid Installation



No.	Description	No.	Description
1	Control	5	Fuel gauge
2	Flexible fuel return line	6	Day tank
3	Flexible fuel supply line	7	Float switch assembly
4	Fuel fill cap	8	Fuel pump and motor

FIGURE 9. TYPICAL IN-SKID DAY TANK INSTALLATION

7.2 Exhaust System

⚠ WARNING

Exhaust gasses.

Inhalation of exhaust gasses can result in severe personal injury or 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 exhaust pipes.

Hot exhaust pipes can start a fire and cause severe injury or death if improperly routed through walls.

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.

Where applicable, refer to NFPA 37, Section 6-3, *Stationary Combustion Engines and Gas Turbines,* for accepted design practices. 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 10 on page 48**) 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. Where applicable, refer to NFPA 37, Section 6-3, *Stationary Combustion Engines and Gas Turbines,* for accepted design practices. 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.

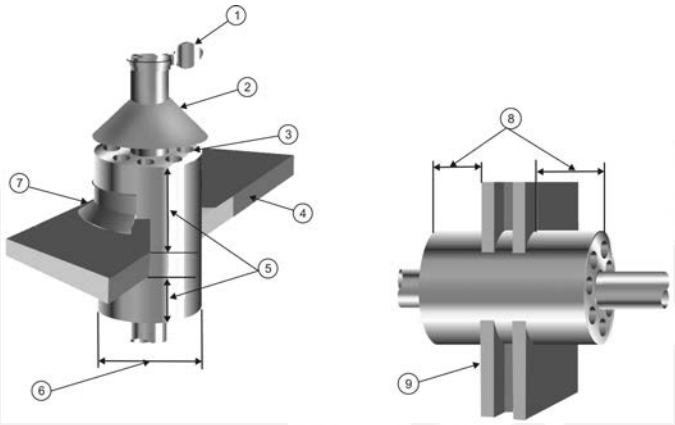
Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support the exhaust system to prevent weight from being applied to engine exhaust outlet elbow/turbocharger connection.

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 11 on page 48**).

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 10. EXHAUST THIMBLE

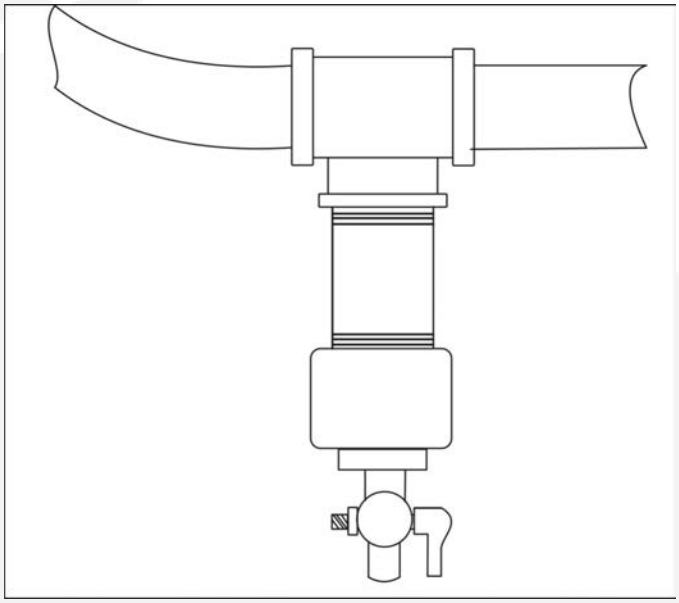
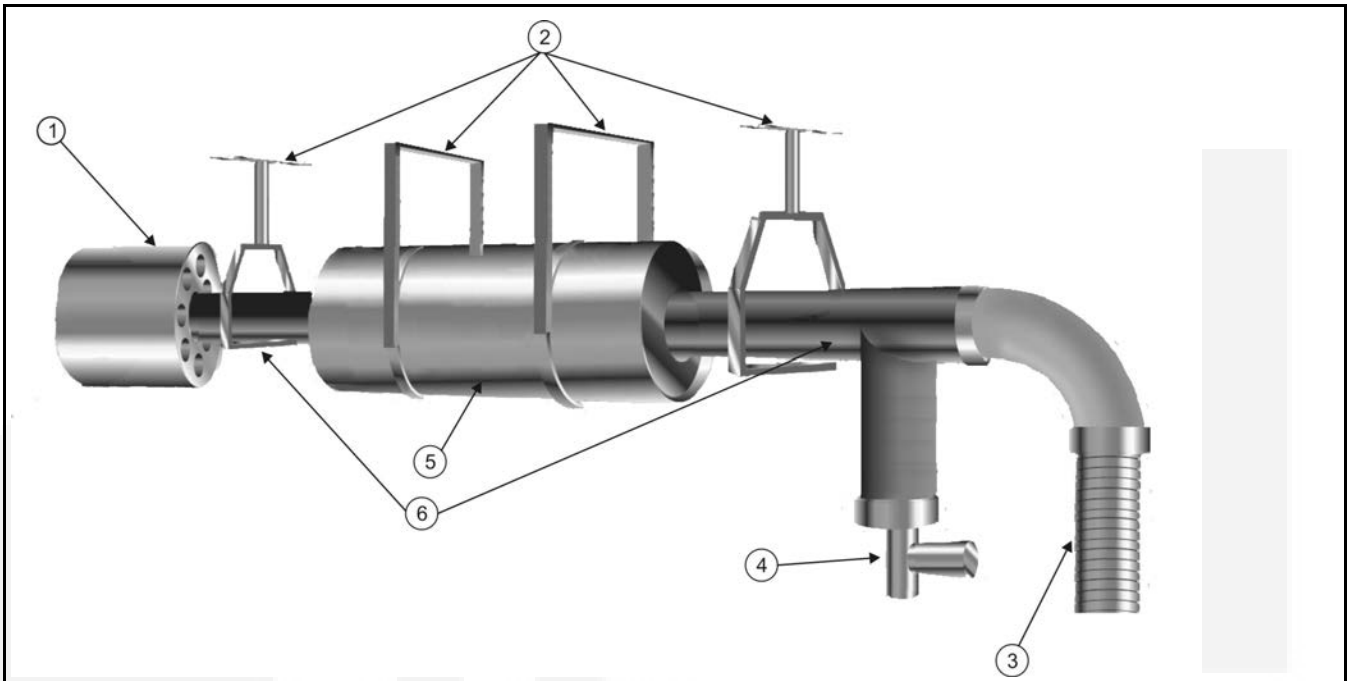


FIGURE 11. CONDENSATION TRAP



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

FIGURE 12. TYPICAL SUSPENDED EXHAUST SYSTEM

7.3 Ventilation and Cooling

⚠ WARNING

Asphyxiation.

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

All engine or radiator cooling air must be discharged to the out-of-doors. Do not use it for heating a room or compartment.

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.

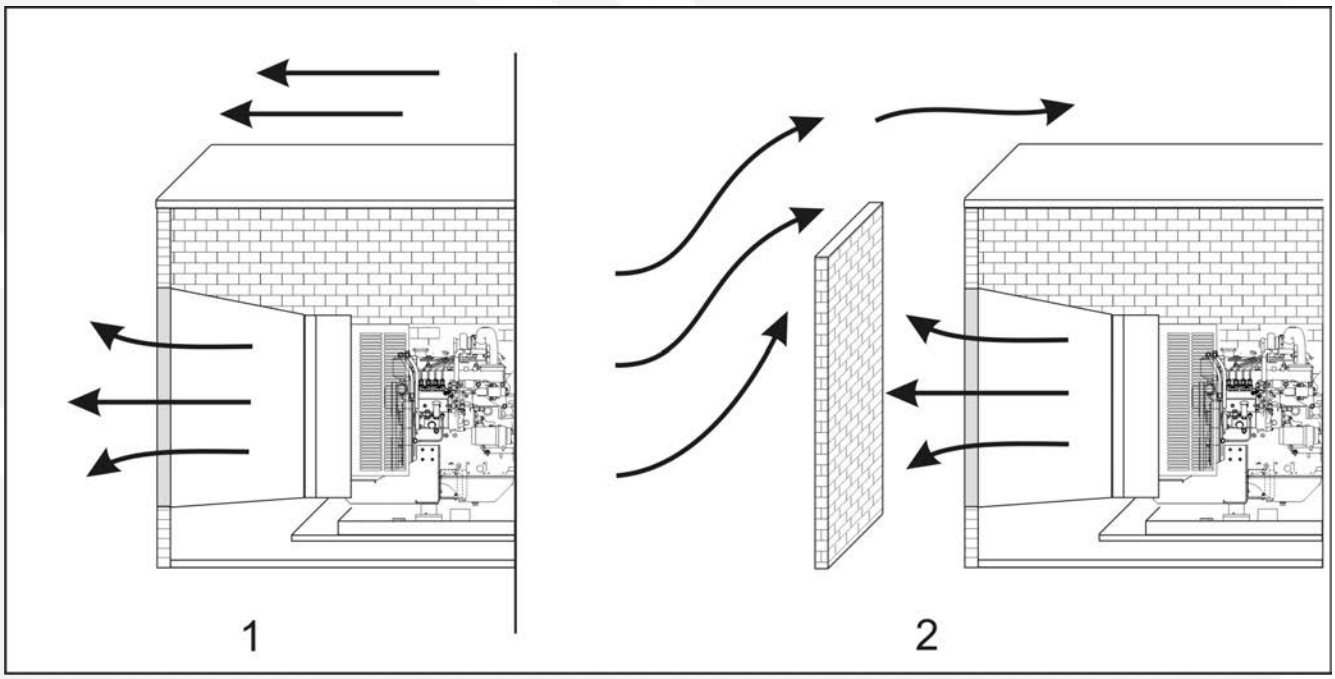
7.4 Vents and Ducts

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.

Size the vents and ducts so they are large enough to allow the required flow rate of air.

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.

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 outlet vent cannot be located as mentioned, install a wind barrier, see **Figure 13**.



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

FIGURE 13. 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.

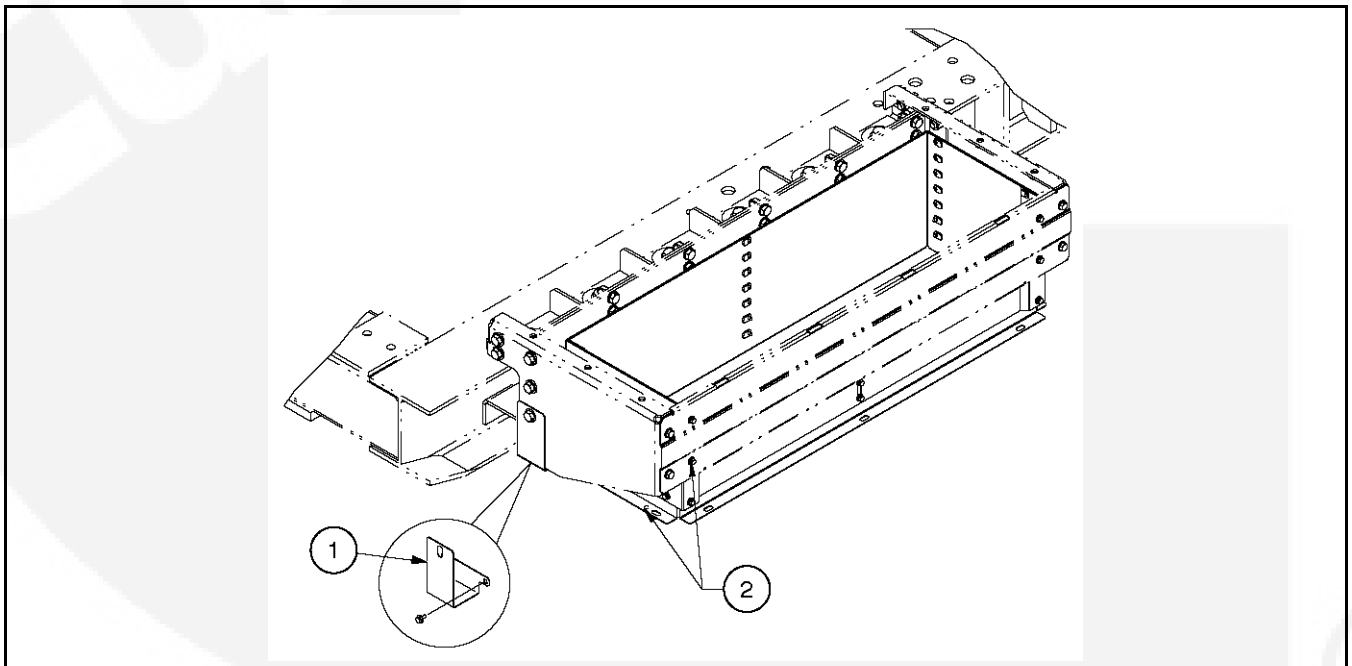
7.6 Cable Chute

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 14**),

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.



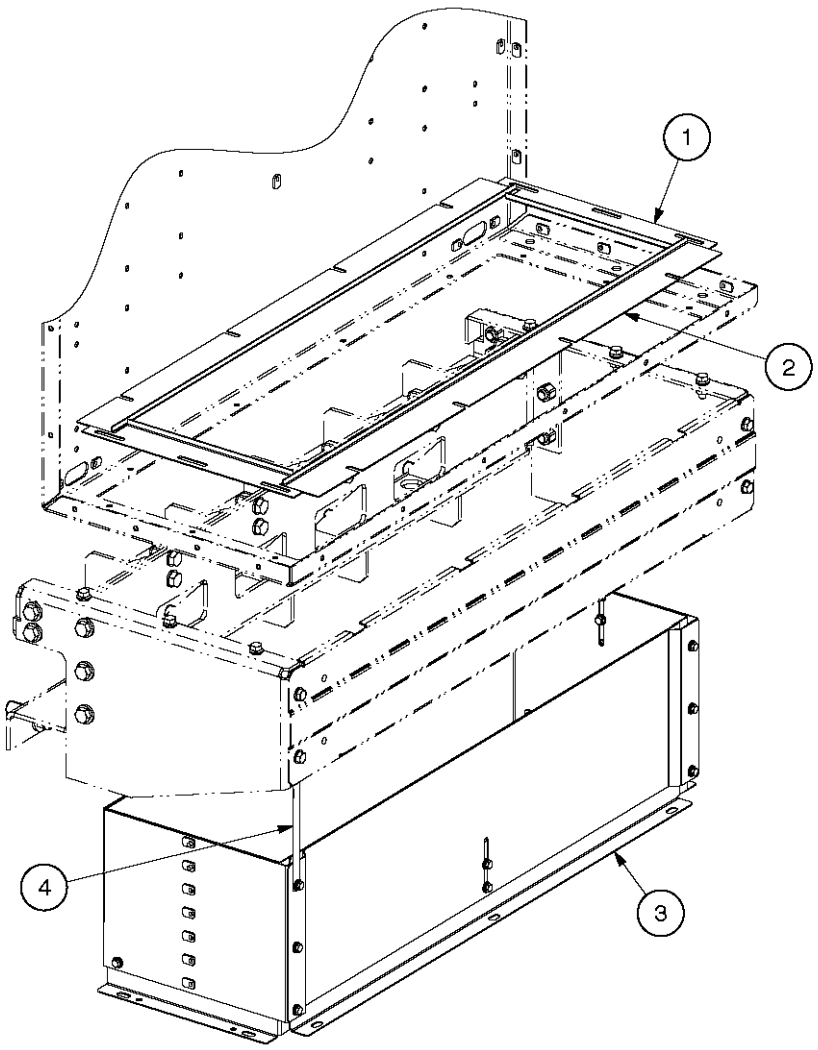
1	Shipping Bracket	2	Hole Plugs

FIGURE 14. CHUTE ASSEMBLY

To install the chute assembly (see **Figure 15**),

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.



1	Cover Plate	3	Chute
2	Cover Plate	4	Electrical Strap

FIGURE 15. 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.

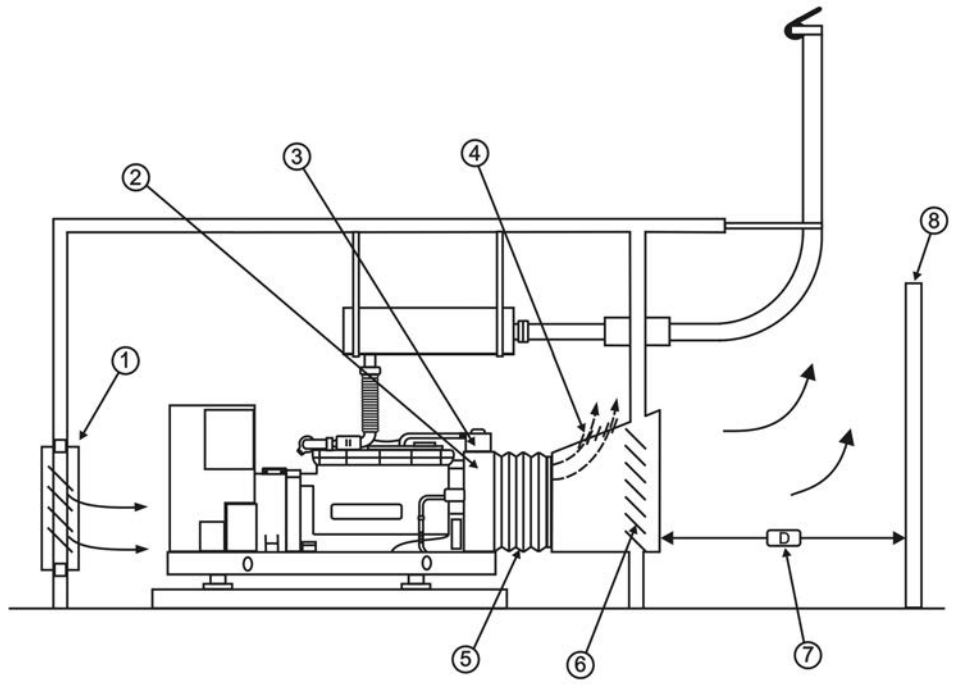
A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

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 Power Generation.



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 16. 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

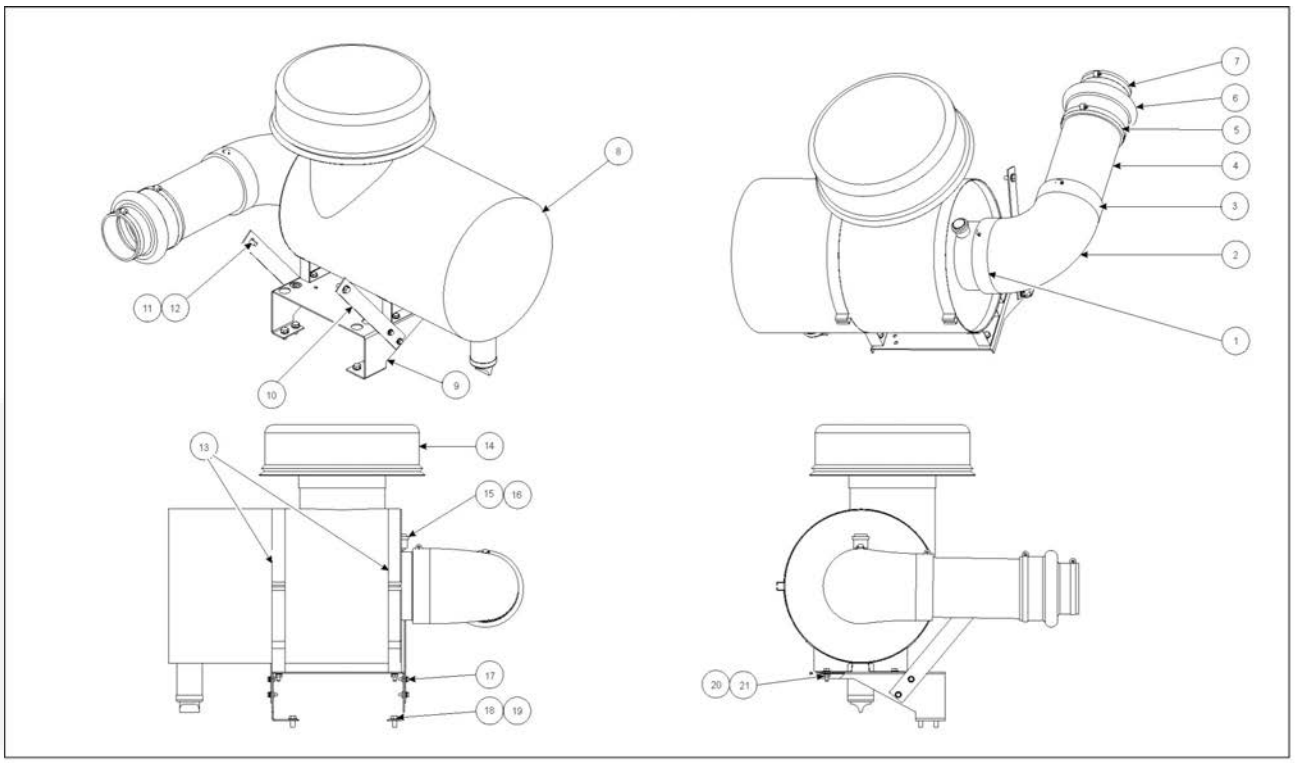


FIGURE 17. HEAVY DUTY AIR CLEANER PARTS

TABLE 6. PART DESCRIPTIONS

Item	Description	Qty	Item	Description	Qty
1	Hose Clamp	1	12	Hex Head Capscrew (M12 x 1.75 x 25)	2
2	Reducing Elbow - 90° - 8" to 7"	1	13	Mounting Band	2
3	Hose Clamp	1	14	Air Inlet Hood	1
4	Air Cleaner Tube - Inlet	1	15	Service Indicator	1
5	Hose Clamp	1	16	Pipe Adapter	1
6	Hose Reducer	1	17	Hex Head Screw (M8 x 1.25 x 20)	4
7	Hose Clamp	1	18	Flat Washer (M12)	4
8	Air Cleaner	1	19	Hex Head Capscrew (1/2 - 13 x 1.00)	4
9	Air Cleaner Bracket	1	20	Hex Head Screw (M8 x 1.25 x 20)	4
10	Air Cleaner Bracket	2	21	Hex Nut - Flange (M8 x 1.5)	4
11	Flat Washer (M12)	2			

The numbers in parenthesis ( ) correspond to the part callout numbers in **Figure 17** and **Table 6**.

⚠ 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.

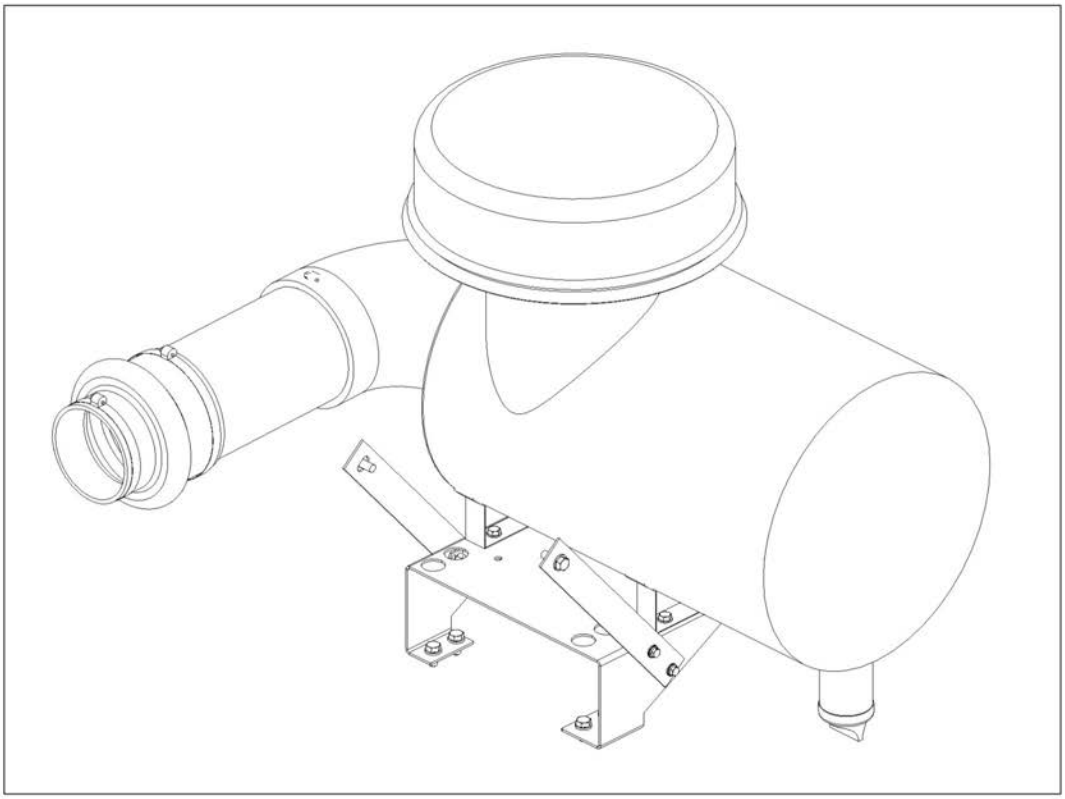


FIGURE 18. INSTALLED HEAVY DUTY AIR CLEANER

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 Power Generation 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 indicate 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.

7.9.2 AmpSentry Labels

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

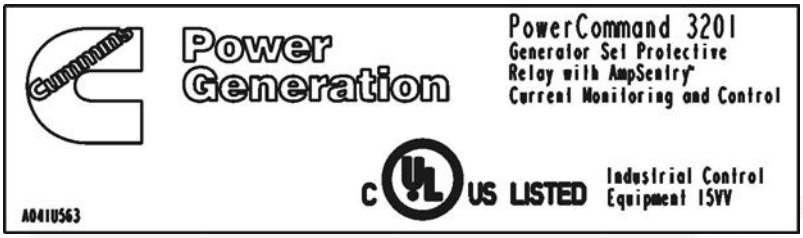
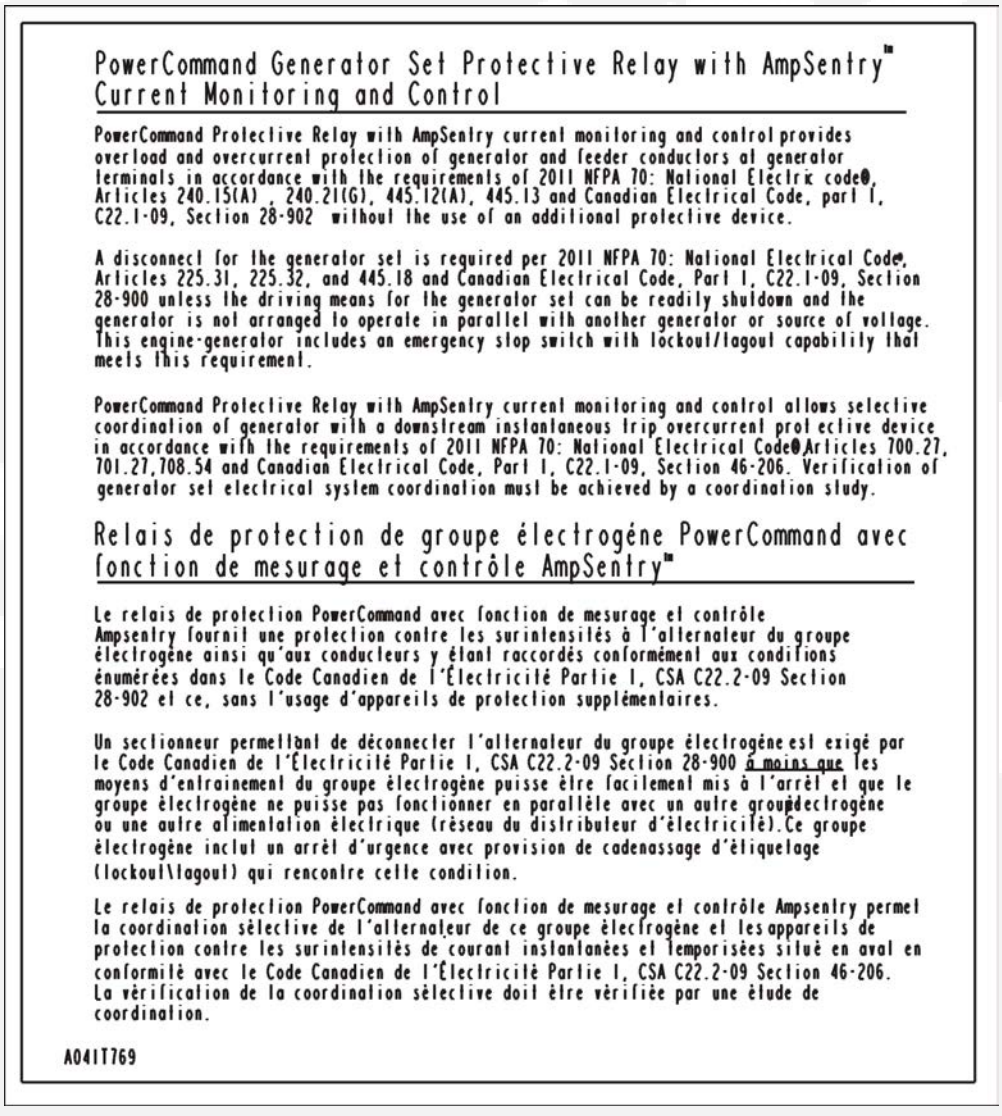


FIGURE 19. POWERCOMMAND 3201 LABEL



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 électrogène PowerCommand avec fonction de mesurage et contrôle AmpSentry™

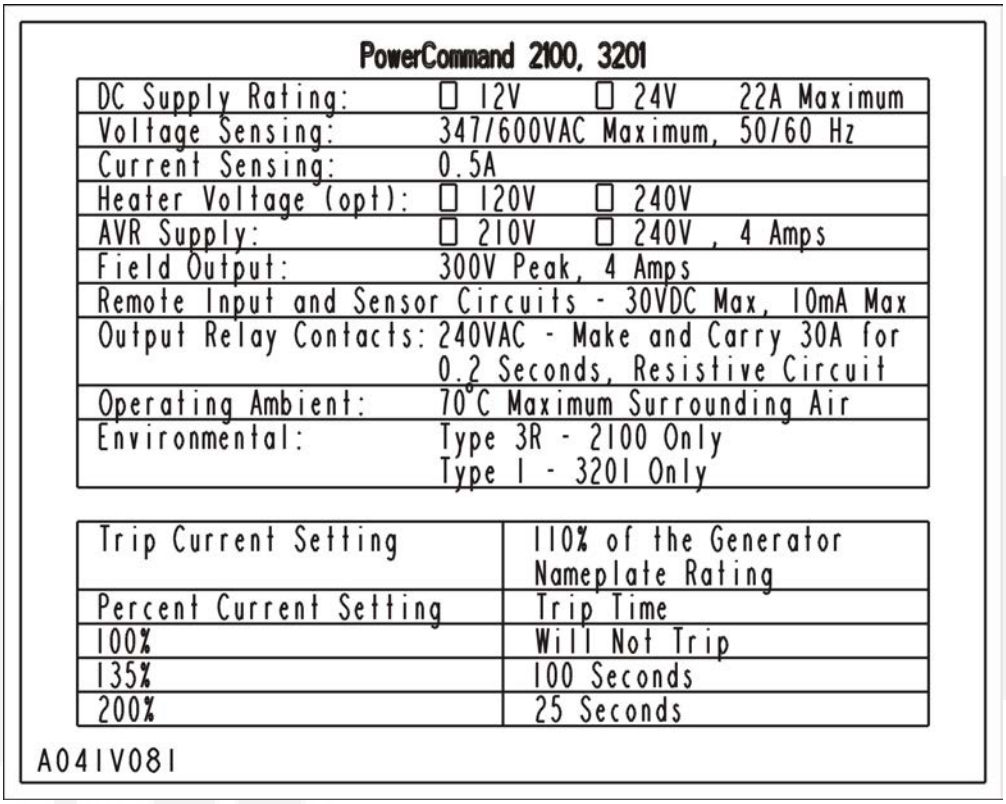
Le relais de protection PowerCommand avec fonction de mesurage et contrôle Ampsentry fournit une protection contre les surintensités à l'alternateur du groupe électrogène ainsi qu'aux conducteurs y étant raccordés conformément aux conditions énumérées dans le Code Canadien de l'Électricité Partie I, 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 groupe électrogène 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 cette 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 20. 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 21. POWERCOMMAND 2100 AND 3201 SPECIFIC CHECK LABEL

7.9.3 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.

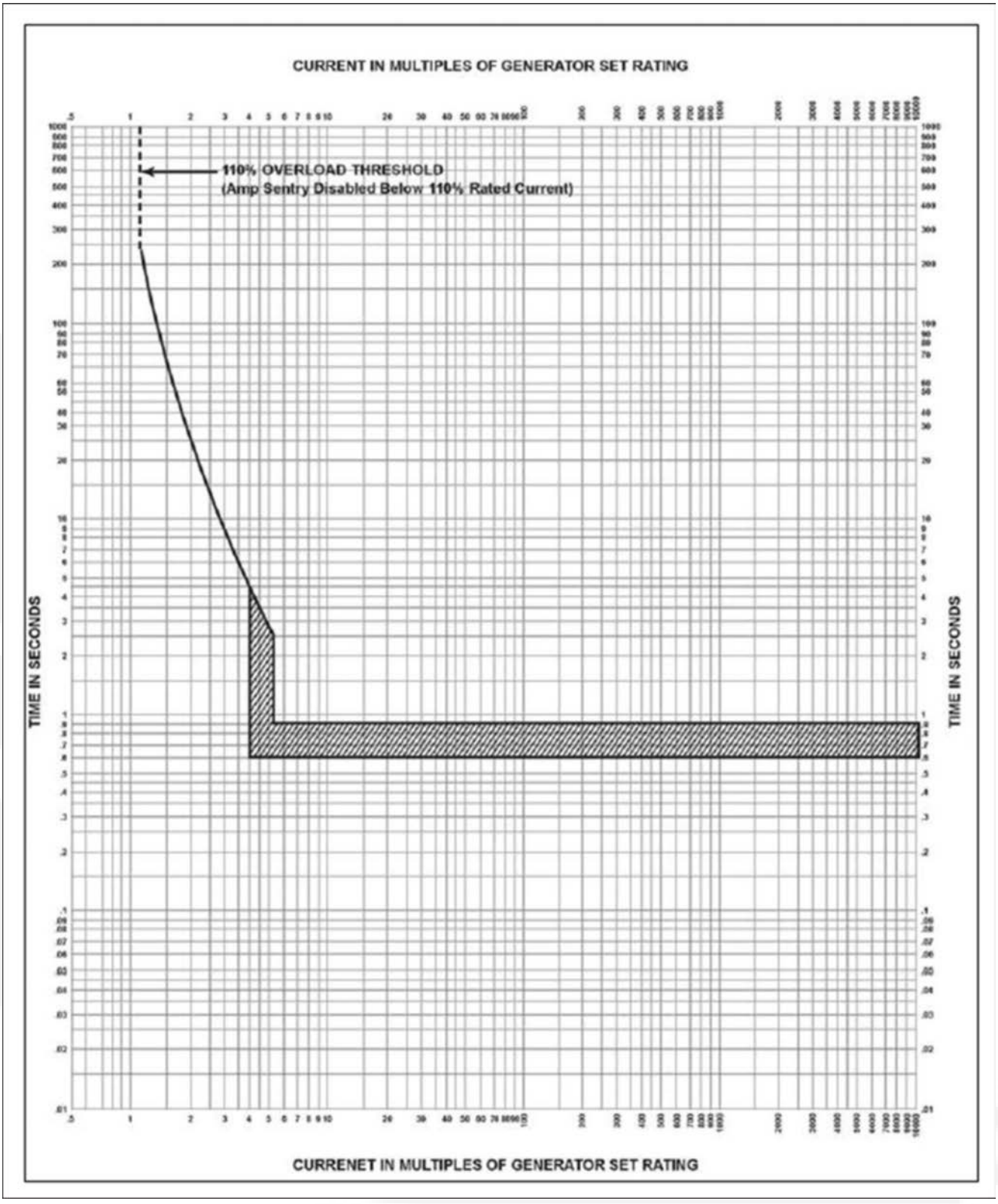


FIGURE 22. AMPSENTRY™ PROTECTIVE RELAY TIME OVER-CURRENT CHARACTERISTIC CURVE

7.9.4 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 www.cumminspower.com for a copy of document R-1053, or it can be found using SKM Power Tools for Windows library or from your distributor.

7.9.5 Additional AmpSentry Protective Relay Information

TABLE 7. ADDITIONAL AMPSENTRY PROTECTIVE RELAY INFORMATION FOR POWERCOMMAND 2100 CONTROL

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
Battery Supply	8-30V		DC	22A	TB1 (17-22)
Voltage Sense Input	347/600V	3	50/60	10mA	J8 (4, 7, 12, 20)
Current Sense Input		3	50/60	5A	J7 (11, 12, 15, 16, 19, 20)
AVR Shunt Supply	240V	1	50/60	100mA	J8 (21-23)
AVR PMG Supply	210V	1	50/60	100mA	
AVR Output (Continuous)	300V (Peak)	1	PWM	4A	J8 (5,13)
AVR Output (Max/10 seconds)	300V (Peak)	1	PWM	6A	
Run Relay Output	30V		DC	8A; 1.44A Pilot Duty	TB1 (17-22)
Customer Relay Output	30V		DC	5A	TB1 (8-15)
	250V	1	AC	5A; C300 Pilot Duty	
Indicator Supply	5V		DC	50mA	J2
Engine Sensors	5V		DC	3mA	J7 (13, 17, 21, 22, 25, 26, 29-35)
Governor Drive	5-30V		DC	100mA	J7 (14, 24, 28, 36)
Power Out	8-30V		DC	100mA	J7 (1-8, 18)
Solenoid Driver Signal	5-30V		DC	100mA	J7 (9, 10, 23, 27)
Switch Input	8-30V		DC	1mA	J1
Membrane Switch Input	5V		DC	1mA	J3
Customer Inputs	8-30V		DC	1mA	TB1 (1-6)
Power Transfer Status	5-30V		DC	1mA	TB2 (5)
Power Transfer Signal Supply	5-30V		DC	100mA	TB2 (3, 4, 6)

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
Interface	5V		DC	1mA	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				

8 DC Control Wiring

⚠ WARNING

Electric shock.

AC voltages and currents present an electrical shock hazard that can result in severe personal injury 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.

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

⚠ WARNING

Electric shock.

Touching uninsulated high voltage parts inside the control box present an electric shook hazard that can result in severe personal injury or death.

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

⚠ WARNING

Electric shock.

Voltages and currents present an electric shook hazard that can result in severe personal injury 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.

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.

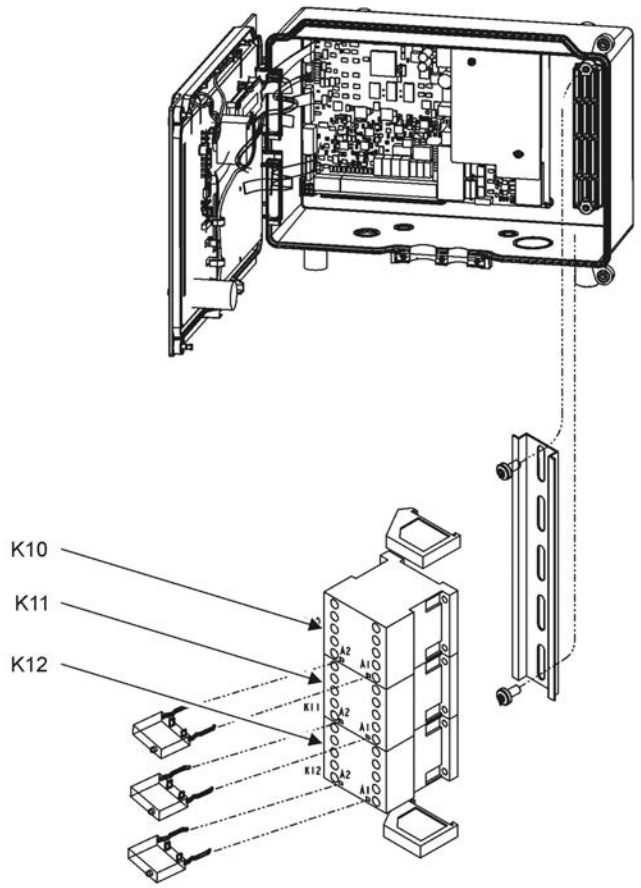
NOTICE

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.

8.1 Customer Relays

8.1.1 Location of Customer Relays



No.	Description	No.	Description
K10	Configurable Output 1	K12	Configurable Output 3
K11	Configurable Output 2		

FIGURE 23. LOCATION OF CUSTOMER RELAYS

8.1.1.1 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.

8.1.1.2 Contact Specifications

The contacts are rated at 10 A at 600 VAC.

8.1.1.3 Schematic

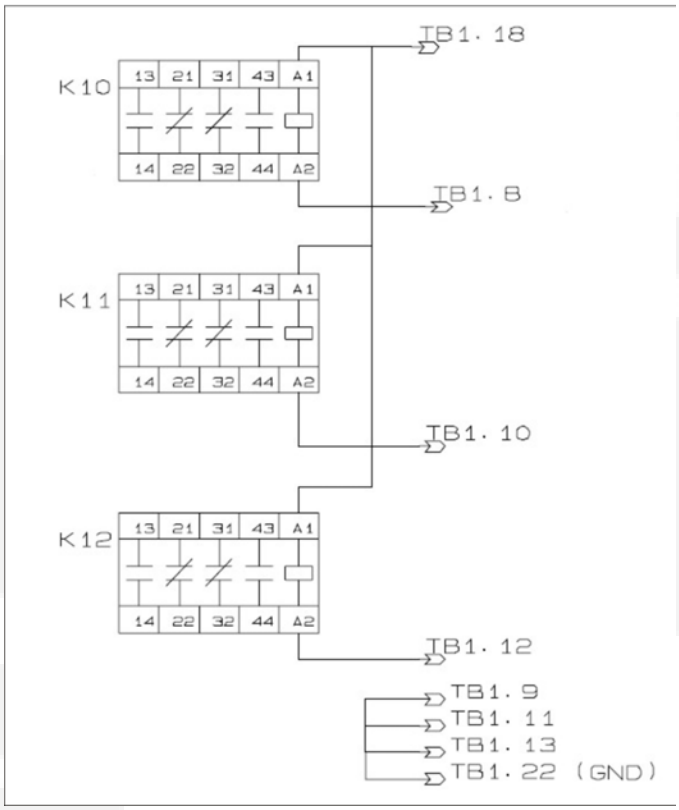


FIGURE 24. SCHEMATIC

8.2 Paralleling Circuit Breaker Control Relays

8.2.1 Paralleling Circuit Breaker Control Relays Installaltion

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

The control logic instructs the genset 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).

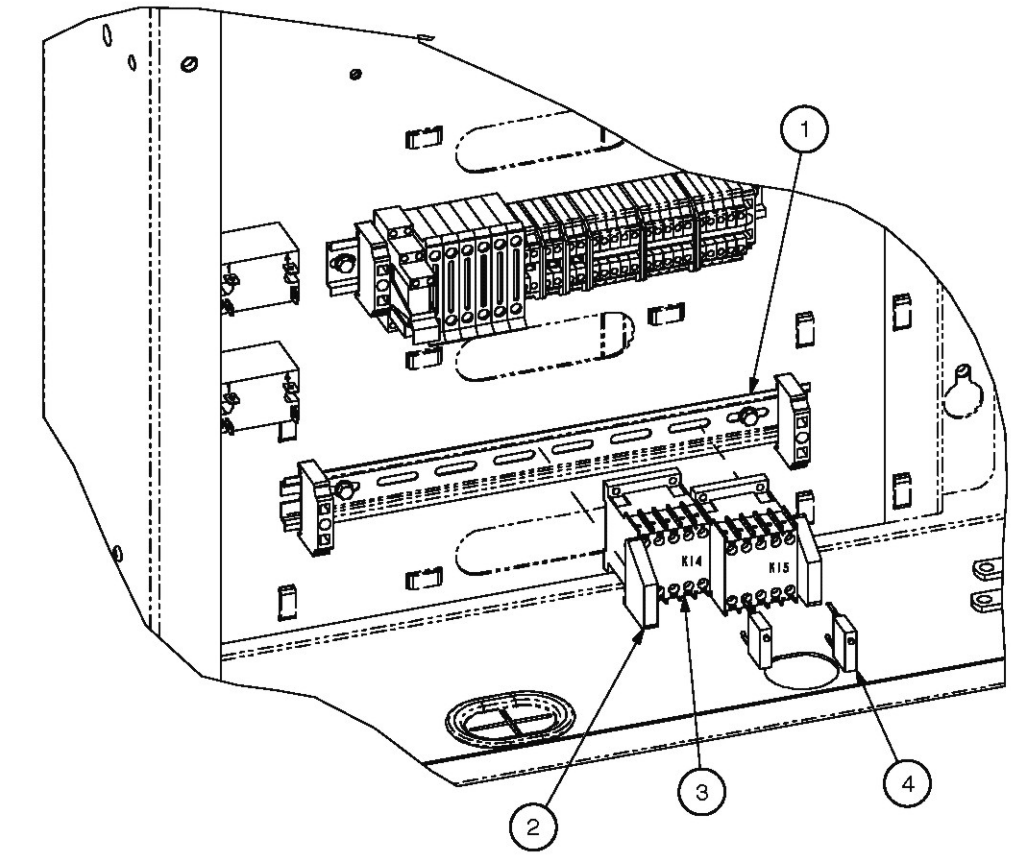
In single genset applications, the relay contact used for breaker closing is capable of being set up to trip the breaker on fault shutdowns only and the breaker positin is not sensed.

TABLE 8. BREAKER CONTROL FUNCTIONS

Connector Pin	Signal Name	Signal Type	Description of Default Function
TB5-1	Genset CB Close Status	Relay Output	Contact for closing genset breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-2			

TB5-3	Genset CB Open Status	Relay Output	Contact for opening genset breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TP5-4			
TP5-5			
TB5-6	Utility CB Close Status	Relay Output	Contact for closing utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-7			
TP5-8	Utility CB Open Status	Relay Output	Contact for opening utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TP5-9			

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



No.	Description	No.	Description
1	Control Relay	3	Terminal Block
2	Voltage Suppressor	4	Terminal DIN Rail

FIGURE 25. PARALLELING CIRCUIT BREAKER CONTROL RELAYS

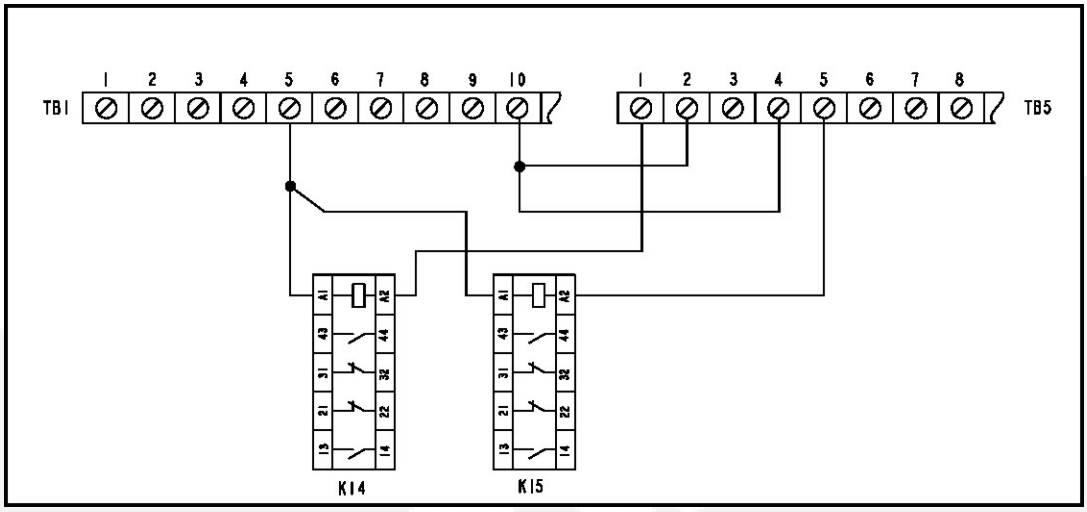


FIGURE 26. WIRING DIAGRAM OF PARALLELING CIRCUIT BREAKER CONTROL RELAYS

8.3 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.

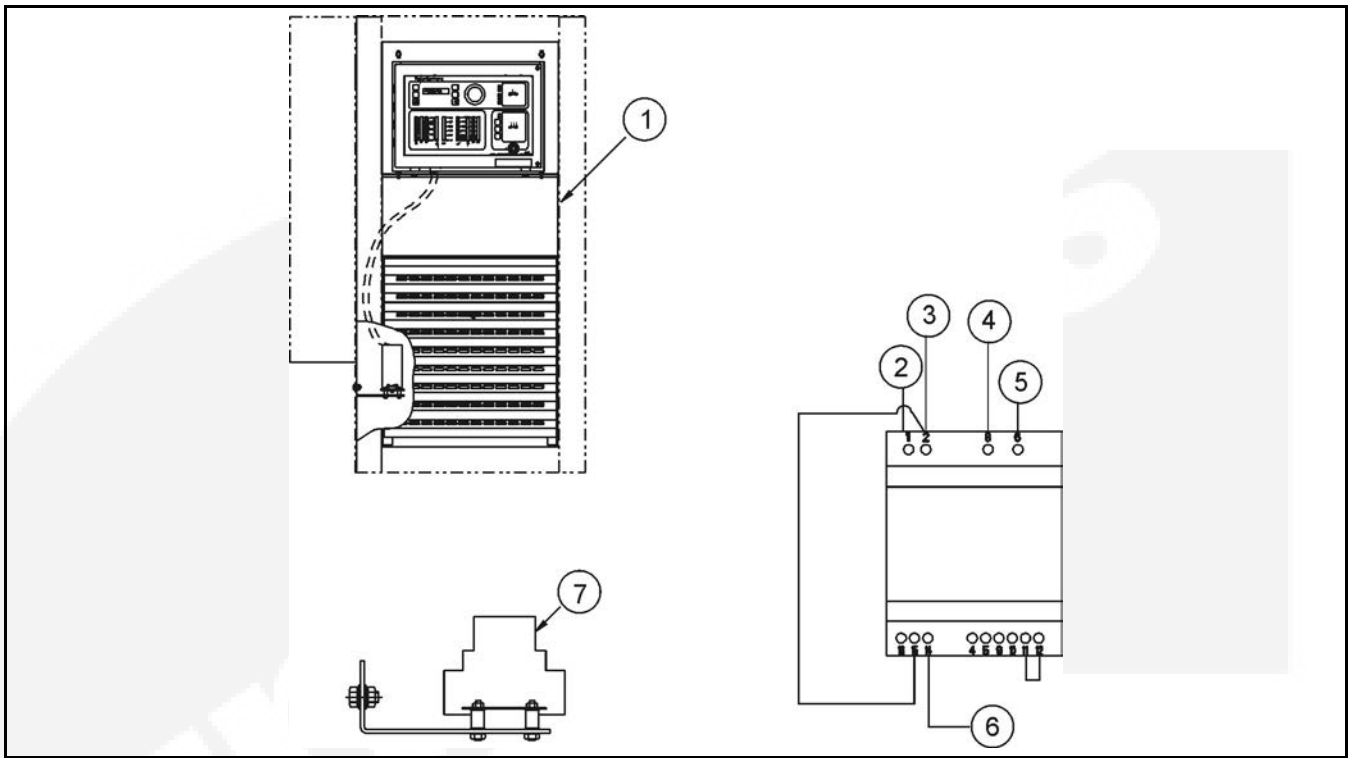
8.3.1 Ground Fault Relay Installation

Refer to the following figure when making wiring connections. The connection points on the ground fault relay that are used include:

- GFR-1 - B+
- GFR-2 - B–
- GFR-6 to CT3
- GFR-8 to CT1
- GFR-14 (Signal) to TB1-14
- GFR-15 (Signal Return) to TB1-15

The two leads connected from GFR-14 and GFR-15 to TB1-14 and 15 are configurable inputs.

The maximum AC terminal voltage for the ground fault relay is 600 VAC. The supply voltage is 12-48 VDC. The continuous current is 5 amps.



No.	Description	No.	Description
1	Panel	5	GND (Gen) [connect terminal 6 to Generatorf Gounding Bolt]
2	TB1-21 (-)	6	TB1-5 (Alarm)
3	TB1-18 (+)	7	Ground Fault Relay
4	Gen Neutral [connect terminal 8 to Generator Neutral Terminal]		

FIGURE 27. 0179-3244 REVISION F GROUND FAULT RELAY INSTALLATION

9 AC Electrical Connections

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

⚠ WARNING

Electric shock.

AC voltages and currents present an electrical shock hazard that can result in severe personal injury 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.

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.

⚠ WARNING

Arcing.

Arcing at battery terminals, a light switch or other equipment, flame, pilot lights, and sparks can ignite battery gases, that can cause severe personal injury or death.

Do not smoke or switch a trouble light ON or OFF near a battery.

Discharge static electricity from your body before touching batteries by first touching a grounded metal surface.

Ventilate the battery area before working on or near a battery.

Using an insulated wrench, disconnect the negative (-) cable first and reconnect it last.

⚠ WARNING

Accidental or remote starting.

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

Prevent accidental or remote starting by disconnecting the starting battery cables (negative [–] first), using an insulated wrench and isolating all auxiliary supplies.

⚠ WARNING

Electrical Maintenance.

Improper procedures may result in property damage, bodily injury or death.

Each of the operations described in this section should be done only by persons trained and experienced in electrical maintenance.

⚠ WARNING

Electric current.

Electric current can cause severe personal injury or death.

The AC sensing harness and other cabling will become energized when the generator set is in operation.

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.

⚠ CAUTION

Voltage spikes.

Disconnecting the battery charger cables from the AC source can result in voltage spikes high enough to damage the DC control circuits of the generator set.

Always disconnect a battery charger from its AC source before disconnecting the battery cables.

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.).

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.

⚠ WARNING

Improper wiring.

Improper wiring can cause a fire or electrical hazard, resulting in severe personal injury or death and/or property and equipment damage.

Wiring should only be carried out by persons trained and experienced in electrical maintenance.

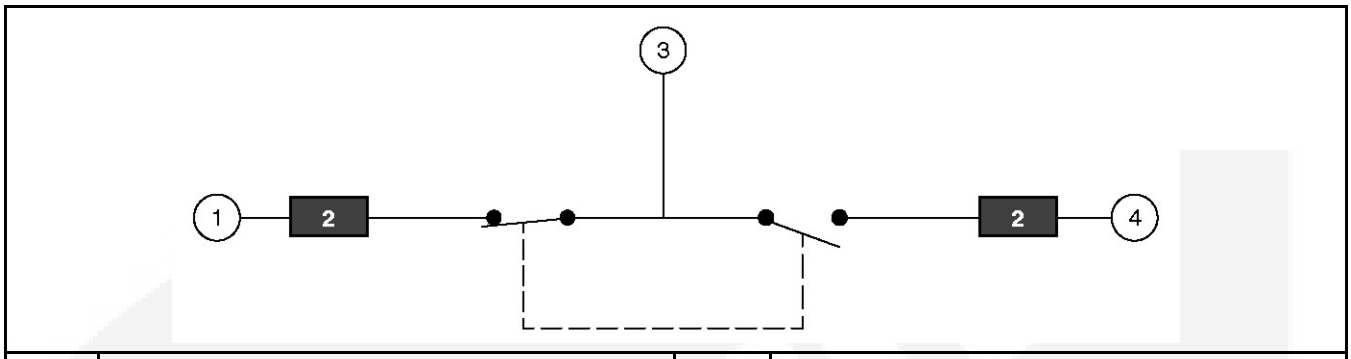
Before starting the generator set, check to make sure that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the generator set are properly connected.

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.

9.1 Transfer Switch

A transfer switch must be used for switching the load from the normal power source to the generator set (see **Figure 28**). 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 28. TYPICAL LOAD TRANSFER FUNCTION

9.2 Generator Voltage Connections

These generators 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 generator 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.

9.3 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 generator by bolting stranded load wires to the appropriate terminals on the generator 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 115** for details about the following:

- Load connections
- Conduit
- Cable Size

9.4 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.

9.5 Fuel Transfer Pump Installation

⚠ WARNING

Combustible fuels.

Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited.

Installation and service must be performed by trained and experienced persons in accordance with the applicable codes.

NOTICE

Do not smoke near fuel and keep flames, sparks, pilot lights, arcing switches and equipment, and other sources of ignition well away.

A fuel transfer pump and control are available as an option when a sub-base or an in-skid day tank is provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

9.5.1 Fuel Transfer Pump Control AC Connections

See the wiring diagrams provided with your generator set when making connections at the fuel pump control.

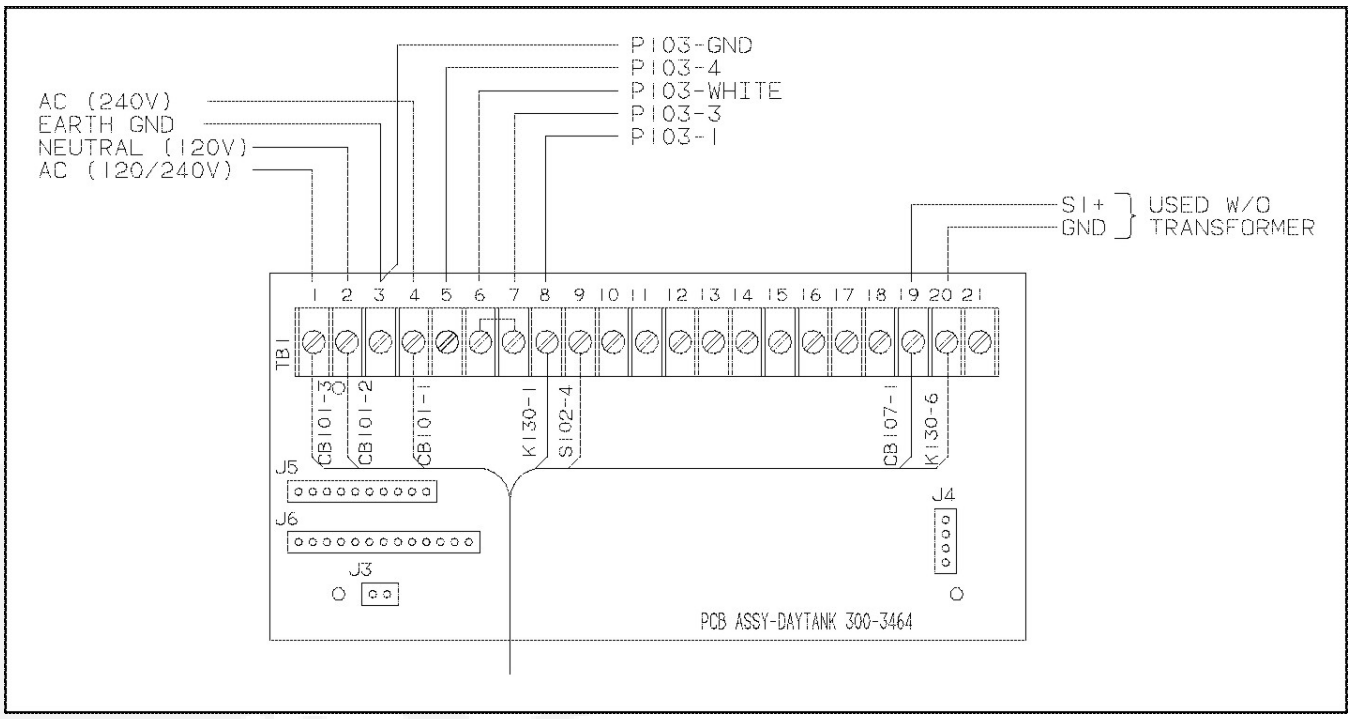


FIGURE 29. FUEL PUMP CONTROL TERMINAL BOARD

The following should be noted.

1. The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC.

NOTICE
To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps. **a. Remove the two jumpers between terminals TB1-6 and TB1-7 in the control box, and connect one jumper between terminals TB1-5 and TB1-6 and the other jumper between terminals TB1-7 and TB1-8.** **b. Move selector switch S103 on the control PCB to the up position for 120 V.** **c. On the control transformer, remove the two jumpers between terminals H2 and H3, and connect one jumper between H1 and H3 and the other jumper between H2 and H4.**

NOTICE
To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps. **a. Remove the jumpers between terminals TB1-5 and TB1-6 and TB1-7 and TB1-8 in the control box, and connect the two jumpers between terminals TB1-6 and TB1-7.** **b. Move selector switch S103 on the control PCB to the down position for 240 VAC.** **c. On the control transformer, remove the jumpers between terminals H1 and H3 and H2 and H4, and connect the two jumpers between H2 and H3.**

2. Attach a tag to the control box indicating the supply voltage.

3. Terminals TB1-8 and TB1-5 are available for connection of a 120- or 240-VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump.

9.6 Current Transformers

Current transformers (CTs) are used to display generator set load in kVA and alternator amperage.

9.6.1 CT Installation Requirements

The CT has a dot on one side. This dot must be facing toward the generator 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 (refer to the Reconnection Diagram in).

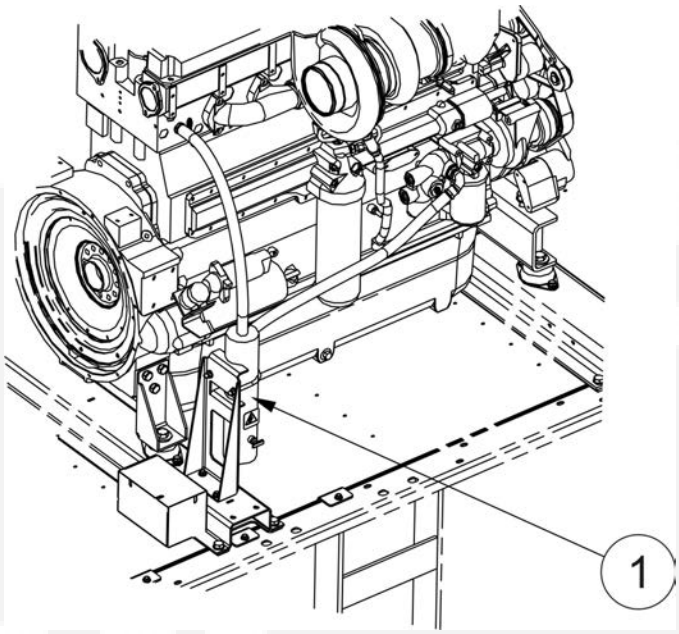
The CTs have dual secondary's (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 3 for low voltage generator sets.

9.7 Coolant Heater

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.

9.7.1 Coolant Heater Installation

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.

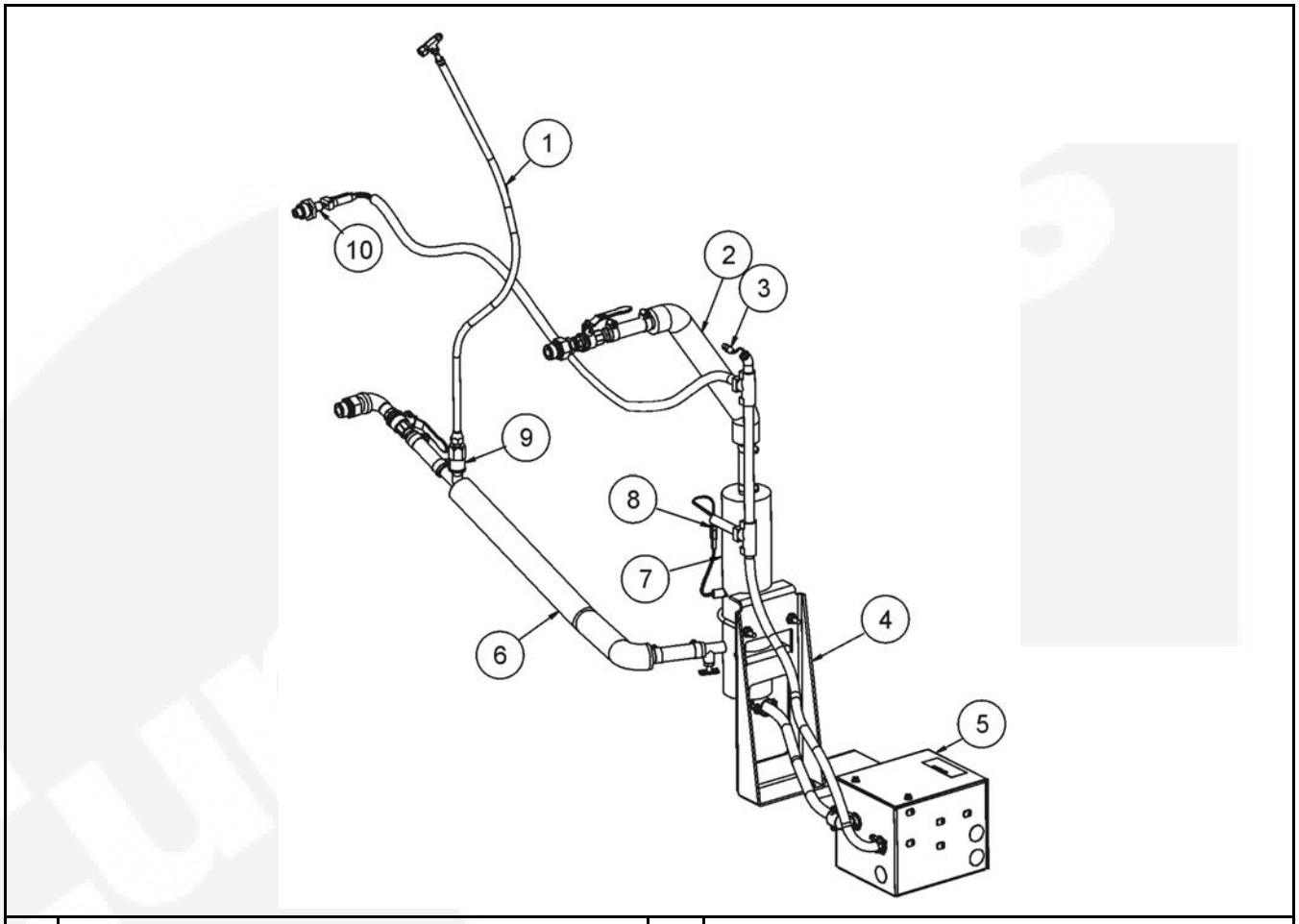


No.	DESCRIPTION
1	Coolant Heater

FIGURE 30. TYPICAL COOLANT HEATER MOUNTED ON THE GENERATOR SET

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

Figure 31 shows the heater line connection. Connect the heater to a source of power that will be on during the time the engine is not running. Ensure the supply voltage and circuit current is correct for the heater element rating.



No.	DESCRIPTION	No.	DESCRIPTION
1	Heater Vent Line	6	Heater Hose
2	Heater Hose	7	Coolant Heater
3	Inline Fuse for Coolant Heater	8	DC Control Harness Plug to Thermostat plug on Heater
4	Coolant Heater Bracket	9	Check Valve
5	Heater Control	10	Thermostat

FIGURE 31. 0179-3536 REVISION E COOLANT HEATER

9.7.2 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 °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 480 V or 240-208 V configurations.

9.8 Alternator Heaters

9.8.1 Alternator Heater Connection

⚠ WARNING

Electric shock.

Water or moisture inside an alternator increases the possibility of flashing and electrical shock, which can cause equipment damage and severe personal injury or death.

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 a alternator, creating flashing and shock hazards.

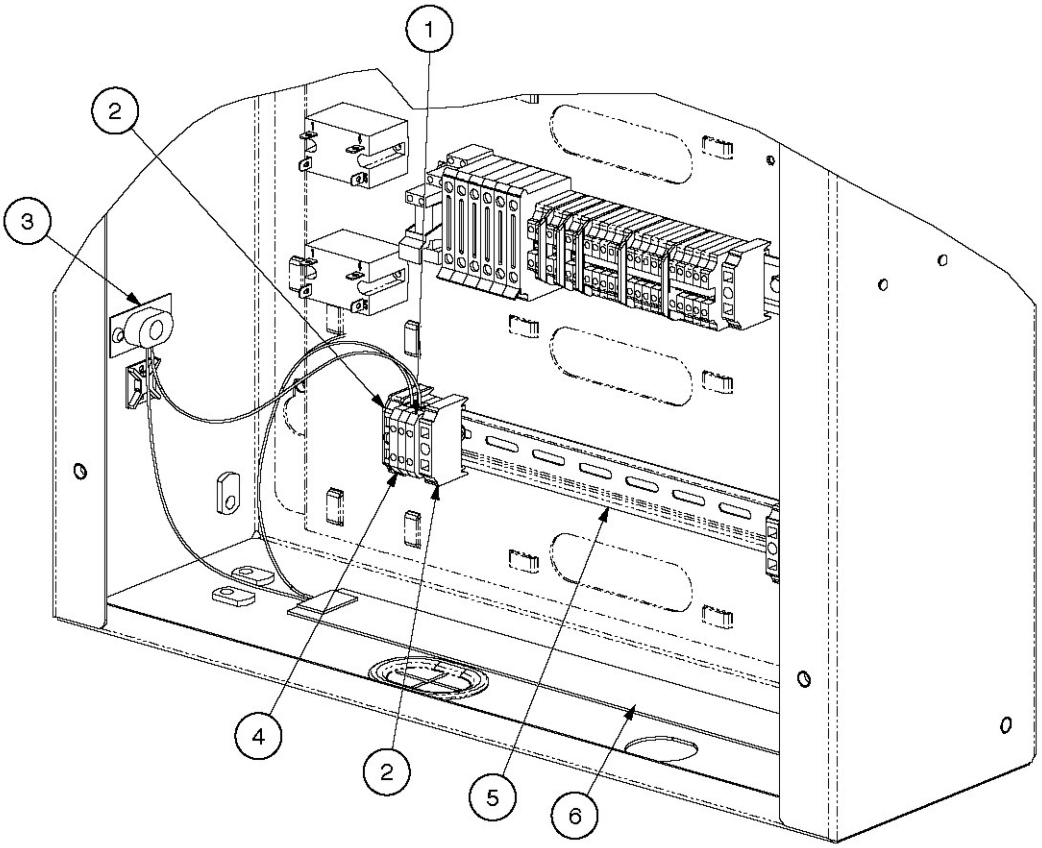
Connect the heater(s) terminals to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

9.9 Control Box Heater

9.9.1 Control Box Heater Installation

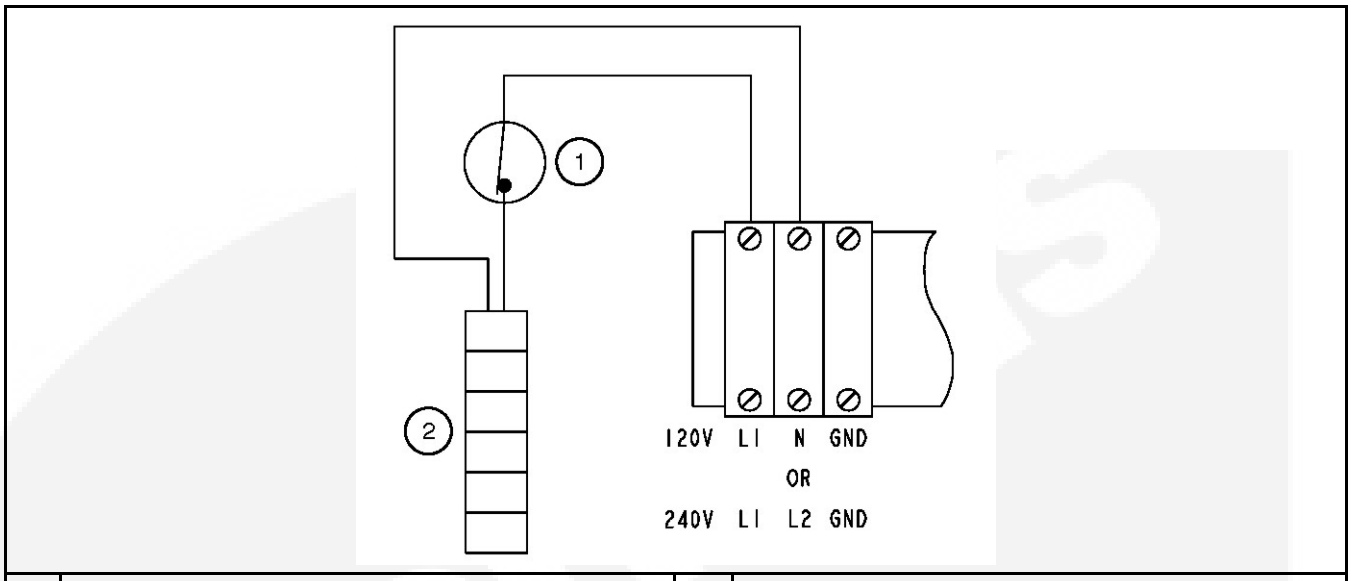
A thermostat controlled heater is installed inside the control cabinet. The heater may be attached to the bottom or the side of the control box. **Figure 32** shows a typical heater. **Figure 33** shows typical heater wiring.

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



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

FIGURE 32. TYPICAL CONTROL BOX HEATER



No.	Description	No.	Description
1	Thermostat	2	Heater

FIGURE 33. TYPICAL HEATER WIRING DIAGRAM

9.10 Oil Heaters

9.10.1 Oil Pan Heater Installation

Oil pan heaters require an external power source.

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

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

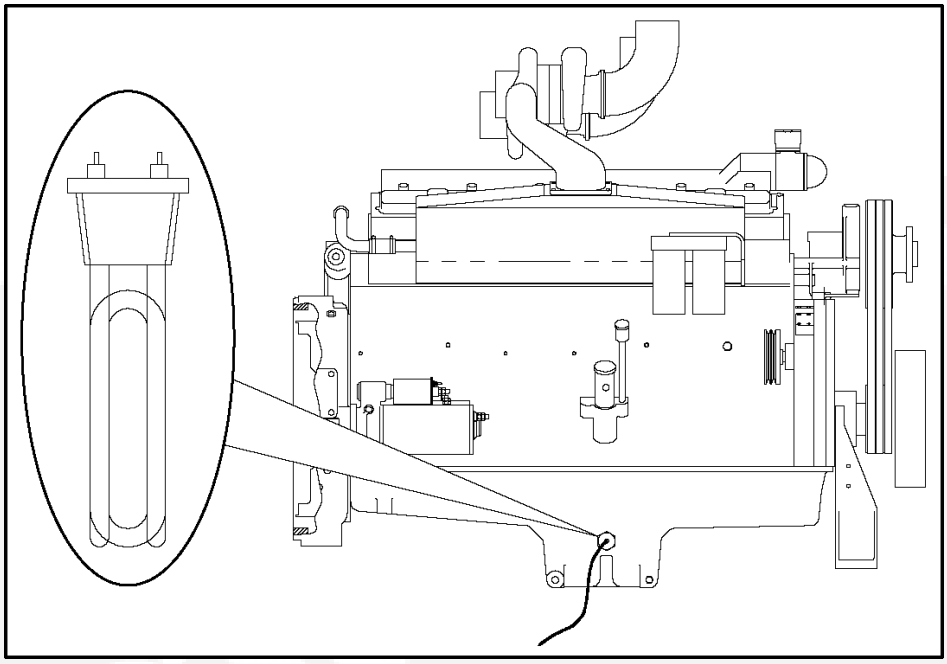


FIGURE 34. 300W OIL PAN HEATER USED IN 120V AND 208/240V APPLICATIONS

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

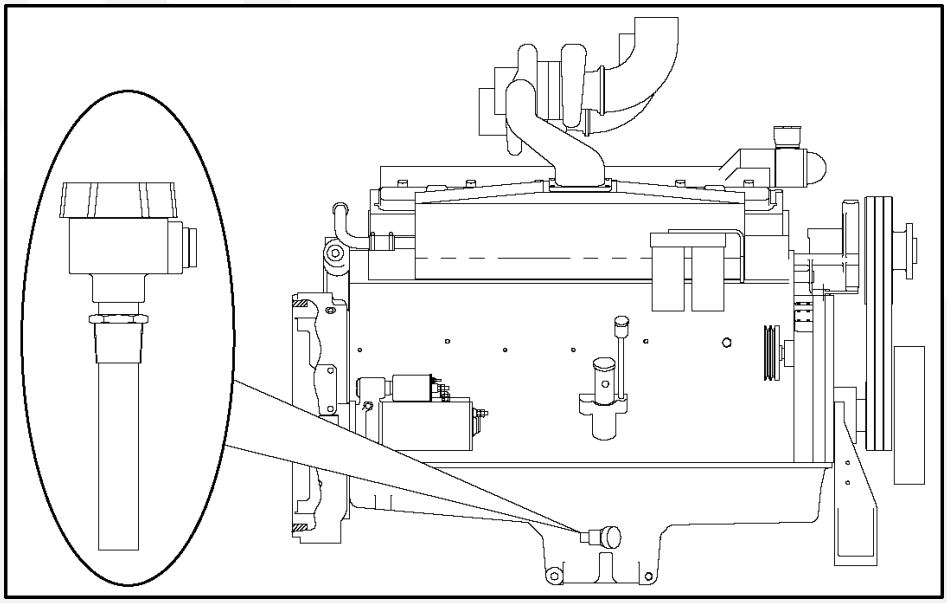


FIGURE 35. 300W OIL PAN HEATER USED IN 480V APPLICATIONS

9.11 Annunciators

9.11.1 PowerCommand Universal Annunciator

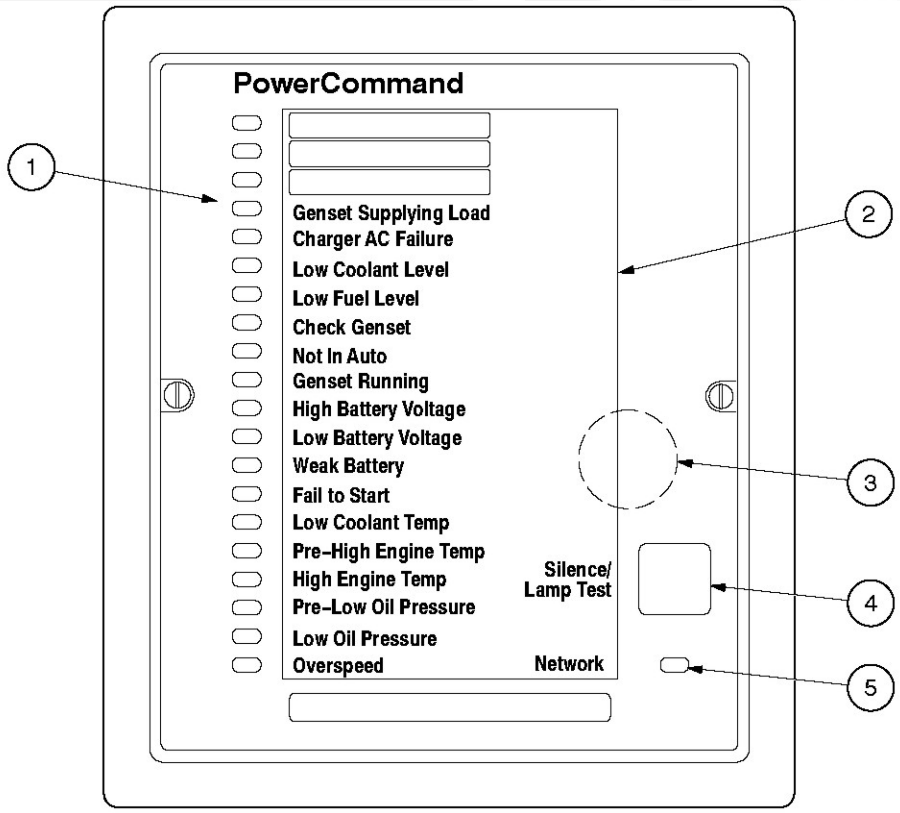
A universal annunciator provides lamps and a horn to annunciate the operating status and fault conditions of an emergency power system. It is designed for connection to either a 12 VDC or a 24 VDC control system. It can be configured to be either a positive or negative signal device.

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.



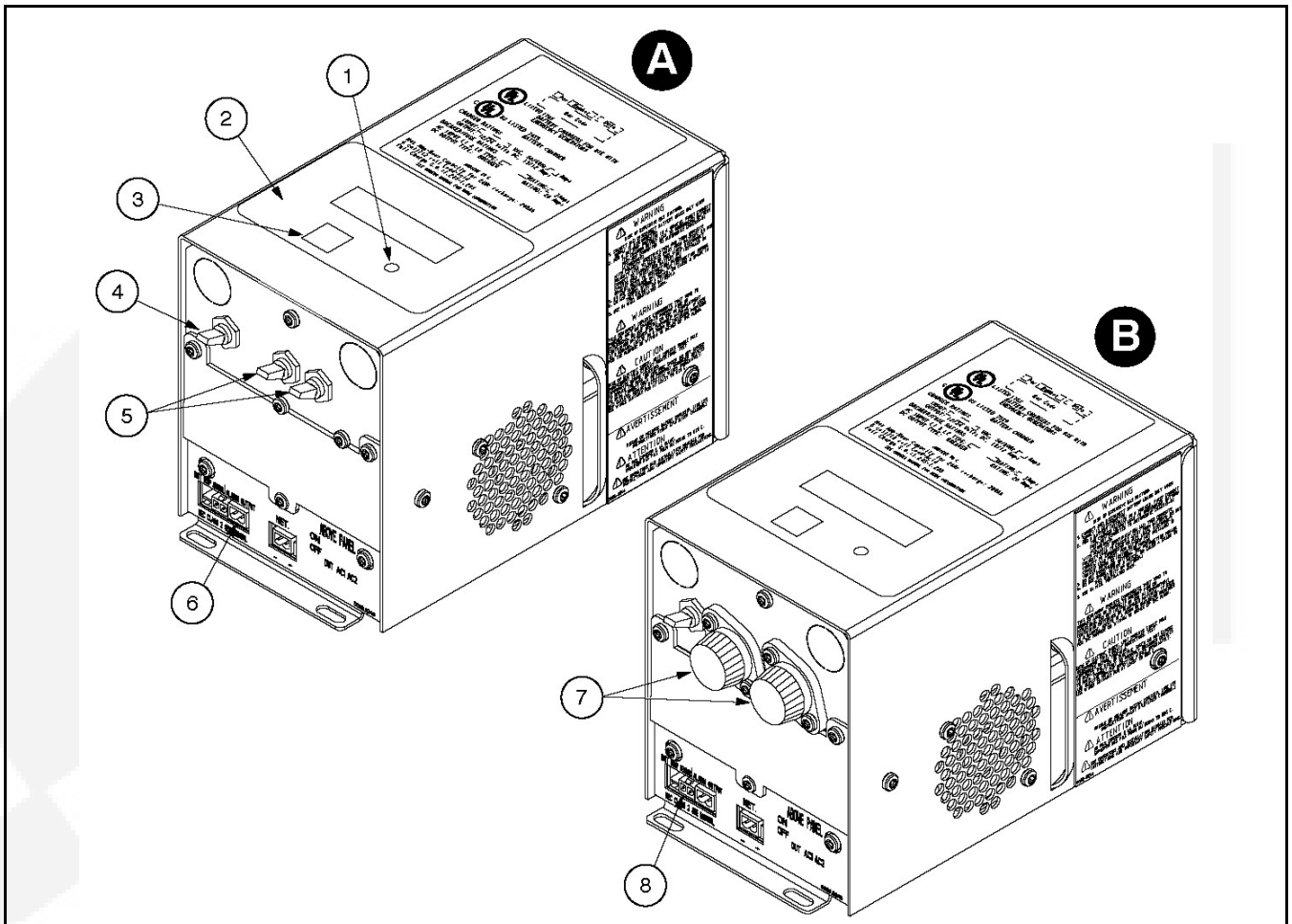
No.	Description	No	Description
1	System Status Lamps	4	Silence/Lamp Test Button
2	Insert Card	5	Network Status Lamp
3	Horn		

FIGURE 36. ANNUNCIATOR COMPONENTS

9.12 Battery Charger

9.12.1 PowerCommand Battery Charger - 15 Amp @ 12 Volt and 12 Amp @ 24 Volt

The two available types of 15/12-amp PowerCommand battery chargers are shown below. For more information, refer to the battery charger owner's manual.



A	120, 208, and 240 VAC Battery Charger	4	20 Amp DC Circuit Breaker Switch (Shown in the "On" position)
B	277, 380, 416, 480, and 600 VAC Battery Charger	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 37. 15/12-AMP POWERCOMMAND BATTERY CHARGERS

9.13 Grounding

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

⚠ WARNING

Electric current.

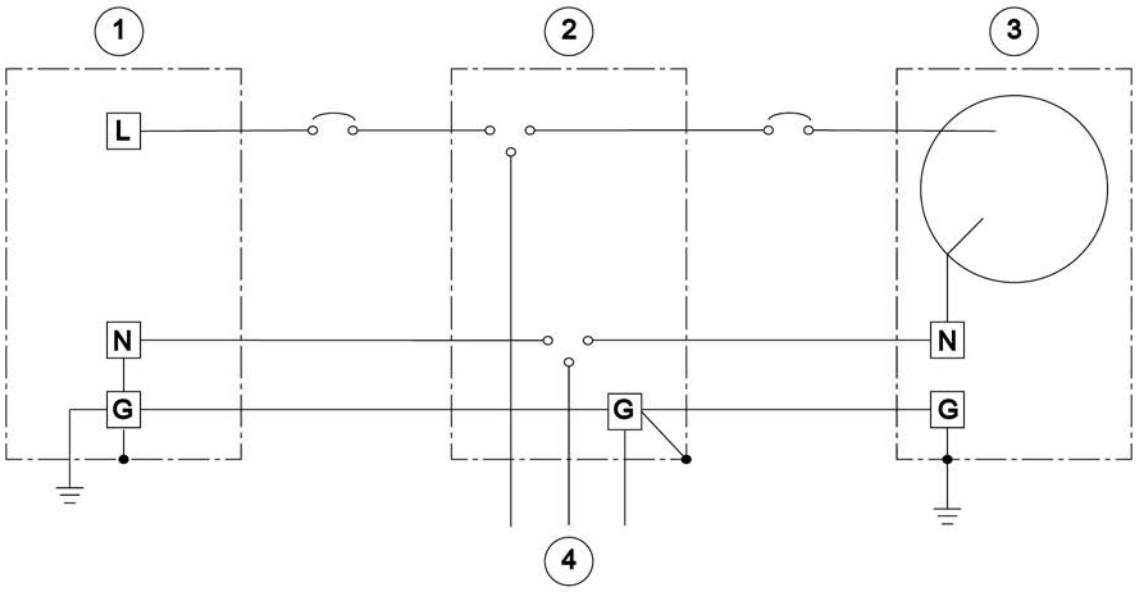
Electric current can cause severe personal injury or death.

Bonding and grounding must be done properly. All metallic parts that could become energized under abnormal conditions must be properly grounded.

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

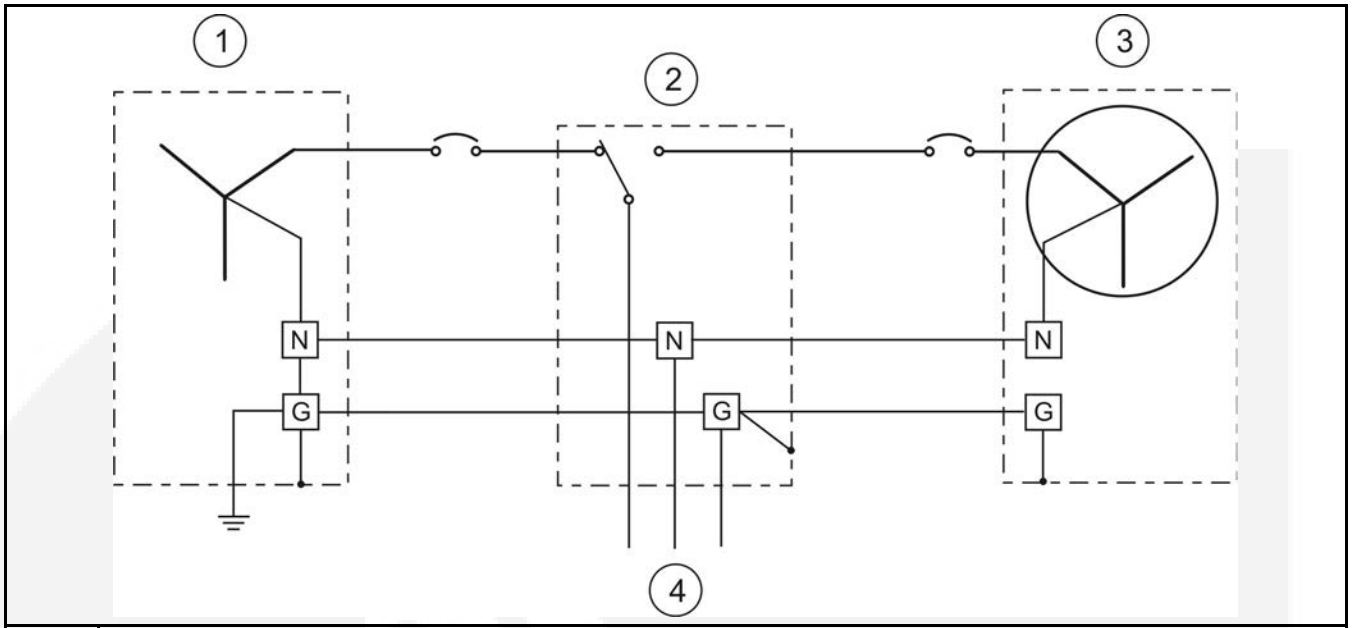
Figure 38, Figure 39 and Figure 40 illustrate typical system grounding for a 2-pole, 3-pole, and 4-pole Automatic Transfer Switcsh (ATS). In the2-pole and 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding 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.



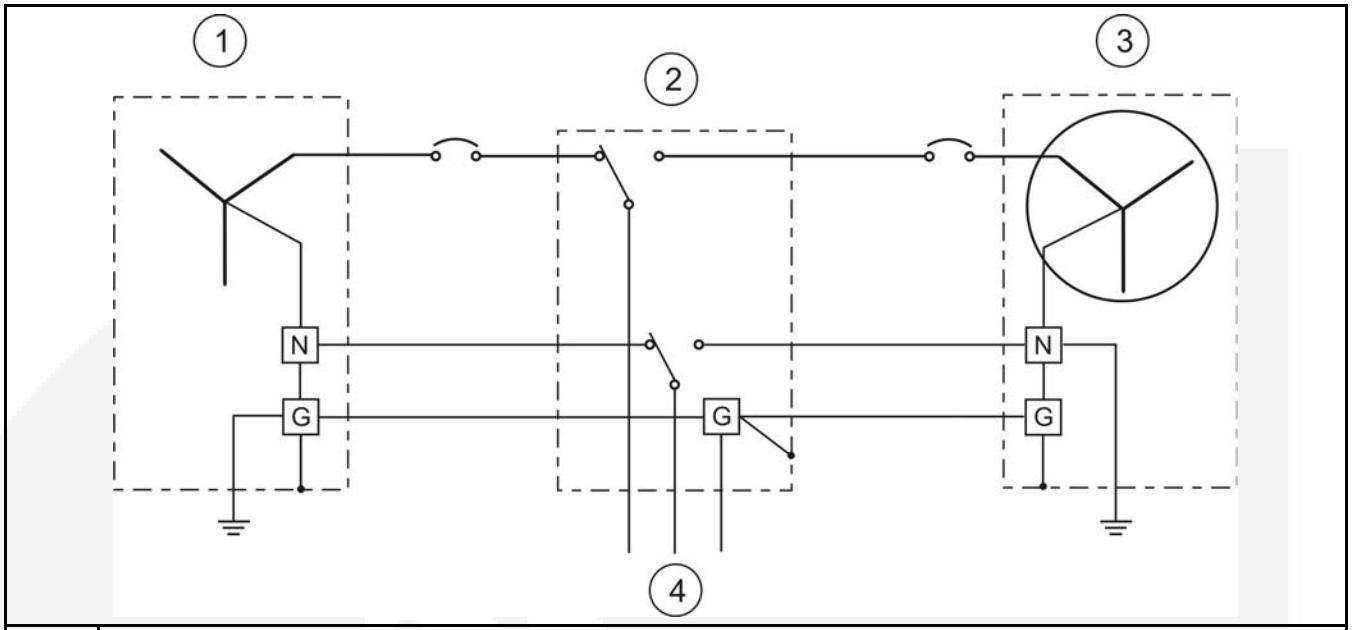
No.	Description
1	Service Entrance
2	2-Pole ATS
3	Generator Set
4	Load

FIGURE 38. TYPICAL SYSTEM - ONE-PHASE, THREE WIRE UTILITY, TWO-POLE ATS



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

FIGURE 39. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, THREE-POLE ATS



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

FIGURE 40. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, FOUR-POLE ATS

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10 Pre-Start Preparation

⚠ WARNING

Incorrect installation.

The failure to do a complete installation can result in equipment damage and severe personal injury or death.

Make sure that all items listed in the Installation Checklist are carried out before starting the generator set.

Before attempting an initial start of the generator set, be sure to complete the Installation Checklist, see **Chapter 11 on page 89**.

10.1 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.

10.2 Battery Connections

⚠ WARNING

Accidental or remote starting.

Accidental or remote starting of the generator set while working on it can cause severe personal injury or death.

Make sure that the PowerCommand® Control is in the OFF mode before connecting the battery cables.

⚠ WARNING

Battery gases.

Ignition of explosive battery gases can cause severe personal injury or death.

Always connect the negative (–) battery cable last to prevent arcing using an insulated wrench.

⚠ WARNING

Arching.

Arcing at battery terminals, light switch or other equipment, flame, pilot lights, and sparks can ignite battery gases and cause severe personal injury or death.

Ventilate the battery area before working on or near a battery. Do not smoke, or switch trouble light ON or OFF near a battery. Discharge static electricity from body before touching the batteries by first touching a grounded metal surface.

Starting the unit requires one or more batteries. For more information on batteries, refer to **Chapter 5 on page 27**. Connect the positive battery cable, using an insulated wrench, before connecting the negative battery cable to prevent arcing.

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.

10.3 Site-specific Configuration

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

Some configuration is done by the factory. Any site-specific configuration should be done by qualified service personnel before starting the generator set.

10.4 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 menus are displaying the correct values.

11 Installation Checklist

11.1 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 $1^{1}/_{2}$ 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.
	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 120 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.
	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.
	External fuel pumps are connected and operational at all times - generator set started or shut down.
	Fuel tanks are filled with the correct grade / type of fuel).
	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.

12 Manufacturing Facilities

NORTH AMERICA	EMEA, CIS	ASIA PACIFIC
Cummins Power Generation Limited 1400 73rd Ave. NE Minneapolis, MN 55432 USA	Cummins Power Generation Limited Columbus Avenue Manston Park Manston, Ramsgate Kent CT12 5BF United Kingdom	Cummins Power Generation Limited 10 Toh Guan Road #07-01 TT International Tradepark Singapore 608838
Phone +1 763 574 5000 Toll Free +1 800 888 6626 Fax +1 763 574 5298	Phone +44 1843 255000 Fax +44 1843 255902	Phone +65 6417 2388 Fax +65 6417 2399
BRAZIL	**CHINA**	**INDIA**
Rua Jati, 310, Cumbica Guarulhos, SP 07180-900 Brazil	Cummins Power Generation 2 Rongchang East Street, Beijing Economic – Technological Development Area Beijing 100176, P.R.China	35A/1/2, Erandawana Pune 411 038 India
Phone +55 11 2186 4195 Fax +55 11 2186 4729	Phone +86 10 5902 3000 Fax +86 10 5902 3199	Phone +91 020 6602 7525 Fax +91 020 6602 8090
LATIN AMERICA	**MEXICO**	
3350 Southwest 148th Ave. Suite 205 Miramar, FL 33027 USA	Eje 122 No. 200 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico	
Phone +1 954 431 551 Fax +1 954 433 5797	Phone +52 444 870 6700 Fax +52 444 824 0082	

12.1 How to Obtain Service

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

12.1.1 Locating Your Distributor

In North America

Telephone +1 800 888 6626 (this is an automated service for touch-tone phones only) to contact the nearest Cummins Power Generation distributor in the United States or Canada. By selecting Option 1 (press 1), you will be automatically connected to the distributor nearest you.

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

GENERATORS – ELECTRIC or

ENGINES – GASOLINE OR DIESEL

If you have difficulty arranging service or resolving an issue, please contact the Service Manager at the nearest Cummins Power Generation distributor for assistance.

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

Outside North America

If you are outside North America, refer to **www.cumminspower.com** and select Distributor 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 Wiring Diagram with PowerCommand 3201 Control

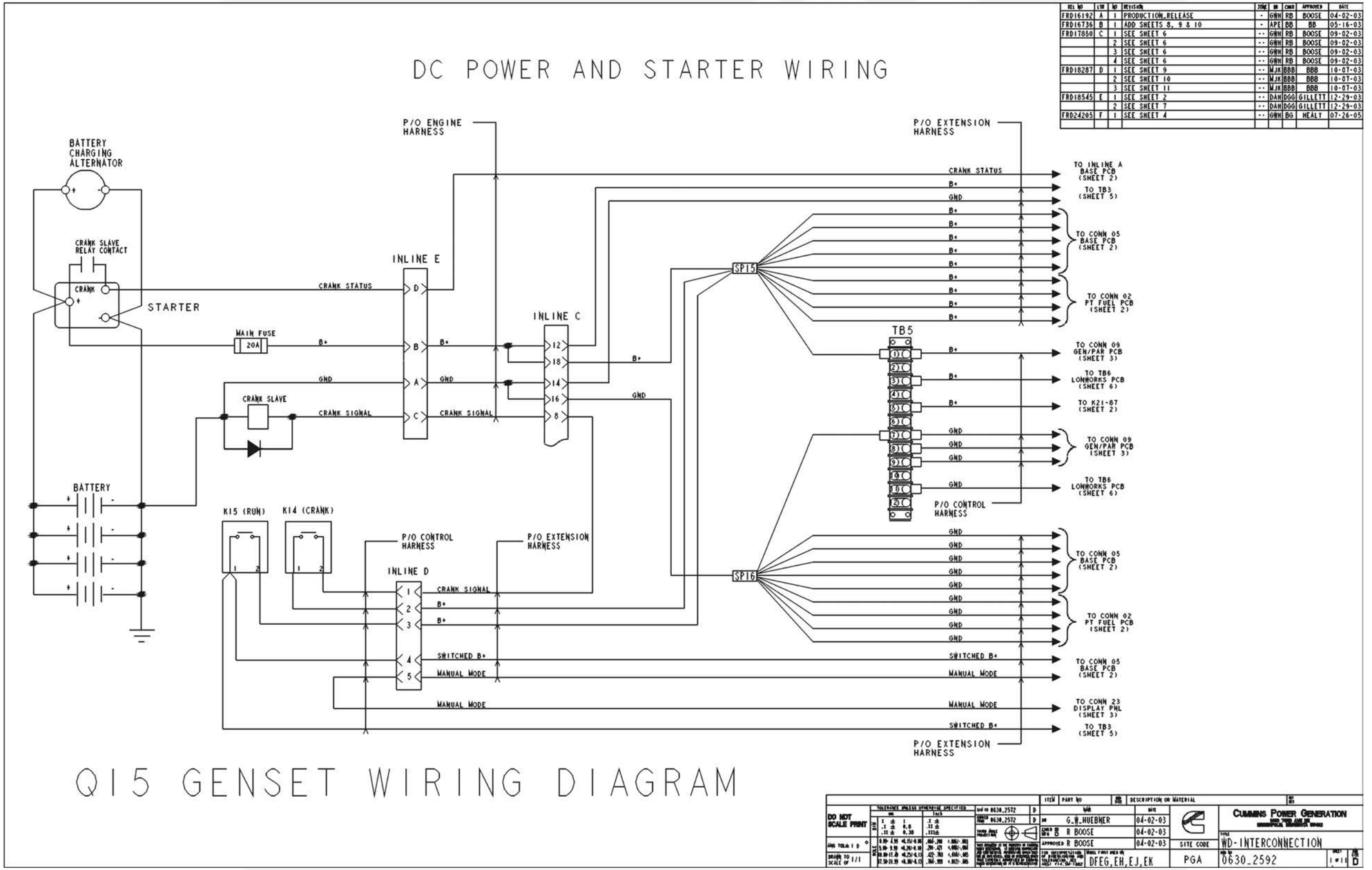


FIGURE 41. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 1)

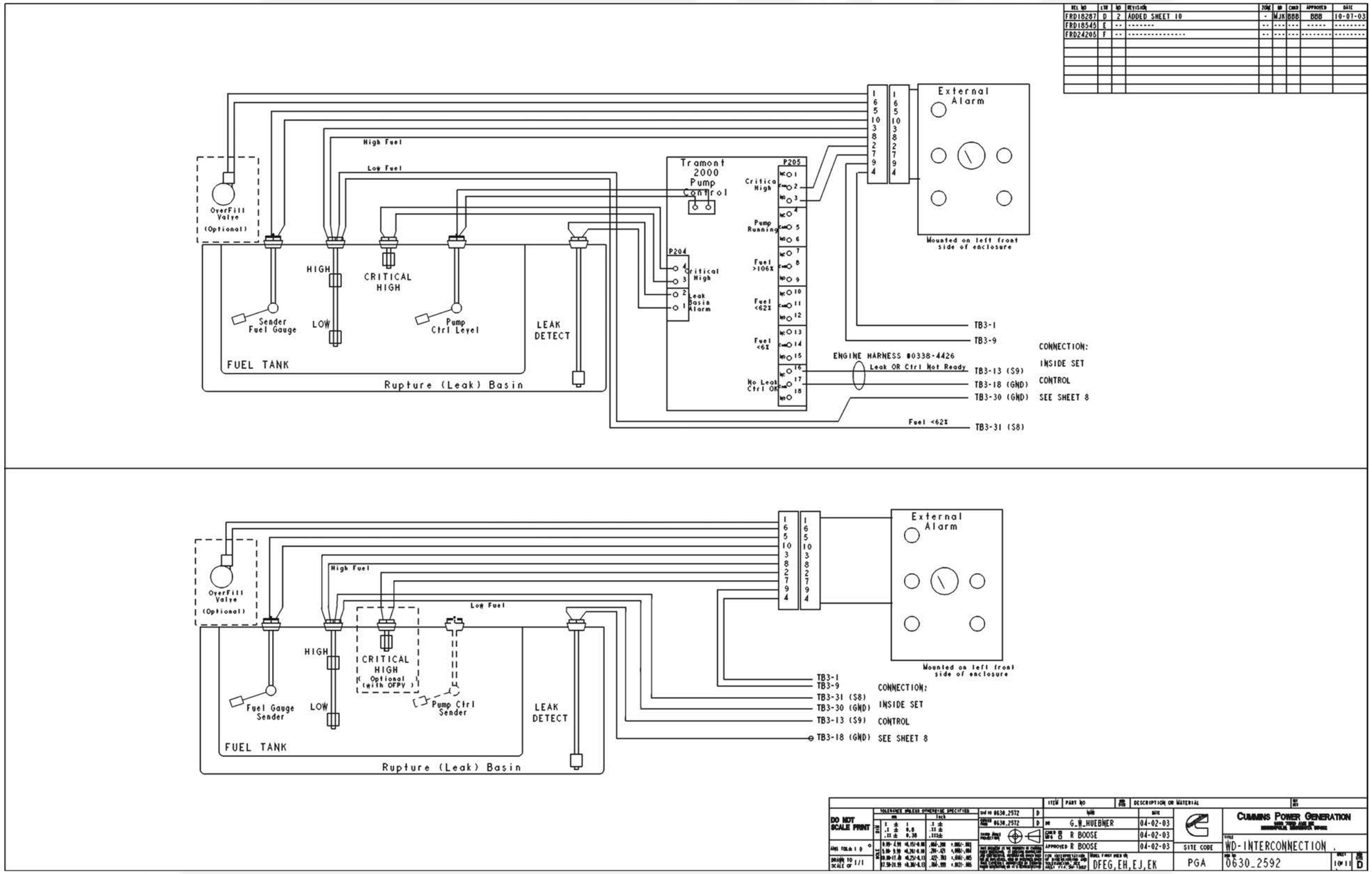


FIGURE 42. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 2)

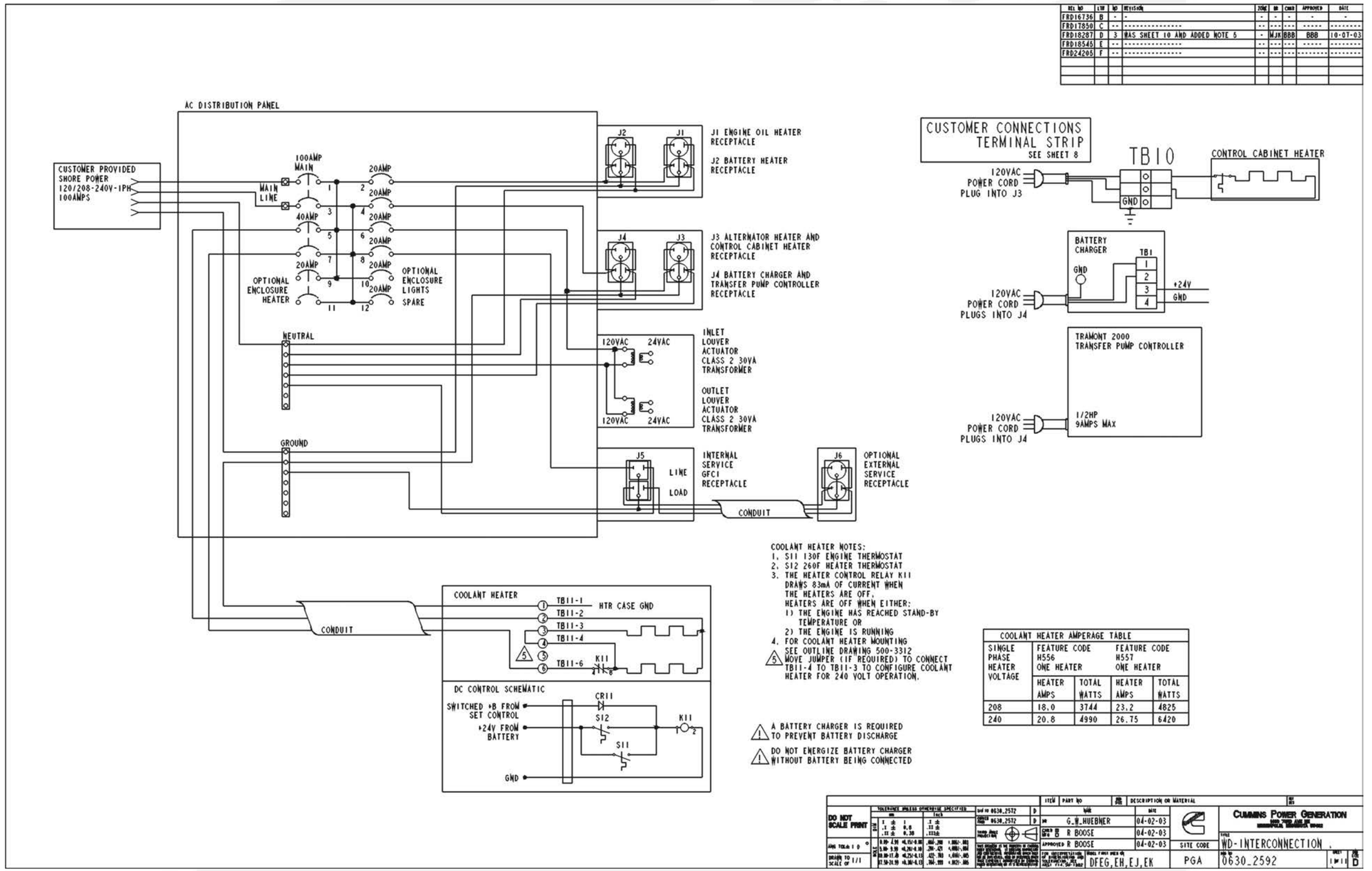


FIGURE 43. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 3)

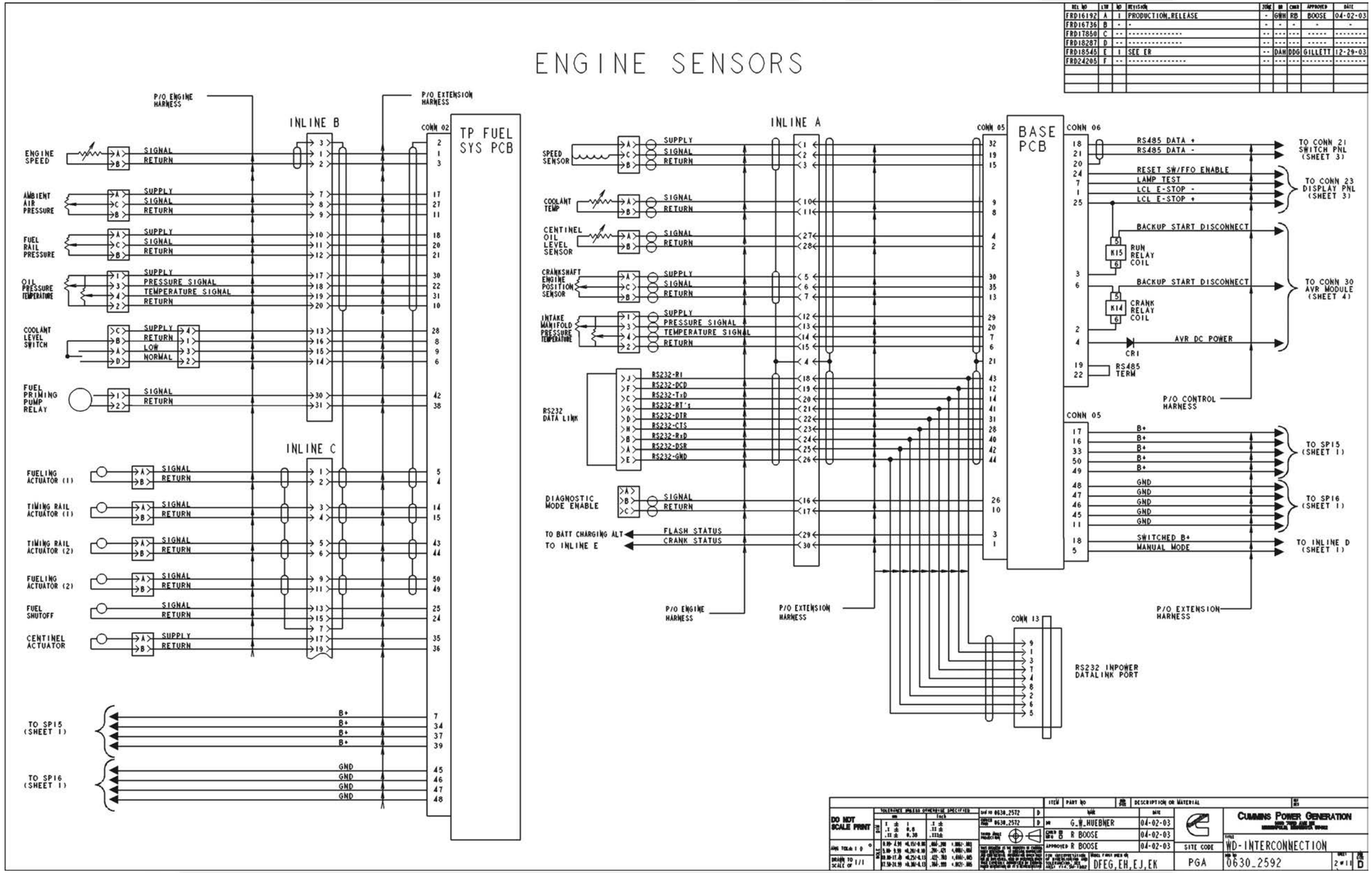


FIGURE 44. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 4)

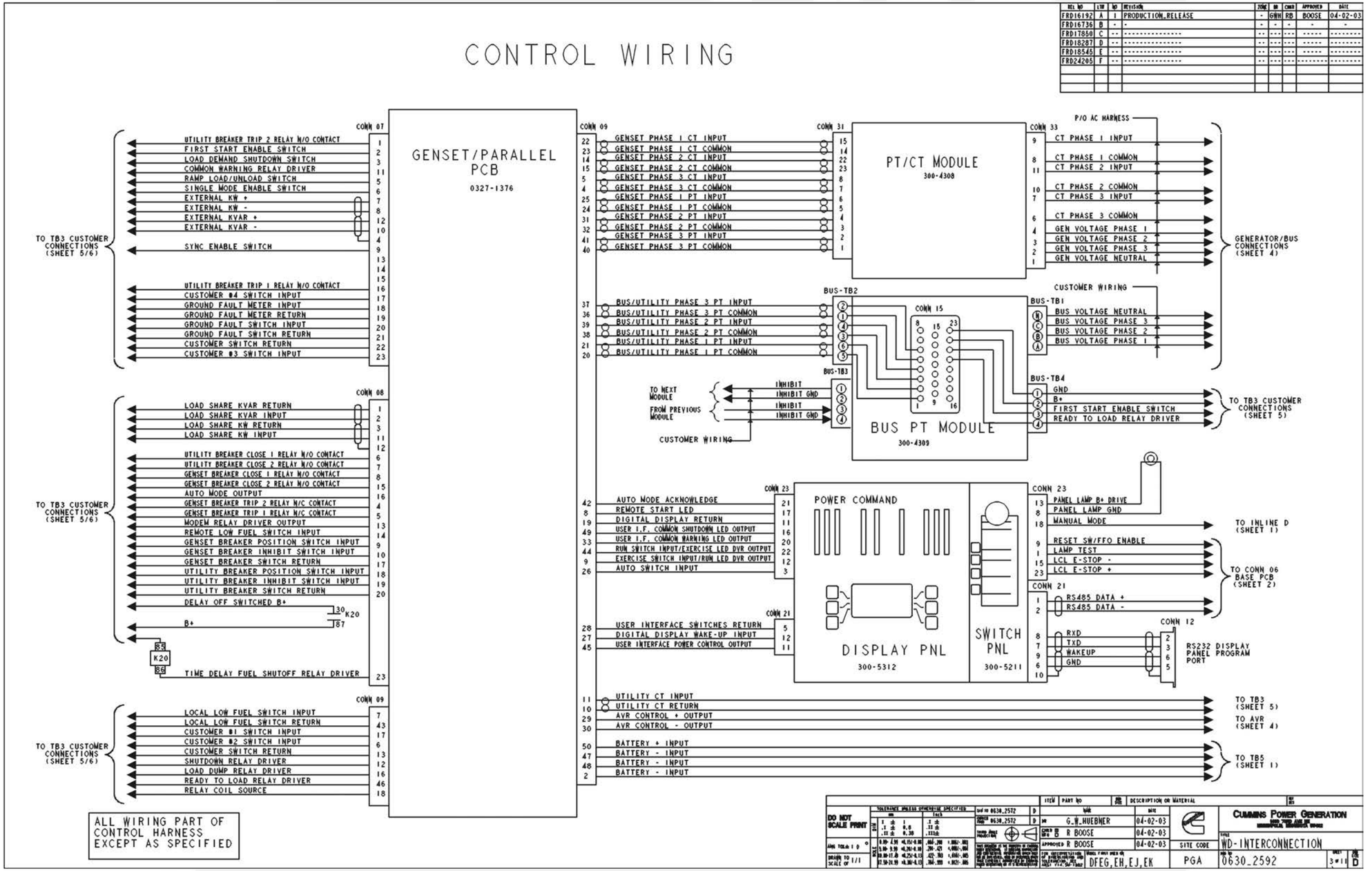


FIGURE 45. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 5)

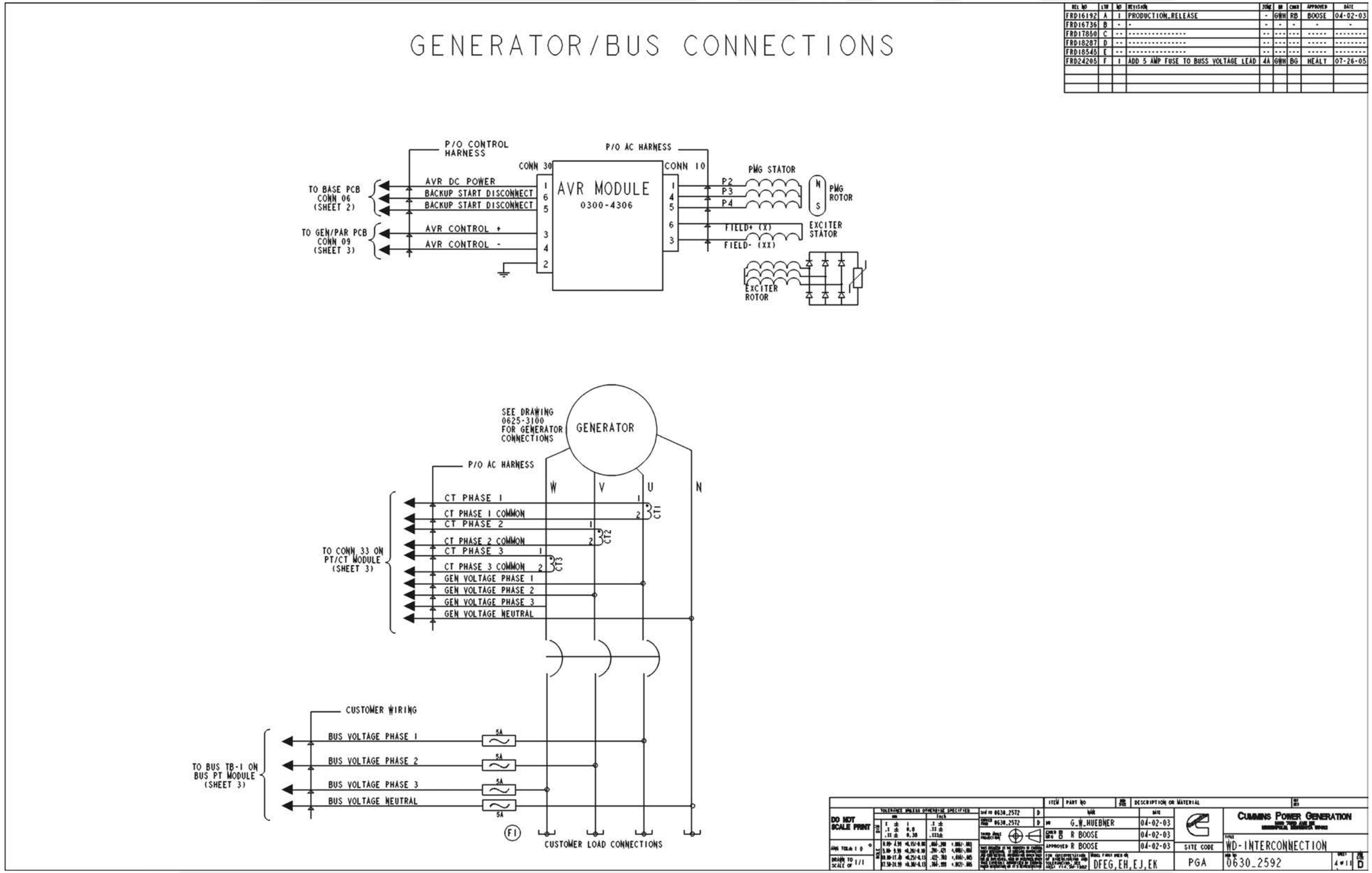


FIGURE 46. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 6)

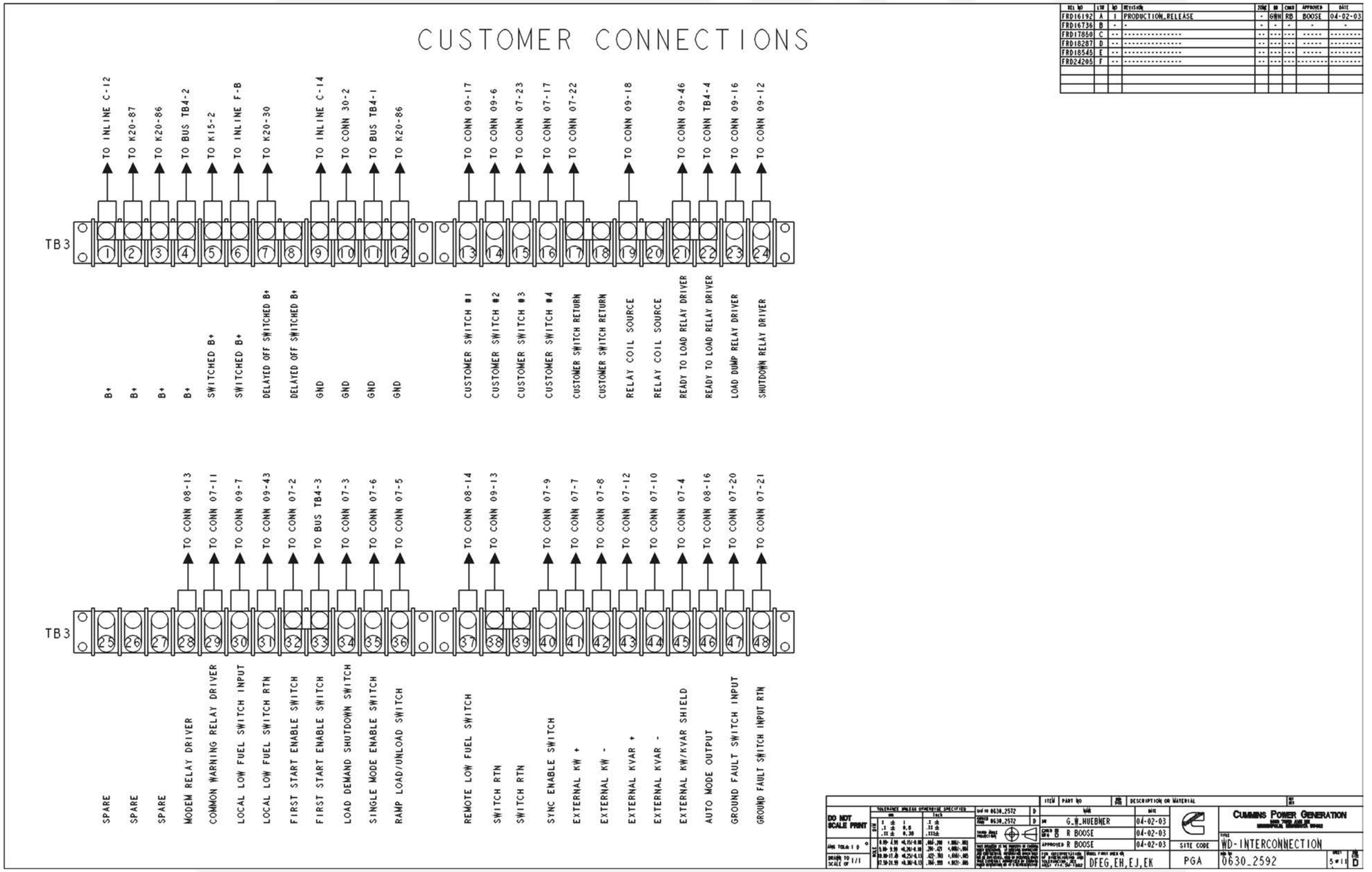
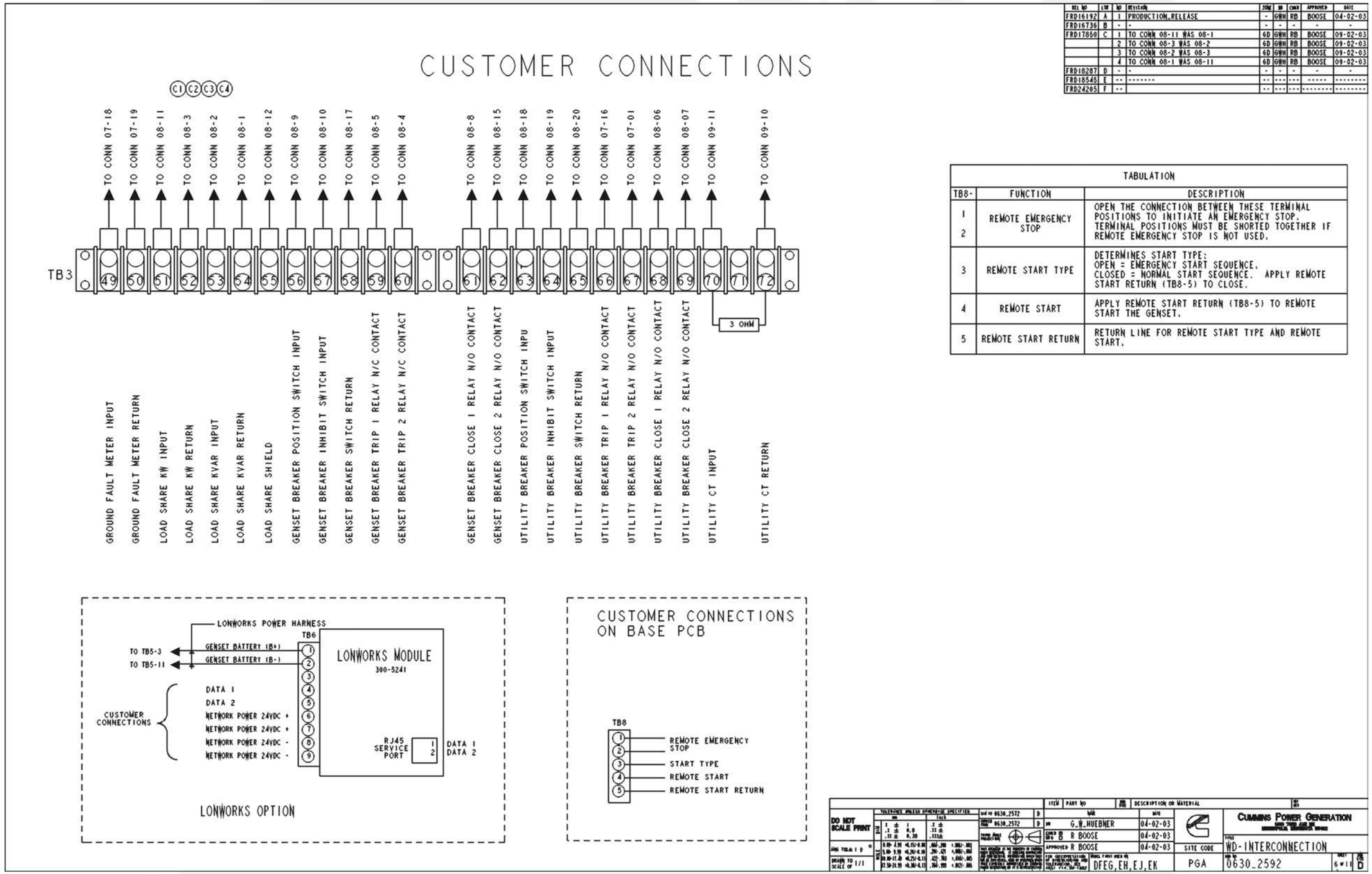


FIGURE 47. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 7)



REL NO	LTR	NO	REVISION	ZONE	BY	CHKD	APPROVED	DATE
FRD16192	A	1	PRODUCTION RELEASE	-	GWH	RB	BOOSE	04-02-03
FRD16736	B	-	-	-	-	-	-	-
FRD17850	C	1	TO CONN 08-11 WAS 08-1	6D	GWH	RB	BOOSE	09-02-03
		2	TO CONN 08-3 WAS 08-2	6D	GWH	RB	BOOSE	09-02-03
		3	TO CONN 08-2 WAS 08-3	6D	GWH	RB	BOOSE	09-02-03
		4	TO CONN 08-1 WAS 08-11	6D	GWH	RB	BOOSE	09-02-03
FRD18287	D	-	-	-	-	-	-	-
FRD18545	E	--	-------	--	---	---	-----	--------
FRD24205	F	--		--	---	---	--------	--------

TABULATION		
TB8-	FUNCTION	DESCRIPTION
1 2	REMOTE EMERGENCY STOP	OPEN THE CONNECTION BETWEEN THESE TERMINAL POSITIONS TO INITIATE AN EMERGENCY STOP. TERMINAL POSITIONS MUST BE SHORTED TOGETHER IF REMOTE EMERGENCY STOP IS NOT USED.
3	REMOTE START TYPE	DETERMINES START TYPE: OPEN = EMERGENCY START SEQUENCE. CLOSED = NORMAL START SEQUENCE. APPLY REMOTE START RETURN (TB8-5) TO CLOSE.
4	REMOTE START	APPLY REMOTE START RETURN (TB8-5) TO REMOTE START THE GENSET.
5	REMOTE START RETURN	RETURN LINE FOR REMOTE START TYPE AND REMOTE START.

DO NOT SCALE PRINT	G.W.HUEBNER	04-02-03	CUMMINS POWER GENERATION
	R BOOSE	04-02-03	
	R BOOSE	04-02-03	SITE CODE: PGA
	DFEG,EH,EJ,EK		WD-INTERCONNECTION
			0630_2592 SHEET 6 of 11 REV D

FIGURE 48. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 8)

TABULATION		
TB3-	FUNCTION	DESCRIPTION
1-4	B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY
5-6	SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING
7-8	DELAYED OFF SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING, CONFIGURABLE DELAYED OFF IS TYPICALLY USED FOR FUEL SHUTOFF
9-12	GND	BATTERY NEGATIVE
13	CONFIGURABLE INPUT #1	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
14	CONFIGURABLE INPUT #2	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
15	CONFIGURABLE INPUT #3	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
16	CONFIGURABLE INPUT #4	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
17	CONFIGURABLE INPUT RETURN	RETURN PATH FOR CONFIGURABLE INPUTS. (TB3-13,14,15,16)
19	RELAY COIL SOURCE	SWITCHED 24VDC POWER SUPPLY. USE ON THE HIGH SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY DRIVER. PROVIDES A MINIMUM 800ma OF CURRENT
21-22	READY TO LOAD RELAY DRIVER	ACTIVATES WHEN GENSET HAS REACHED 90% OF FREQUENCY. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
23	LOAD DUMP RELAY DRIVER	ACTIVATES AT A CONFIGURABLE LOAD LEVEL OR UNDER FREQUNCY CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
24	COMMON SHUTDOWN RELAY DRIVER	ACTIVATES ON ANY GENSET SHUTDOWN CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
25	SPARE	
26	SPARE	
27	SPARE	
28	MODEM RELAY DRIVER	PROVIDES A CONFIGURABLE METHOD OF CONTROLLING AND CYCLING POWER TO AN EXTERNAL MODEM. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
29	COMMON WARNING RELAY DRIVER	ACTIVATES ON ANY WARNING CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
30	LOCAL LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS SUPPLIED WITH A DAY TANK OR AN INTEGRATED FUEL TANK. SWITCH RETURN WITH TB3-31
31	LOCAL LOW FUEL RETURN	SWITCH RETURN FOR LOCAL LOW FUEL INPUT (TB3-30)
32-33	FIRST START INPUT	FOR PARALLELLING APPLICATIONS. CONNECTS TO REMOTE MASTER START SENSOR OR BUS PT MODULE WITH FIRST START SENSOR
34	LOAD DEMAND INPUT	FOR MULTIPLE GENSET PARALLEL APPLICATIONS. INPUT ALLOWS GENSET TO RAMP TO NO LOAD, OPEN BREAKER AND SHUT DOWN. REMOVING INPUT CAUSES GENSET TO START, SYNCHRONIZE, CLOSE BREAKER, AND RAMP TO LOAD. APPLY WITH SWITCH RETURN (TB3-38/39)
35	SINGLE MODE ENABLE INPUT	FOR SINGLE GENSET PARALLEL POWER TRANSFER (PLT) APPLICATIONS ONLY. APPLY WITH SWITCH RETURN (TB3-38/39) TO ENABLE MODE
36	RAMP LOAD/UNLOAD SWITCH	USED WITH MULTIPLE GENSETS IN PARALLEL IN CONJUNCTION WITH A MASTER CONTROL OR OTHER PLC DEVICE. APPLY SWITCH RETURN (TB3-38/39) TO LOAD/UNLOAD GENSET AS LOAD PROFILE DICTATES
37	REMOTE LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS THAT ARE NOT FITTED WITH AN INTEGRATED FUEL TANK. APPLY SWITCH RETURN TB3-38/39 TO ACTIVATE
38-39	SWITCH RETURN	SWITCH RETURN FOR TB3-34, 35, 36, AND 37
40	SYNC ENABLE INPUT	FOR USE IN SINGLE MODE PLT APPLICATIONS ONLY. INPUT SIGNALS GENSET TO SYNCHRONIZE WITH UTILITY
41	LOAD GOVERN KW+ INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KW LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC
42	LOAD GOVERN KW-	RETURN LINE LOAD GOVERN KW
43	LOAD GOVERN KVAR+ INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KVAR LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC. THIS INPUT IS DEFAULTED TO "DISABLED" AND IS ENABLED WITH INPOWER
44	LOAD GOVERN KVAR-	RETURN LINE LOAD GOVERN KVAR

TABULATION		
TB3-	FUNCTION	DESCRIPTION
45	EXTERNAL KW/KVAR SHIELD	SHIELD TERMINATION POINT FOR LOAD GOVERN INPUTS
46	AUTO MODE OUTPUT	SWITCH BATTERY 24VDC. FUSED AT 5A. AVAILABLE WHEN GENSET IS IN AUTO MODE
47	GROUND FAULT INPUT	ACTIVATES A GROUND FAULT WARNING WHEN SWITCHED TO THE GROUND FAULT RETURN (TB3-48). USE IN CONJUNCTION WITH AN EXTERNAL GROUND FAULT RELAY
48	GROUND FAULT RETURN	RETURN LINE FOR GROUND FAULT INPUT
49	GROUND FAULT ANALOG INPUT	FUTURE FEATURE
50	GROUND FAULT METER RETURN	RETURN LINE FOR GROUND FAULT ANALOG INPUT
51	LOAD SHARE KW+	FOR ISOLATED BUS PARALLELING ONLY. KW LOAD SHARING LINES FOR POWER COMMAND GENSETS
52	LOAD SHARE KW-	RETURN FOR LOAD SHARE KW
53	LOAD SHARE KVAR+	FOR ISOLATED BUS PARALLELING ONLY. KVAR LOAD SHARING LINES FOR POWER COMMAND GENSETS
54	LOAD SHARE KVAR+	RETURN FOR LOAD SHARE KVAR
55	LOAD SHARE SHIELD	SHIELD TERMINATION POINT FOR LOAD SHARE KW AND LOAD SHARE KVAR LINES
56	GENSET BREAKER POSITION SWITCH INPUT	FOR PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT GENSET BREAKER IS CLOSED. USE WITH GENSET BREAKER SWITCH RETURN (TB3-58)
57	GENSET BREAKER INHIBIT SWITCH INPUT	FOR PARALLELING APPLICATIONS. WHEN CLOSED TO GENSET BREAKER SWITCH RETURN (TB3-50), GENSET BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
58	GENSET BREAKER SWITCH RETURN	RETURN LINE FOR TB3-56/57
59	GENSET BREAKER OPEN COMMAND	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN GENSET BREAKER. USE WITH TB3-60
60	GENSET BREAKER OPEN COMMAND RETURN	USE WITH TB3-59
61	GENSET BREAKER CLOSE COMMAND	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE GENSET BREAKER. USE WITH TB3-62
62	GENSET BREAKER CLOSE COMMAND RETURN	USE WITH TB3-61
63	UTILITY BREAKER POSITION INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT UTILITY BREAKER IS CLOSED. USE WITH UTILITY BREAKER RETURN (TB3-65)
64	UTILITY BREAKER INHIBIT INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED TO UTILITY BREAKER RETURN (TB3-65), UTILITY BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
65	UTILITY BREAKER RETURN	USE WITH TB3-63/64
66	UTILITY BREAKER OPEN COMMAND	FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN UTILITY BREAKER. USE WITH TB3-67
67	UTILITY BREAKER OPEN COMMAND RETURN	USE WITH TB3-66
68	UTILITY BREAKER CLOSE COMMAND	FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE UTILITY BREAKER. USE WITH TB3-69
69	UTILITY BREAKER CLOSE COMMAND RETURN	USE WITH TB3-68
70	SYSTEM LOAD INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. ACCEPTS CT INPUT FOR MONITORING B PHASE CURRENT ON THE UTILITY BUS. USE UTILITY CT RETURN (TB3-72). A 3 OHM BURDEN RESISTOR IS CONNECTED ACROSS TB3-70 AND TB3-72
71	SPARE	
72	SYSTEM LOAD RETURN	USE WITH TB3-70

REL NO	LTR	NO	REVISION	ZONE	BY	CHKD	APPROVED	DATE
FRD16192	A	1	PRODUCTION RELEASE	-	GWH	RB	BOOSE	04-02-03
FRD16736	B	-	-	-	-	-	-	-
FRD17850	C	--	----------	--	---	---	------	--------
FRD18287	D	--	----------	--	---	---	------	--------
FRD18545	E	2	SEE ER	--	DAH	DDG	GILLETT	12-29-03
FRD24205	F	--	----------	--	---	---	------	--------

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL

DO NOT SCALE PRINT

	NAME	DATE
DRAWN	G.W.HUEBNER	04-02-03
CHKD R	R BOOSE	04-02-03
APPROVED R	BOOSE	04-02-03

CUMMINS POWER GENERATION

TITLE: WD-INTERCONNECTION

SITE CODE: PGA

DWG NO: 0630_2592

SIZE: D

SHEET 1 OF 1

FIGURE 49. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 9)

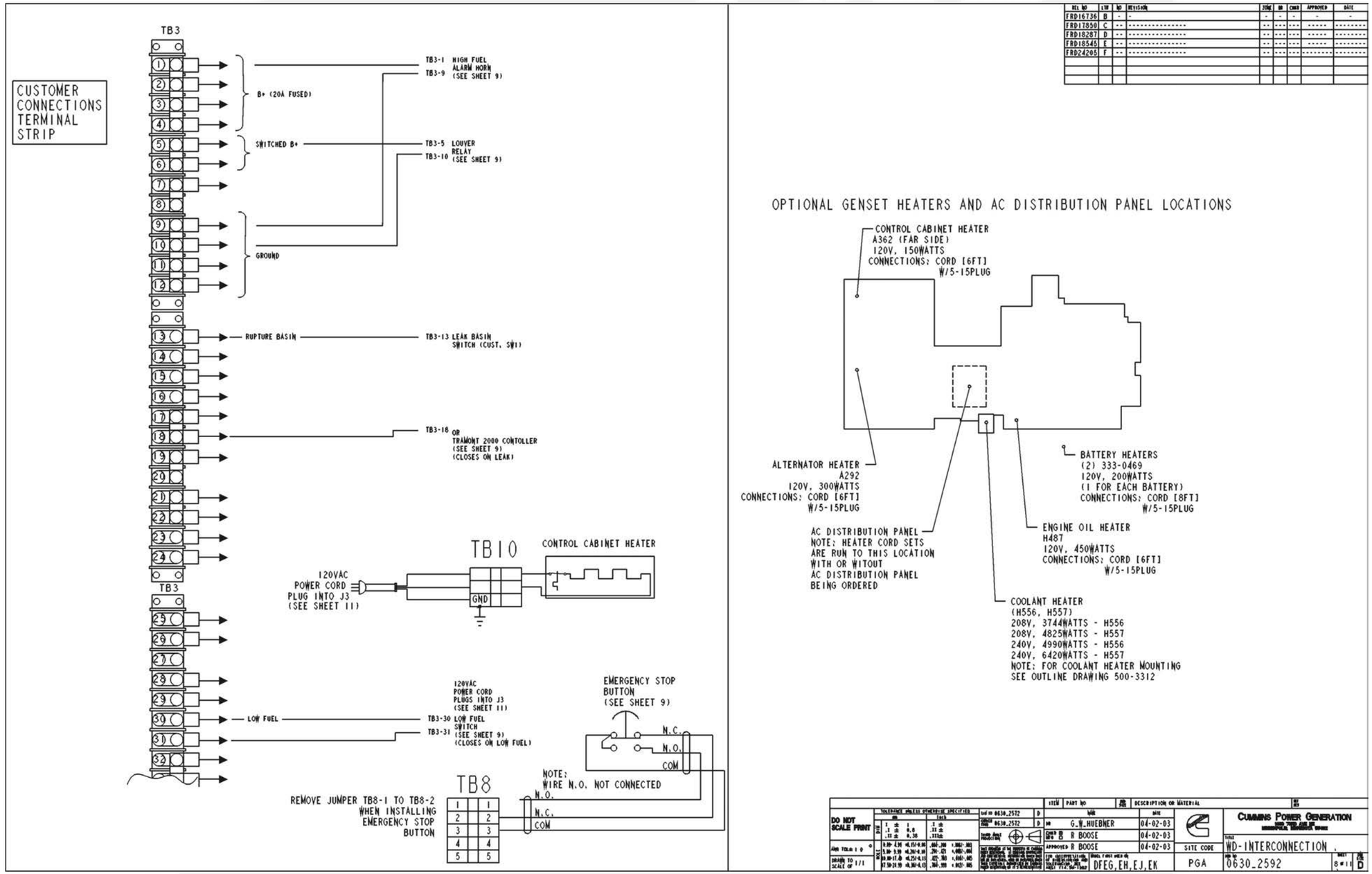


FIGURE 50. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 10)

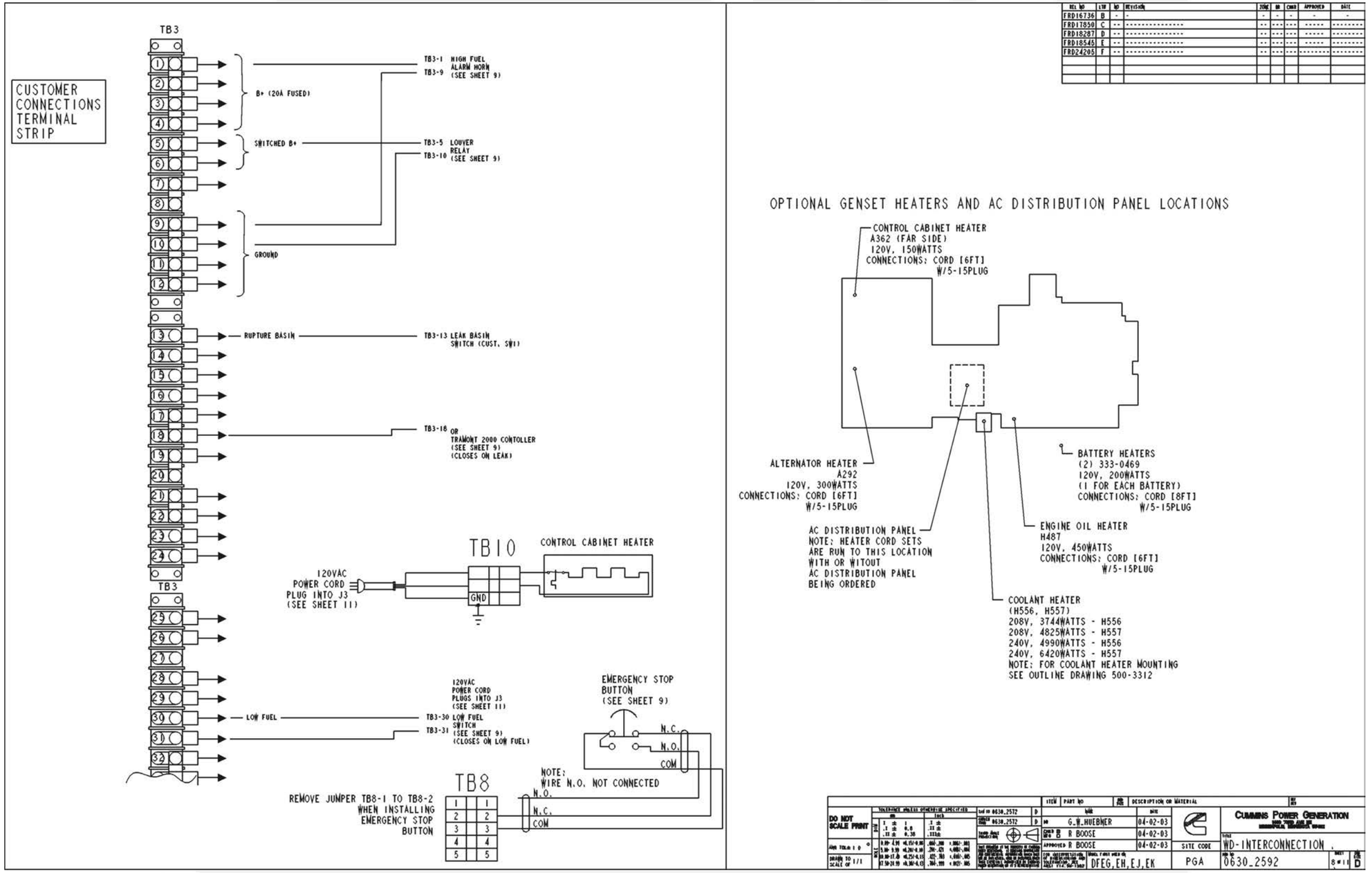


FIGURE 51. WIRING DIAGRAM WITH POWERCOMMAND 3201 CONTROL (SHEET 11)

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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 with PCC 2100

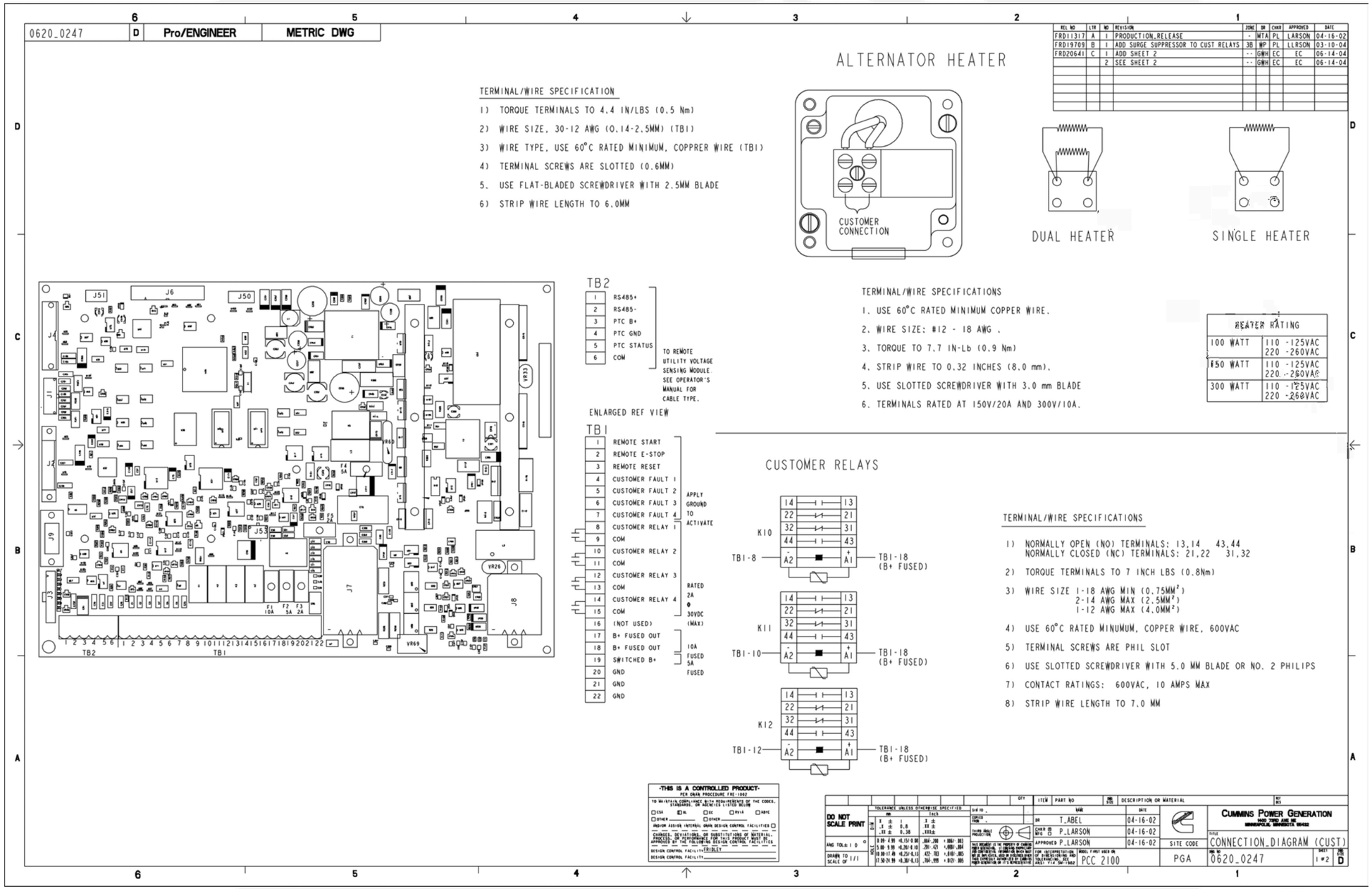
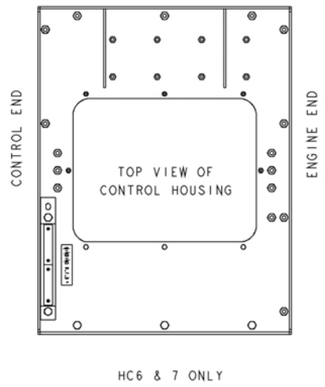


FIGURE 52. CUSTOMER CONNECTIONS WITH PCC 2100 (SHEET 1)

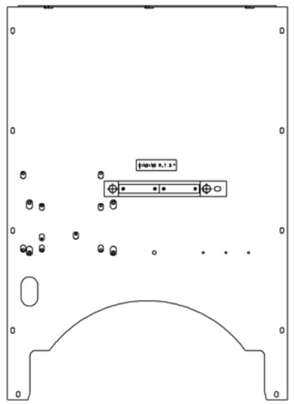
0620_0247	D	Pro/ENGINEER	METRIC DWG

REL NO	LTR	NO	REVISION	ZONE	BY	CHKD	APPROVED	DATE
FRD20641	C	2	UPDATE RTD CONNECTION DIAGRAM	6A	GWH	EC	EC	06-14-04

RTD CUSTOMER CONNECTIONS



HC6 & 7 ONLY

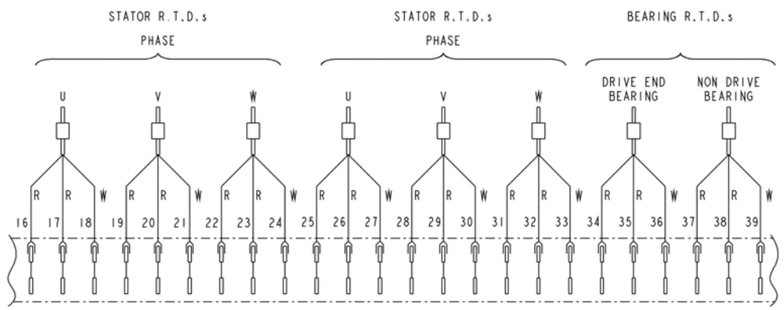


HC4 & 5 ONLY

RTD TERMINAL BLOCK CONNECTIONS:

1. USE 60°C RATED MINIMUM COPPER WIRE.
2. USE WIRE SIZES 22 TO 12 AWG.
3. TORQUE TO 7.7 LBS-IN (0.9 N-M)
4. STRIP WIRE TO 0.32 INCHES (8.0 MM).
5. USE SLOTTED SCREWDRIVER WITH A 3.0 MM BLADE.
6. TERMINALS RATED AT 150V/20A AND 300V/10A.

R.T.D. (Resistance Temperature Detector)



NOTES:
(1) R = RED W = WHITE

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL	MAT'L

	NAME	DATE
DR	G W HUEBNER	06-14-04
CHKR / MFG	E CZECHOWSKI	06-14-04
APPROVER	E CZECHOWSKI	06-14-04

DO NOT SCALE PRINT

ANG TOL: ± 0°

DRAWN TO SCALE OF 1/1

NEXT ASSY PCC 2100

SITE CODE PGA

CUMMINS POWER GENERATION
1400 73RD AVE NE
MINNEAPOLIS, MINNESOTA 55432

TITLE: CONNECTION_DIAGRAM (CUST)

DWG NO 0620_0247 SHEET 2 of 2 REV D

FIGURE 53. CUSTOMER CONNECTIONS WITH PCC 2100 (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 Alternator Reconnect Drawing

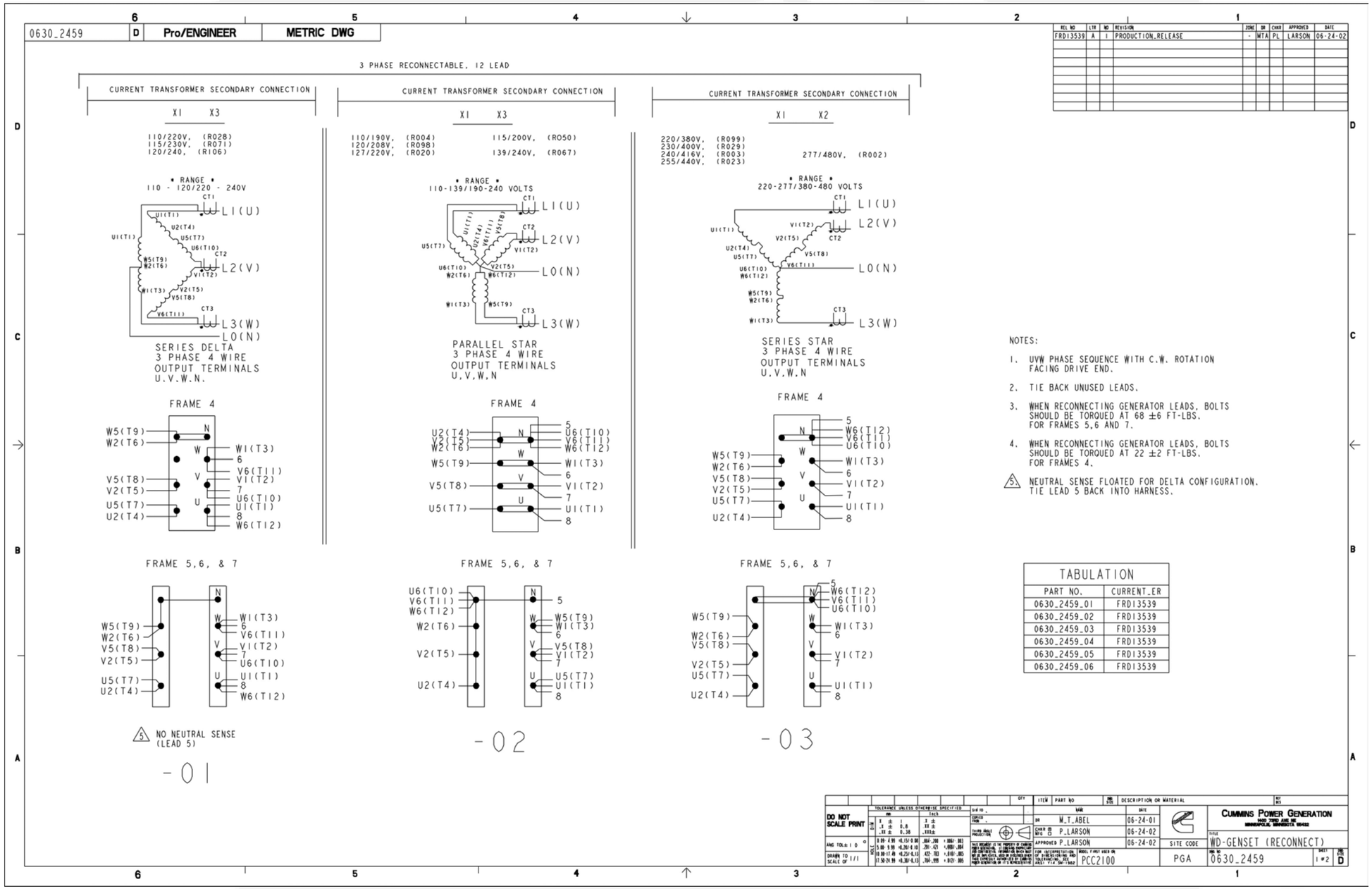


FIGURE 54. ALTERNATOR RECONNECT DRAWING (SHEET 1)

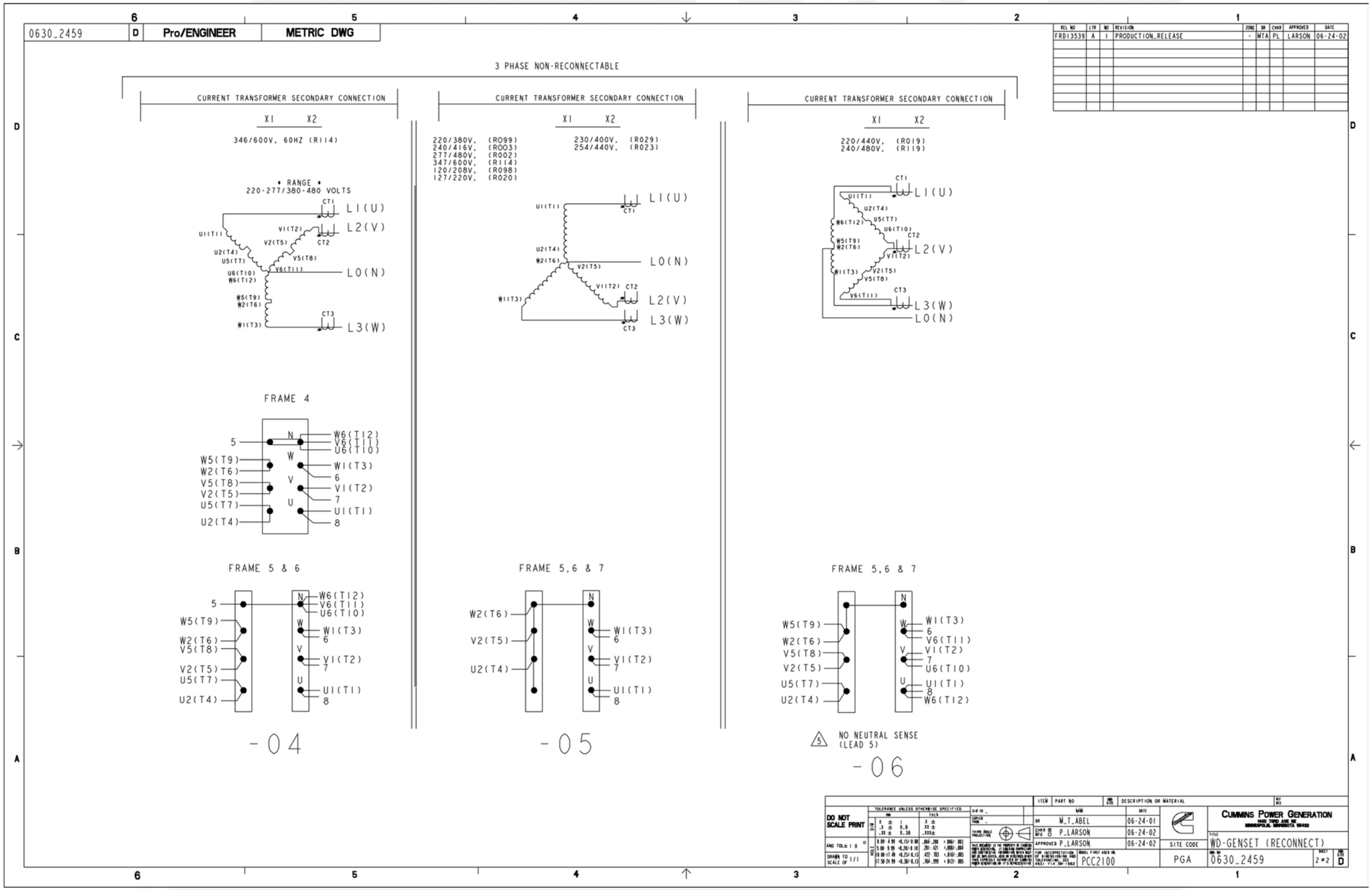


FIGURE 55. ALTERNATOR RECONNECT DRAWING (SHEET 2)

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.

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D.1 Generator Set Outline Drawing (Seismic)

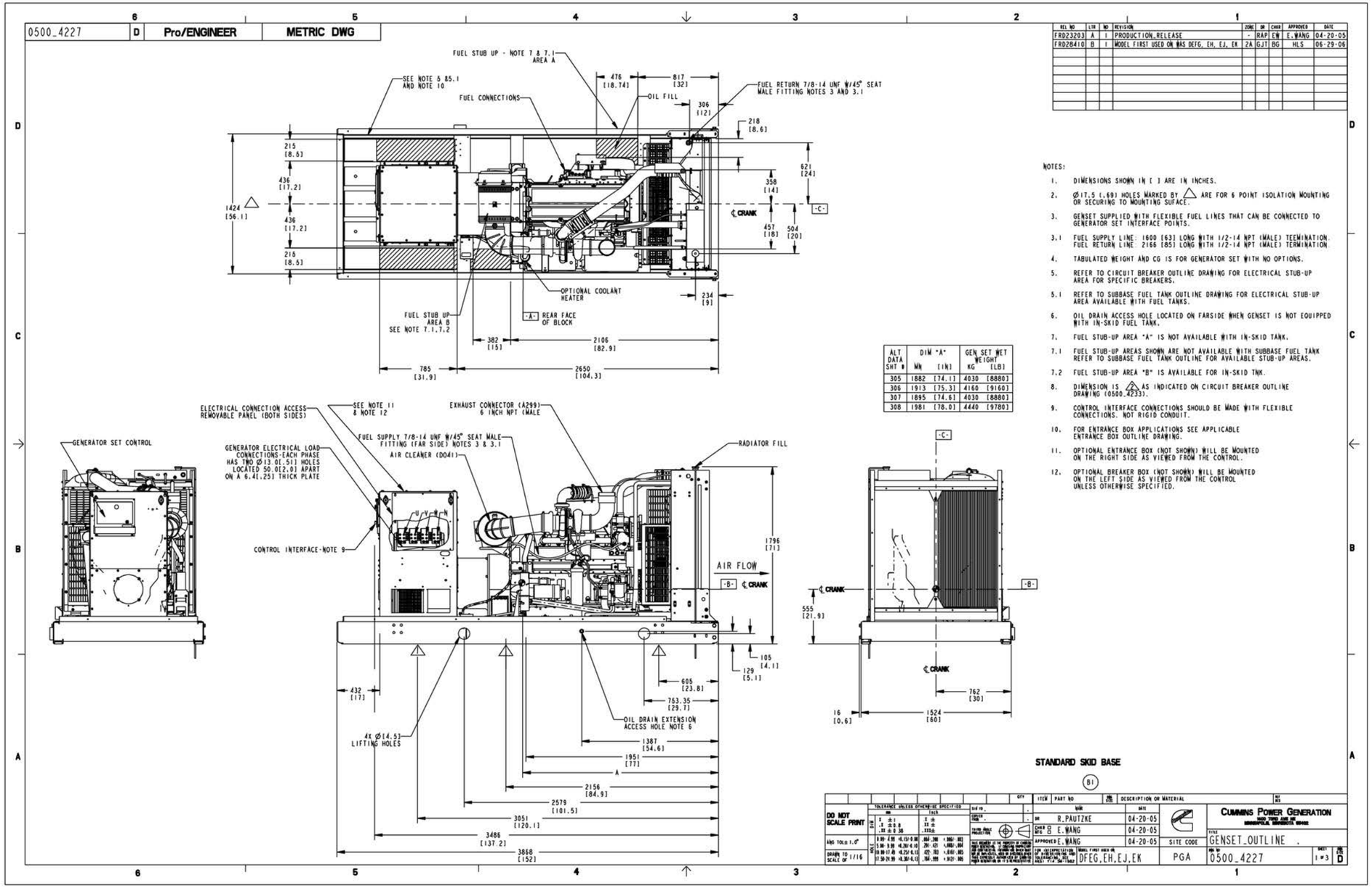


FIGURE 56. GENERATOR SET OUTLINE DRAWING (SHEET 1)

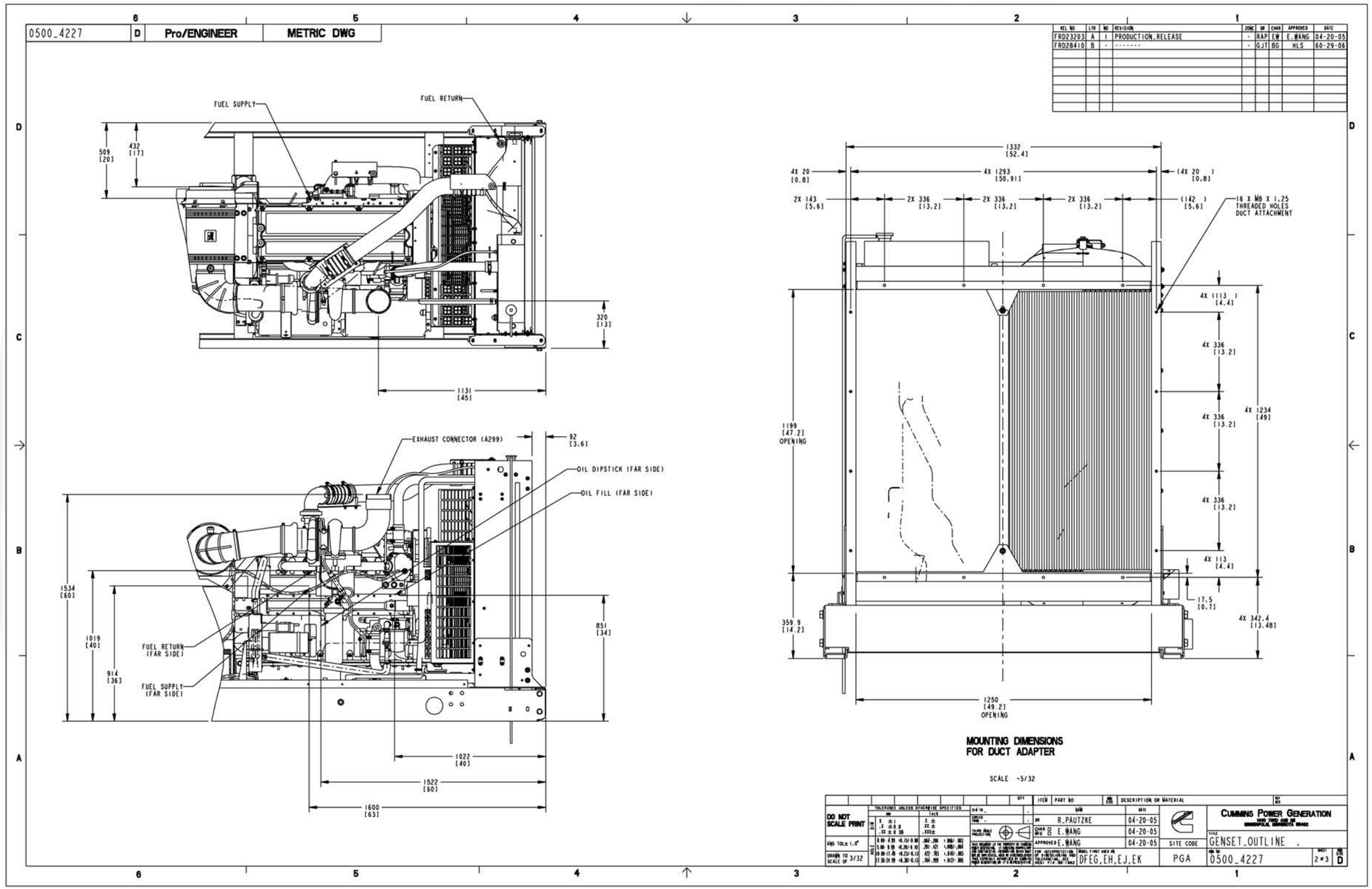


FIGURE 57. GENERATOR SET OUTLINE DRAWING (SHEET 2)

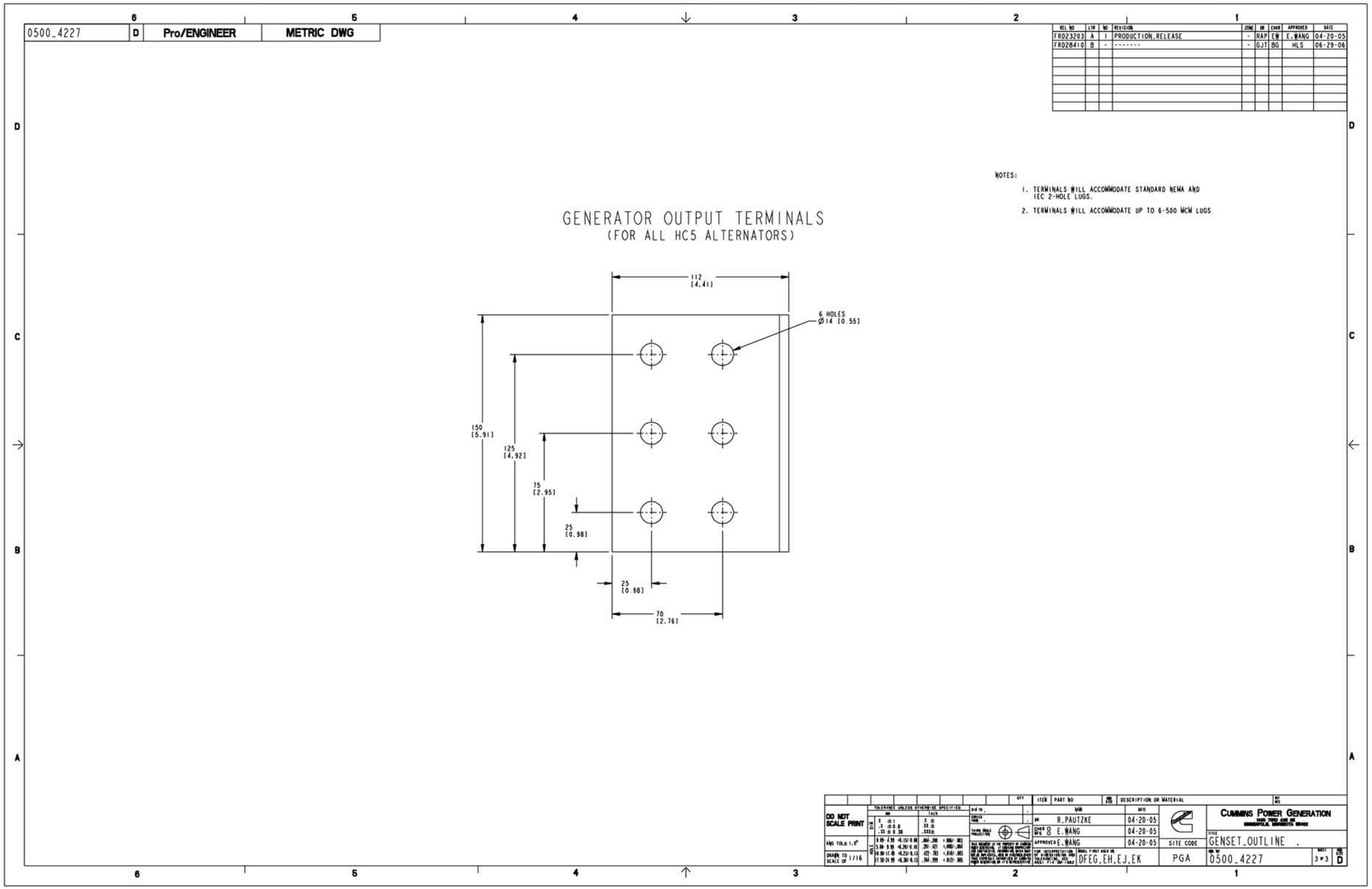


FIGURE 58. GENERATOR SET OUTLINE DRAWING (SHEET 3)

D.2 Enclosure Outline Drawing (F208, F209) (Seismic)

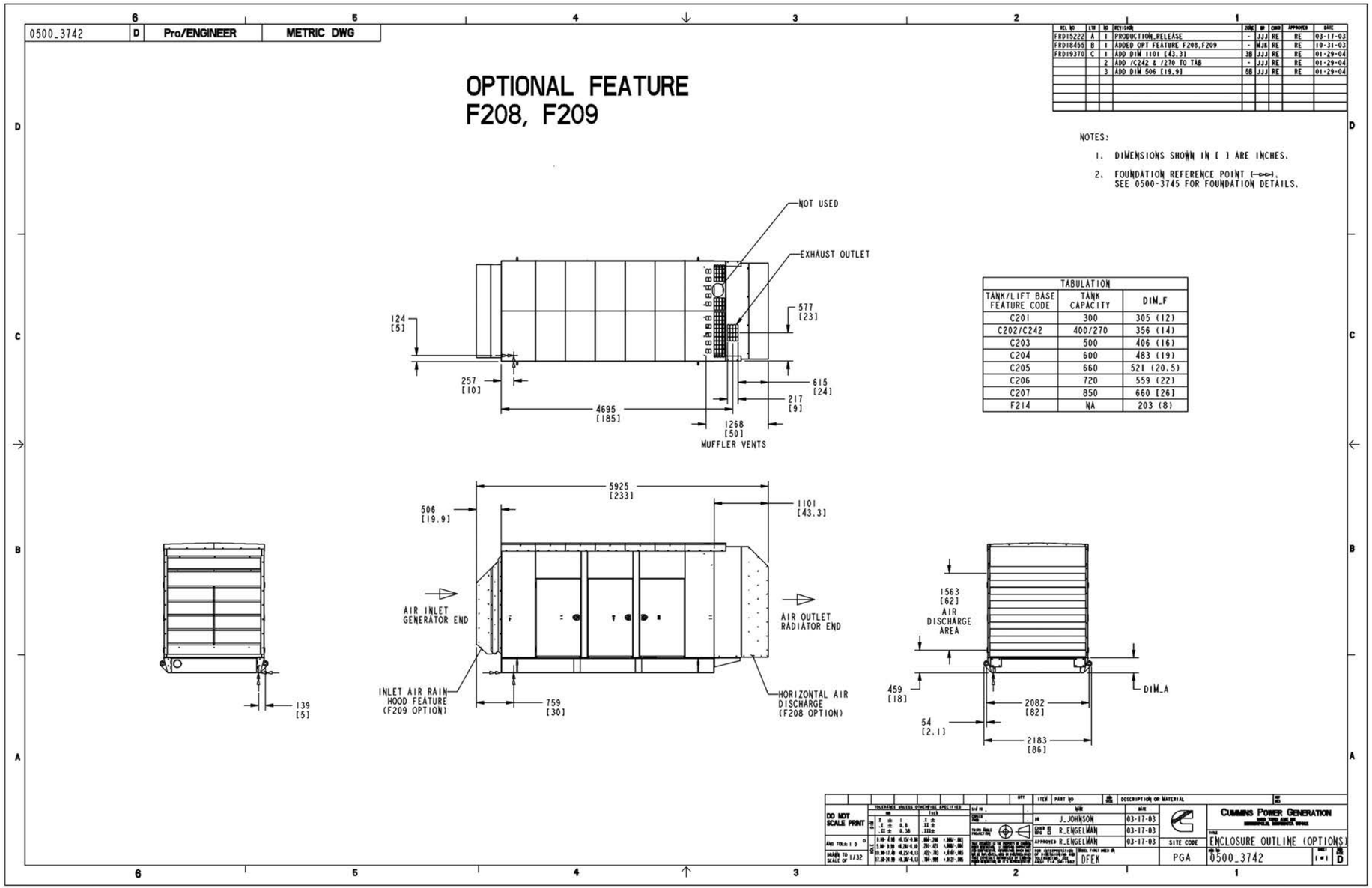


FIGURE 59. ENCLOSURE OUTLINE DRAWING (F208, F209) (SHEET 1 OF 1)

D.3 Enclosure Outline Drawing (Seismic)

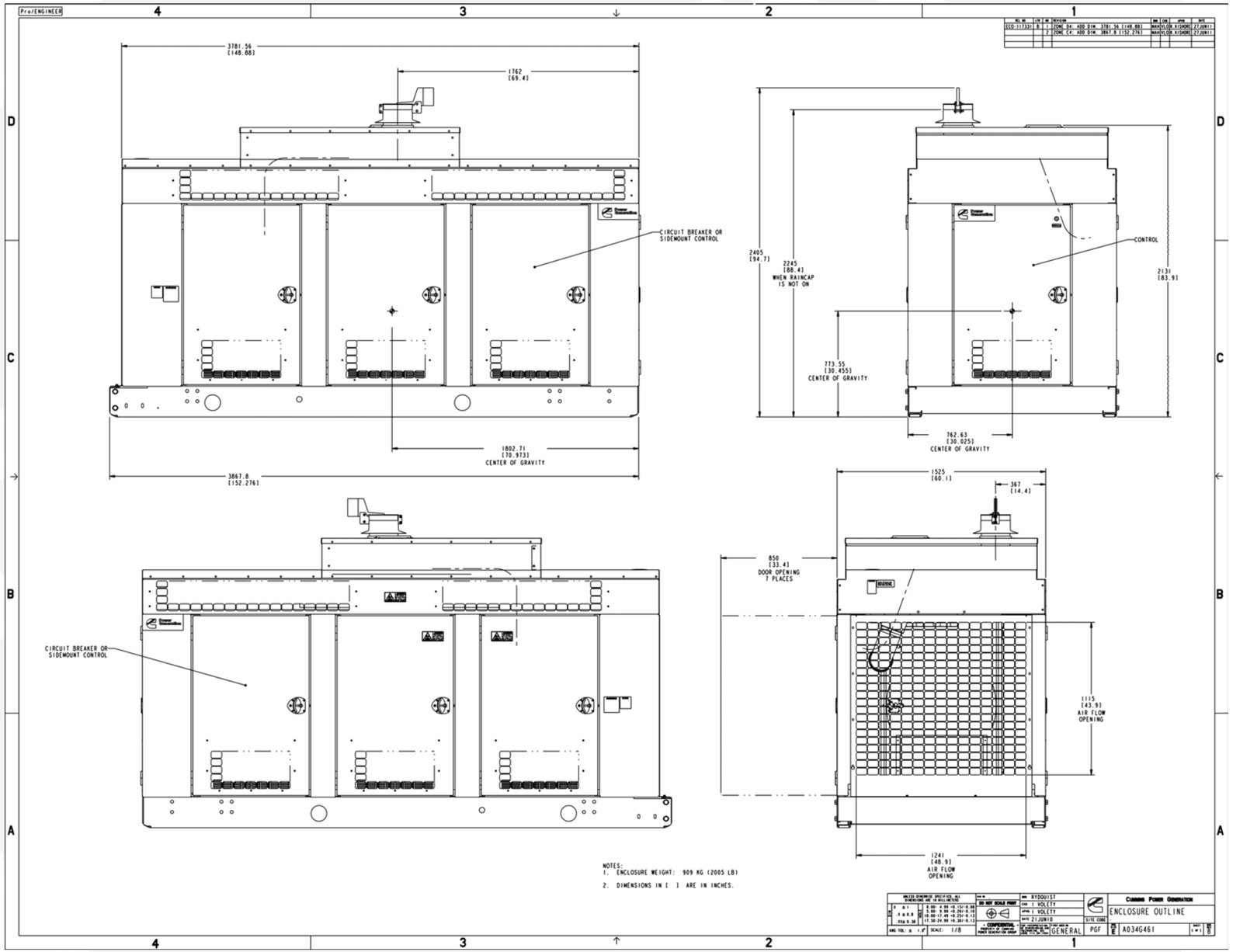


FIGURE 60. ENCLOSURE OUTLINE DRAWING (SHEET 1 OF 1)

D.4 Enclosure Outline Drawing (Weather) (Seismic)

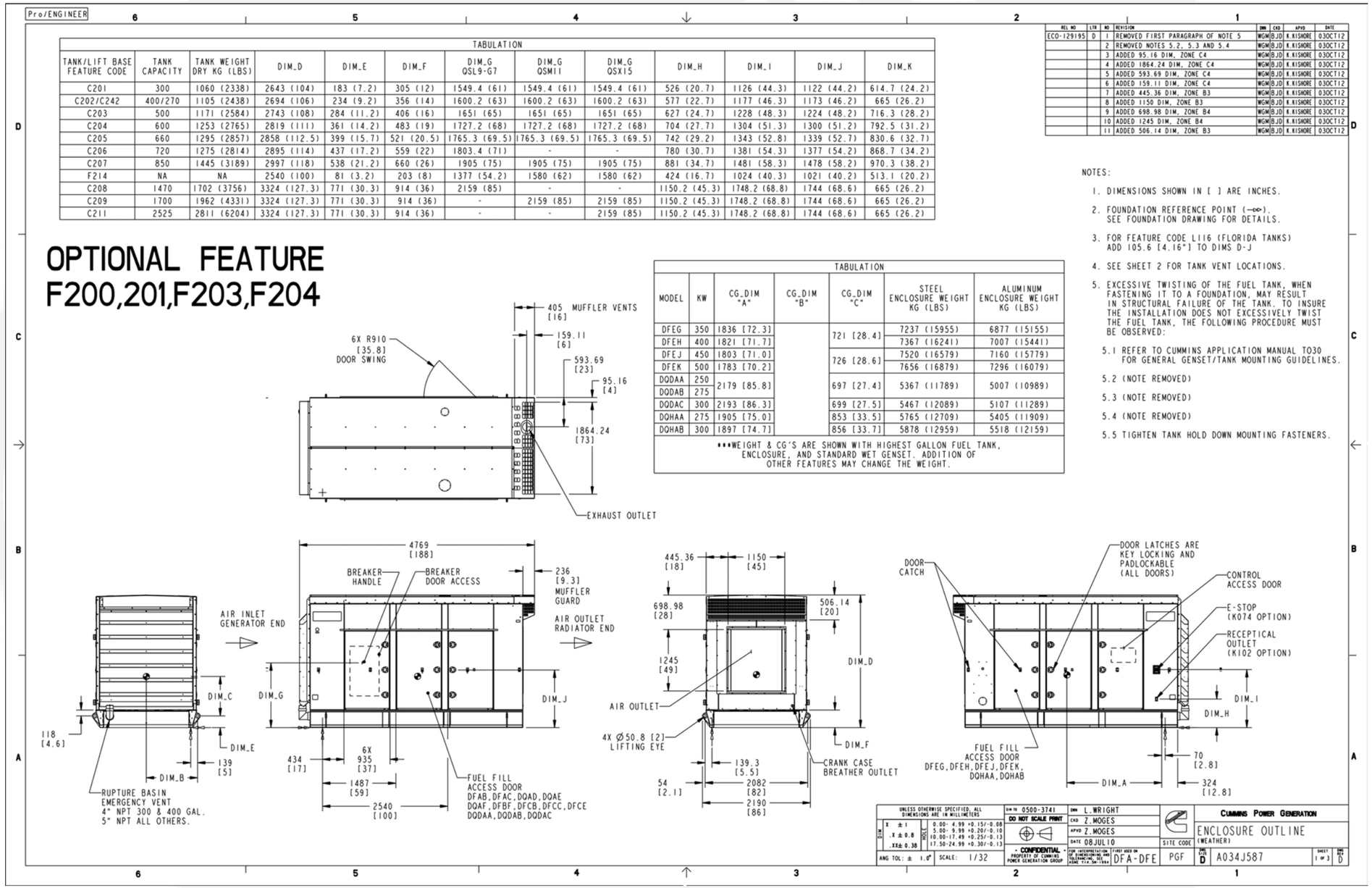


FIGURE 61. ENCLOSURE OUTLINE DRAWING (WEATHER) (SHEET 1)

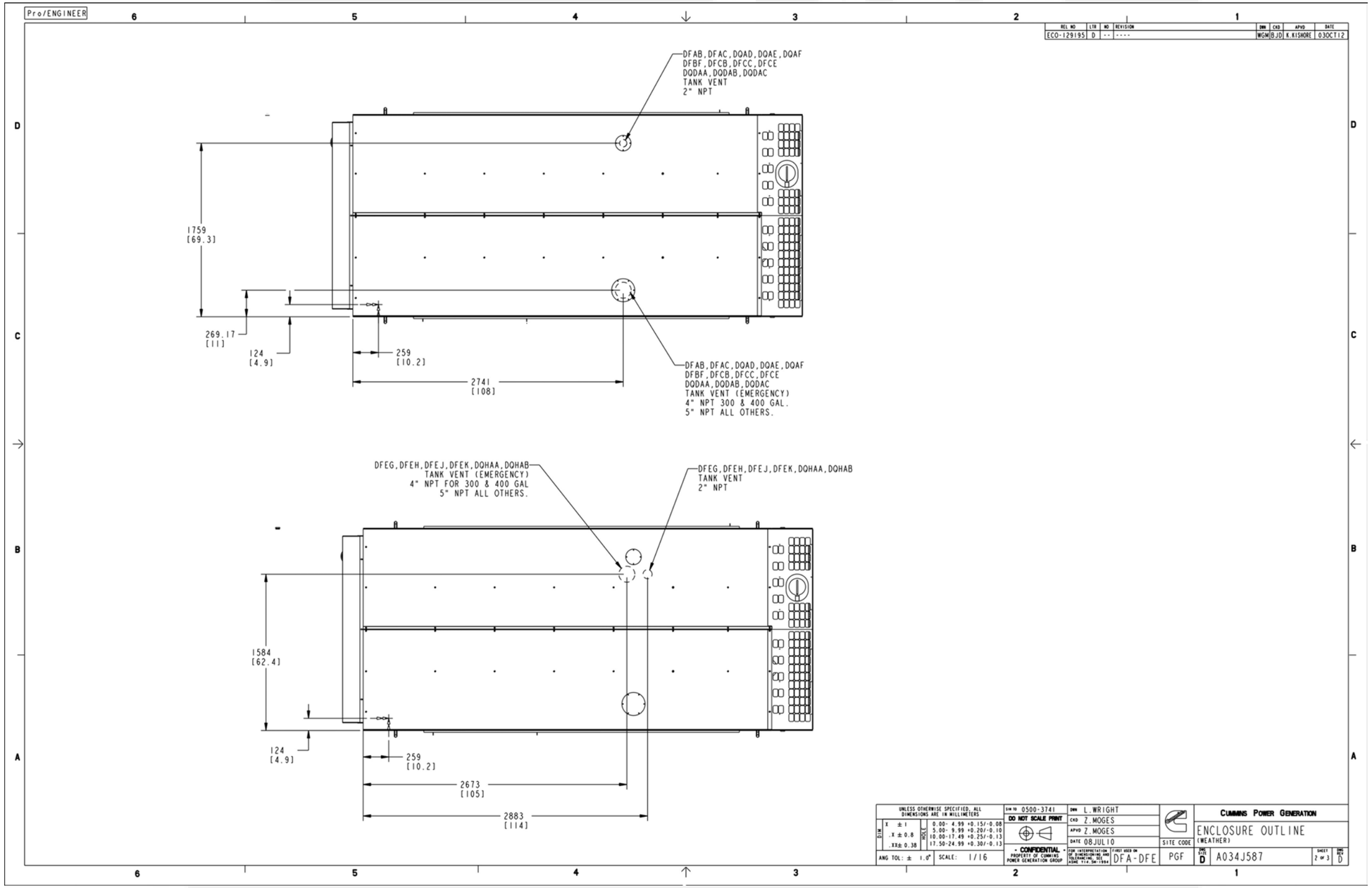


FIGURE 62. ENCLOSURE OUTLINE DRAWING (WEATHER) (SHEET 2)

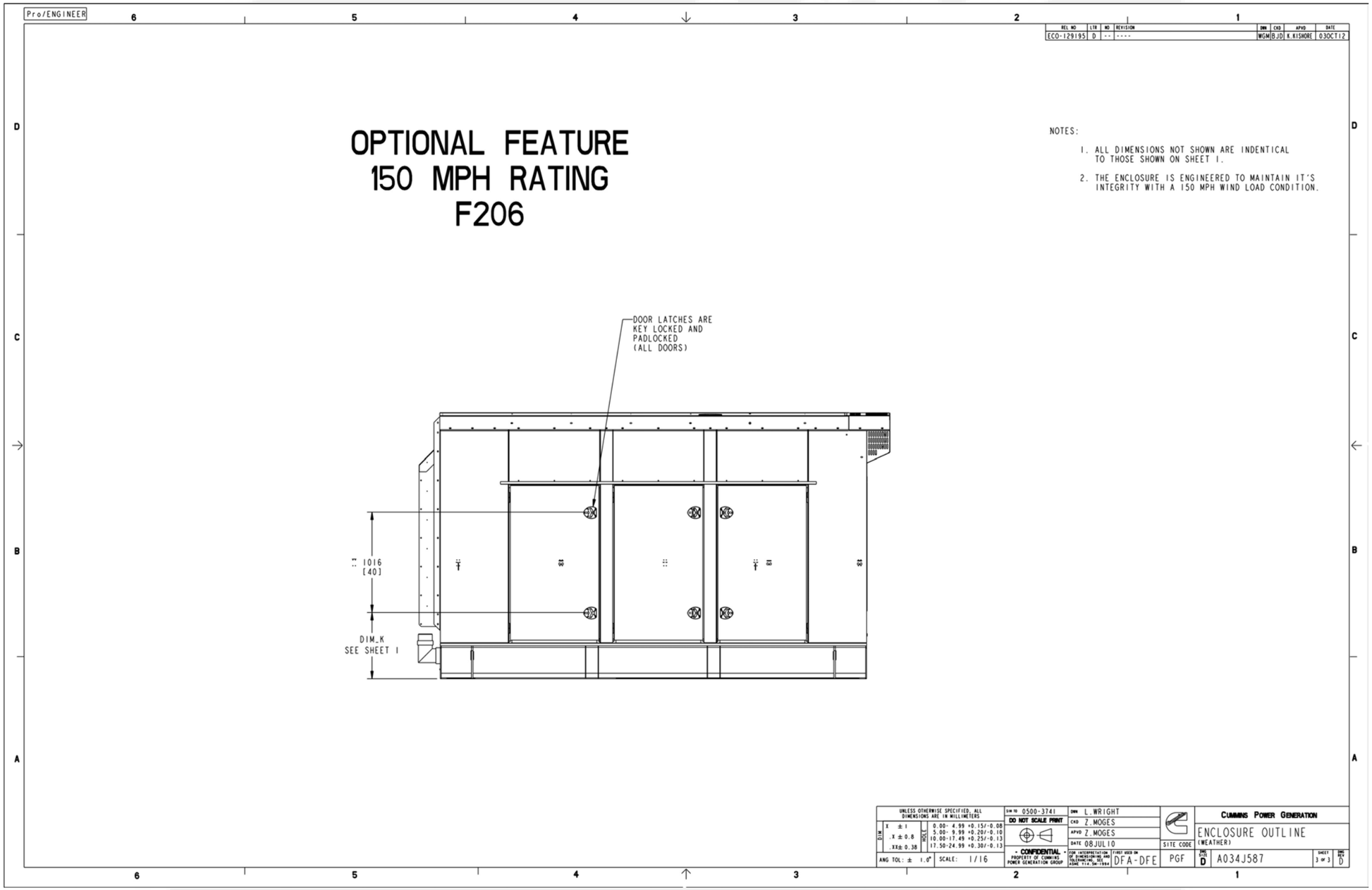


FIGURE 63. ENCLOSURE OUTLINE DRAWING (WEATHER) (SHEET 3)

D.5 Enclosure Outline Drawing (F202, F205, F206, F208, F209) (Seismic)

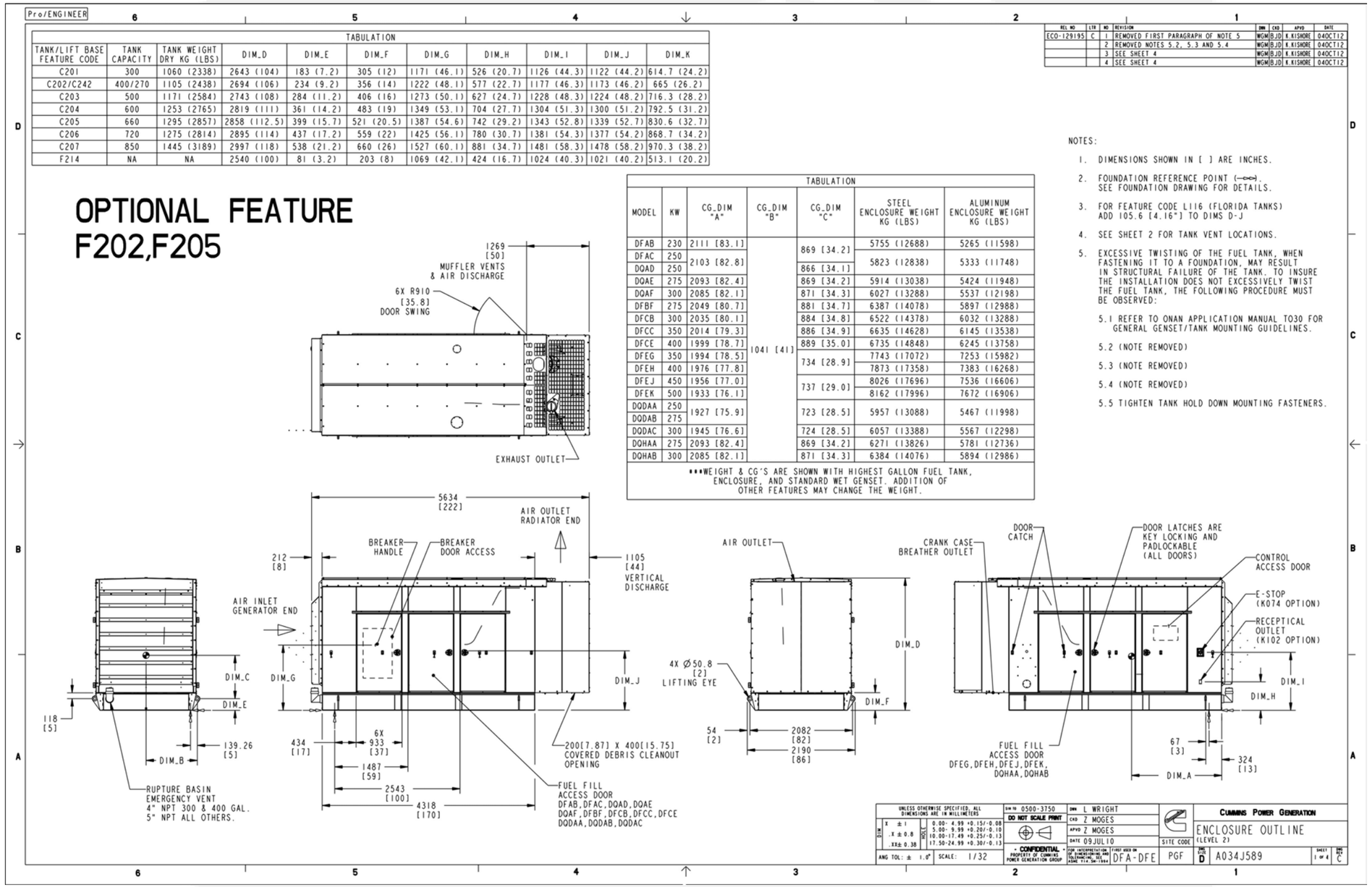


FIGURE 64. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 1)

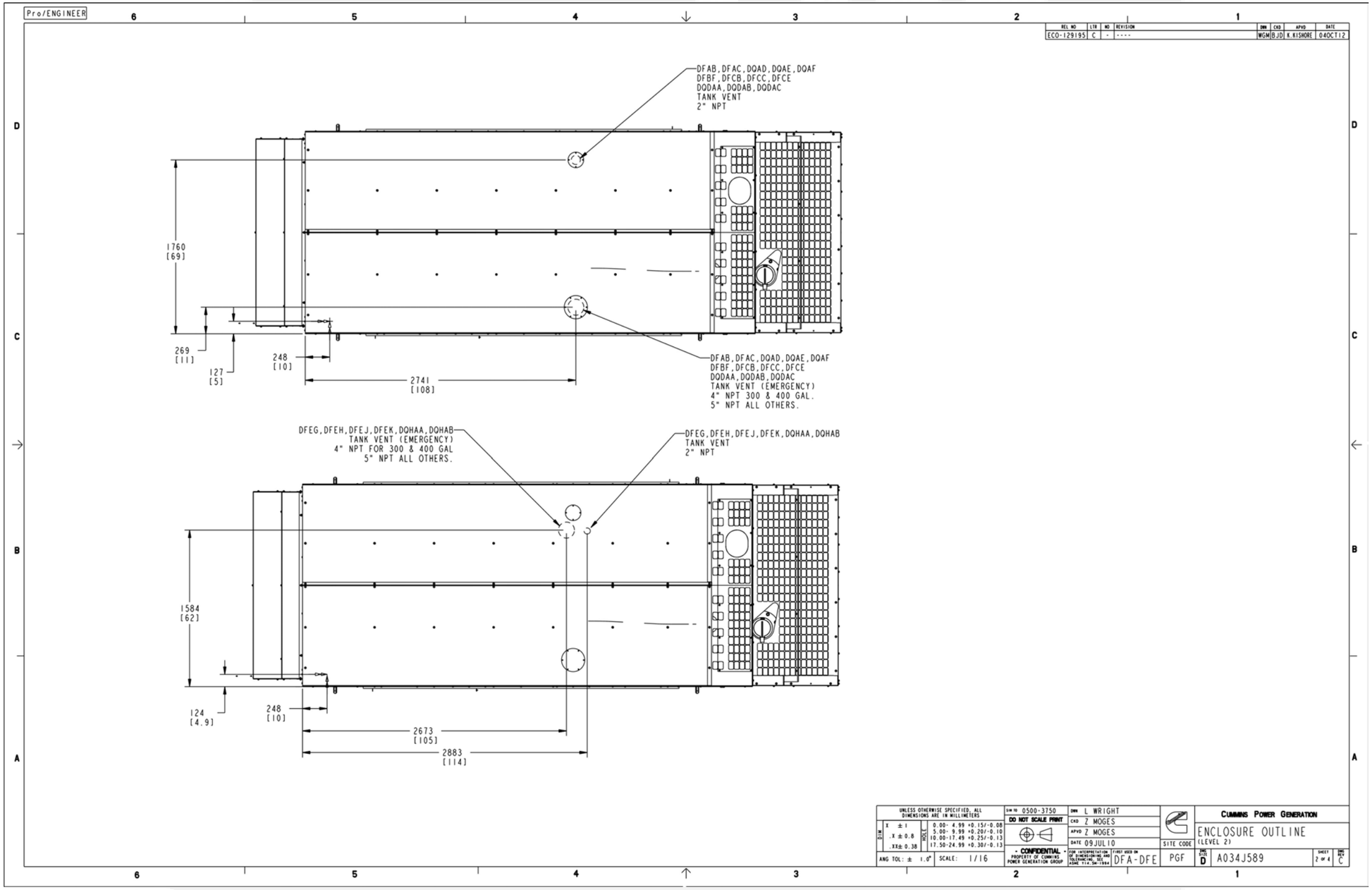


FIGURE 65. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 2)

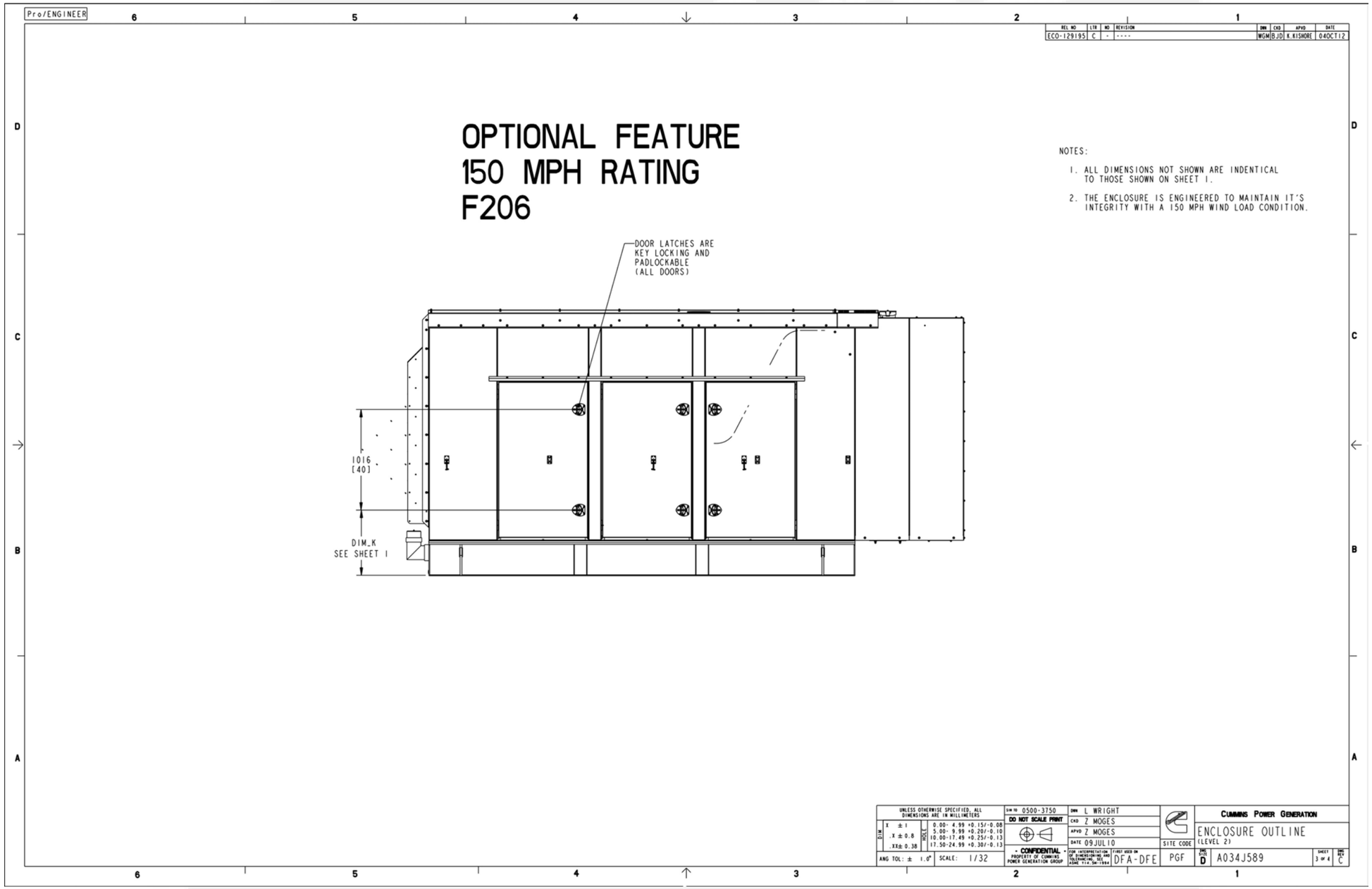


FIGURE 66. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 3)

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-129195	C	3	REMOVED FIRST PARAGRAPH OF NOTE 5	WGM	BJD	K.KISHORE	040CT12
		4	REMOVED NOTES 5.2, 5.3 AND 5.4	WGM	BJD	K.KISHORE	040CT12

TABULATION

TANK/LIFT BASE FEATURE CODE	TANK CAPACITY	TANK WEIGHT DRY KG (LBS)	DIM_D	DIM_E	DIM_F	DIM_G	DIM_H	DIM_I	DIM_J	DIM_K
C201	300	1060 (2338)	2643 (104)	183 (7.2)	305 (12)	1171 (46.1)	526 (20.7)	1126 (44.3)	1122 (44.2)	614.7 (24.2)
C202/C242	400/270	1105 (2438)	2694 (106)	234 (9.2)	356 (14)	1222 (48.1)	577 (22.7)	1177 (46.3)	1173 (46.2)	665 (26.2)
C203	500	1171 (2584)	2743 (108)	284 (11.2)	406 (16)	1273 (50.1)	627 (24.7)	1228 (48.3)	1224 (48.2)	716.3 (28.2)
C204	600	1253 (2765)	2819 (111)	361 (14.2)	483 (19)	1349 (53.1)	704 (27.7)	1304 (51.3)	1300 (51.2)	792.5 (31.2)
C205	660	1295 (2857)	2858 (112.5)	399 (15.7)	521 (20.5)	1387 (54.6)	742 (29.2)	1343 (52.8)	1339 (52.7)	830.6 (32.7)
C206	720	1275 (2814)	2895 (114)	437 (17.2)	559 (22)	1425 (56.1)	780 (30.7)	1381 (54.3)	1377 (54.2)	868.7 (34.2)
C207	850	1445 (3189)	2997 (118)	538 (21.2)	660 (26)	1527 (60.1)	881 (34.7)	1481 (58.3)	1478 (58.2)	970.3 (38.2)
F214	NA	NA	2540 (100)	81 (3.2)	203 (8)	1069 (42.1)	424 (16.7)	1024 (40.3)	1021 (40.2)	513.1 (20.2)

TABULATION

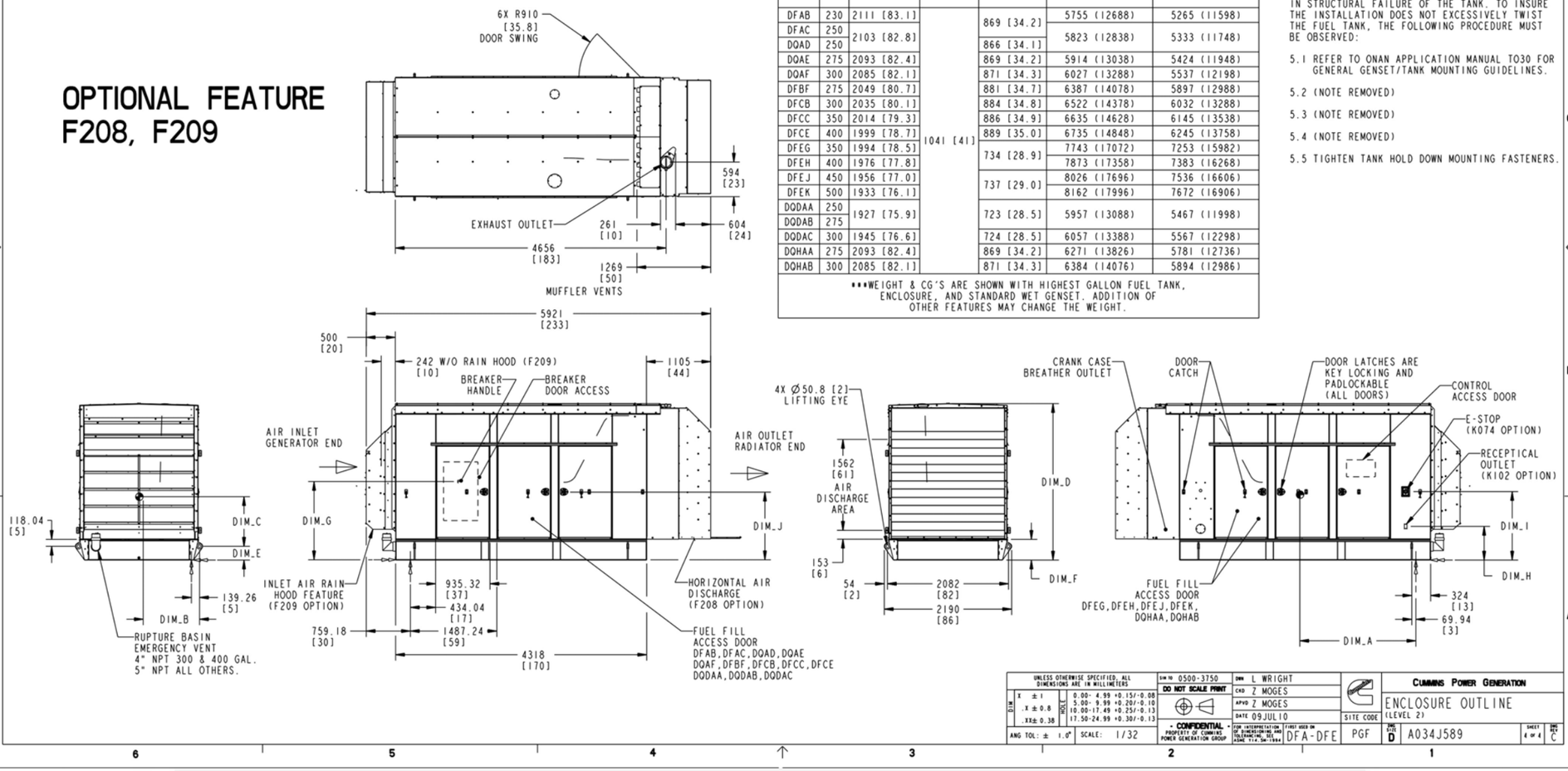
MODEL	KW	CG_DIM "A"	CG_DIM "B"	CG_DIM "C"	STEEL ENCLOSURE WEIGHT KG (LBS)	ALUMINUM ENCLOSURE WEIGHT KG (LBS)
DFAB	230	2111 [83.1]	1041 [41]	869 [34.2]	5755 (12688)	5265 (11598)
DFAC	250	2103 [82.8]			5823 (12838)	5333 (11748)
DQAD	250			866 [34.1]		
DQAE	275	2093 [82.4]		869 [34.2]	5914 (13038)	5424 (11948)
DQAF	300	2085 [82.1]		871 [34.3]	6027 (13288)	5537 (12198)
DFBF	275	2049 [80.7]		881 [34.7]	6387 (14078)	5897 (12988)
DFCB	300	2035 [80.1]		884 [34.8]	6522 (14378)	6032 (13288)
DFCC	350	2014 [79.3]		886 [34.9]	6635 (14628)	6145 (13538)
DFCE	400	1999 [78.7]		889 [35.0]	6735 (14848)	6245 (13758)
DFEG	350	1994 [78.5]		734 [28.9]	7743 (17072)	7253 (15982)
DFEH	400	1976 [77.8]			7873 (17358)	7383 (16268)
DFEJ	450	1956 [77.0]		737 [29.0]	8026 (17696)	7536 (16606)
DFEK	500	1933 [76.1]			8162 (17996)	7672 (16906)
DQDAA	250	1927 [75.9]		723 [28.5]	5957 (13088)	5467 (11998)
DQDAB	275					
DQDAC	300	1945 [76.6]		724 [28.5]	6057 (13388)	5567 (12298)
DQHAA	275	2093 [82.4]		869 [34.2]	6271 (13826)	5781 (12736)
DQHAB	300	2085 [82.1]		871 [34.3]	6384 (14076)	5894 (12986)

***WEIGHT & CG'S ARE SHOWN WITH HIGHEST GALLON FUEL TANK, ENCLOSURE, AND STANDARD WET GENSET. ADDITION OF OTHER FEATURES MAY CHANGE THE WEIGHT.

NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. FOUNDATION REFERENCE POINT ( ). SEE FOUNDATION DRAWING FOR DETAILS.
3. FOR FEATURE CODE L116 (FLORIDA TANKS) ADD 105.6 [4.16"] TO DIMS D-J
4. SEE SHEET 2 FOR TANK VENT LOCATIONS.
5. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:
   - 5.1 REFER TO ONAN APPLICATION MANUAL TO30 FOR GENERAL GENSET/TANK MOUNTING GUIDELINES.
   - 5.2 (NOTE REMOVED)
   - 5.3 (NOTE REMOVED)
   - 5.4 (NOTE REMOVED)
   - 5.5 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.

OPTIONAL FEATURE
F208, F209



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1, .X ±0.8, .XX± 0.38
ROUT: 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: 1/32
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DWN L WRIGHT 09JUL10
CKD Z MOGES
APVD Z MOGES
DFA-DFE
SITE CODE PGF
CUMMINS POWER GENERATION
ENCLOSURE OUTLINE (LEVEL 2)
SIZE D A034J589
SHEET 4 of 4
DWG REV C

FIGURE 67. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 4)

D.6 Enclosure Outline Drawing (F200, F201, F203, F204, F206) (Seismic)

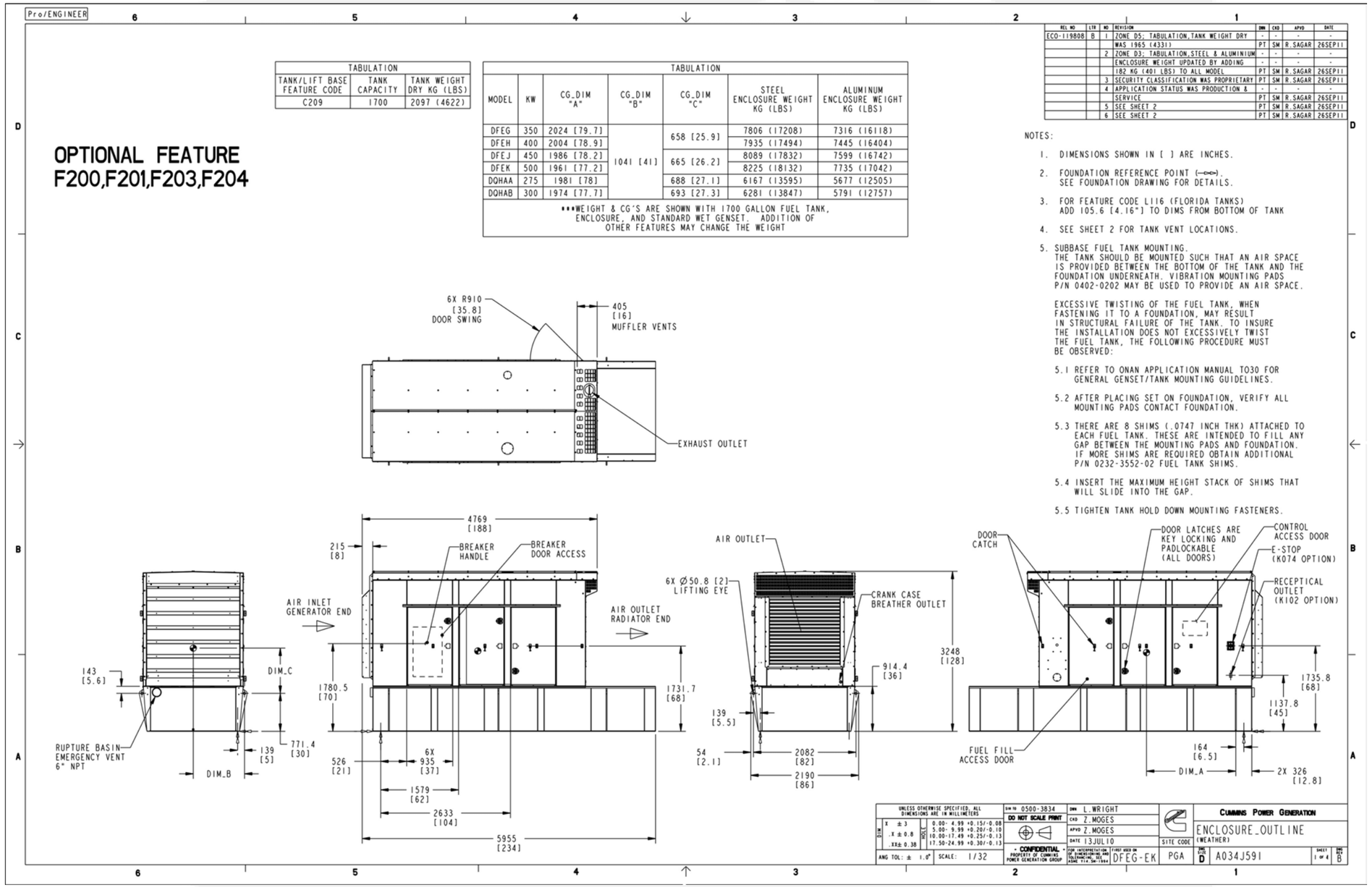


FIGURE 68. ENCLOSURE OUTLINE DRAWING (F200, F201, F203, F204, F206) (SHEET 1)

Pro/ENGINEER

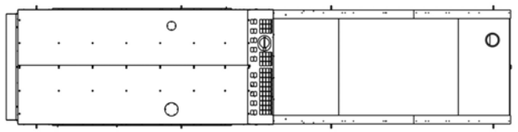
REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-119808	B	5	ZONE D4; TABULATION,TANK WEIGHT DRY	-	-	-	-
			WAS 2954 (6512)	PT	SM	R.SAGAR	26SEP11
		6	ZONE D1; TABULATION,STEEL & ALUMINIUM	-	-	-	-
			ENCLOSURE WEIGHT UPDATED BY ADDING	-	-	-	-
			61 KG (135 LBS) TO ALL MODEL	PT	SM	R.SAGAR	26SEP11

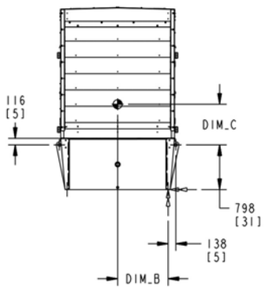
OPTIONAL FEATURE
F200,F201,F203,F204

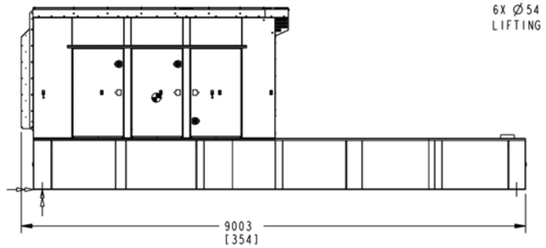
TABULATION		
TANK/LIFT BASE FEATURE CODE	TANK CAPACITY	TANK WEIGHT DRY KG (LBS)
C211	2525	2965 (6536)

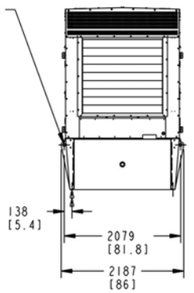
TABULATION						
ADS	GENSET MODEL	CG_DIM "A"	CG_DIM "B"	CG_DIM "C"	STEEL ENCLOSURE WEIGHT KG (LBS)	ALUMINUM ENCLOSURE WEIGHT KG (LBS)
305	DFEG, EH, EJ, EK	3001 [118.14]	1008 [39.7]	1226 [48.27]	8131 (17926.8)	7641 (16836.8)
306	DFEG, EH, EJ, EK	2988 [117.63]		1232 [48.5]	8261 (18213.4)	7771 (17123.4)
307	DFEH, EJ, EK	2973 [117.06]		1239 [48.76]	8411 (18184.1)	7921 (17094.1)
308	DFEJ, EK	2960 [116.55]		1245 [49]	8551 (18852.7)	8061 (17762.7)

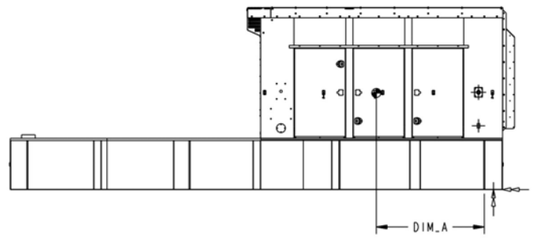
***WEIGHT & CG'S ARE SHOWN WITH 2525 GALLON FUEL TANK, (DRY WEIGHT) ENCLOSURE, AND STANDARD WET GENSET. ADDITION OF OTHER FEATURES MAY CHANGE THE WEIGHT.











UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±3, .X ±0.8, .XX± 0.38
DECIMAL: 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: 1/40
DWG NO 0500-3834
DO NOT SCALE PRINT
* CONFIDENTIAL * PROPERTY OF CUMMINS POWER GENERATION GROUP
DRN L.WRIGHT
CKD Z.MOGES
APVD Z.MOGES
DATE 13JUL10
FIRST USED ON DFEG-EK
CUMMINS POWER GENERATION
ENCLOSURE_OUTLINE (WEATHER)
SITE CODE PGA
SIZE D A034J591
SHEET 2 of 4
REV B

FIGURE 69. ENCLOSURE OUTLINE DRAWING (F200, F201, F203, F204, F206) (SHEET 2)

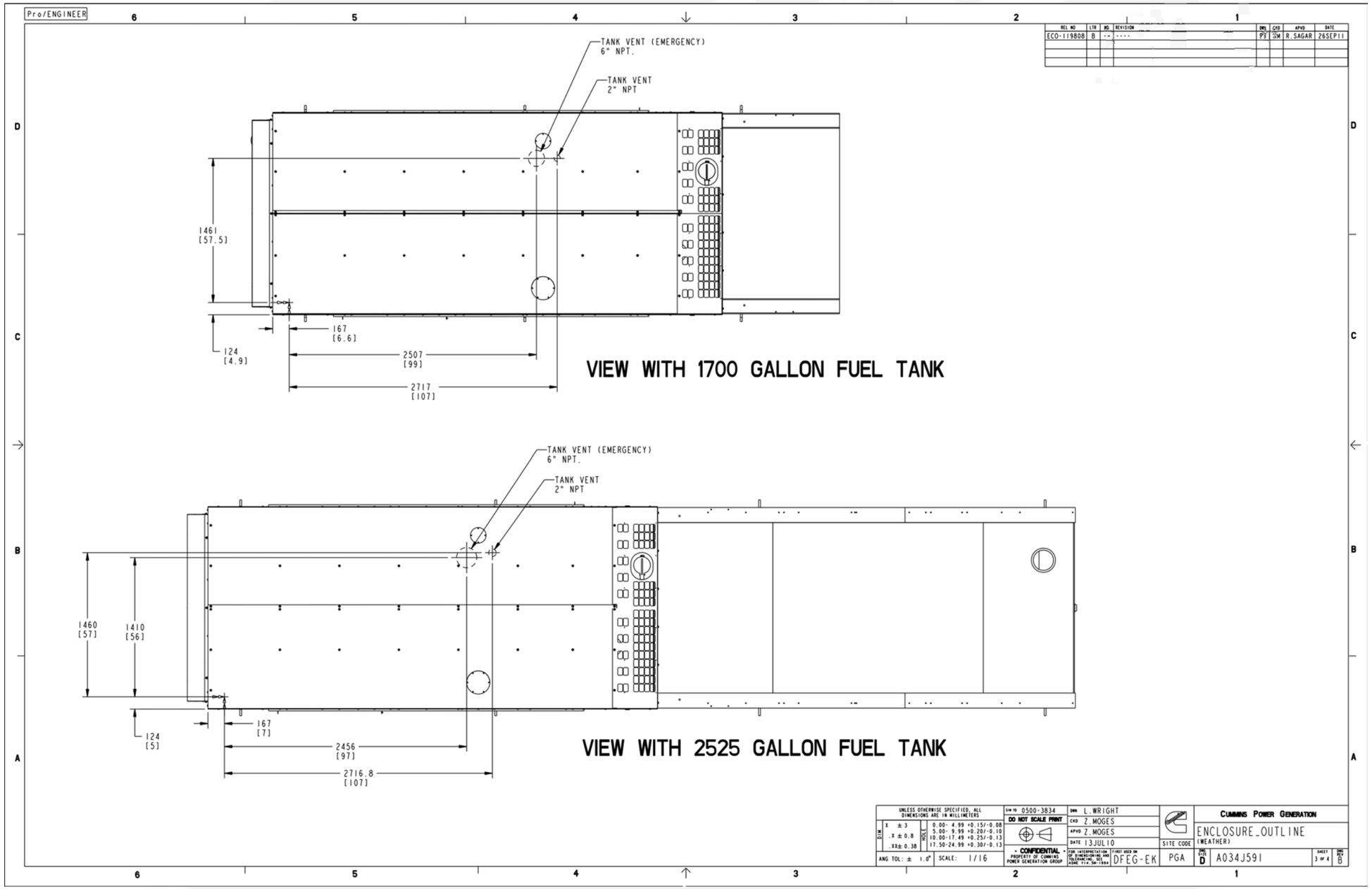


FIGURE 70. ENCLOSURE OUTLINE DRAWING (F200, F201, F203, F204, F206) (SHEET 3)

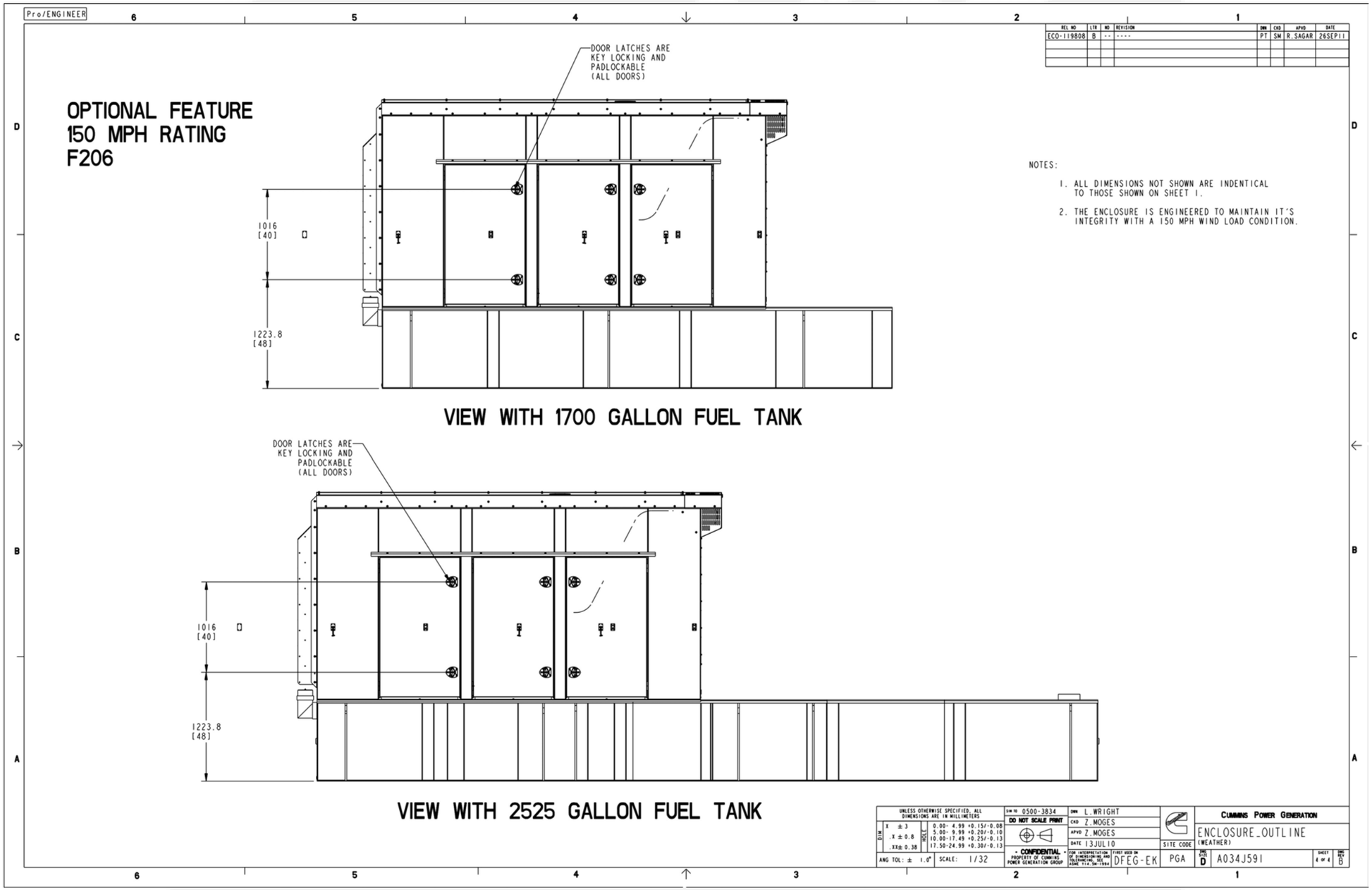


FIGURE 71. ENCLOSURE OUTLINE DRAWING (F200, F201, F203, F204, F206) (SHEET 4)

D.7 Enclosure Outline Drawing (F202, F205, F206, F208, F209) (Seismic)

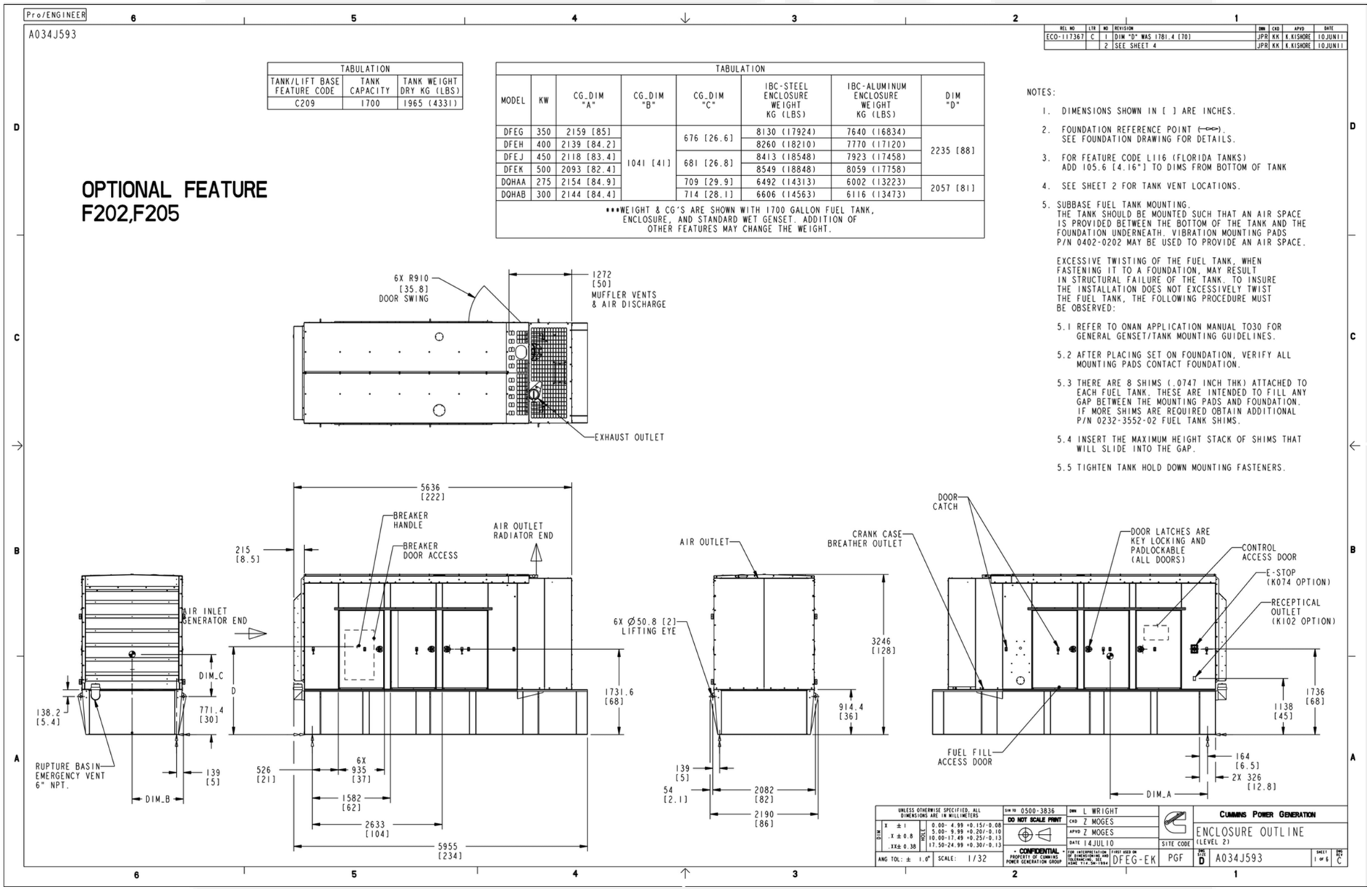


FIGURE 72. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 1)

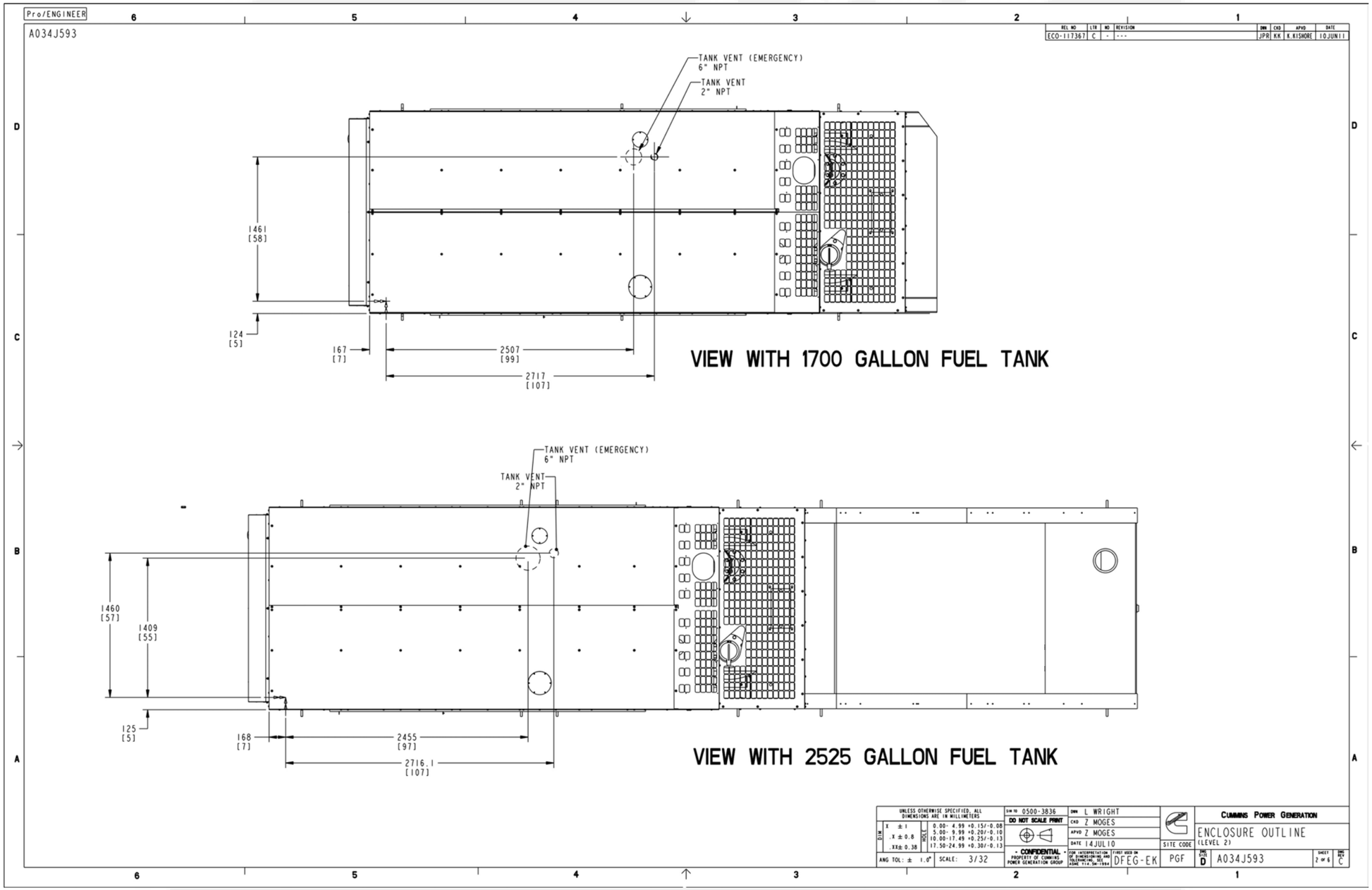


FIGURE 73. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 2)

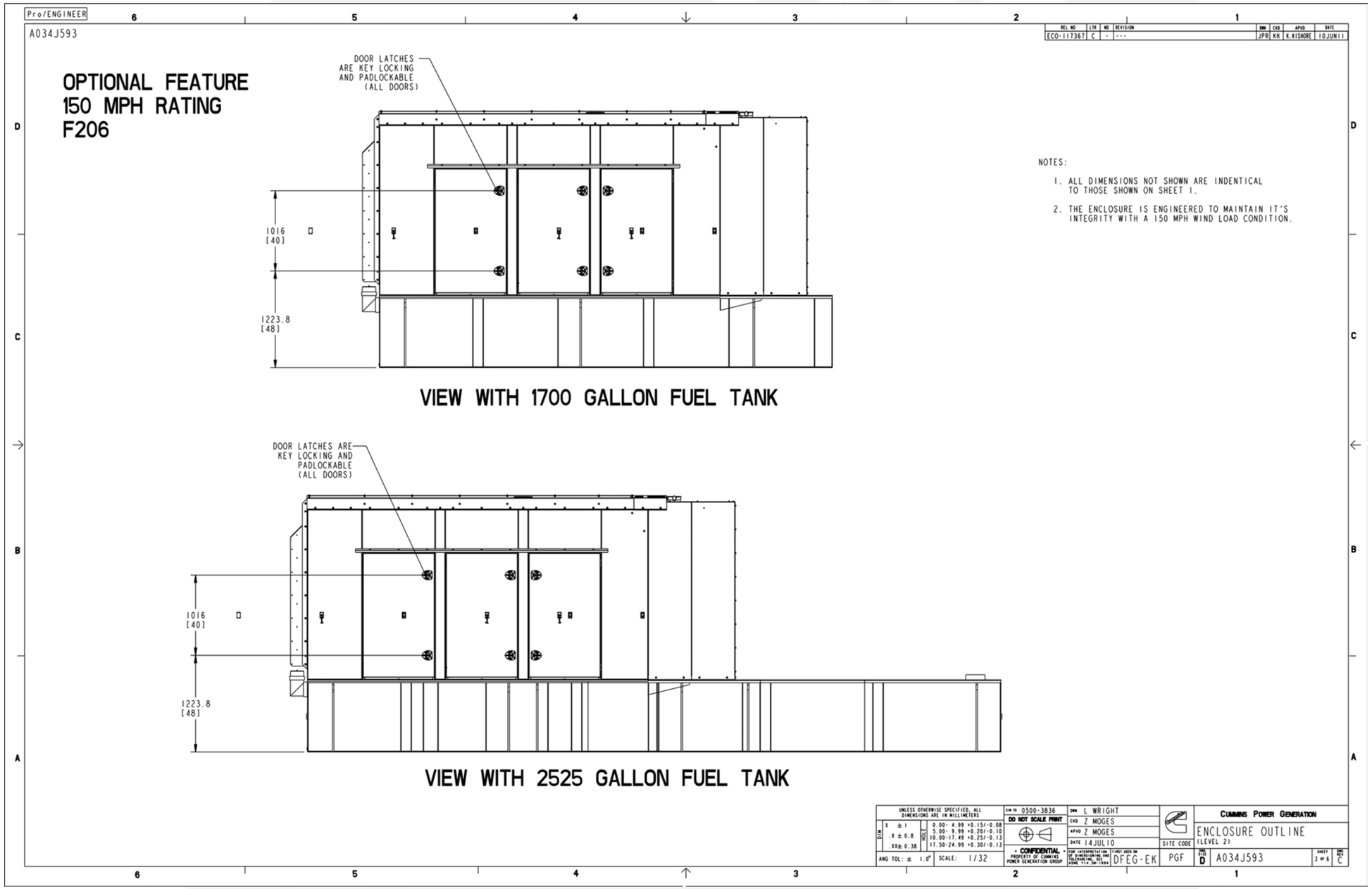


FIGURE 74. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 3)

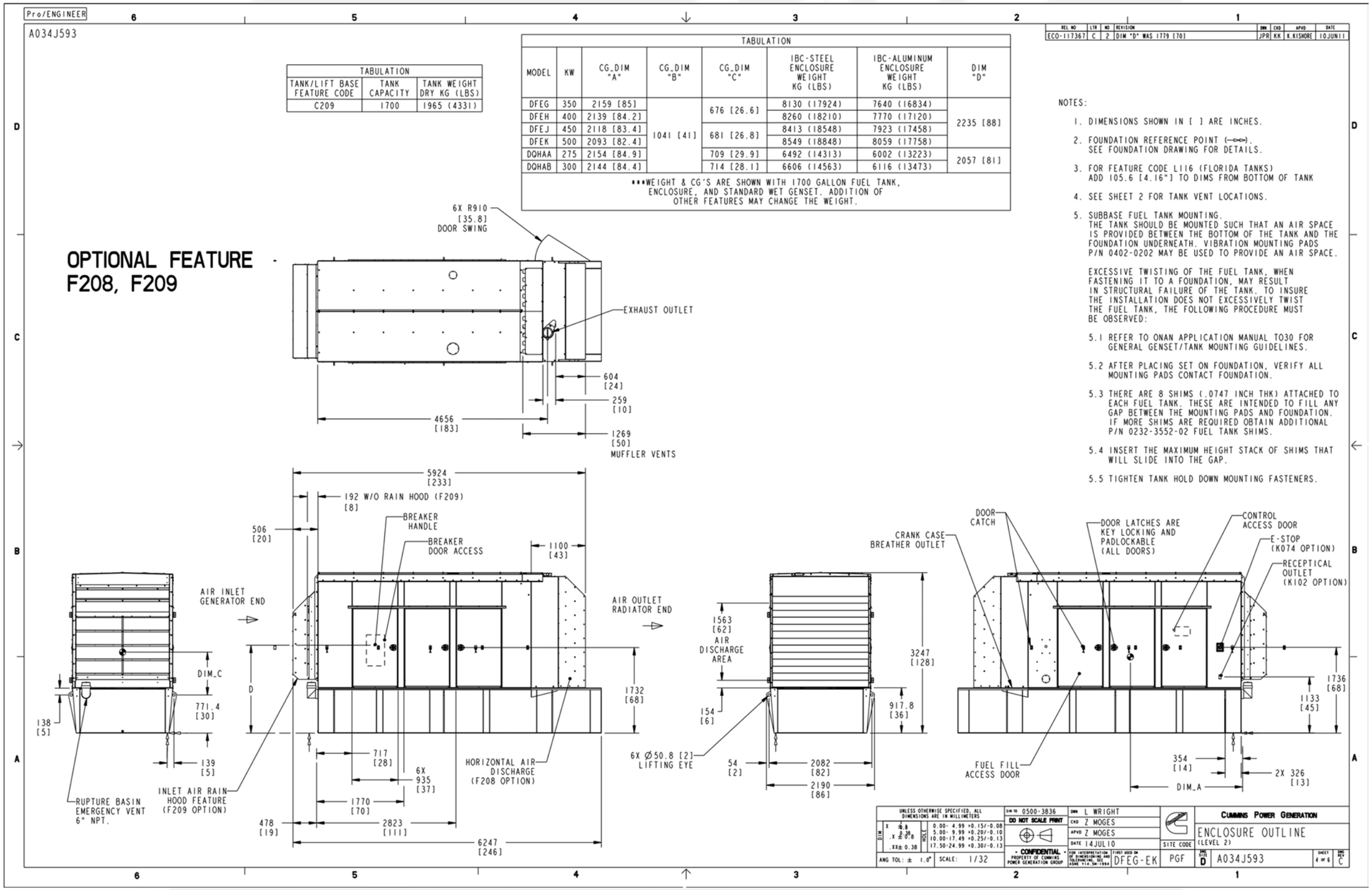


FIGURE 75. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 4)

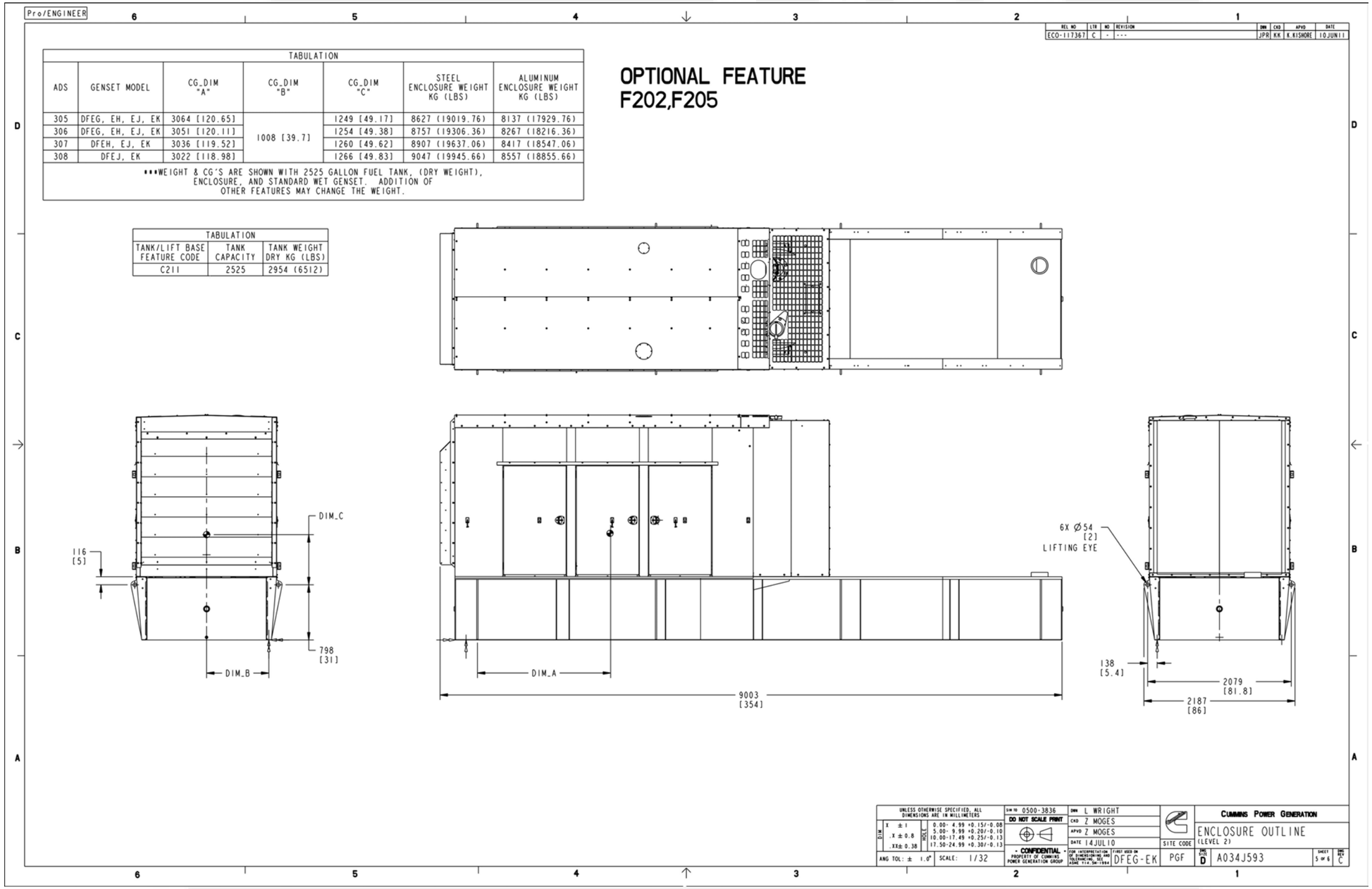


FIGURE 76. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 5)

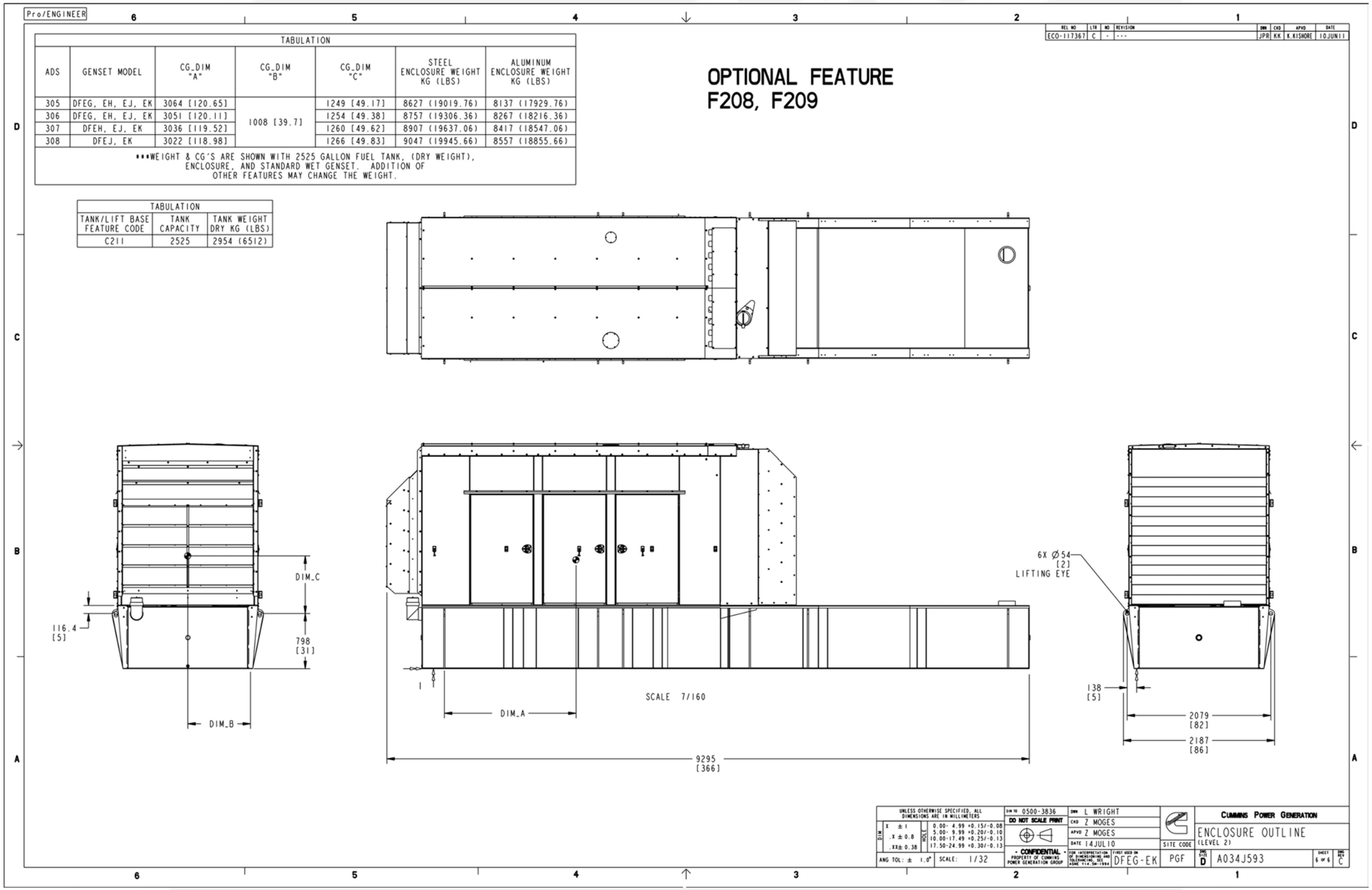


FIGURE 77. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 6)

D.8 Circuit Breaker Outline Drawing (Seismic)

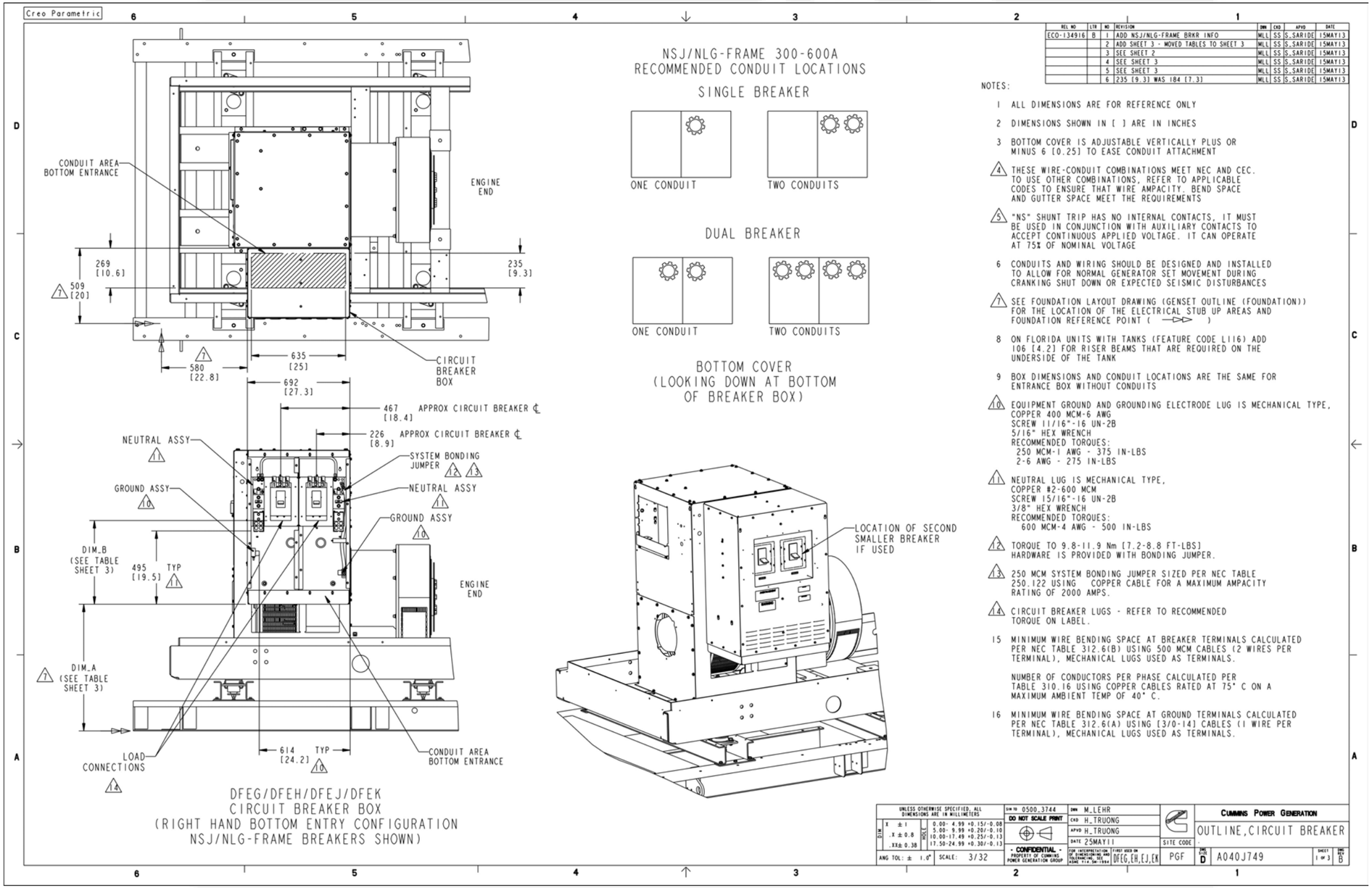


FIGURE 78. CIRCUIT BREAKER OUTLINE (SHEET 1)

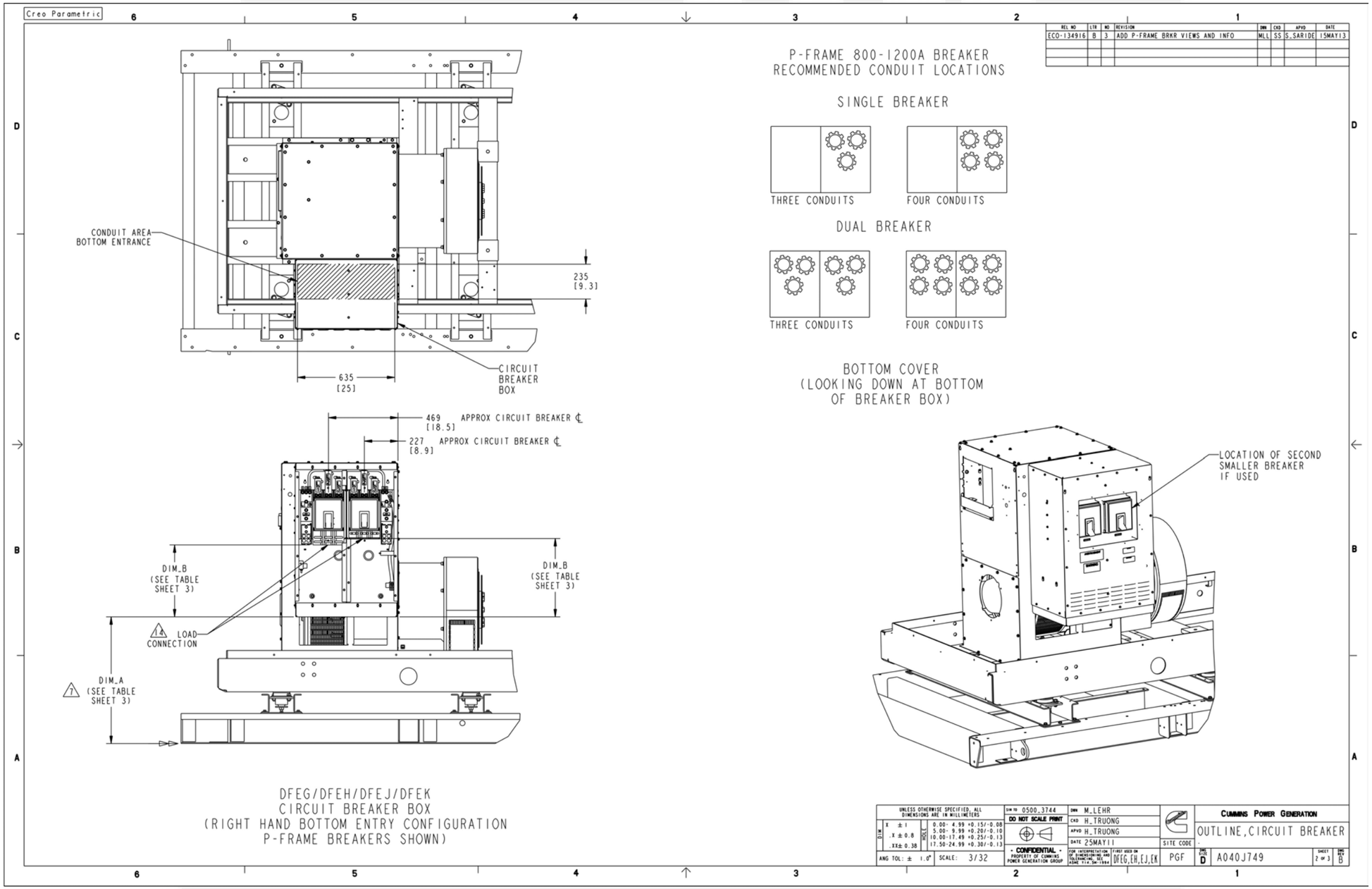


FIGURE 79. CIRCUIT BREAKER OUTLINE (SHEET 2)

Creo Parametric

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-134916	B	2	ADD SHEET 3	MLL	SS	S.SARIDE	15MAY13
		4	ADD P-FRAME BRKR INFO TO LARGE TABLE AND CONDUIT AND WIRE SIZE TABLE	MLL	SS	S.SARIDE	15MAY13
		5	ADD "/NLG" TO NSJ IN FRAME COLUMN OF UL/IEC LUGS TABLE	MLL	SS	S.SARIDE	15MAY13

UL/IEC LUGS					ACCESSORY SPECIFICATIONS			
LUG	FRAME	MAX AMPS	WIRE RANGE COPPER	DIM_B	ACCESSORY DESCRIPTION	CONTACT RATING	INRUSH CURRENT	CONNECTION TYPE
	NSJ/NLG	400A 3 POLE	#2-600 KCMIL	565 [22.2]	24 VDC SHUNT TRIP	-	10A △5	COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 1.13 Nm [10 LB-IN]
		600A 3-POLE	2/0-350 KCMIL		1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM	6A AT 690 VAC 2.5A AT 48 VDC, 0.3A AT 250 VDC	-	
	P	800A 3-POLE	3/0-500 KCMIL	18.9 [480]	24 VDC SHUNT TRIP	-	200VA	COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 1.13 Nm [10 LB-IN]
					1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VDC	-	
	P	1200A 3-POLE	3/0-500 KCMIL	17.2 [437]	24 VDC SHUNT TRIP	-	200VA	COMPRESSION TERMINALS FOR 1 OR 2 #18-16 AWG. TORQUE: 1.13 Nm [10 LB-IN]
					1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VAC	-	

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC 2008, ARTICLE 310.15 AT 75C TEMPURATURE RATED CONDUCTOR AT 40C AMBIENT AND ANNEX C (LIQUID TIGHT FLEXIBLE METAL CONDUIT - LFCM) △4

MAX BRKR AMPS	WIRE (COPPER)		CONDUIT	
	QTY	SIZE	QTY	SIZE
1200	4	500 KCMIL	4	4"
800	3	350 KCMIL	3	3 1/2"
600	2	350 KCMIL	2	3 1/2"
500	2	300 KCMIL	2	3 1/2"
450	2	300 KCMIL	2	3 1/2"
400	1	600 KCMIL	1	4"
350	1	600 KCMIL	1	4"
300	1	500 KCMIL	1	4"

DIM_A TABULATION

MODEL NAME	TANK/LIFT BASE FEATURE CODE	TANK CAPACITY (GAL)	HEIGHT DIM_A
DFEG,DFEH DFEJ,DFEK	C201	300	914[36]
	C202	400	965[38]
	C203	500	1015[40]
	C204	600	1092[43]
	C205	660	1130[44.5]
	C206	720	1168[46]
	C207	850	1269[50]
	F214	NA	812[32]

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM ID: 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: 3/32
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DRW M_LEHR CKD H_TRUONG APVD H_TRUONG DATE 25MAY11
FIRST USED ON DFEG,EH,EJ,EK
SITE CODE PGF
CUMMINS POWER GENERATION
OUTLINE,CIRCUIT BREAKER
SIZE D A040J749 SHEET 3 OF 3 REV B

FIGURE 80. CIRCUIT BREAKER OUTLINE (SHEET 3)

D.9 Fuel System Outline Drawing (Non-Seismic)

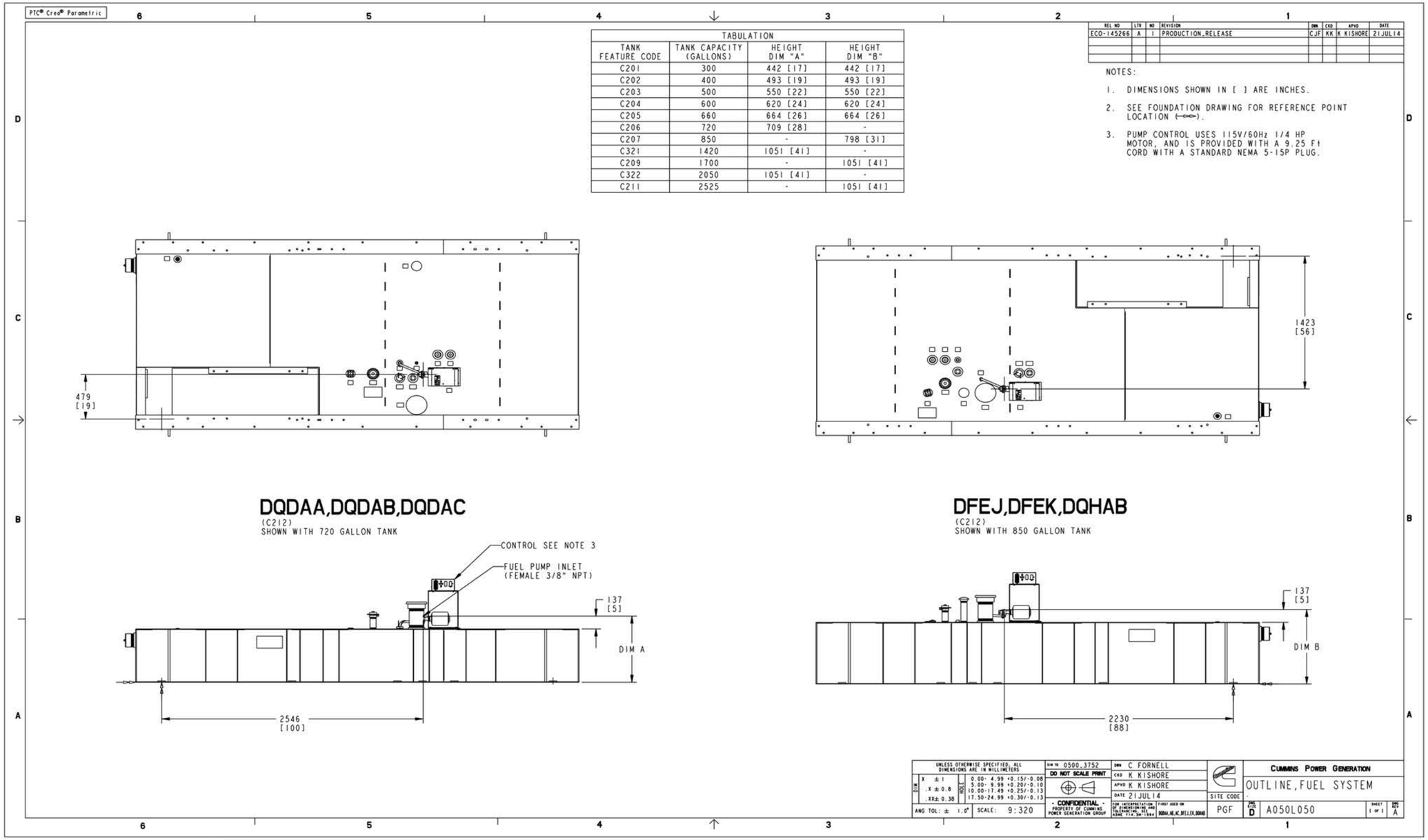


FIGURE 81. FUEL SYSTEM OUTLINE DRAWING

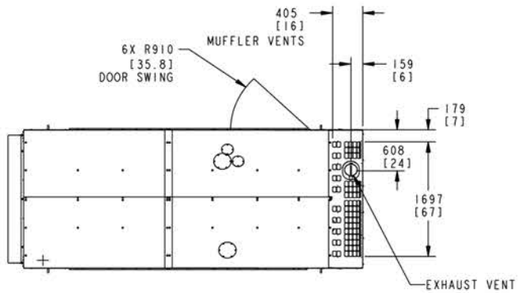
D.10 Enclosure Outline Drawing (Weather) (Non-Seismic)

PTC® Creo® Parametric

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-145311	A	1	PRODUCTION_RELEASE	CJF	KK	K KISHORE	23JUL14

TABULATION

TANK/LIFT BASE FEATURE CODE	TANK CAPACITY	TANK WEIGHT DRY KG (LBS)	DIM_D	DIM_E	DIM_F	DIM_G QSL9-G7	DIM_G QSM11	DIM_G QSX15	DIM_H	DIM_J	DIM_K	DIM_L
C201	300	954 [2103]	2643 (104)	183 (7.2)	305 (12)	1549.4 (61)	1549.4 (61)	1549.4 (61)	526 (20.7)	1126 (44.3)	1122 (44.2)	614.7 (24.2)
C202/C242	400/270	1019 [2246]	2694 (106)	234 (9.2)	356 (14)	1600.2 (63)	1600.2 (63)	1600.2 (63)	577 (22.7)	1177 (46.3)	1173 (46.2)	665 (26.2)
C203	500	1097 [2419]	2745 [108]	295 [11.6]	417 [16]	1662 [65]	1662 [65]	1662 [65]	637 [25]	1235 [49]	1231 [48.5]	723 [28.5]
C204	600	1161 [2559]	2819 (111)	361 (14.2)	483 (19)	1727.2 (68)	1727.2 (68)	1727.2 (68)	704 (27.7)	1304 (51.3)	1300 (51.2)	792.5 (31.2)
C205	660	1198 [2641]	2859 [113]	409 [16]	531 [21]	1772 [70]	1772 [70]	1772 [70]	751 [30]	1349 [53]	1345 [53]	837 [33]
C206	720	1243 [2741]	2904 [114]	454 [18]	576 [23]	1817 [72]	-	-	796 [31]	1394 [55]	1390 [55]	882 [35]
C207	850	1332 [2936]	2997 (118)	538 (21.2)	660 (26)	-	1905 (75)	1905 (75)	881 (34.7)	1481 (58.3)	1478 (58.2)	970.3 (38.2)
F214	NA	NA	2540 (100)	81 (3.2)	203 (8)	1377 (54.2)	1580 (62)	1580 (62)	424 (16.7)	1024 (40.3)	1021 (40.2)	513.1 (20.2)
C208	1420	1789 [3943]	3324 (127.3)	771 (30.3)	914 (36)	2159 (85)	-	-	1150.2 (45.3)	1748.2 (68.8)	1744 (68.6)	665 (26.2)
C209	1700	2022 [4458]	3324 (127.3)	771 (30.3)	914 (36)	-	2159 (85)	2159 (85)	1150.2 (45.3)	1748.2 (68.8)	1744 (68.6)	665 (26.2)
C211	2525	2935 [6471]	3324 (127.3)	771 (30.3)	914 (36)	-	-	2159 (85)	1150.2 (45.3)	1748.2 (68.8)	1744 (68.6)	665 (26.2)



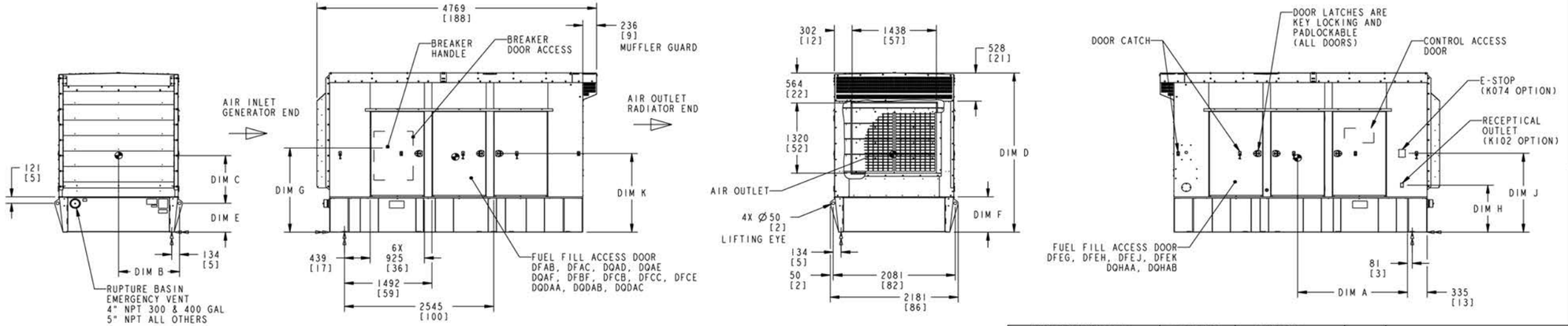
TABULATION

MODEL	KW	CG_DIM "A"	CG_DIM "B"	CG_DIM "C"	STEEL ENCLOSURE WEIGHT KG (LBS)	ALUMINUM ENCLOSURE WEIGHT KG (LBS)
DFEJ	450	1803 [71.0]	1041 [41]	726 [28.6]	7520 (16579)	7160 (15779)
DFEK	500	1783 [70.2]			7656 (16879)	7296 (16079)
DQDAA	250	2179 [85.8]		697 [27.4]	5367 (11789)	5007 (10989)
DQDAB	275					
DQDAC	300	2193 [86.3]		699 [27.5]	5467 (12089)	5107 (11289)
DQHAB	300	1897 [74.7]		856 [33.7]	5878 (12959)	5518 (12159)

***WEIGHT & CG'S ARE SHOWN WITH HIGHEST GALLON FUEL TANK, ENCLOSURE, AND STANDARD WET GENSET. ADDITION OF OTHER FEATURES MAY CHANGE THE WEIGHT.

NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. FOUNDATION REFERENCE POINT (⊸⊸). SEE FOUNDATION DRAWING FOR DETAILS.
3. FOR FEATURE CODE L116 (FLORIDA TANKS) L120 (MICHIGAN TANK) ADD 162 [6.4"] TO DIMS D-J
4. SEE SHEET 2 FOR TANK VENT LOCATIONS.
5. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:
   - 5.1 REFER TO CUMMINS APPLICATION MANUAL T030 FOR GENERAL GENSET/TANK MOUNTING GUIDELINES.
   - 5.2 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1; .X ±0.8; .XX± 0.38
TOL: 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: 1/32
DWG NO A034J587
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DRN C FORNELL
CKD K KISHORE
APVD K KISHORE
DATE 23JUL14
FIRST USED ON DFA-DFE
SITE CODE PGF
CUMMINS POWER GENERATION
OUTLINE, ENCLOSURE
SIZE D DWG NO A050L281 SHEET 1 OF 3 REV A

FIGURE 82. ENCLOSURE OUTLINE DRAWING SHEET 1 OF 3

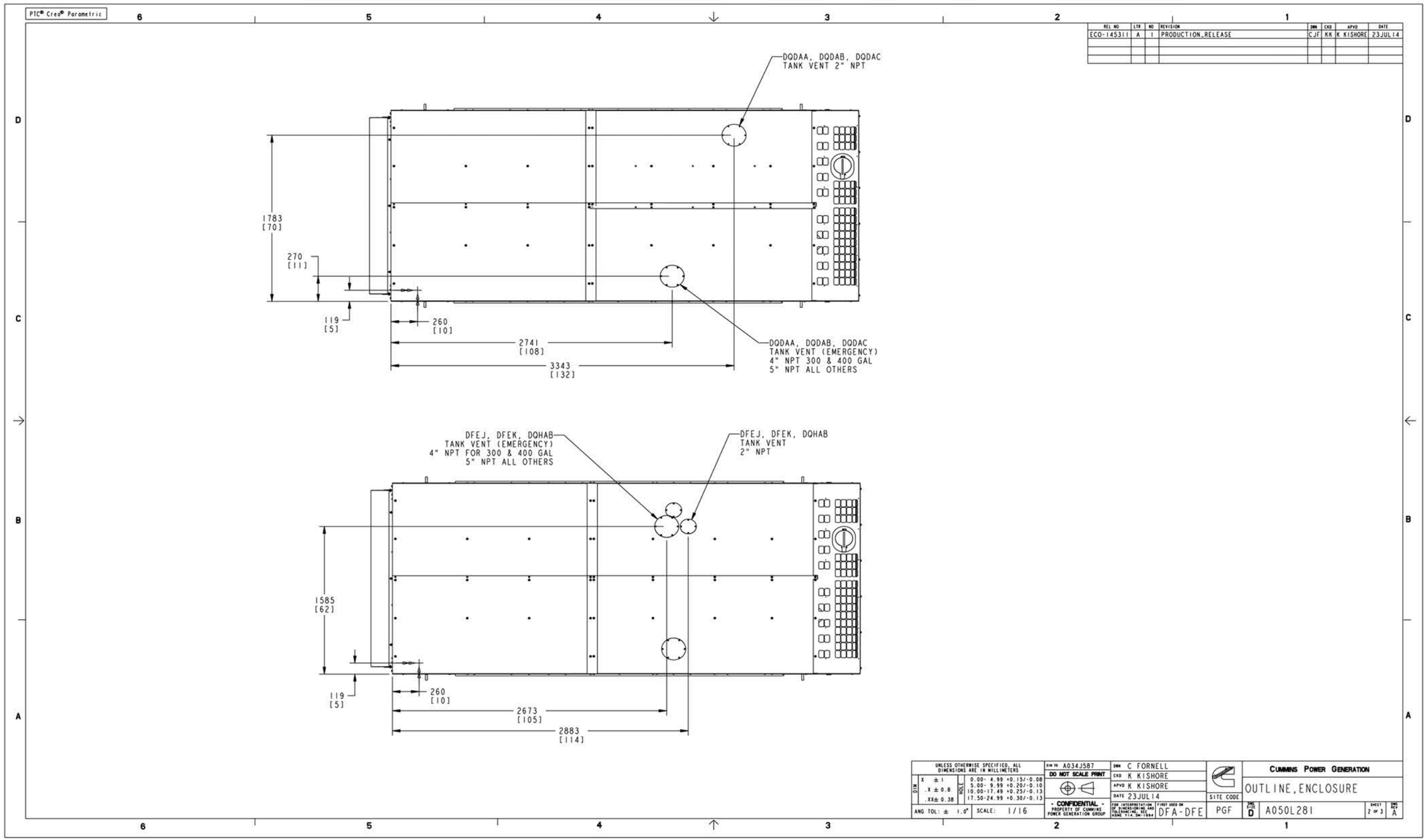


FIGURE 83. ENCLOSURE OUTLINE DRAWING SHEET 2 OF 3

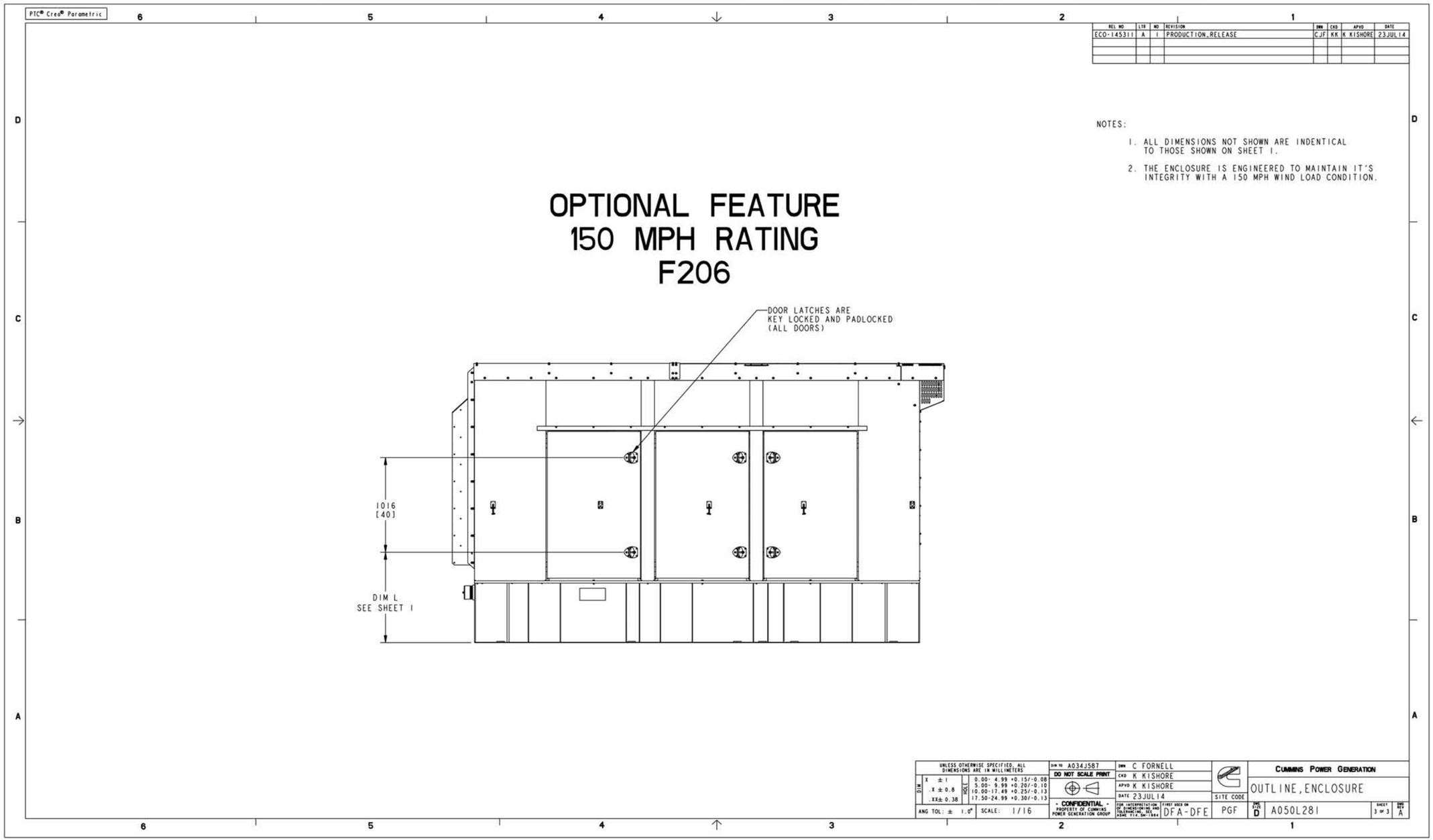


FIGURE 84. ENCLOSURE OUTLINE DRAWING SHEET 3 OF 3

D.11 Enclosure Outline Drawing (F202, F205, F206, F208, F209) (Non-Seismic)

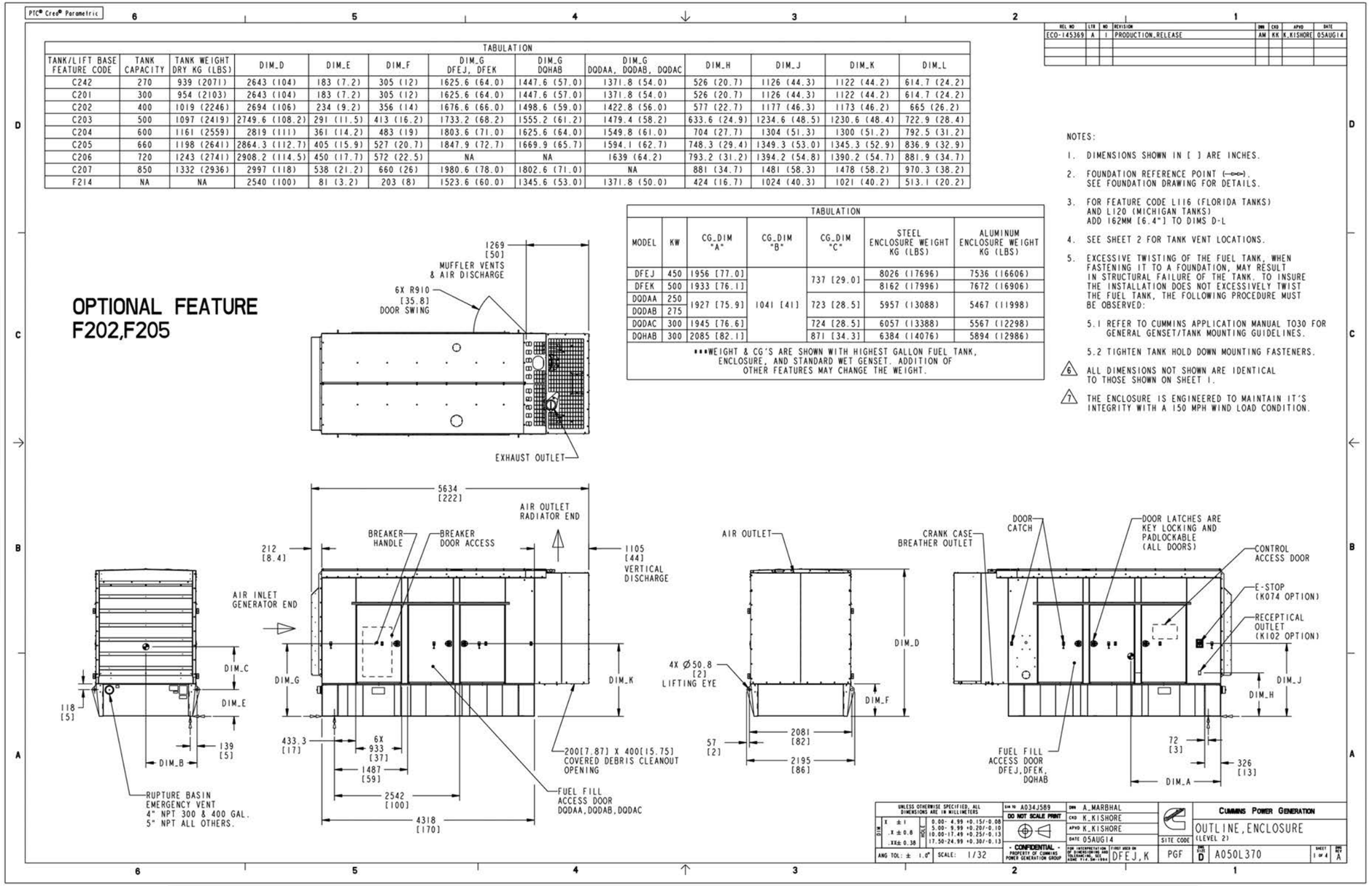


FIGURE 85. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 1)

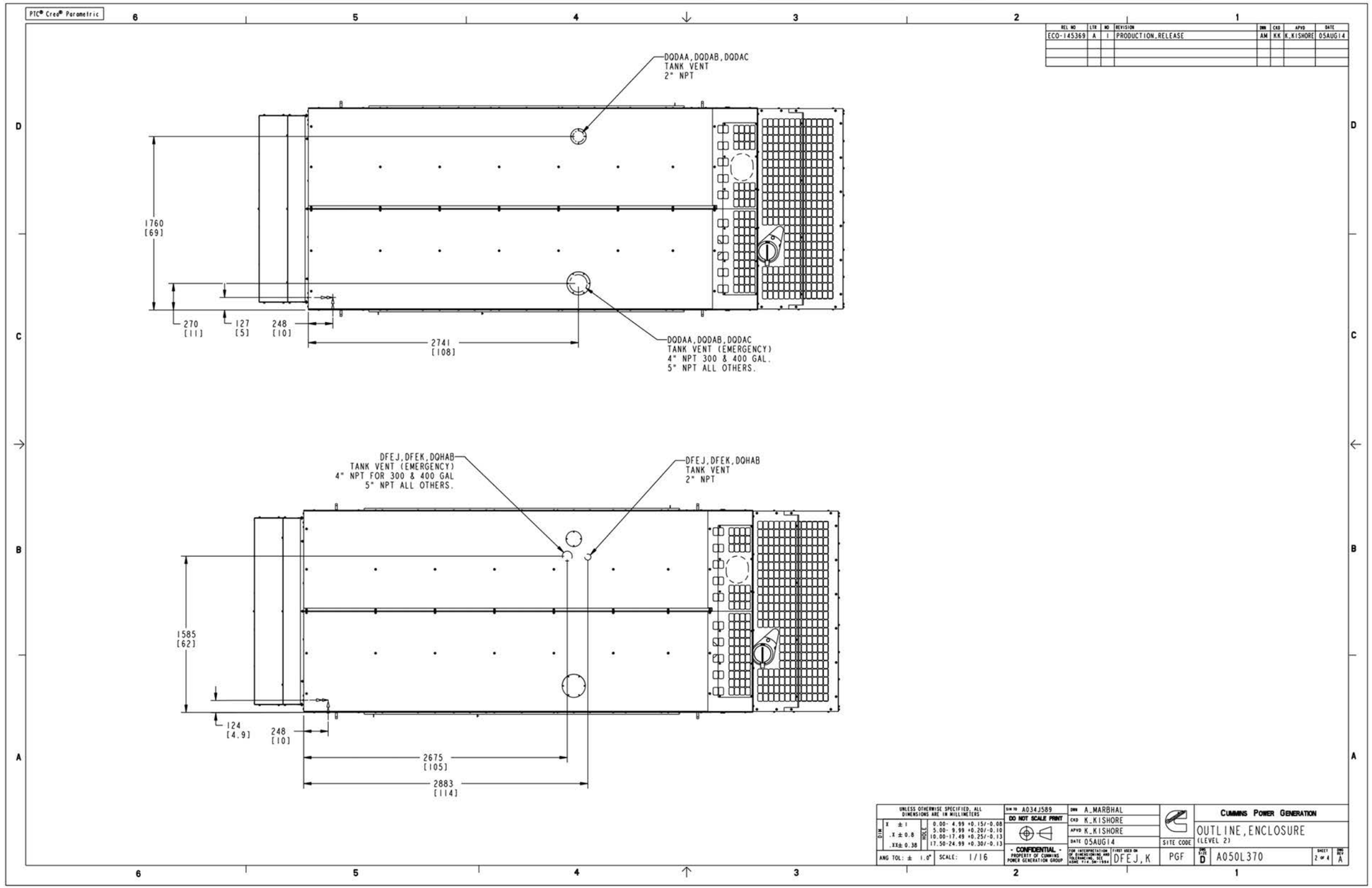


FIGURE 86. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 2)

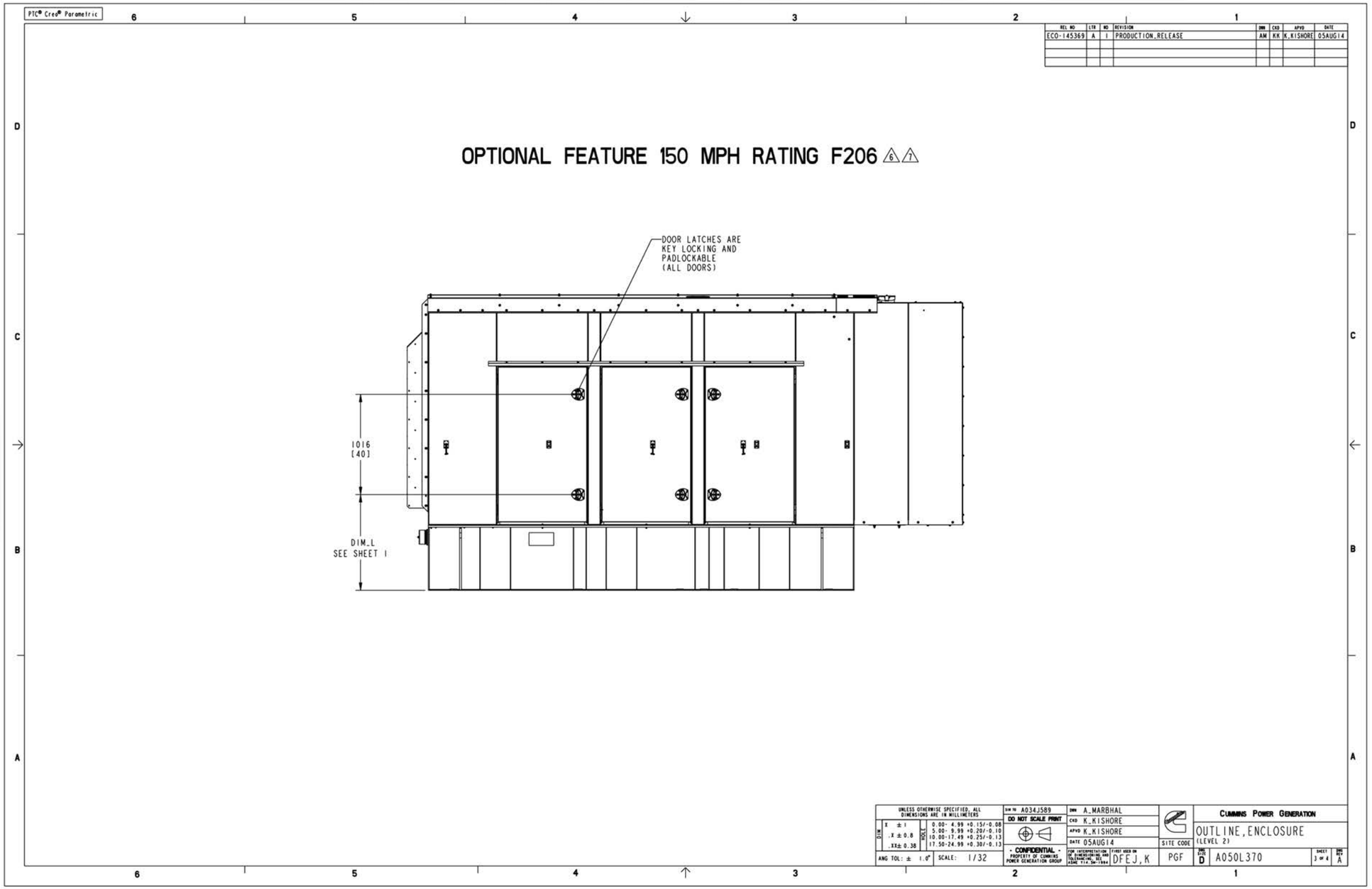


FIGURE 87. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 3)

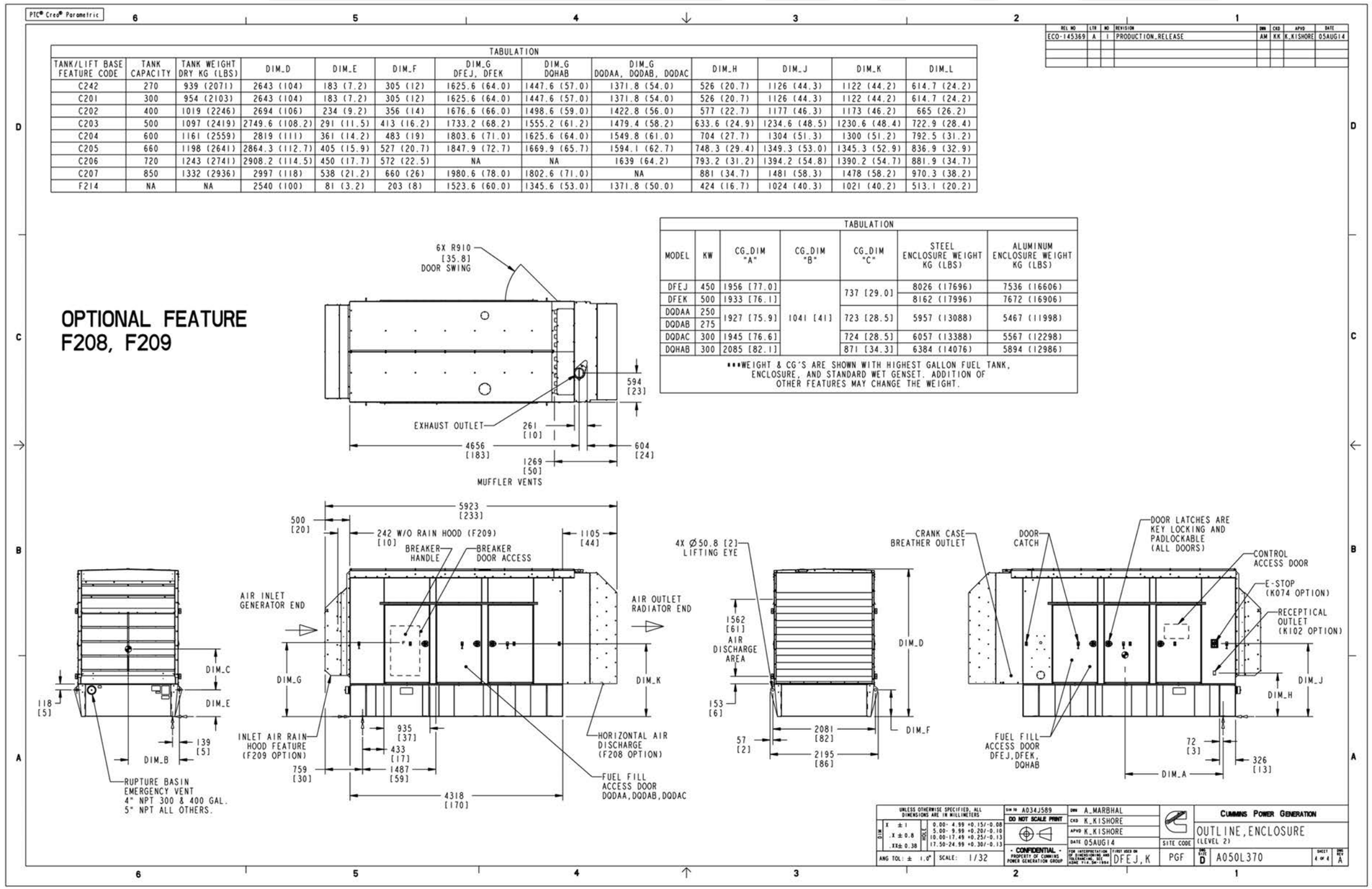


FIGURE 88. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 4)

D.12 Enclosure Outline Drawing F200, F201, F203, F204, F206 (Non-Seismic)

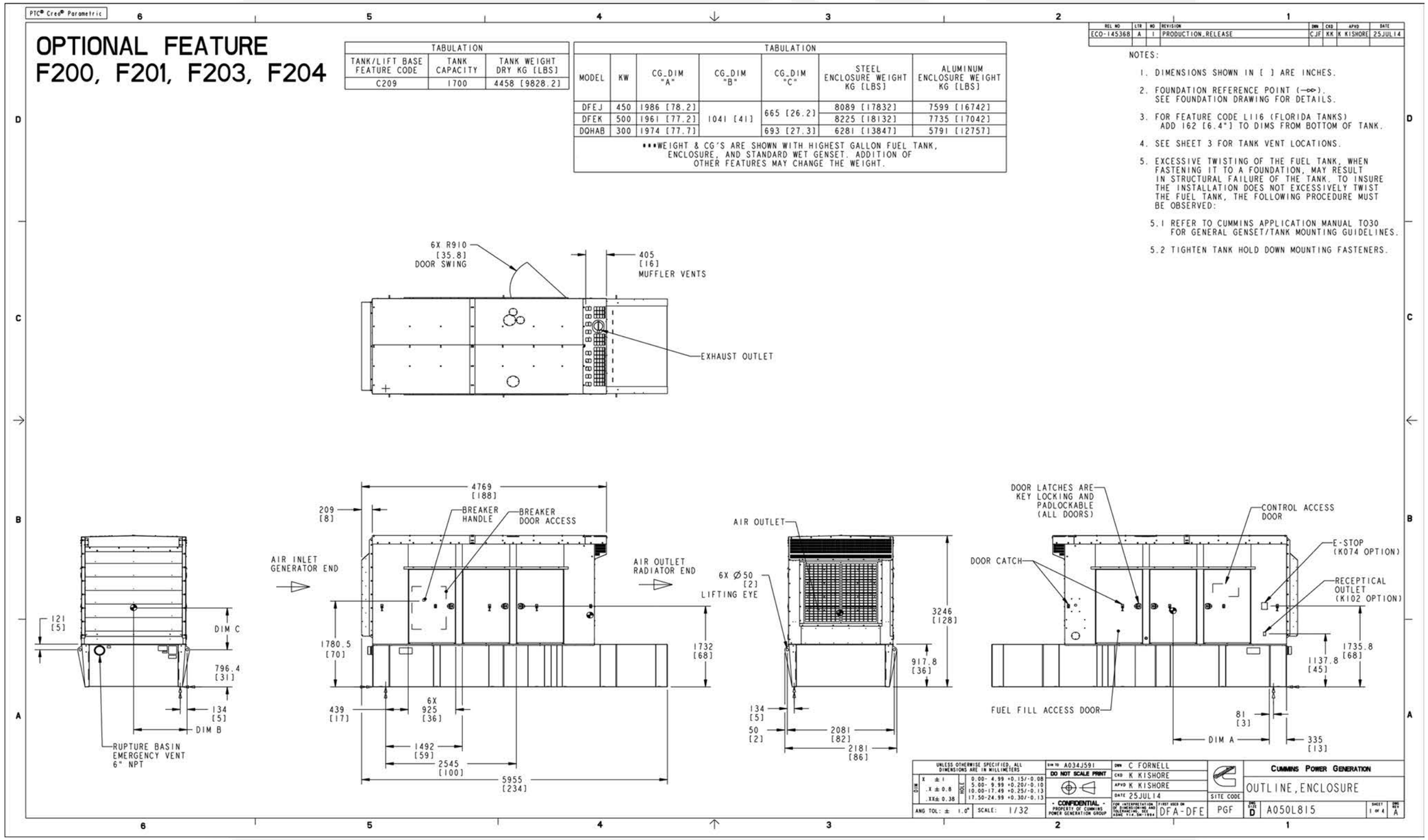


FIGURE 89. ENCLOSURE OUTLINE DRAWING F200, F201, F203, F204, F206 SHEET 1 OF 4

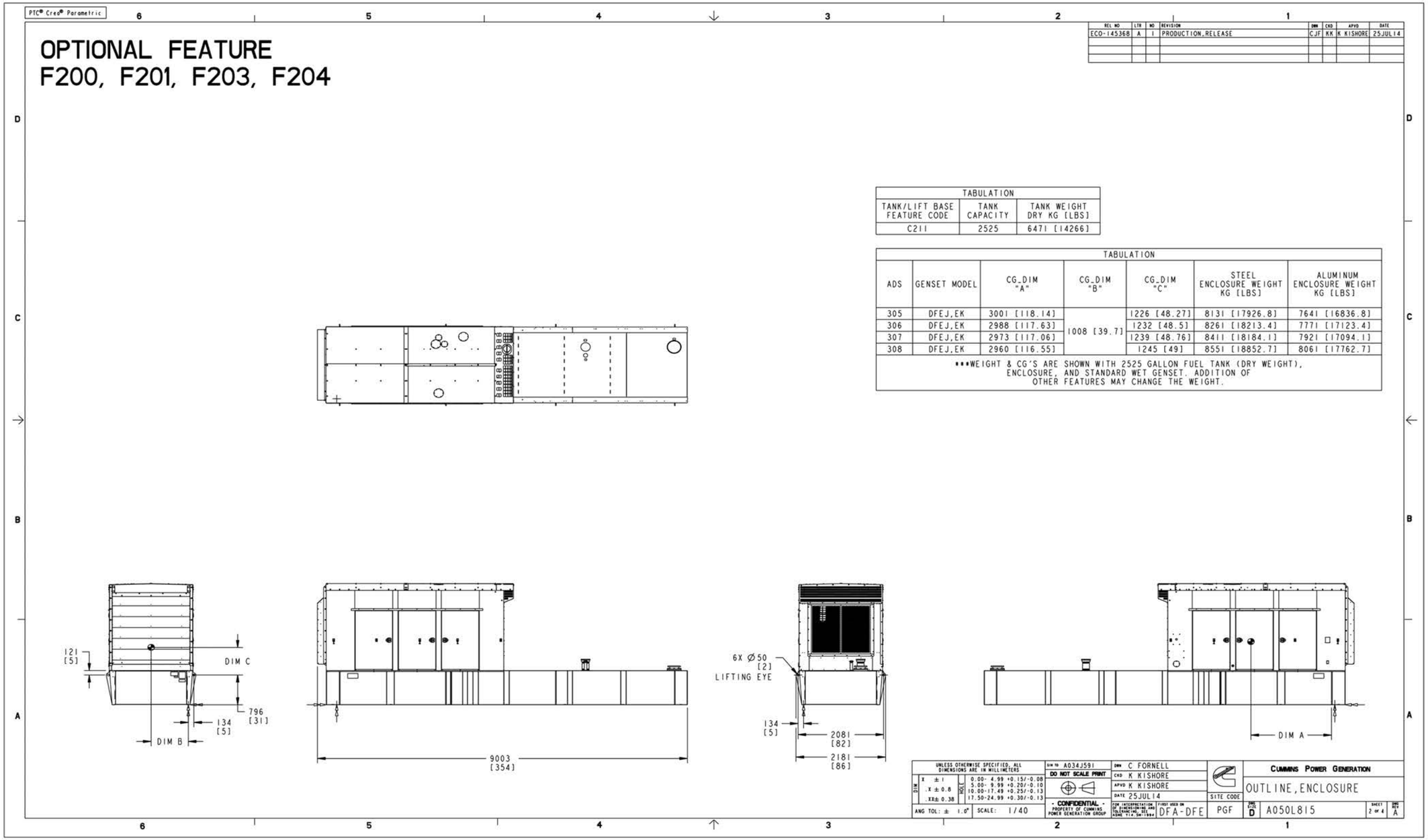


FIGURE 90. ENCLOSURE OUTLINE DRAWING F200, F201, F203, F204, F206 SHEET 2 OF 4

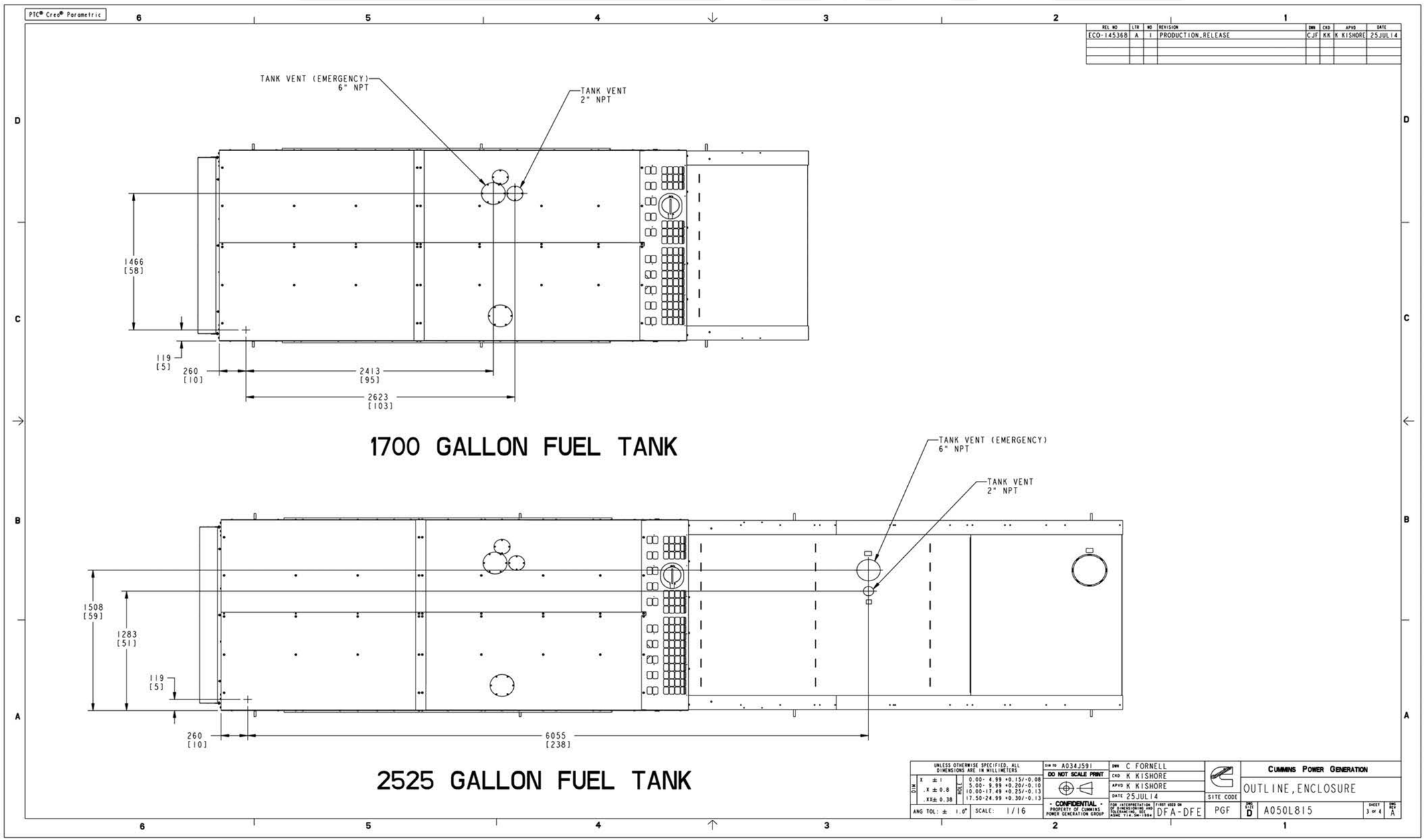


FIGURE 91. ENCLOSURE OUTLINE DRAWING F200, F201, F203, F204, F206 SHEET 3 OF 4

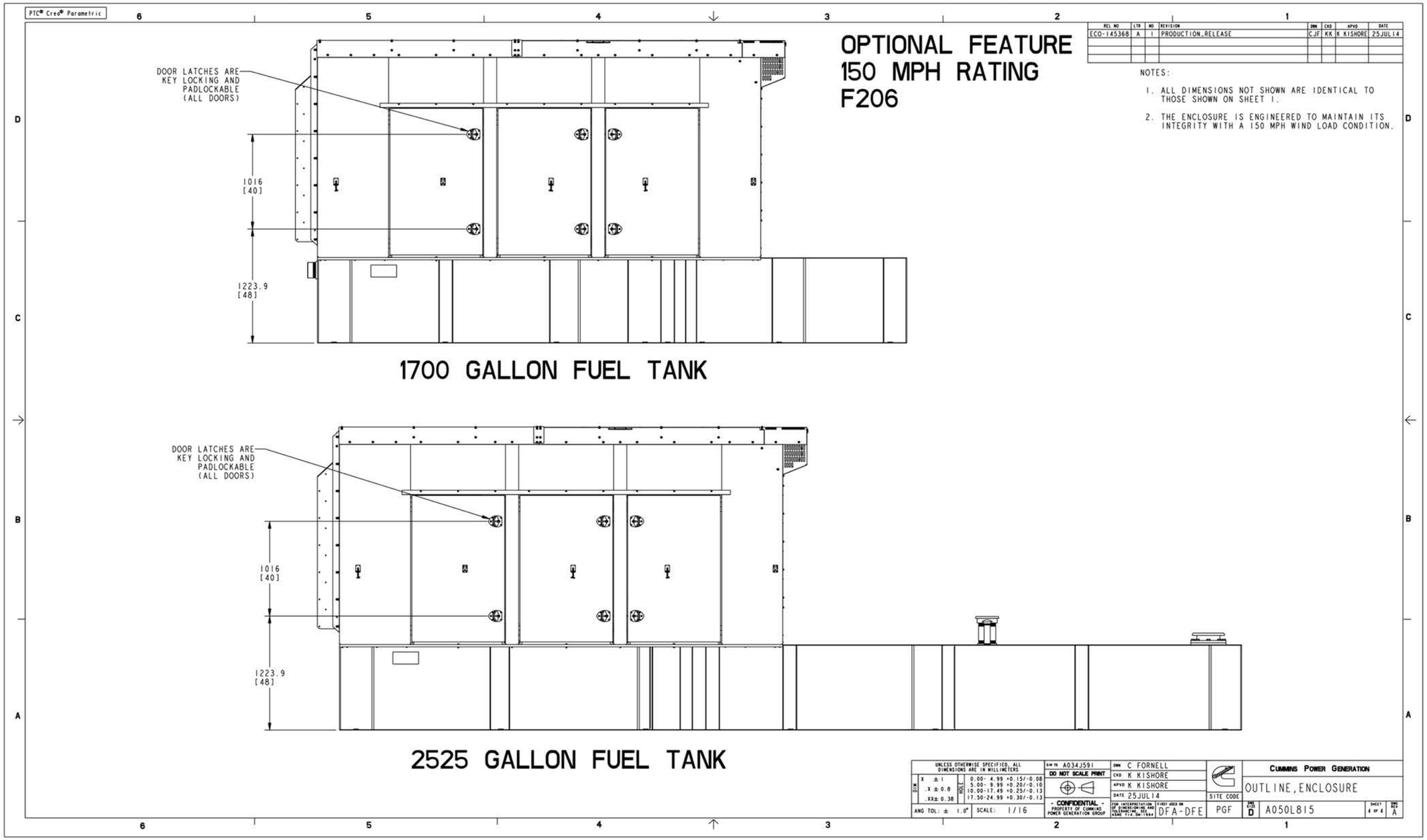


FIGURE 92. ENCLOSURE OUTLINE DRAWING F200, F201, F203, F204, F206 SHEET 4 OF 4

D.13 Enclosure Outline Drawing (F202, F205, F206, F208, F209) (Non-Seismic)

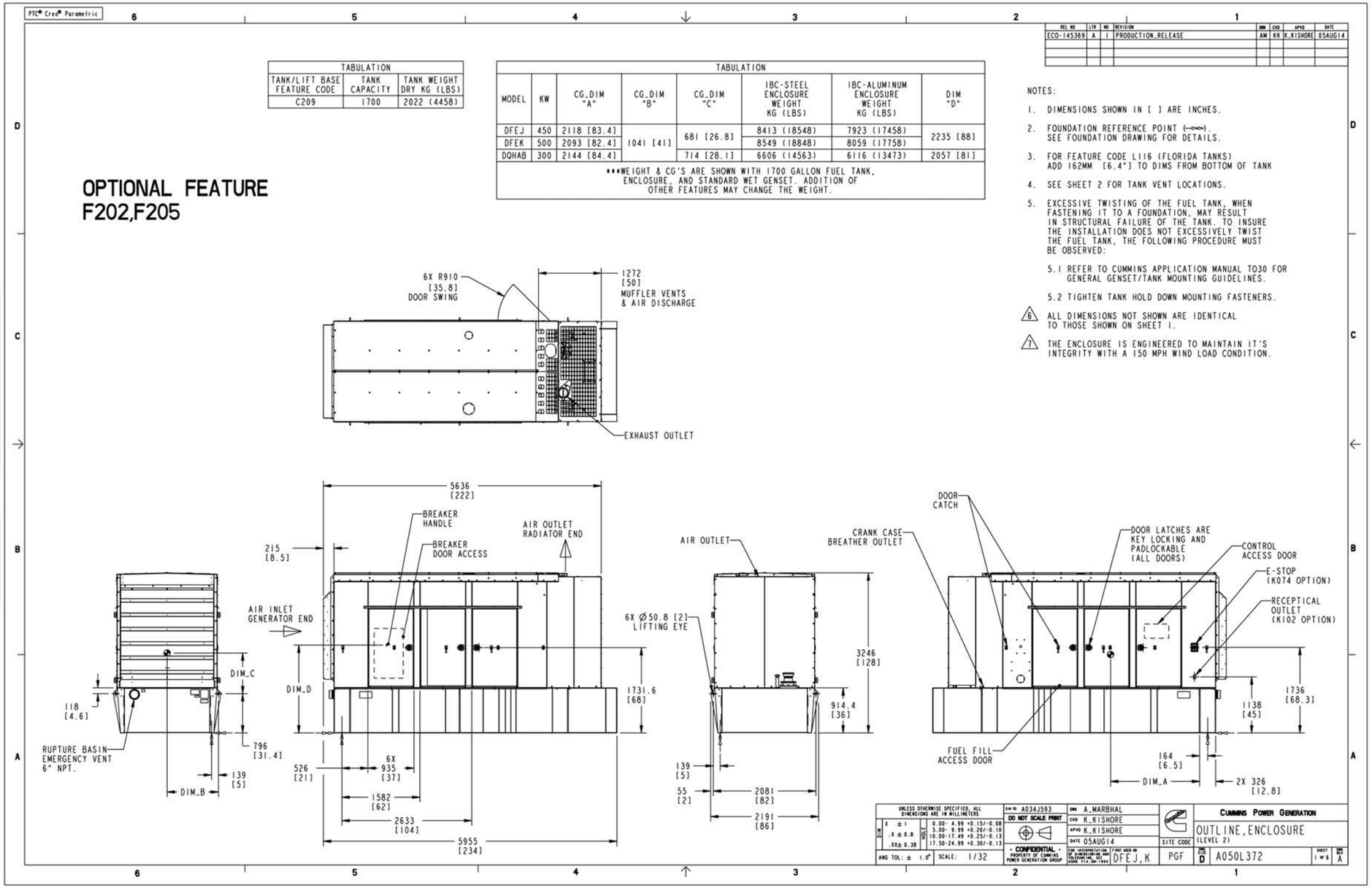


FIGURE 93. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 1)

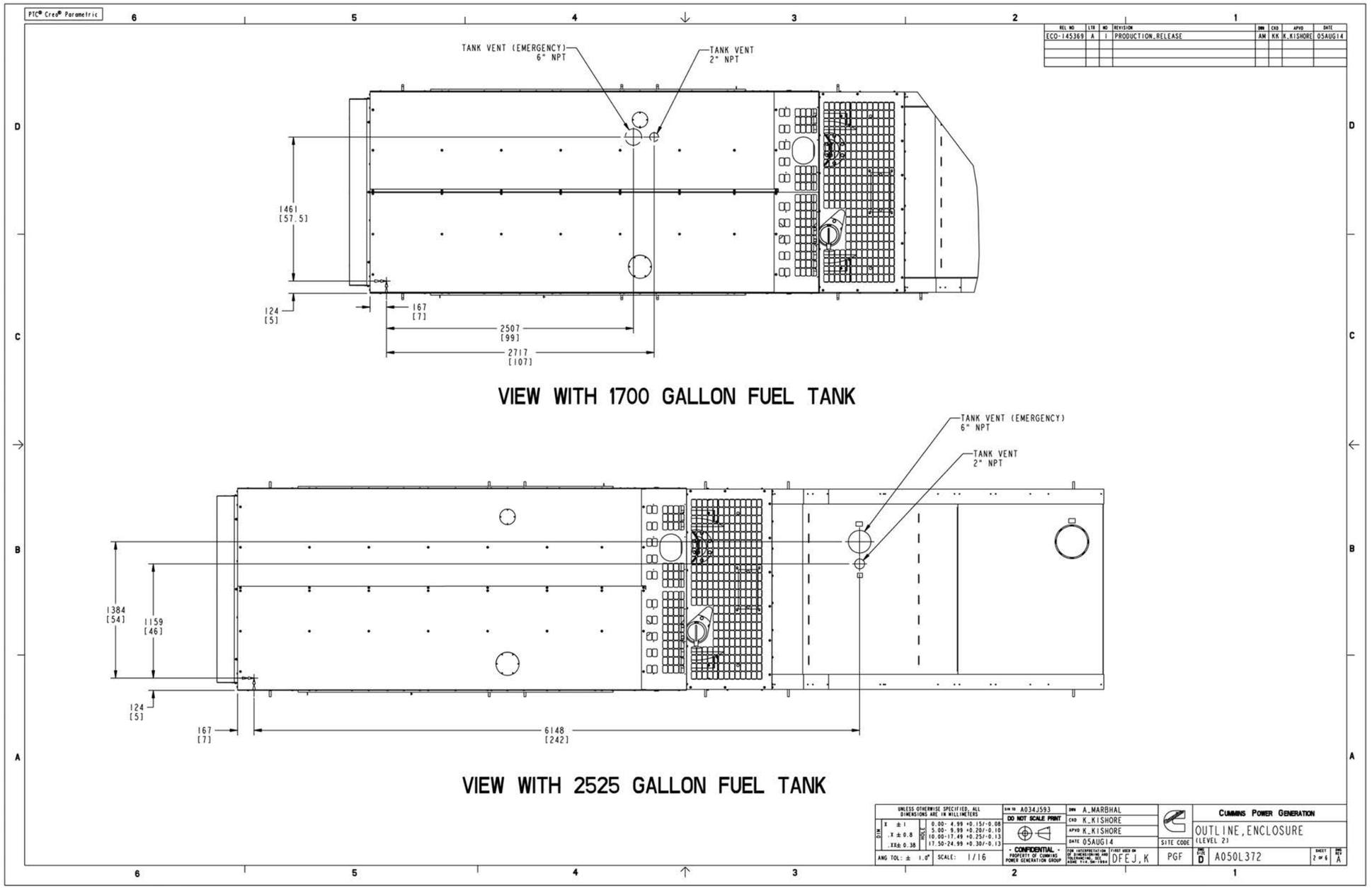


FIGURE 94. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 2)

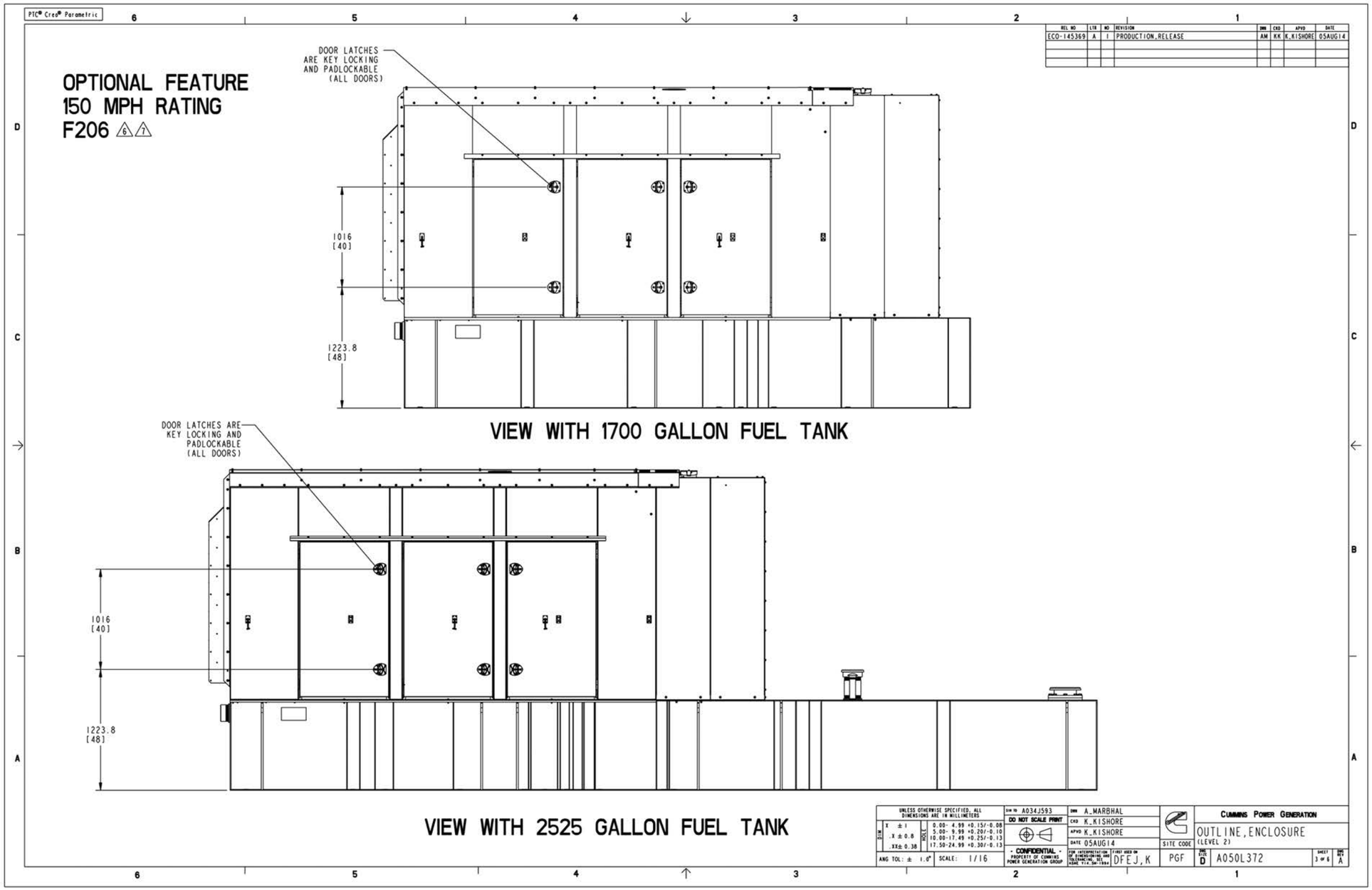


FIGURE 95. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 3)

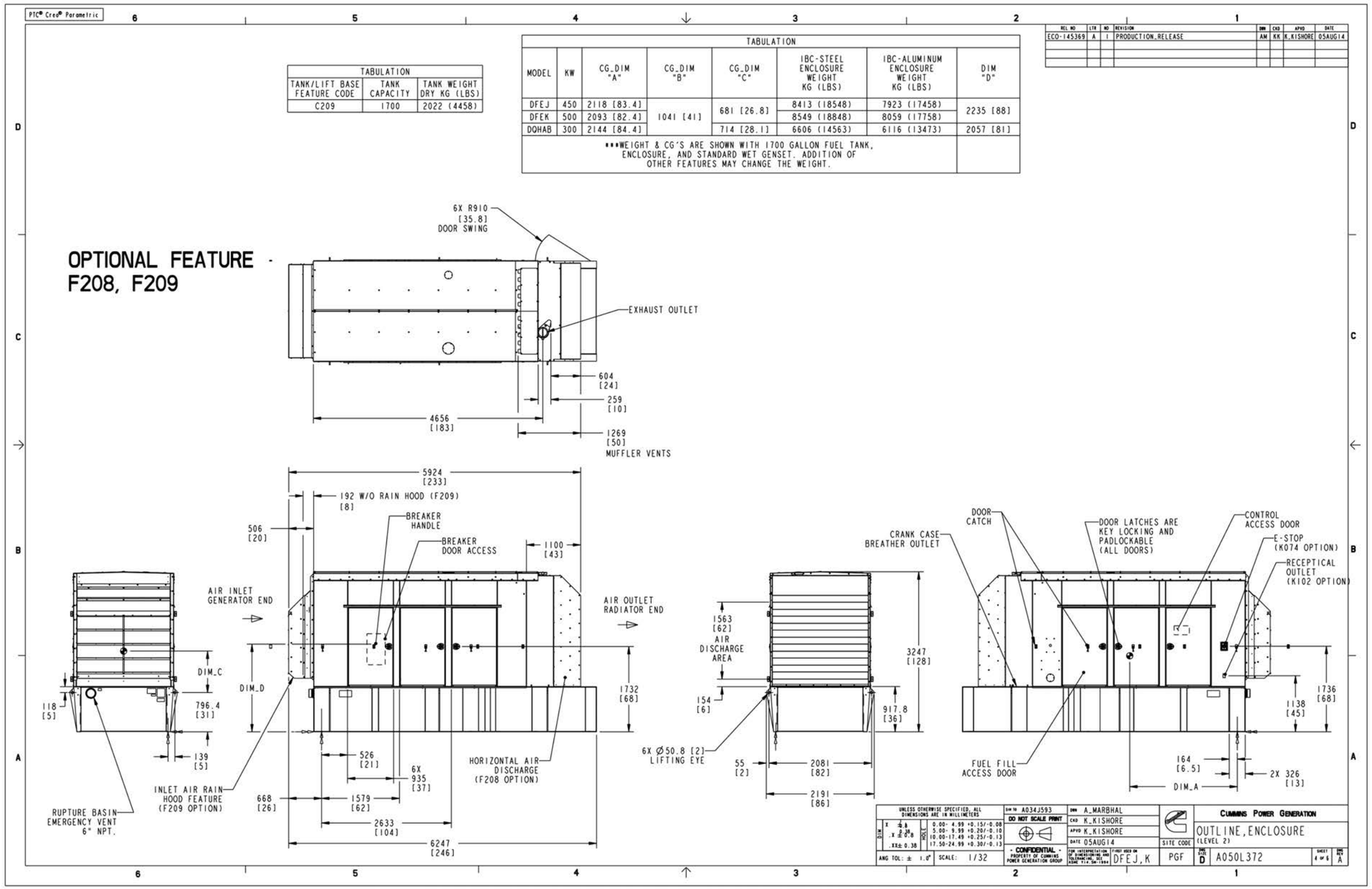


FIGURE 96. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 4)

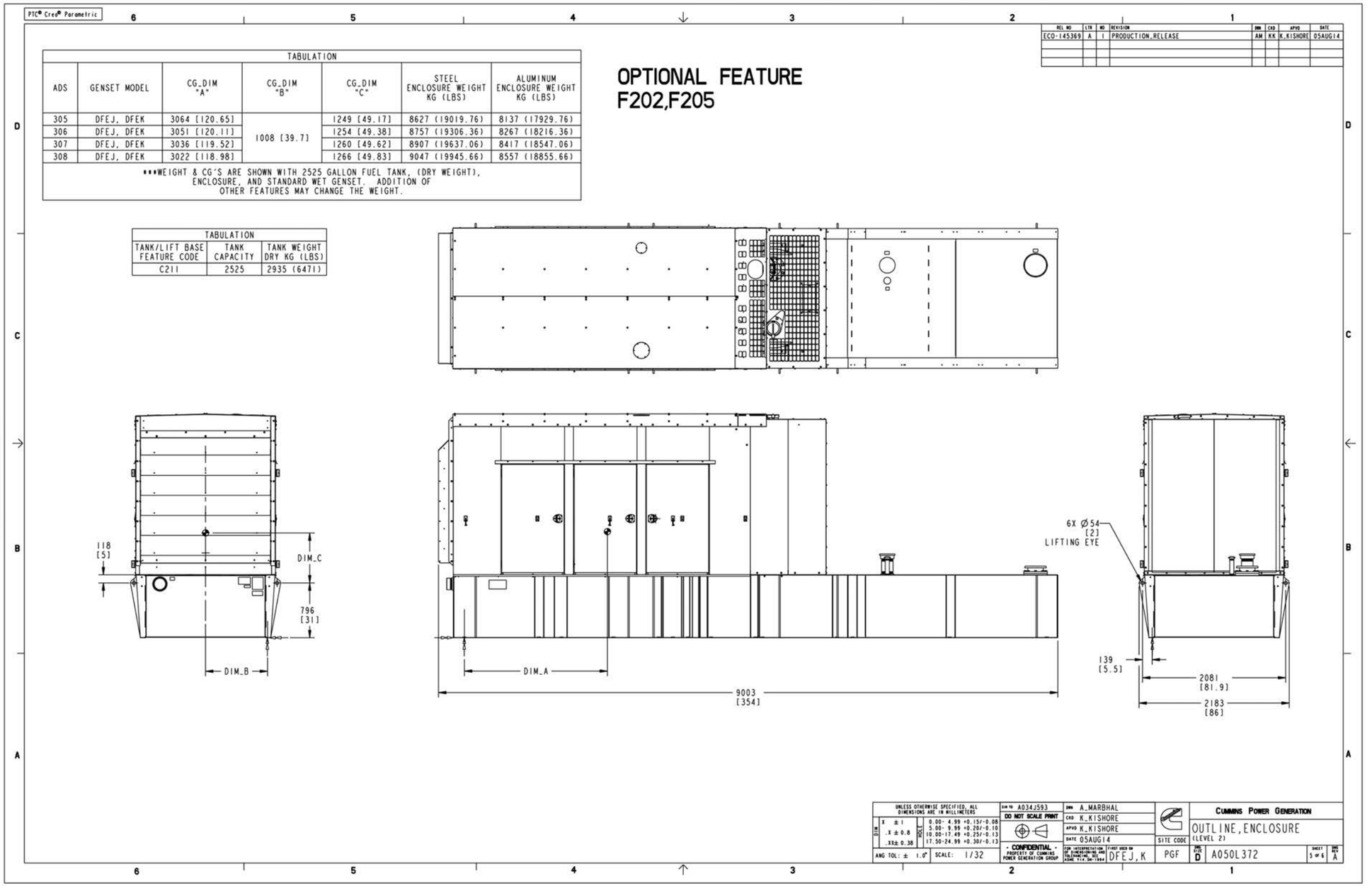


FIGURE 97. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 5)

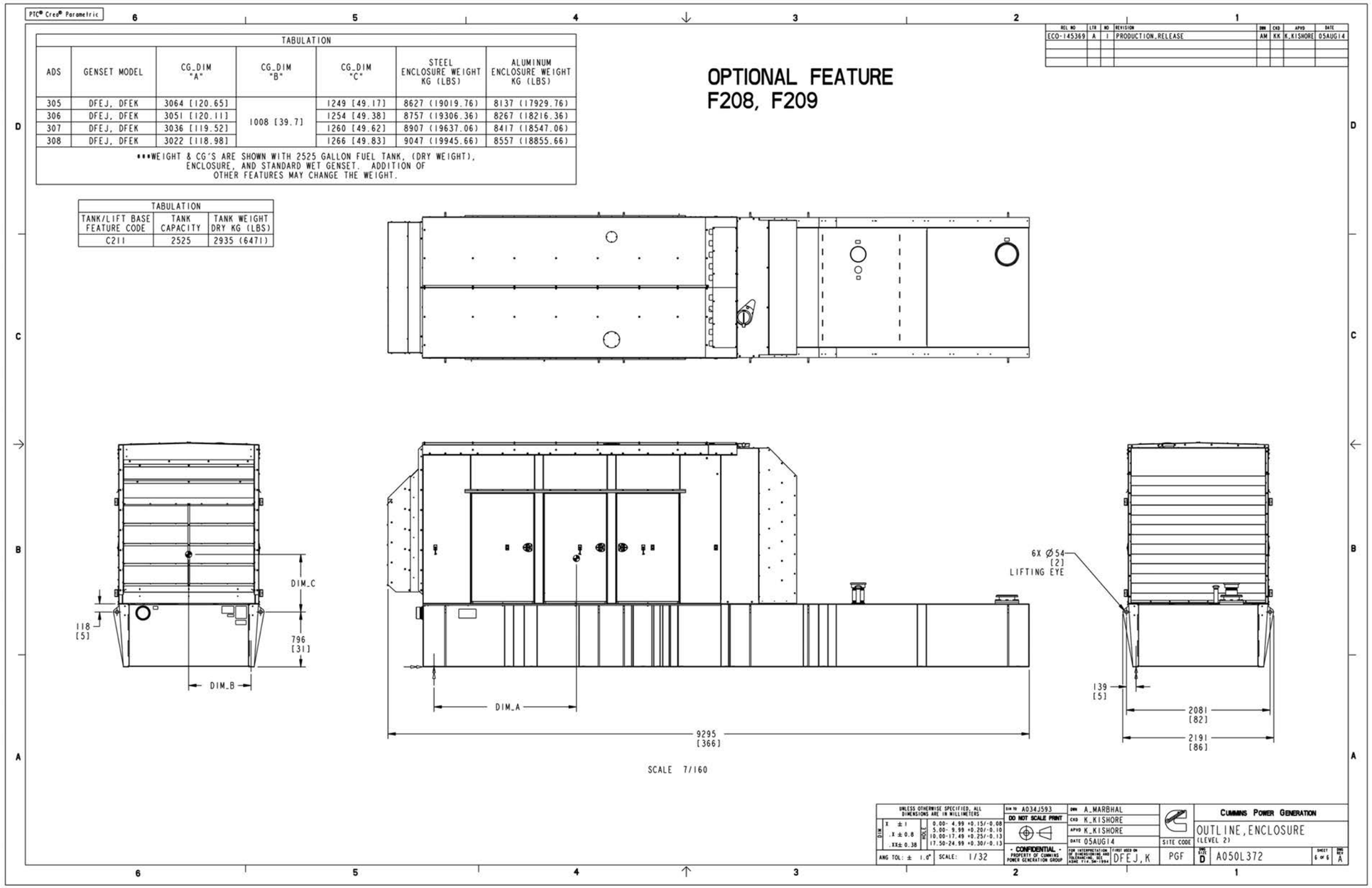


FIGURE 98. ENCLOSURE OUTLINE DRAWING (F202, F205, F206, F208, F209) (SHEET 6)

D.14 Tank Outline Drawing DFEJ, DFEK, DQDAA, DQDAB, DQDAC, DQHAB (Non-Seismic)

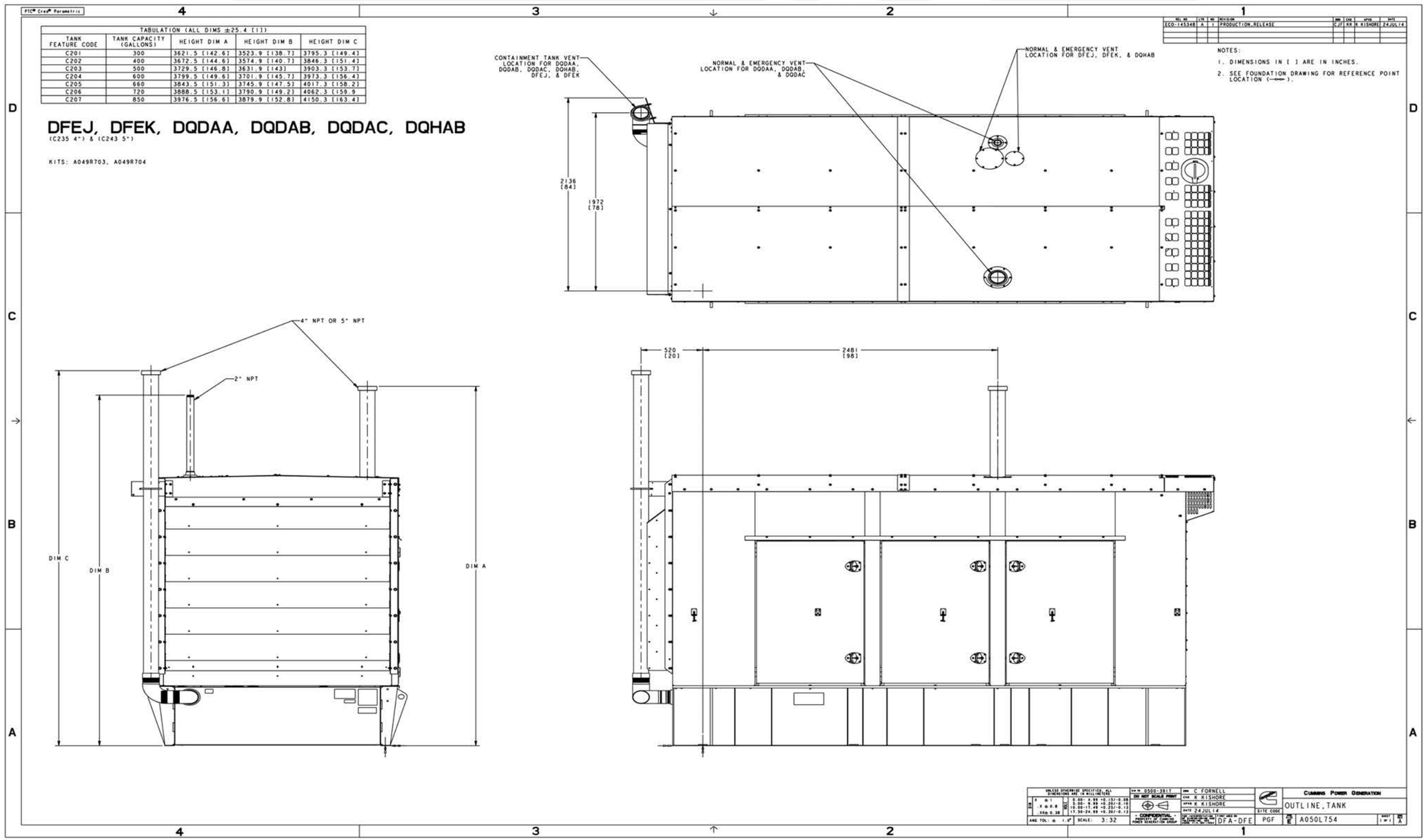


FIGURE 99. TANK OUTLINE DRAWING DFEJ, DFEK, DQDAA, DQDAB, DQDAC, DQHA

Appendix E. Breakerless Conductor Terminal Box Outline Drawings

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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 Breakerless Conductor Terminal Box Outline Drawing

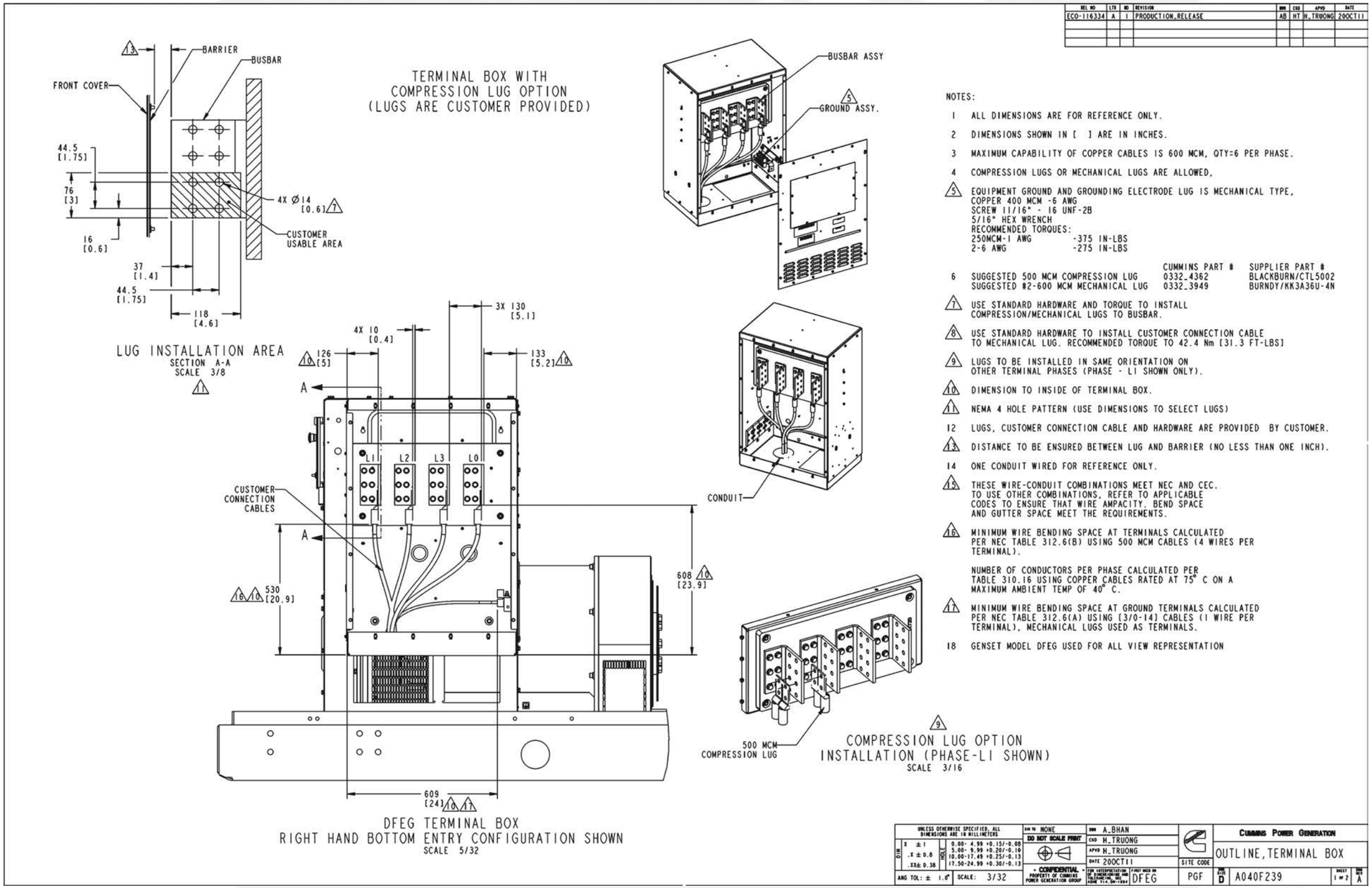

FIGURE 100. BREAKERLESS CONDUCTOR TERMINAL BOX OUTLINE DRAWING (SHEET 1)

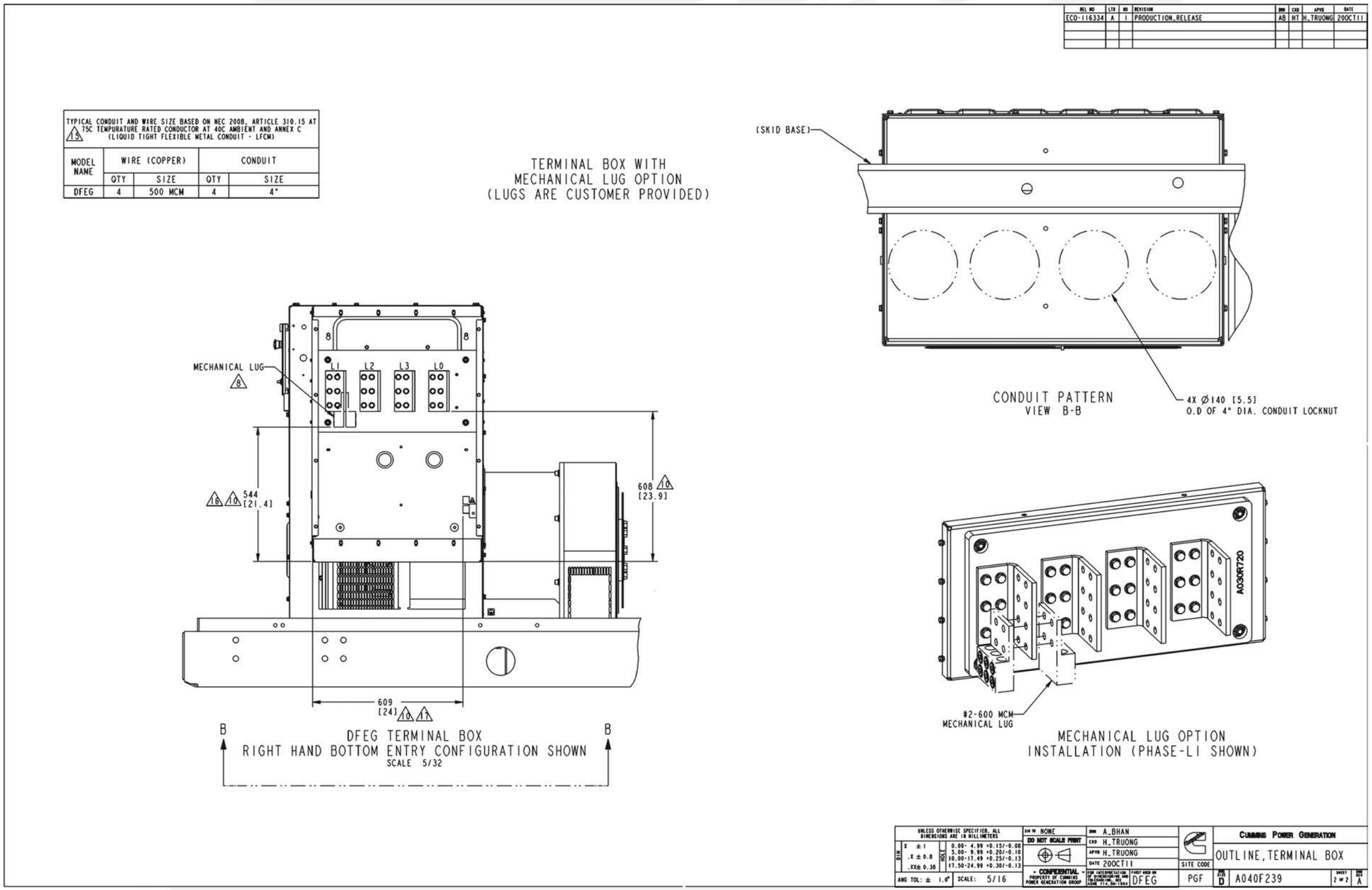

FIGURE 101. BREAKERLESS CONDUCTOR TERMINAL BOX OUTLINE DRAWING (SHEET 2)

Appendix F. Seismic Requirements

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

F.1 Seismic Installation Instructions

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-116466	E	1	SEE SHEET 2	MR.J	KK	K.KISHORE	03MAY11

SEISMIC INSTALLATIONS 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 PER-QUALIFICATION TEST REPORT AS DEFINED IN NOTE 1. FOR "IBC 2000" AND "IBC 2003" APPLICATIONS, THE MINIMUM EMBEDMENT MUST BE 8X 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 ON THIS INSTALLATION DRAWING.
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 PUBLISHED ON THIS CUMMINS INSTALLATION DRAWING.
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 SEISMIC CERTIFIED EQUIPMENT TO ANY CONCRETE BLOCK WALLS OR UNFILLED 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 GENSET 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 SPECIAL CONSIDERATIONS FOR SEISMIC APPLICATIONS ARE AS FOLLOWS; CONNECTIONS TO NON-ISOLATED COMPONENTS OR EQUIPMENT MAY BE INSTALLED MANUAL. TYPICAL FOR THAT PARTICULAR APPLICATION. CONNECTIONS TO ISOLATED COMPONENTS (EX. BREAKER BOX BOLTED DIRECTLY TO AN ISOLATED GENSET) AS OR ISOLATED EQUIPMENT (EX. AN ENCLOSED GENSET 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.

REQUIREMENTS FOR GENSETS MODELS
DQDAA, DQDAB, DQDAC, DQHAA,
DQHAB, DFEG, DFEH, DFEJ, DFEK, LIFTING BASE

PARAMETERS	IBC 2009	IBC 2006	IBC 2003	IBC 2000
	Sds<=1.93	1.93<Sds<=2.28	Sds<=2.41	2.41<Sds<=2.46
	Ip<=1.5	Ip<=1.5	Ip<=1.5	Ip<=1.5
	ap/Rp<=1.25	ap/Rp<=1.25	ap/Rp<=1.00	ap/Rp<=1.00
	z/h<=1.0 (roof)	z/h=0 (grade)	z/h<=1.0 (roof)	z/h=0 (grade)

REQUIREMENTS FOR FUEL TANKS
USED ON:
DQDAA, DQDAB, DQDAC, DQHAA,
DQHAB, DFEG, DFEH, DFEJ, DFEK

PARAMETERS	IBC 2009	IBC 2006	IBC 2003	IBC 2000
	Sds<=1.93	1.93<Sds<=2.28	Sds<=2.08	2.08<Sds<=2.46
	Ip<=1.5	Ip<=1.5	Ip<=1.5	Ip<=1.5
	ap/Rp<=1.25	ap/Rp<=1.25	ap/Rp<=1.00	ap/Rp<=1.00
	z/h<=1.0	z/h<=0.77	z/h<=1.0	z/h<=0.77

-THIS IS A CONTROLLED PRODUCT-
PER CPG PROCEDURE FRE-1002
TO MAINTAIN COMPLIANCE WITH REQUIREMENTS OF THE CODES, STANDARDS, OR AGENCIES LISTED BELOW
☐ CSA ☐ UL ☐ CE ☐ RINA ☐ ABYC
☒ IBC ☐ OTHER ☐ OTHER
AND/OR ASSIGN INTERNAL CPG 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 TRIDLEY
DESIGN CONTROL FACILITY

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1 / .X ±0.8 / .XX±0.38
TOL: 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

SIM TO A030B114
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PROPERTY OF CUMMINS POWER GENERATION GROUP
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, REF. ASME Y14.5M-1994
DRN L WRIGHT
CKD Z MOGES
APVD Z MOGES
DATE 10MAR10
FIRST USED ON DQDAA
SITE CODE PGF

CUMMINS POWER GENERATION
INSTALLATION, GENSET
SEISMIC REQUIREMENTS
SIZE D | A030W791 | SHEET 1 of 3 | DWG REV C

FIGURE 102. SEISMIC INSTALLATION INSTRUCTIONS (SHEET 1 OF 3)

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-116466	E	1	ZONE D-4, CHG QTY OF ANCHORS FOR DQHAA & DQHAB TO QTY 6 WAS QTY 4	MRJ	KK	K.KISHORE	03MAY11

GRADE/ROOF MOUNTED GENERATOR SETS

	CUMMINS GENSET MODEL	RANGE	CONFIGURATION	CONCRETE ANCHORS	ANCHOR EMBEDMENT	ANCHOR SPACING	DISTANCE TO THE NEAREST EDGE	DISTANCE TO ANY OTHER EDGE	CONCRETE SLAB THICKNESS
1	DFEG, DFEH, DFEJ & DFEK	0<=Sds<=2.27	SKID	(QTY 6) 3/4" DIA. USP DUC34-1000H CONCRETE ANCHORS THRU THE BASE RAIL MOUNTING HOLES	10" MIN 254 mm MIN	10" MIN 254 mm MIN	15" MIN 381 mm MIN	8" MIN 203.2 mm MIN	15" MIN 381 mm MIN
2	DQHAA & DQHAB	0<=Sds<=2.27	SKID	(QTY 6) 3/4" DIA. USP DUC34-1000H CONCRETE ANCHORS THRU THE BASE RAIL MOUNTING HOLES	10" MIN 254 mm MIN	10" MIN 254 mm MIN	15" MIN 381 mm MIN	8" MIN 203.2 mm MIN	15" MIN 381 mm MIN
3	DQDAA, DQDAB & DQDAC	0<=Sds<=2.27	SKID	(QTY 4) 3/4" DIA. USP DUC34-1000H CONCRETE ANCHORS THRU THE BASE RAIL MOUNTING HOLES	10" MIN 254 mm MIN	10" MIN 254 mm MIN	15" MIN 381 mm MIN	8" MIN 203.2 mm MIN	15" MIN 381 mm MIN
4	LIFTING BASE (THOR 1)	0<=Sds<=2.27	LIFTING BASE	(QTY 8) 3/4" DIA. USP DUC34-1000H CONCRETE ANCHORS THRU THE BASE RAIL MOUNTING HOLES	10" MIN 254 mm MIN	10" MIN 254 mm MIN	15" MIN 381 mm MIN	8" MIN 203.2 mm MIN	15" MIN 381 mm MIN

GRADE/ROOF MOUNTED FUEL TANKS

	CUMMINS FUEL TANK PART NUMBERS	GALLONS	FEATURE CODE	RANGE	INSTALLATION	CONCRETE ANCHORS	ANCHOR EMBEDMENT	EDGE DISTANCE (FROM CORNER ANCHOR LOCATION) ALONG LONG SIDE	EDGE DISTANCE (FROM CORNER ANCHOR LOCATION) ALONG SHORT SIDE	CONCRETE SLAB THICKNESS
1	A030U731	2525	C211	0<=Sds<=1.93	GROUND LEVEL ONLY	(QTY 14) 5/8" DIA ANCHORS (CAST IN PLACE) HEX HEAD ASTM F 1554, GR 105	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN 4000 PSI CONCRETE
2	A030U416 & A030U423	1700	C209	0<=Sds<=1.93	GROUND LEVEL ONLY	(QTY 16) 5/8" DIA ANCHORS (CAST IN PLACE) HEX HEAD ASTM F 1554, GR 105	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN 4000 PSI CONCRETE
3	A030U015, A030U016, A030U020 THRU A030U040 & A030U293 THRU A030U315	270 720 850	C242 C206 C207	0<=Sds<=1.93	ROOFTOP & GROUND LEVEL	(QTY 12) 1" DIA ANCHORS (CAST IN PLACE) HEAVY HEX HEAD ASTM F 1554, GR 105	10" MIN 254 mm MIN	12" MIN 304.8 mm MIN	12" MIN 304.8 mm MIN	18" MIN 457.2 mm MIN 4000 PSI CONCRETE
4	A030U291 A030U292 A030U017 A030U018 A030U019	300 400 500 600 660	C201 C202 C203 C204 C205	0<=Sds<=1.93	ROOFTOP & GROUND LEVEL	(QTY 12) 1" DIA ANCHORS (CAST IN PLACE) HEX HEAD ASTM F 1554, GR 105	10" MIN 254 mm MIN	12" MIN 304.8 mm MIN	12" MIN 304.8 mm MIN	18" MIN 457.2 mm MIN 4000 PSI CONCRETE
5	A030V131 A030V137	1470 1470	C208	0<=Sds<=1.93	GROUND LEVEL ONLY	(QTY 10) 5/8" DIA ANCHORS (CAST IN PLACE) HEX HEAD ASTM F 1554, GR 105	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN 4000 PSI CONCRETE
6	A030V135	2100	C210	0<=Sds<=1.93	GROUND LEVEL ONLY	(QTY 12) 5/8" DIA ANCHORS (CAST IN PLACE) HEX HEAD ASTM F 1554, GR 105	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN	6" MIN 152.4 mm MIN	12" MIN 304.8 mm MIN 4000 PSI CONCRETE

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1; .X ±0.8; .XX±0.38
DECIMAL: 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
DWG NO A030B114
DO NOT SCALE PRINT
* CONFIDENTIAL * PROPERTY OF CUMMINS POWER GENERATION GROUP
DRN L WRIGHT
CKD Z MOGES
APVD Z MOGES
DATE 10MAR10
FIRST USED ON DQDAA
SITE CODE PGF
CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SIZE D A030W791 SHEET 2 OF 3 REV E

FIGURE 103. SEISMIC INSTALLATION INSTRUCTIONS (SHEET 2 OF 3)

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-116466	E	--	---	MRJ	KK	K.KISHORE	03MAY11

SEISMIC ISOLATOR SELECTION

				ATTACHMENT TO STEEL	ATTACHMENT TO CONCRETE				
CONFIGURATION	GENSET MODEL	SEISMIC ISOLATOR	QTY	ISOLATOR ATTACHMENT HARDWARE TO STEEL	ISOLATOR ATTACHMENT HARDWARE TO CONCRETE	ANCHOR EMBEDMENT	ANCHOR EDGE DISTANCE	MINIMUM CONCRETE COMPRESSION STRENGTH	SLAB THICKNESS
LIFTINGBASE MOUNT (F214-2)	DQDAA, DQDAB, DQDAC (9L)	A034E948 (MSSH-1E-2000)	8	4 PER ISOLATOR (32 TOTAL) 5/8" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (32 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	12" MIN 304.8mm MIN	4000 PSI	12" MIN 304.8mm MIN
LIFTINGBASE MOUNT (F214-2)	DQHAA, DQHAB (11L)	A034E948 (MSSH-1E-2000)	8	4 PER ISOLATOR (32 TOTAL) 5/8" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (32 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	12" MIN 304.8mm MIN	4000 PSI	12" MIN 304.8mm MIN
LIFTINGBASE MOUNT (F214-2)	DFEG, DFEH, DFEJ, DFEK (15L)	A030W097 (MSSH-1E-2990N)	8	4 PER ISOLATOR (32 TOTAL) 5/8" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (32 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	14" MIN 355.6mm MIN	16" MIN 406.4mm MIN	4000 PSI	16" MIN 406.4mm MIN
SKID/CHASSIE MOUNT (OPEN SET)	DQDAA, DQDAB, DQDAC (9L)	A034E948 (MSSH-1E-2000)	4	4 PER ISOLATOR (16 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (16 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	12" MIN 304.8mm MIN	4000 PSI	12" MIN 304.8mm MIN
SKID/CHASSIE MOUNT (OPEN SET)	DQHAA, DQHAB (11L)	A034E946 (MSSH-1E-1700N)	6	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	8" MIN 203.2mm MIN	10" MIN 254mm MIN	4000 PSI	10" MIN 254mm MIN
SKID/CHASSIE MOUNT (OPEN SET)	DFEG, DFEH, DFEJ, DFEK (15L)	A034E951 (MSSH-1E-2575N)	6	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	14" MIN 355.6mm MIN	4000 PSI	12" MIN 304.8mm MIN
SKID/CHASSIE MOUNT HOUSED (F183-2)	DQDAA, DQDAB, DQDAC (9L)	A034E948 (MSSH-1E-2000)	4	4 PER ISOLATOR (16 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (16 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	12" MIN 304.8mm MIN	4000 PSI	12" MIN 304.8mm MIN
SKID/CHASSIE MOUNT HOUSED (F183-2)	DQHAA, DQHAB (11L)	A034E948 (MSSH-1E-2000)	6	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	10" MIN 254mm MIN	10" MIN 254mm MIN	4000 PSI	12" MIN 304.8mm MIN
SKID/CHASSIE MOUNT HOUSED (F183-2)	DFEG, DFEH, DFEJ, DFEK (15L)	A030W097 (MSSH-1E-2990N)	6	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, ASTM A325 BOLTS	4 PER ISOLATOR (24 TOTAL) 3/4" DIA, HILTI HIT-HY 150 MAX-SD ADHESIVE W/ HAS B7 ROD	14" MIN 355.6mm MIN	16" MIN 406.4mm MIN	4000 PSI	16" MIN 406.4mm MIN

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
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DWG TO A030B114
DRN L WRIGHT
CKD Z MOGES
APVD Z MOGES
DATE 10MAR10
FIRST USED ON DQDAA
SITE CODE PGF
CUMMINS POWER GENERATION
INSTALLATION, GENSET SEISMIC REQUIREMENTS
SIZE D A030W791 SHEET 3 OF 3 REV E

FIGURE 104. SEISMIC INSTALLATION INSTRUCTIONS (SHEET 3 OF 3)

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