DOCKETED	
Docket Number:	21-TPG-02
Project Title:	Greenleaf 1 Temporary Power Generators Proceeding
TN #:	239598
Document Title:	Calpine Greenleaf Holdings, Inc Self-Certification Application
Description:	N/A
Filer:	Deric Wittenborn
Organization:	Ellison Schneider Harris & Donlan LLP
Submitter Role:	Applicant
Submission Date:	9/3/2021 4:03:49 PM
Docketed Date:	9/3/2021

CALPINE GREENLEAF HOLDINGS, INC.

717 Texas Avenue
Suite 1000
Houston, TX 77002

September 3, 2021

Mr. Drew Bohan
Executive Director
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

RE: CALPINE GREENLEAF HOLDINGS, INC. (GLH) SELF-CERTIFICATION TEMPORARY POWER GENERATOR LICENSING PROCESS

Dear Mr. Bohan:

In response to the Emergency Proclamation issued by the Governor on July 30, 2021, Calpine Greenleaf Holdings, Inc. (GLH) is pleased to submit this completed self-certification template and initial documentation for licensing of a new temporary facility, Greenleaf 1, under the California Energy Commission's (CEC's) Temporary Power Generator Licensing Process.

Greenleaf 1 will be located on GLH property pursuant to a site agreement between GLH and the Department of Water Resources (DWR). Greenleaf 1 will be comprised of two (2) TM2500 +G4 package units. The package units will be installed, owned, decommissioned, and removed by DWR. Greenleaf 1 will be connected to existing interconnection facilities, water supply line, and natural gas pipeline located on site and owned by GLH. GLH or its affiliate will operate Greenleaf 1 under a contract with DWR.

In response to Section III(a)(8) of the *Order Re: Process for Licensing New Emergency and Temporary Power Generators (Order),* GLH and DWR agree to provide the CEC access to the site and to DWR's power generating equipment and to provide all available documentation regarding the equipment and site as requested by the CEC. In response to Section III(d) of the *Order*, GLH will report emissions in excess of federal air permits to the CEC.

Please contact Barbara McBride (Barbara.McBride@calpine.com) if you have any questions regarding the self-certification template and supporting documentation.

I certify under penalty of perjury that the information contained in the self-certification template and documentation is true and correct to the best of my knowledge and belief.

Sincerely,

DocuSigned by:
Teresa Wilson
6D24E56CDC30478...

DS

Teresa Wilson
Vice President
Calpine Greenleaf Holdings, Inc.

CALPINE GREENLEAF HOLDINGS, INC. (GLH) SELF-CERTIFICATION TEMPLATE FOR LICENSING NEW EMERGENCY AND TEMPORARY POWER GENERATORS

TEMPLATE FOR LICENSING NEW EMERGENCY AND TEMPORARY POWER GENERATORS						
LICENSE APPLICANT ENTITY: CALPINE GREENLEAF HOLDINGS, INC. (GLH)	**APPLICANT PRIMARY CONTACT NAME: BARBARA MCBRIDE**		**EMAIL ADDRESS: Barbara.McBride@calpine.com**		**PHONE NUMBER: 925-570-0849**	
				COLUMNS BELOW FOR CEC STAFF USE ONLY		
	SELF-CERTIFICATION YES OR NO	**PROVIDE WITH CHECKLIST**	**DOCUMENTATION PROVIDED AS ATTACHMENT**	**ADEQUATE YES OR NO**	**INFORMATION NEEDED TO MAKE ADEQUATE**	**APPLICABLE ENVIRONMENTAL CONDITIONS**
Cover Letter	N/A	Letter dated and signed by each applicant attesting under penalty of perjury to the application's truth and accuracy.	Cover letter provided with template.			
General Project Description	N/A	Provide a general description of the proposed temporary power generator site and a site map delineating the fence line.	Attachment 1: project description and site map			
III. CRITERIA AND PROCEDURES						
(a)(1) The power generator(s) will deliver 10 MW or more on a single grid intertie.	YES	Unit description, manufacturer specifications and cut sheets for engine-generator package.	Attachment 2: TM2500 brochure. Attachment 10, pp. 1-11.			
	YES	Description and one-line diagram showing the generating unit's proposed intertie to the substation, including GSU, breakers and switches.	Attachment 3: project one-line diagram.			
(a)(2) the power generator(s) will deliver net peak energy no later than October 31, 2021.	YES	Schedule showing estimated major milestones including generator delivery, interconnection agreements, fuel and demin water availability.	Attachment 4: project equipment delivery schedule.			
(a)(3) The owner or operator has control over the site, and	YES	Copy of proof of site control (e.g., certificate of title, a deed, ALTA survey, lease agreement or other legal document specifying ownership).	Attachment 5: Grant Deed for the project site, which is owned by GLH and subject to a site agreement between			

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			GLH and DWR for the facility.			
(a)(3)i. generation will be located in a previously disturbed site;	YES	Date-stamped photographs, aerial photographs, maps, or documents that show the site consists-or consisted of- a concrete pad, pavement, gravel, previously excavated, compacted, or otherwise improved area.	Attachment 6: plot plan which shows the TM2500 Turbines located on a previously disturbed site.			
	YES	A description of previous disturbances or development of the candidate site.	Attachment 1. The site is a decommissioned power plant site.			
(a)(3)ii. generation will use natural gas as soon after construction as practicable;	YES	Initial fuel plan if not natural gas, and description of plan and schedule for conversion to natural gas.	Attachment 1. Greenleaf 1 will utilize natural gas.			
(a)(3)iii. there is a secure water supply for the project; and	YES	Description of planned demin water supply including source, storage and replenishment methods.	Attachment 1. Sutter Energy Center will supply demin water to the facility through an existing pipeline.			
(a)(3)iv. there is an available grid interconnection.		See (a)(7) below.	Attachment 1. Also see response to (a)(7).			
(a)(4) The power generator(s) can accommodate best available control technology (BACT) and the owner or operator will install BACT as soon as practicable. Operators of sites on which generators and equipment procured by DWR have been located shall collaborate with DWR on the installation of BACT.	YES	Description of plan for how and when the engine-generator will be made BACT compliant as soon as practicable.	Attachment 10, PDF pp. 12-13. DWR has indicated that SCR will be available and installed by late 2022.			
(a)(5) The owner or operator will implement best management practices and a worker environmental		Copy of worker environmental awareness program, storm water pollution prevention, if applicable,	Attachment 8: Sutter Energy Center WEAP.			

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awareness program, as appropriate, during installation and removal of the power generators to protect any environmental resources.		and other associated best management practices that will be implemented at the site.	Attachment 11: Contractor Hazardous Materials Business Plan for construction. Attachment 13: Cultural Resources addition to WEAP. Attachment 14: SWPPP Waiver Attachment 15: Wildlife Observation Form Greenleaf 1			
(a)(6) The installation of the power generator(s) will be consistent with manufacturer specifications and safety codes and standards.		Attestation letter with agreement to provide completed engineering drawings for installation of the power generator package and all associated appurtenances after commissioning.	Attachment 10, PDF pp. 14-15.			
		Manufacturer cut sheet(s) for all balance of plant appurtenances related to the power generator(s) package	See information on DWR FTP site.			
		Manufacturer cut sheet(s) for the step-up transformer, if applicable	Attachment 9: Manufacturer cut sheets.			
		Manufacturer's cut sheet showing noise specification(s) for the turbine(s), gas compressor(s), and step-up transformer(s). Distance from the project fence lines to the turbine(s), gas compressor(s), and step-up transformer(s).	See information on DWR FTP site. Attachment 10, PDF pp. 16-19. Attachment 12: Package Unit Noise Study for Greenleaf 1 site.			
	YES	Proof of contract and contact information for the party who will do the installation, and a copy of	Attachment 7: Contractor IIPP and Safety Program.			

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		their Injury and Illness Prevention Plan.	Attachment 10, PDF pp. 20-22.			
(a)(7) The owner or operator has received authorization to interconnect the power generator(s) to the distribution or transmission grid by the relevant grid authority.		Documentation from the California Independent System Operator or Interconnecting Utility indicating preliminary approval of the interconnection of the additional generation. And, when available, provide the Federal Energy Regulatory Commission approved generator interconnection agreement or modified existing interconnection agreement for the emergency generators.	The CAISO has prepared a draft amendment to the existing LGIA that would provide for the incremental capacity (10.8MW) required to operate at 60 MW. Concurrently, the CAISO has sought a tariff waiver at FERC seeking the authority to grant incremental capacity on a temporary basis. The execution of any amendment to the LGIA will be dependent upon FERC granting the waiver. See CAISO, *Petition for Limited Tariff Waiver of the California Independent System Operator Corporation and Request for Shortened Comment Period and Expedited Commission Approval*, filed in FERC Docket No. ER21-2753-000, (Aug. 25, 2021).			
(a)(8) The owner or operator will provide access to CEC for inspection of the power generating equipment and site, and provide all available documentation	YES	Statement of agreement that owner or operator will provide access to CEC for inspection and provide all available	See Cover Letter.			

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regarding the equipment and site as requested by the CEC.		documentation requested by CEC.				
(b) Within 10 days after an owner or operator files a self-certification, the Executive Director shall verify that the self-certification is complete and meets the requirements of section (a) and that, based on the information available at the time of review, the project will deliver net peak energy by October 31, 2021. The Executive Director shall file a decision on the self-certification granting or denying the license and may impose conditions or reporting requirements on the license as appropriate. The decision of the Executive Director is final and not subject to further consideration or appeal.		N/A	---			
(c) The owner or operator is authorized to operate the power generators up to 5 years from the date that the Executive Director grants the license.		N/A	---			
(d) To support the Emergency Proclamation's directive to the California Air Resources Board to develop and promptly implement a State-funded plan to mitigate the effects of additional emissions authorized by the Emergency Proclamation beyond permitted levels, all owners or operators of new and temporary power generators shall report emissions in excess of federal air permits to the CEC for transmittal to the California Air Resources Board.	YES	Statement of agreement that the owner or operator will report emissions data to the CEC.	See Cover Letter.			

ATTACHMENT 1

GENERAL PROJECT DESCRIPTION

ATTACHMENT 1

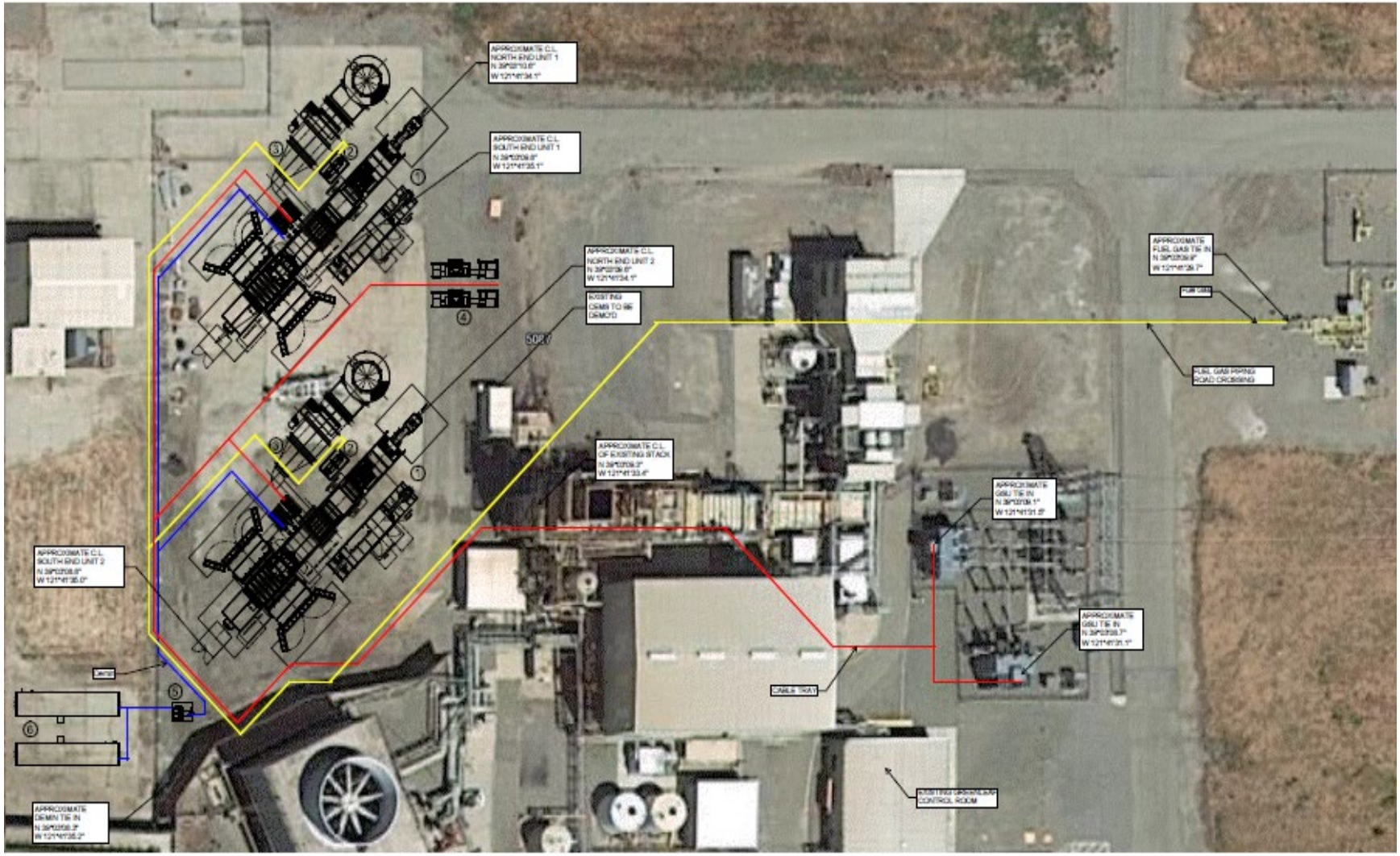
GENERAL PROJECT DESCRIPTION

Greenleaf 1 will be an approximately 60-megawatt natural gas-fired simple cycle electric generating facility located on a decommissioned powerplant site in Yuba City, California adjacent to the existing Sutter Energy Center. Greenleaf 1 will be a temporary facility licensed pursuant to the Governor's July 30, 2021 Emergency Proclamation.

Greenleaf 1 will consist of two TM 2500+G4 gas turbines package units. The package units will be skid mounted units which will arrive complete with air filters, fuel gas skid, and generator. The package units are equipped with nitrogen oxide (NOx) water injection to control emissions from the units to 25 ppm @15% oxygen. The units will be retrofitted with a Selective Catalytic Reduction (SCR) system and Catalytic Oxidation system when available. DWR anticipates that the SCR systems will be available and installed by late 2022.

The units are located on previously disturbed land at the site of the decommissioned Greenleaf 1 Cogeneration facility. The new combustion turbines will utilize the existing natural gas line, which is located at the northeast corner of the site, to interconnect and receive natural gas from the Pacific Gas and Electric (PG&E) natural gas system. Approximately 620-feet of aboveground piping will be installed to facilitate the gas interconnection. Two existing generator step-up units (GSUs) will be used to step up the voltage to interconnect into existing 115 KV transmission lines which will provide power to the California Independent System Operator (CAISO) controlled-grid. Demineralized water for NOx control will be provided from the Sutter Energy Center site through an existing pipeline. Greenleaf 1 will be installed, owned, decommissioned, and removed by the Department of Water Resources. GLH or its affiliate will operate Greenleaf 1 under a contract with DWR. The facility is planned to commence commercial operation on September 17, 2021.

CALPINE GREENLEAF HOLDINGS, INC. (GLH) SELF-CERTIFICATION TEMPLATE FOR LICENSING NEW EMERGENCY AND TEMPORARY POWER GENERATORS



ATTACHMENT 2

TM2500 BROCHURE

GE Power & Water
Distributed Power

TM2500 GEN8
Mobile Gas Turbine Generator Set

Product Specification

Improvements and Changes
It is understood that GE has the right to make changes in product design and add improvements to products or services at any time without incurring any obligations to install the same on or in connection with the equipment or services identified in this document. DATE OF ISSUE 7/2015

Table of Contents

Tab

List of Effective Pages

Dates of issue for original and changed pages are:

Original 0 07 2015

Total number of pages in this volume is 124 consisting of the following:

	Change Number		Change Number
Title/Blank	0	8-1 - 8-9	0
i	0	9-1	0
A	0	10-1 - 10-8	0
1-1 - 1-4	0	11-1 - 11-3	0
2-1 - 2-10	0	12-1	0
3-1 - 3-5	0	13-1 - 13-4	0
4-1 - 4-12	0	14-1 - 14-8	0
5-1 - 5-17	0	15-1 - 15-3	0
6-1 - 6-4	0	16-1 - 16-3	0
7-1 - 7-22	0	17-1 - 17-7	0

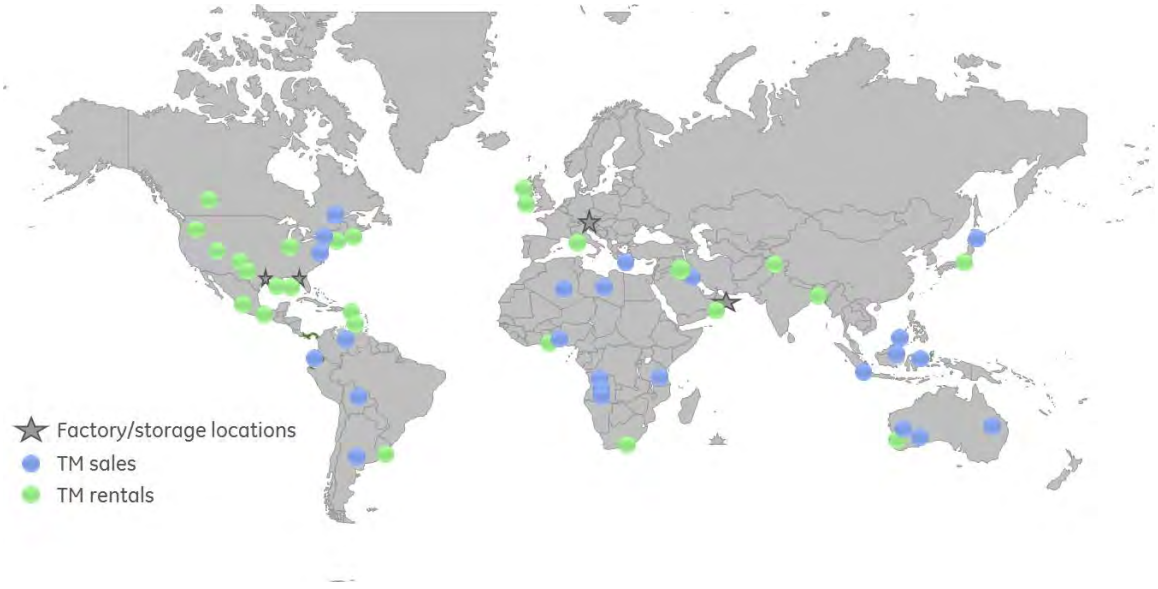
1. Introduction – TM2500 GEN8 Mobile Gas Turbine Generator Set

1.1 Packaging Concept

Known as GE's "Power Plant on Wheels", our TM2500 GEN8 mobile aeroderivative gas turbine generator set is ideal for providing a base-load bridge to permanent power installations or for generating backup power in support of natural disaster relief, plant shutdowns, or equipment maintenance, with the capacity to produce more than 35 megawatts of power—that's 13% more than its predecessor, the TM2500+™. Equipped with our proven LM2500+G4™ and engineered for flexibility and quick dispatch, the TM2500 GEN8 is the go to solution for fast, mobile power needs in almost any environment.

As the newest enhancement of GE Power & Water's trailer-mounted unit, the TM2500 GEN8 offers improved global mobility of the trailer package with its split trailer design. The split-trailer design has a shorter wheelbase resulting in a 20% improvement in the turning radius, as well as lowering the load per trailer. Another feature of this new design is the telescopic front and back trailer ends which can adjust to comply with global transportation requirements, as needed.

Global Experience



Features and Benefits

- Increased MW performance @ 50 Hz with the LM2500+G4™
- Smaller footprint compared to mobile unit competitors
- Laser Alignment System - simplified field alignment procedure and tooling
- 20% improvement in turning radius and lower weight per trailer axle
- Onboard Crane option allows for self-sufficiency
- Available for both 50 Hz and 60 Hz applications
- Aerosol Fire Suppression System
- Full power within 10 minutes or less
- Developed specifically to respond to fast and mobile power needs
- Flexible operation on either natural gas or distillate liquid fuels
- Quick conversion between 50 Hz and 60 Hz with no reduction gearbox
- Low emissions with demineralized water injection
- Quick dispatch and easy to operate and maintain
- Road legal trailers
- Trailer mounted air filters for increased accessibility and simplified installation
- Many options available
- Reduced system interconnects for faster installation

Class Certifications

The TM2500 GEN8 Mobile Gas Turbine Generator (MGTG) set design meets the requirements of UL/FM Class Certification, as well as CSA, CE/ATEX, and Australian standards.

1.2 Aeroderivative Engine

The cornerstone of this mobile unit's offering is GE's fourth generation upgrade of the LM2500® product line, the LM2500+G4™. It possesses technical features inherent to its design, which offer significant operational and economic advantages to the end user. This brochure presents an overall description of GE's TM2500 GEN8 mobile aeroderivative gas turbine generator set, with rated ISO shaft power output of 34.8 megawatts and 41% efficiency. It presents the value added to customers based on demonstrated high reliability and availability of the LM2500® gas turbine heritage.

The LM2500+G4™ shares in GE Aircraft Engine's research and development funding; which has surpassed one billion dollars each year for the past 16 years. Today, GE's entire gas turbine product line continues to benefit from this constant infusion of

research and development funding. Advances are constantly being incorporated to improve the benefits of GE's gas turbines to the customer.

Engine Heritage

The LM2500® product line is GE's most experienced aeroderivative engine. It is derived from the TF-39 engine used on DC-10 wide-bodied jets. More than 1,800 LM2500® engines are in service worldwide with more than 70 million hours of operational experience.

Simple Design

The LM2500+G4™ design includes a six-stage power turbine with a nominal speed of 3,600 rpm for 60 Hz applications and 3,000 rpm for 50 Hz applications.

Emissions Control

Most countries today are environmentally responsible and desire low emissions for new power plants. Even with the high firing temperatures and pressures, the LM2500+G4™ is capable of guaranteeing 25 ppm NOx level with Gas Fuel and 42 ppm NOx level with Liquid Fuel at 15% O_2 dry.

Fuel Flexibility

At GE, we understand flexibility in fuel choices is a high priority. Our Alternate Fuels Center of Excellence is leading the industry in identifying, designing, and delivering fuel flexibility options—all with the high reliability, availability, and maintainability standards you expect from GE.

The LM2500+G4™ dual fuel single annular combustor (SAC) gas turbine offers fuel flexibility. It is capable of operating with a variety of fuels such as:

- Natural Gas fuel
- #2 Diesel
- Kerosene
- Jet Fuel

Additional operating fuel options available with fuel retrofit kits include:

- Naptha
- Pentane
- Liquefied Petroleum Gas (LPG)
- Alcohol

High Availability and Reliability

By utilizing aircraft experience and design, our aeroderivative design approach incorporates features such as split casings, modular construction, individual replacement of internal and external parts, and GE's "lease pool" engine program. Our extensive use of high quality components common with parent aircraft engines validates engine reliability and offers reduced parts cost.

Various inspections and hot section repairs can be performed on the gas turbine at site within the turbine enclosure. The "Hot Section," HPT and combustor can be removed / replaced in the field within 72 hours, allowing for greater availability during planned maintenance. Greater availability is achieved by the on-condition maintenance program, which inspects and repairs only as necessary to desired operational condition.

1.3 Summary

This unit configuration, coupled with GE's most experienced aeroderivative engine, provides users with optimum value in reliability and cost of ownership.

The TM2500 GEN8 MGTG set delivers the following benefits over competitive designs:

- Increased power for 50 Hz market with the LM2500+G4™
- Smaller footprint vs competitor (2,417 sq. ft. vs 3,294 sq. ft.)
- Global mobility with split trailer design
- 20% improvement in turning radius; meets EU requirements
- 40% weight reduction of heaviest lift; onboard crane option
- Field engine alignment eliminated
- 90 dBA on liquid fuel or 87 dB(A) on gas fuel guarantee (standard)
- Seismic and Wind Rating is up to 0.35G and 100 mph (293 kg/m^2) (standard)

2. Performance Curves and Data

2.1 Turbine Performance

Gas turbine performance is affected by several factors, including:

- Ambient temperature
- Barometric pressure
- Relative humidity
- Elevation above sea level
- Inlet pressure losses
- Exhaust pressure losses
- Emission controls
- Fuel type

2.2 ISO Conditions

To assist buyers, the International Organization for Standardization (ISO) has defined the following standard conditions for rating and comparing gas turbine engines:

- Ambient Temperature - 59°F (15°C)
- Barometric Pressure - 14.7 psia (101.3 kPa)
- Relative Humidity - 60%
- Elevation - Sea Level
- Inlet and Exhaust Losses – None
- Emission Controls – None

2.3 ISO Performance Data

The charts, curves and data in this manual are shown at standard ISO conditions, except as specifically noted. Distributed Power will be glad to prepare performance data for customer's individual job site conditions.

	LM2500+G4™ SAC (NOx Control: None)			
	NPT: 3600 rpm	**NPT: 3000 rpm**	**NPT: 3600 rpm**	**NPT: 3000 rpm**
Fuel	**Natural Gas, per MID-TD-0000-1**		**Liquid, per MID-TD-0000-2**	
Power Output, SHP (kW) @ generator terminals	44757 (33375)	43189 (32206)	43303 (32291)	41947 (31280)
Heat Rate (Average), BTU/hp-hr. (KJ/kW-hr)	6532 (9241)	6863 (9711)	6599 (9336)	6909 (9775)
Exhaust Flow, lbs./sec (kg/sec)	201.9 (91.6)	204.8 (92.9)	199.5 (90.5)	202.4 (91.8)
Exhaust Temperature, °F (°C)	976 (524)	1004 (540)	981 (527)	1008 (542)
Power Turbine Speed, rpm	3600	3000	3600	3000
NOx @ 15% O_2, PPMvd (mg/Nm3)	302 (618)	311 (638)	454 (930)	470 (962)
Based on the following ISO conditions:				
Inlet Temperature, °F (°C)	59 (15)			
Altitude (Sea Level), ft. (m)	0 (0)			
Inlet & Exhaust Losses, inH_2O (mmHg)	Zero			
Relative Humidity	60%			
Bleed Air Extraction	0			
Accessory Power Extraction	0			
Generator Voltage, Power Factor, Frequency	13.8 kV, 0.9 PF, 60 Hz	11.5 kV, 0.9 PF, 50 Hz	13.8 kV, 0.9 PF, 60 Hz	11.5 kV, 0.9 PF, 50 Hz

Table 2.1 - LM2500+G4™ SAC Combustor Performance at ISO Conditions

2.4 Motor Load List

ITEM	NAMEPLATE INFORMATION	TAG NAME	400/3P/50 Hz	480/3P/60 Hz
1	TURBINE LUBE OIL/HYDRAULIC OIL TANK HEATER	HE-1004	3.5 hp (2.6 kW)	4 hp (3 kW)
2	GENERATOR LUBE OIL TANK HEATER	HE-0005	3.7 hp (2.77 kW)	5.4 hp (4 kW)
3	GENERATOR STATOR / EXCITER SPACE HEATER	HE-4050/4051	3.7 hp (2.77 kW)	5.4 hp (4 kW)
4	TURBINE WATER WASH PUMP	MOT-5035	2 hp (1.5 kW)	2 hp (1.5 kW)
5	TURBINE ENCLOSURE VENT FAN	MOT-4017	80 hp (59.7 kW)	80 hp (59.7 kW)
6	TURBINE HYDRAULIC STARTER MOTOR	MOT-6015	200 hp (149 kW)	200 hp (149 kW)
7	TURBINE NOX WATER INJECTION PUMP	MOT-2075	41 hp (30.6 kW)	50 hp (37.3 kW)
8	TURBINE LIQUID FUEL PUMP	MOT-2022	41 hp (30.6 kW)	50 hp (37.3 kW)
9	TURBINE LUBE OIL/HYDRAULIC OIL HEAT EXCHANGER FAN	MOT-1078	7.5 hp (5.6 kW)	7.5 hp (5.6 kW)
10	GENERATOR LUBE OIL HEAT EXCHANGER FAN	MOT-0189	5 hp (3.7 kW)	5 hp (3.7 kW)
11	PULSE FILTER SKID COMPRESSOR	MOT-4297	20 hp (15 kW)	20 hp (15 kW)
12	LIGHTING AND DISTRIBUTION TRANSFORMER	45 kVA TRANSFORMER	48.2 hp (45 kVA)	48.2 hp (45 kVA)
13	LIGHTING AND DISTRIBUTION PANEL (230/133 3PH 4W 25 CKT)	LDP	10.7 hp (10 kVA)	10.7 hp (10 kVA)

Table 2.2 - Motor Load List

2.5 Typical Approximate Dimensions and Weights

	Approx. Weight (lbs.)	L x W x H (feet)
Turbine Trailer[1,2]		
Without Stinger	90,145	55' L x 9.8' W x 13.2' H
With Stinger	95,139	69.6' L x 9.8' W x 13.2' H
Generator Trailer[1,2]		
Extendable Stinger set to EU	157,380	68.6' L x 9.8' W x 12.4' H
Extendable Stinger to US	157,380	76' L x 9.8' W x 12.4' H
Extendable Stinger set to CAN	157,380	84' L x 9.8' W x 12.4' H
With Cold Steel Version	161,822	Dependent on Stinger Setup
Control House Trailer[1,2]	47,490	41.7' L x 9.2' W x 14' H
Transportation Trailer[1,2,3]	49,435	43.2' L x 9.8' W x 13.6' H
Air Filter Assembly (including support bracket)[2]	8,674	17.8' L x 8.3' W x 10.2' H
Switchgear	8,900	6' L x 9.4' W x 8.1' H
Generator 62-170ERT	84,878	19' L x 8.9' W x 7.2' H
Generator Ventilation	6,724	12.7' L x 8.4' W x 9.1' H
Control House	25,463	22.8' L x 8.3' W x 9.4' H
Ventilation Fan Assembly	4,530	10.3' L x 8.3' W x 7.9' H
Exhaust Stack	16,323	12.2' L x 8.3' W x 11' H
Crane[2]	9,140	5.3' L x 8.3' W x 8.75' H
Generator Air Filters[2]	1,600	4.4' L x 8.3' W x 8.75' H

[1] Trailer weights include mounted assemblies & skids
[2]Weights and Dimensions reflect amounts during transport
[3]Maximum values shown, varies with selected options

Table 2.3 Typical Approximate Dimensions and Weights

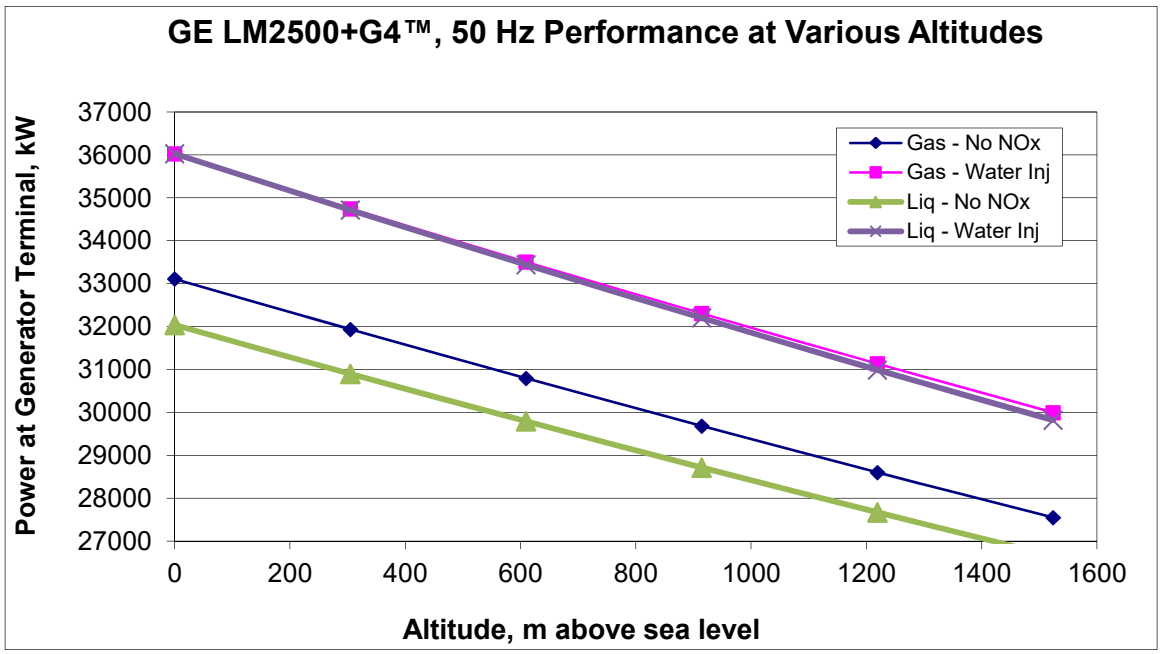
Note 1: Some equipment listed in this table may not be applicable to all projects.
Note 2: Main Unit is composed of the Turbine Trailer and Generator Trailed coupled together.

2.6 Performance Curves

From these curves it is possible to determine performance at ambient temperatures, altitudes, and conditions differing from those listed in the performance specifications.

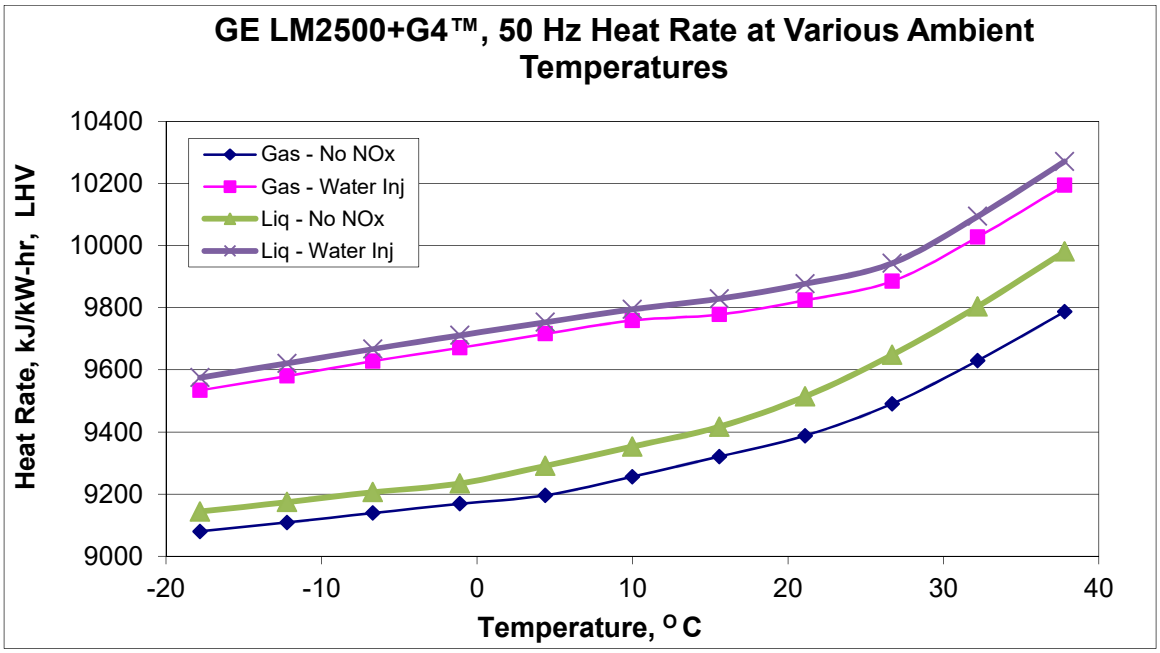
- Power at Generator Terminal vs. Altitude above Sea Level
- Heat Rate vs. Ambient Temperature
- Power at Generator Terminal vs. Ambient Temperature
- Heat Rate, % of Base Load vs. % of Base Load
- Efficiency % vs. % of Base Load

2.6.1 LM2500+G4™, 50 Hz Curves



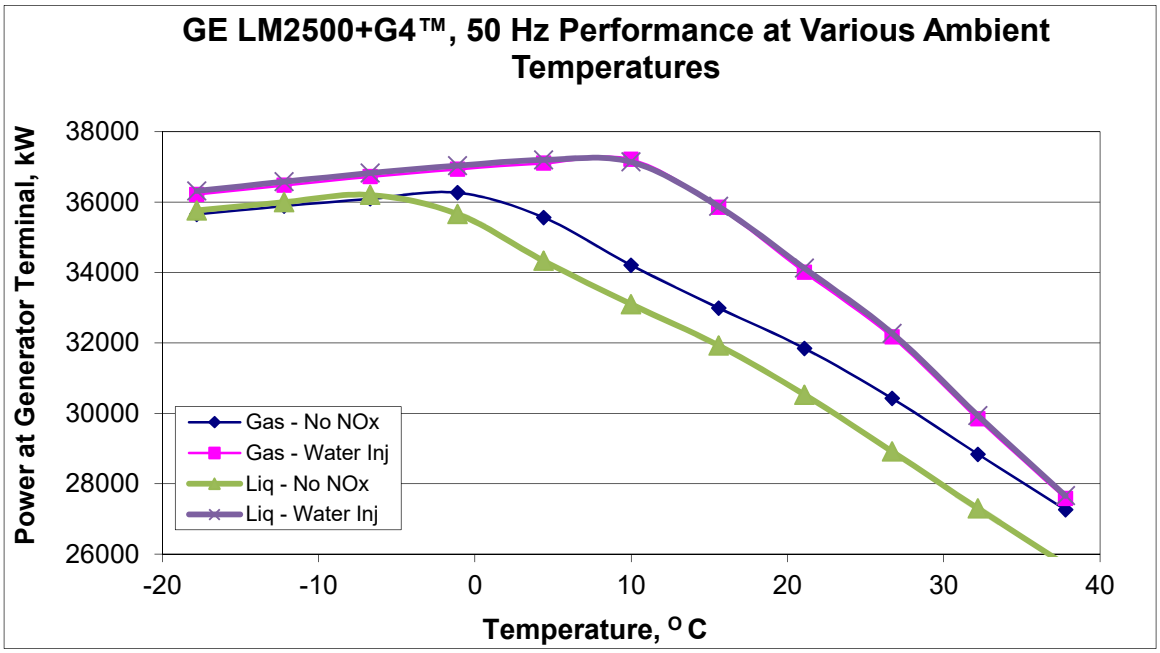
Basis of Performance: RH of 60% with 0imm H_20 inlet/0mm H_20 exhaust losses at 0ft MSL, Fuels: Natural Gas (44194 kJ/kg LHV) or Distillate (18400 Btu/lb LHV), 50 Hz, 11.5kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 51 mg/Nm3 @15% O_2; Liquid Fuel NOx Water is to 86 mg/Nm3 @15%O_2.

Figure 2.1 - Power at Generator Terminal vs. Altitude above Sea Level



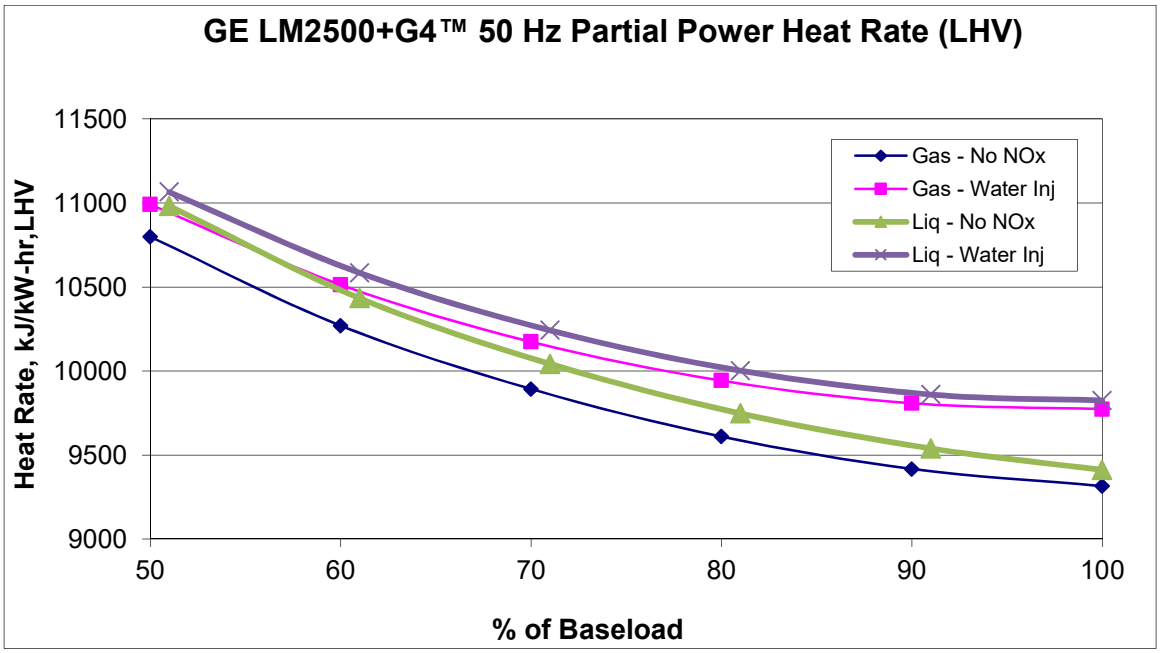
Basis of Performance: RH of 60% with 0imm H_20 inlet/0mm H_20 exhaust losses at 0ft MSL, Fuels: Natural Gas (44194 kJ/kg LHV) or Distillate (18400 Btu/lb LHV), 50 Hz, 11.5kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 51 mg/Nm3 @15% O_2; Liquid Fuel NOx Water is to 86 mg/Nm3 @15%O_2.

Figure 2.2 - Heat Rate vs. Ambient Temperature



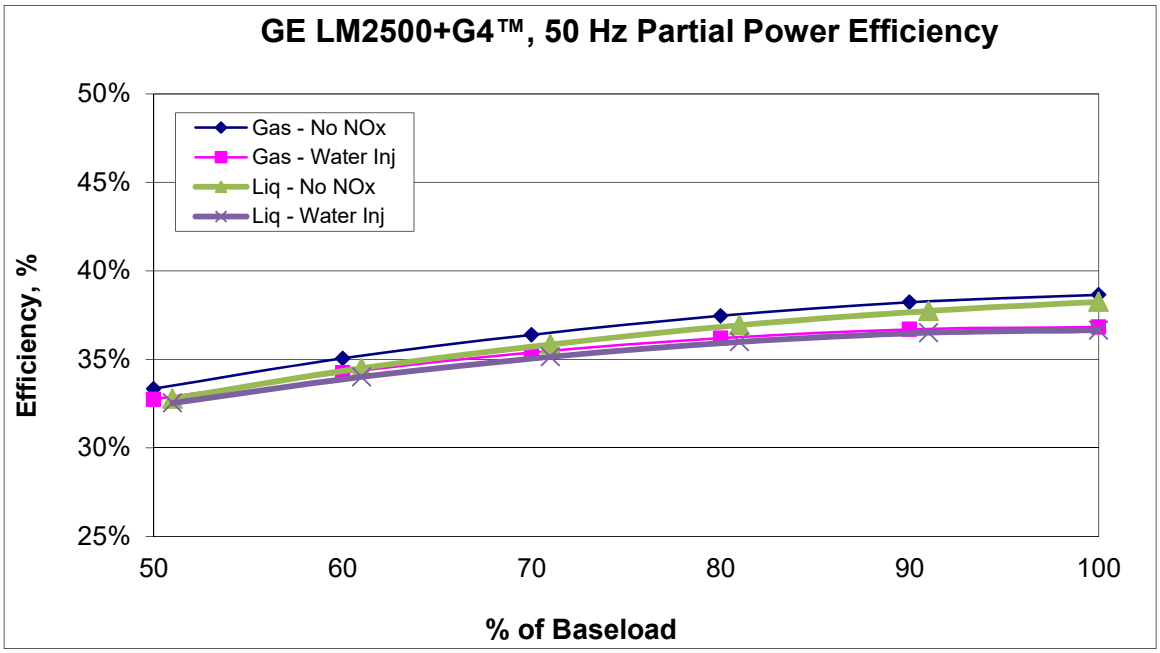
Basis of Performance: RH of 60% with 0imm H_20 inlet/0mm H_20 exhaust losses at 0ft MSL, Fuels: Natural Gas (44194 kJ/kg LHV) or Distillate (18400 Btu/lb LHV), 50 Hz, 11.5kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 51 mg/Nm3 @15% O_2; Liquid Fuel NOx Water is to 86 mg/Nm3 @15%O_2.

Figure 2.3 - Power at Generator Terminal vs. Ambient Temperature



Basis of Performance: RH of 60% with 0imm H_20 inlet/0mm H_20 exhaust losses at 0ft MSL, Fuels: Natural Gas (44194 kJ/kg LHV) or Distillate (18400 Btu/lb LHV), 50 Hz, 11.5kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 51 mg/Nm3 @15% O_2; Liquid Fuel NOx Water is to 86 mg/Nm3 @15%O_2.

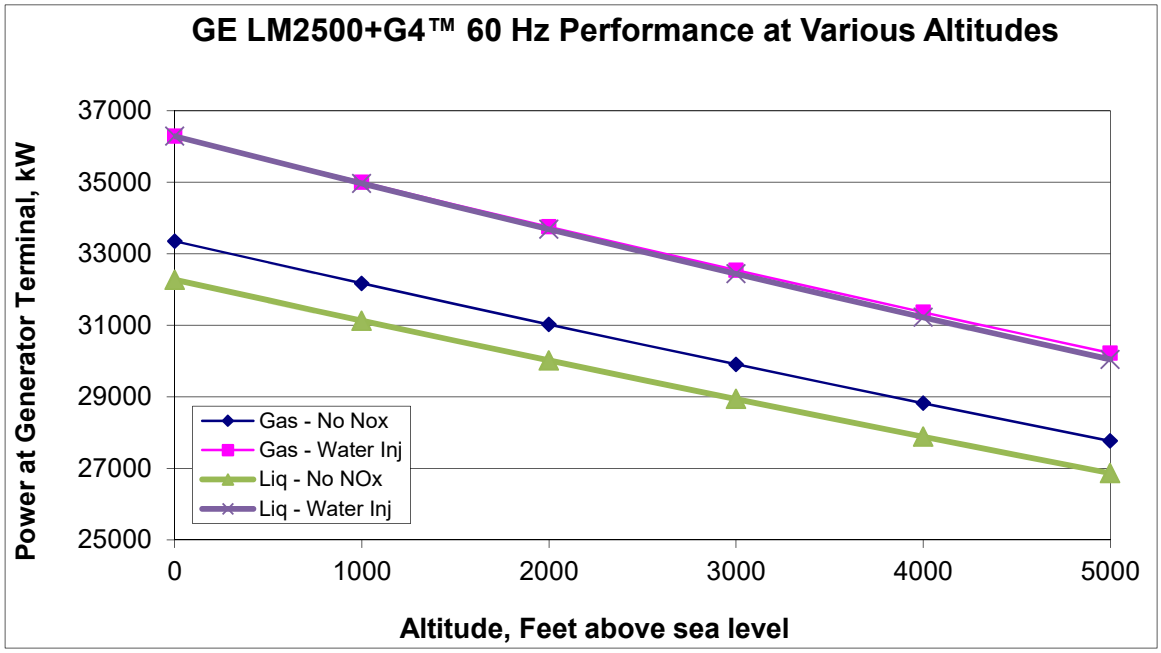
Figure 2.4 - Estimated Engine Heat Rate, % Base Load vs. Heat Rate kJ/Kw-hr, LHV



Basis of Performance: RH of 60% with 0imm H_20 inlet/0mm H_20 exhaust losses at 0ft MSL, Fuels: Natural Gas (44194 kJ/kg LHV) or Distillate (18400 Btu/lb LHV), 50 Hz, 11.5kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 51 mg/Nm3 @15% O_2; Liquid Fuel NOx Water is to 86 mg/Nm3 @15%O_2.

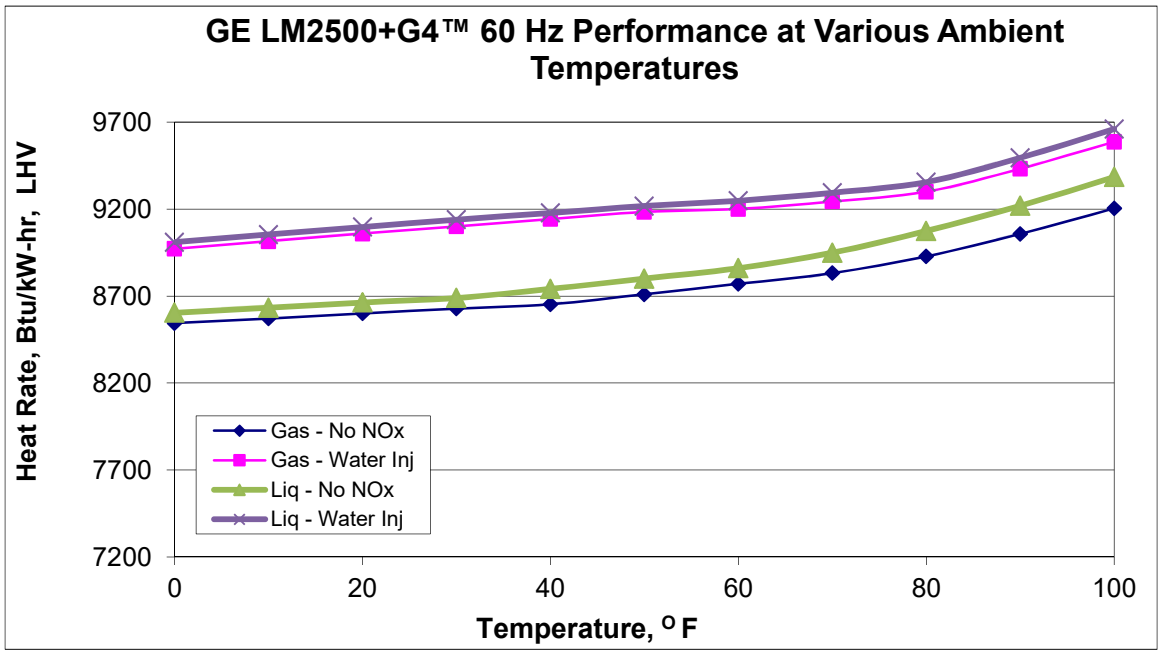
Figure 2.5 - Efficiency % vs. % of Base Load

2.6.2 LM2500+G4™, 60 Hz Curves



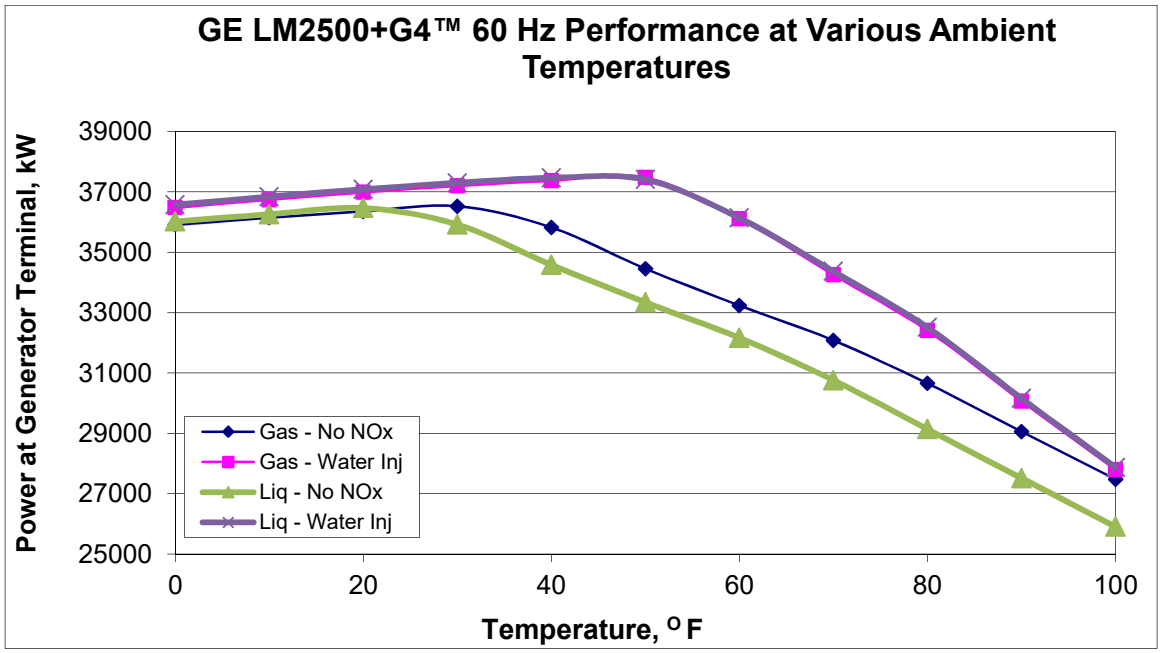
Basis of Performance: Amb 59°F RH of 60% with 0in H_20 inlet/0in H_20 exhaust losses at 0ft MSL, Fuel: Natural Gas (19000 Btu/lb LHV) or Distillate (18400 Btu/lb LHV), 60 Hz, 13.8kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 25 ppmvd @15% O_2; Liquid Fuel NOx Water is to 42 ppmvd @ 15% O_2.

Figure 2.6 - Power at Generator Terminal vs. Altitude above Sea Level



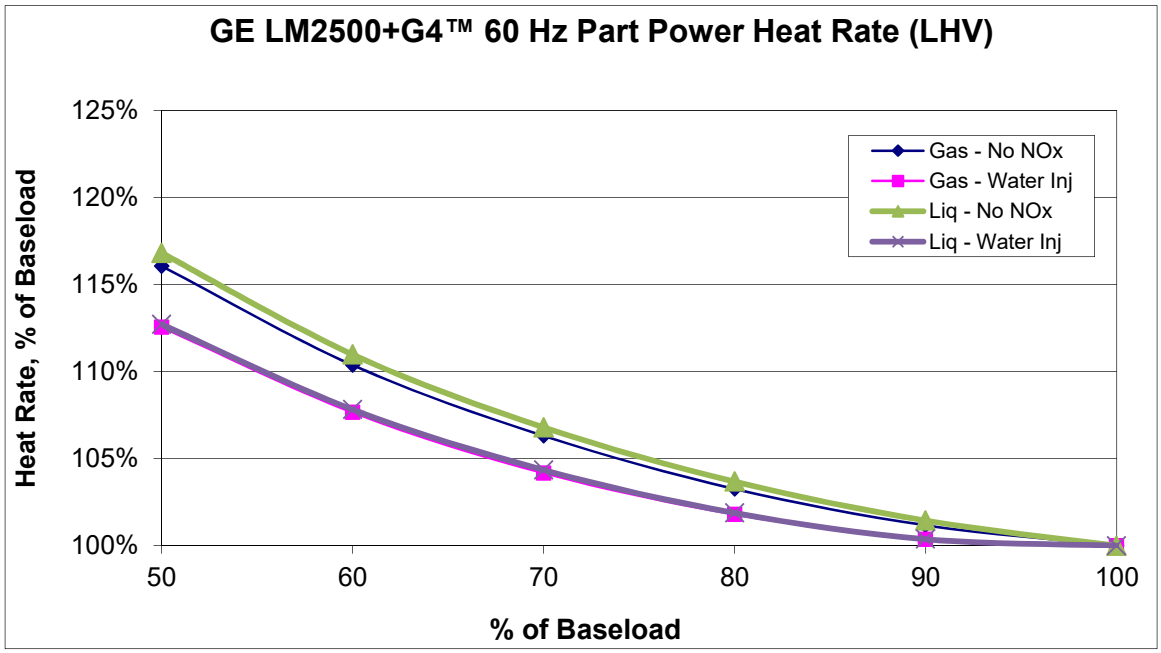
Basis of Performance: Amb 59°F RH of 60% with 0in H_20 inlet/0in H_20 exhaust losses at 0ft MSL, Fuel: Natural Gas (19000 Btu/lb LHV) or Distillate (18400 Btu/lb LHV), 60 Hz, 13.8kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 25 ppmvd @15% O_2; Liquid Fuel NOx Water is to 42 ppmvd @ 15% O_2.

Figure 2.7 - Heat Rate vs. Ambient Temperature



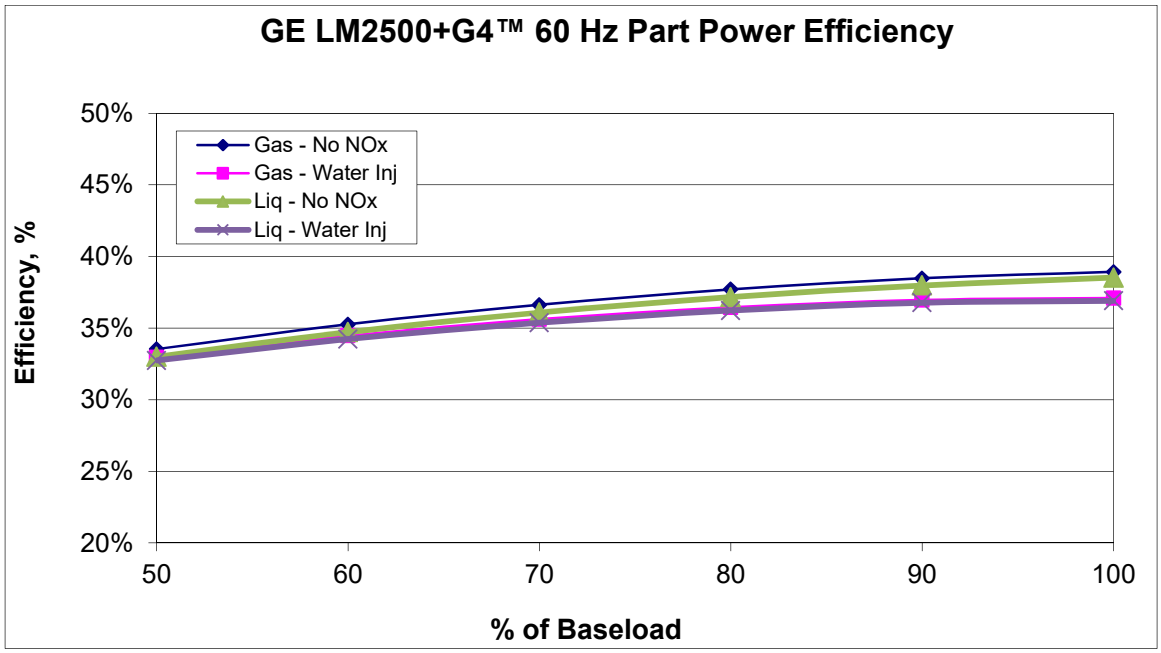
Basis of Performance: Amb 59°F RH of 60% with 0in H_20 inlet/0in H_20 exhaust losses at 0ft MSL, Fuel: Natural Gas (19000 Btu/lb LHV) or Distillate (18400 Btu/lb LHV), 60 Hz, 13.8kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 25 ppmvd @15% O_2; Liquid Fuel NOx Water is to 42 ppmvd @ 15% O_2.

Figure 2.8 - Power at Generator Terminal vs. Ambient Temperature



Basis of Performance: Amb 59°F RH of 60% with 0in H_20 inlet/0in H_20 exhaust losses at 0ft MSL, Fuel: Natural Gas (19000 Btu/lb LHV) or Distillate (18400 Btu/lb LHV), 60 Hz, 13.8kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 25 ppmvd @15% O_2; Liquid Fuel NOx Water is to 42 ppmvd @ 15% O_2.

Figure 2.9 - Heat Rate, % of Base Load vs. % of Base Load



Basis of Performance: Amb 59°F RH of 60% with 0in H_20 inlet/0in H_20 exhaust losses at 0ft MSL, Fuel: Natural Gas (19000 Btu/lb LHV) or Distillate (18400 Btu/lb LHV), 60 Hz, 13.8kV, 0.9PF. Not for guarantee. Gas Fuel NOx Water is to 25 ppmvd @15% O_2; Liquid Fuel NOx Water is to 42 ppmvd @ 15% O_2.

Figure 2.10 - Efficiency % vs. % of Base Load

2.7 Guarantee Basis

Performance guarantees are based upon local (ambient) conditions and overall cleanliness of the gas turbine with less than 200 fired hours. If more than 200 fired hours have elapsed before conducting a performance test, a General Electric representative has the right to inspect the unit to ensure condition and cleanliness standards have been met. Guarantees are based on a site test conducted in accordance with Distributed Power's standard practices and protocols as described in the Test Specifications. Distributed Power reserves the right to have a representative present during the performance test.

3. Codes and Standards

The applicable sections of the Global Codes and Standards listed are the most relevant standards for Distributed Power's manufactured gas turbine. GE designs and procedures are compliant with the applicable sections of the following listed standards. Applicability of listed standards, local specific standards and optional standards are applied within the specific project Transactional Compliance Plan. Revisions of the standards included below are based on at the time of publication of this document. Latest revisions as applicable are tracked and reviewed by Engineering and will be included during the next revision of this document.

Product Baseline Specifications (PBCSs) for your specific region will be provided upon request.

3.1 US and Canadian Codes and Standards

GE 60 Hz designs and procedures are compliant with the applicable sections of the following listed directives and standards. Canadian Standards applicable to Gas Turbines are equivalent to U.S. Codes and Standards.

Standard	Edition	Title
ANSI/ABMA 9	90(R2008)	Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA 11	90(R2008)	Load Ratings and Fatigue Life for Roller Bearings
ASCE 7-10	2010 SUPP 1 2013	Minimum Design Loads for Buildings and Other Structures
ASME B1.1	2003 (R2008)	Unified Inch Screw Threads
ASME B1.20.1	2013	Pipe Threads, General Purpose, Inch
ASME B16.5	2013	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B16.9	2012	Factory-Made Wrought Butt Welding Fittings
ASME B16.21	2011	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B31.1	2014	Power Piping
ASME B133.8	2011	Gas Turbine Installation Sound Emissions
NFPA 70	2014 ERRATA 4 2014	National Electrical Code
IEEE 37.90	2005	Relays Associated with Electric Power Apparatus
API 614	5ED 2008 ERRATA 08	Lubrication, Shaft-Sealing and Oil-Control Systems and Auxiliaries
API 616	5ED 2011	Gas Turbines for Petroleum, Chemical, and Gas Industry Services
API 650	2013 ERRATA 2013	Storage Tanks

3.1 US and Canadian Codes and Standards (continued)

Standard	Edition	Title
API 670	4ED 2000(R2010)	Machinery Protection Systems
API 671	4ED 2007(R2010)	Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services
ASME PTC22	2005	Performance Test Code On Gas Turbines
ASME PV Code 8 DIV 1	2013	ASME Boiler and Pressure Vessel Code
ASME PV Code 9	2013	ASME Boiler and Pressure Vessel Code
IEEE C37.2	2008	Electrical Power System Device Function Numbers, Acronyms, and Contact Designations
IEEE 100	7ED 2000	Authoritative Dictionary of IEEE Standards Terms
NEMA MG 1	2011	Motors and Generators
NEMA MG 2	2014	Safety Standard and Guide for Selection, Installation, and Use of Electric Motors and Generators
ANSI S12.51	2012	Acoustics - Determination Of Sound Power Levels And Sound Energy Levels Of Noise Sources Using Sound Pressure - Precision Methods For Reverberation Test Rooms
ANSI S1.4-1	2014	Specification for Sound Level Meters
ANSI S1.13	2005(R2010)	Measurement of Sound Pressure Levels In Air
ASHRAE 52.2	2012	Gravimetric and Dust Spot Procedures for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter
SAE J 184	2014 STABILIZED	Qualifying a Sound Data Acquisition System
AGMA 6011	I2003	Standard Practice for High Speed Helical and Herringbone Gear Units
IBC	2012	International Building Code
IEEE 421.1	2007	Definitions for Excitation Systems for Synchronous Machines
ISO 4413	2010	Hydraulic Fluid Power - General Rules And Safety Requirements For Systems And Their Components
TIA 232	F1997(R2012)	Interface Between Data Terminal Equipment And Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
UL 796	10ED REV SEP 2013	Printed-Wiring Boards
J-STD-001	F2014 ADDENDUM 14	Guidelines
EN 55011	2009 AMD 1 2010	Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement

3.2 European Directives and Standards

GE 50 Hz designs and procedures are compliant with the applicable sections of the following listed directives and standards. Several International Standards are equivalent to listed European Normative (EN) Standards. Directives and Standards are mandatory for projects installed in the European Union (EU) and recommended for non-EU countries that accept the standards in lieu of their own local standards.

Directive	Title
ATEX 94/9/EC	Equipment and Protective Systems intended for use in Potentially Explosive Atmospheres Directive
2013/59/EURATOM	Basic Safety Standards for Ionized Radiation
PED 97/23/EC	Pressure Equipment Directive
RoHS 2011/65/EU	Restriction of Hazardous Substances (RoHS) Directive
WEEE 2012/19/EU	Waste Electrical & Electronic Equipment (WEEE) Directive
EMC 2004/108/EC	Electromagnetic Compatibility Directive
REACH 1907/2006/EC	Registration, Evaluation, Authorization of Chemicals (REACH) Directive
MD 2006/42/EC	Machinery Safety Directive
2006/66/EC	Battery Directive
LVD 2006/95/EC	Low Voltage Directive
IED 2010/75/EU	Industrial Emissions Directive

TRS Category	Standard	Edition	Title	Harmonized/ Design Standard
Electromagnetic Compatibility/ Interference	EN 55011	2009 AMD 1 2010	Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement	Harmonized
Electromagnetic Compatibility/ Interference	IEC 61000-4-2	2ED 2008	Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test	Design
Electromagnetic Compatibility/ Interference	IEC 61000-4-3	2010 (CONED) 3.2	Electromagnetic Compatibility (EMC) - Part 4-3: Testing and Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field Immunity Test	Design

3.2 European Directives and Standards (Continued)

TRS Category	Standard	Edition	Title	Harmonized/ Design Standard
Electromagnetic Compatibility/ Interference	IEC 61000-4-4	3ED 2012	Electromagnetic Compatibility (EMC) - Part 4-4: Testing and Measurement Techniques - Electrical Fast Transient/ Burst Immunity Test	Design
Electromagnetic Compatibility/ Interference	IEC 61000-4-5	3ED 2014	Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test	Design
Electromagnetic Compatibility/ Interference	IEC 61000-4-6	4ED 2013	Electromagnetic Compatibility (EMC) - Part 4-6: Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields	Design
Electromagnetic Compatibility/ Interference	IEC 61000-4-11	2ED 2004	Electromagnetic Compatibility (EMC) - Part 4-11: Testing and Measurement Techniques - Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests	Design
Low Voltage Directive 2006/ 95/EC	IEC 60034-1	12ED 2010	Rotating Electrical Machines - Part 1: Rating and Performance	Harmonized
Low Voltage Directive	IEC 60034-3	6ED 2007	Rotating Electrical Machines - Part 3: Specific Requirements for Synchronous Generators Driven by Steam Turbines or	Harmonized
Electrical Safety	IEEE C37.90.1	2012	Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated With Electric Power Apparatus	Design
Electrical Safety	EN 61010-1	2010	Safety Requirements for Electrical Equipment for Measurement , Control and Laboratory Use, Part 1: General Requirements	Harmonized
Explosive Atmospheres	EN 60079-15	2010	Electrical apparatus for explosive gas atmospheres - Part 15: Construction, test and marking of type of protection "n" electrical apparatus	Harmonized

3.3 Optional Drafting Standards

The GE Gas Turbine Drafting Standards are based on the following Standards appropriated to the Gas Turbine. Please note that in several instances, symbols, etc. have been devised for GE's special needs (such as flow dividers and manifolds):

Standard	Edition	Title
ASME B46.1	2009	Surface Texture, Surface Roughness, Waviness, and Lay
ASME V14.36M	96(2008)	Surface Texture Symbols
IEEE 315	75(R1993)	Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters)
AWS D1.1	2010 ERRATA 2011	American Welding Specification
AWS A2.4	2012	Standard Symbols For Welding, Brazing, And Nondestructive Examination

3.4 Other Optional Codes and Standards

GE contracts may take exception to any unidentified codes or standards listed in this section or additional standards identified by a specification. Applicability and compliance through similarity comments can be prepared to such codes or standards. Type certification compliance requires additional business commitment and approval through PCB.

Product Baseline Specification (PBCS) additional standards and the compliance requirements will be provided upon request.

3.5 Compliance with Legislations and Regulatory Approvals

Engineering and manufacture of the Gas Turbine equipment is in accordance with GE Aviation design practices, manufacturing processes, procedures, and quality assurance programs, to comply with the applicable portions of the codes and standards listed in this section. Separate analysis for each project for compliance to the applicable national laws of a country that impact the design requires review and approval with PCB.

4. Major Equipment List

The TM2500 GEN8 MGTG set is a trailer mounted mobile power package. The trailer system allows for simplified transportation and set up of the package. The TM2500 GEN8 MGTG set typically consists of three trailers: the Turbine Trailer, Generator Trailer, Control House Trailer, as well as an optional Transportation Trailer. The basic scope of supply for each of these trailers is described in the following subsections and in Section 5 – Mechanical System Description.

4.1 Turbine Trailer

The main deck of the turbine trailer contains an inlet silencing system for the turbine and the turbine module. Located on the gooseneck of the trailer is the auxiliary skid, which contains the TCP (Turbine Control Panel) along with various package support systems. When the package is fully installed the turbine trailer assembly is fitted with the air filter modules, turbine exhaust silencer and ventilation fan assembly for the turbine enclosure.

Located at the rear of the turbine trailer is a docking station that provides the female interface required to connect the turbine and generator trailers together for the operational configuration.

Located on the turbine trailer are the following components and assemblies:

- Turbine Trailer (with optional stinger for US and Canadian transport compliance)
- Gas Turbine Engine w/ Turbine Enclosure
- Turbine Gauge Panel (TGP)
- Fire Protection Aerosol Canisters
- Auxiliary Skid - contains the following:
  - Turbine Control Panel (TCP)
  - Turbine Lube Oil (TLO) System (shared)
  - Hydraulic Start System
  - Off-Line Water Wash System
- Air Inlet Silencer with enclosure
- Inlet Air Filter System (when package is fully assembled)
- Dual Fuel with Water Injection system
- Turbine Exhaust (when package is fully assembled)
- High Speed Coupling Shaft
- Ventilation Fan Assembly skid (when package is fully assembled)
- Alignment System

For transportation requirements in the United States and Canada, the turbine trailer has an optional stinger available.

Trailer and optional stinger

A three-axle, air ride suspension trailer with two steerable axles is used to transport the turbine trailer components. The optional stinger has a single-axle and is used to assist in weight distribution to meet U.S. and Canadian transport requirements. At the jobsite, the turbine trailer is connected to the generator trailer. Landing legs are provided to support and level the equipment at the jobsite.

Turbine Enclosure

The turbine trailer is supplied with a weatherproof, acoustic enclosure for the turbine which provides ventilation and fire system containment. The enclosure is designed for noise abatement to 90 dB(A) for liquid fuel and 87 dB(A) for gas fuel. The enclosure is completely assembled and mounted over the equipment prior to testing and shipment. Provisions for turbine removal and personnel access are included.

Gas Turbine Engine

Located inside the turbine enclosure is a General Electric gas turbine engine (Model LM2500+G4™), the turbine engine is equipped to operate on liquid fuel or natural gas with or without water injection. The turbine engine is mounted to the turbine trailer which is independent from the generator trailer. See Section 5.1 for more details.

Turbine Gauge Panel (TGP)

The turbine gauge panel is located on the right hand side of the turbine enclosure (with respect to the turbine aft looking forward) beside the turbine enclosure door. The turbine gauge panel provides an enclosure used to house various pressure transmitters.

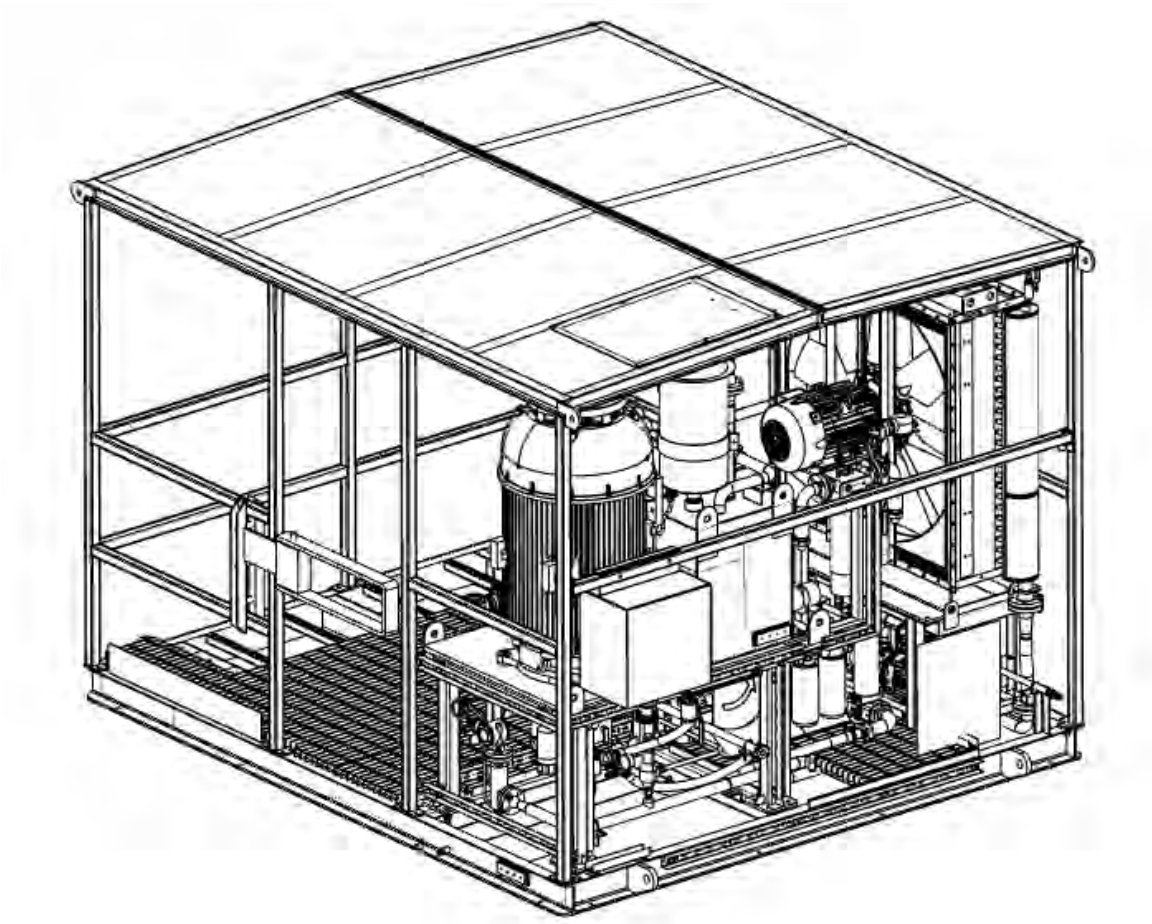
Fire Protection Aerosol Canisters

Fire protection aerosol canisters are located on top of the turbine enclosure, included as part of the ventilation fan assembly. These canisters are connected to the fire protection system located in the Generator Control Panel (GCP) and provide the

necessary extinguishing agent in the event of a fire inside the enclosure. See Section 5.10 for more details.

Auxiliary Skid

The auxiliary skid is a compact installation of several systems and equipment and is positioned on the gooseneck of the turbine trailer. This skid contains a variety of support equipment including a TCP, the Hydraulic Start System with shared turbine lube oil reservoir, Turbine Lube Oil System, and the Off-Line Water Wash System. Some of the systems on the skid contain transmitters that provide remote system monitoring. The pressure and pressure differential transmitters have instrument valves in their feed lines to simplify maintenance.



Auxiliary Skid (TCP not shown)

Mechanical interconnections between the auxiliary skid and turbine skid are made with hoses as required and come preassembled from the factory on the turbine

trailer. Electrical interconnections are provided to allow the required interfacing between the auxiliary skid and the control house as needed, otherwise wiring is factory installed.

TCP – The Turbine Control Panel mounted on the auxiliary skid will include:

- RX3i
- VersaMax Controllers
- Servo Position Controllers (For variable geometry and compressor discharge)
- Bently Nevada 3701
- Jaquet T401

Hydraulic Start System – The hydraulic start system mounted on the auxiliary skid will include:

- Hydraulic Pump & Motor
- Various Temperature Elements, Pressure Gauges, and Hydraulic filters
- Oil Reservoir (shared)

See Section 5.8 for more details.

Turbine Lube Oil (TLO) System – The synthetic lube oil system mounted on the auxiliary skid will include:

- Tank Flame Arrestor
- Turbine and Hydraulic Lube Oil Reservoir
- Tank Demister
- Turbine / Hydraulic Start Fin-Fan Heat Exchanger

See Section 5.7 for more details.

Off-Line Water Wash System – The water wash system mounted on the auxiliary skid will include:

- Polyethylene Tank
- Suction Pump
- Water Inlet Shut-Off Valve
- Strainer

See Section 5.9 for more details.

Air Filter Assembly and Silencer Enclosure

The air filter assembly contains combustion and ventilation air filtration equipment including pre-filters, high-efficiency filters, a ventilation fan assembly, and a concentric intake silencer in an enclosure. The turbine compartment is fully ventilated by a ventilation fan which draws filtered air from the silencer enclosure. See Section 5.2 for more details.

Dual Fuel with Water Injection System

All components for the dual fuel system with water injection, with the exception of the gas fuel skid, are located on the turbine trailer. All components come preassembled from the factory. Mechanical interconnect locations for liquid fuel and water are provided for customer connection just below the turbine gauge panel. See Section 5.6 for more details.

Gas fuel system major components include:

- Gas Fuel Duplex Filter Assy
- Gas Fuel Purge & Bleed Ball Valve
- Gas Fuel Purge Check Valve
- Gas Fuel Vent Valve
- Woodward Gas Fuel Valve
- Purge Valve

Liquid fuel system major components include:

- Liquid Fuel Y-strainer
- Liquid Fuel Pump/Motor
- Liquid Fuel Ball Valve
- Liquid Fuel Relief Valve
- Liquid Fuel Duplex Filter Assy
- Liquid Fuel Control Valve
- Purge & Bleed Valve
- Primary & Secondary Shut-off Valve
- Fuel Manifold
- 30 Fuel Nozzles
- Return Check Valve

Water Injection System:

GE provides the necessary controls, metering equipment, and interconnecting piping within the turbine enclosure. All piping is stainless steel, and the valves are trimmed with stainless steel. Water injection can reduce NOx emissions to 25 ppm (51 mg/Nm3) for gaseous fuel and to 42 ppm (86 mg/Nm3) for liquid fuel. The customer must provide a supply of pressurized water in accordance with the Injection Water Quality Specification MID-TD-0000-3.

Gas Fuel Skid

The gas fuel skid is transported on the gooseneck of the generator trailer and provides the final filtration of gas fuel to the package. When in operation the gas fuel skid is connected to the turbine trailer with the only GE mechanical interconnect provided with the package.

Turbine Exhaust

The LM2500+G4™ gas turbine exhaust flows through an exhaust collector and roof mounted exhaust silencer. The standard TM2500 GEN8 exhaust collector exit is oriented in the upright position.

The exhaust collector provides a direct path into the turbine exhaust silencer. The exhaust collector consists of an inner and outer duct forming a diffusing passage from the power turbine rear frame. See Section 5.5 for more details.

Exhaust system components include:

- Exhaust Collector
- Exhaust Silencer

High Speed Coupling Shaft

A high-speed flexible coupling shaft connects the low-pressure turbine/power turbine to the generator. It consists of a forward adapter which mates with the power turbine, two flexible couplings, a distance piece, and an aft adapter which mates with the connected load. The flexibility in the coupling allows for minor deviations in-between the turbine and generator shafts, this flexibility aids in successful connection between the turbine and the generator.

Alignment System

The Laser Alignment System consists of the following components:

- IP Camera (2)
- Laser (Green)
- Light
- Power Switch
- Tablet (Microsoft Surface™)

4.2 Generator Trailer

The main deck of the generator trailer contains the generator, generator ventilation, generator lube oil system, and switchgear. The gooseneck of the generator trailer may be optionally removed in operational configurations to reduce overall footprint.

Located at the rear of the generator trailer is a docking station that provides the male interface required to connect the turbine and generator trailers together for the operational configuration.

The Generator Trailer consists of the following components:

- Generator Trailer with stinger for transportation
- Generator
- Generator Lube Oil Skid
- Generator Ventilation (when package is fully assembled)
- Switchgear

For transportation purposes, the generator trailer has a stinger with hydraulic steering. **The stinger must be connected when transporting the generator trailer at all times.**

Generator Trailer with Stinger

A four-axle, air ride suspension trailer with two tracking axles and a three axle steerable stinger, is used to transport the generator trailer components. At the jobsite, the generator trailer is connected to the turbine trailer. Landing legs are provided to support and level the equipment at the jobsite.

Generator

The AC generator operates at a synchronous speed of 3,600 rpm (60-Hz applications) or 3,000 rpm (50-Hz applications), eliminating the need for a speed-reducing gearbox during simple-cycle operation. The TM2500 GEN8 generator is an air-cooled Brush generator (Model BDAX62-170ERT) with an air filter assembly and exhaust assembly.

Dry coupled to the engine, the generator is mounted directly to the generator trailer. This arrangement enables engine/generator shaft alignment to be adjusted with the turbine trailer with the suspension system of the turbine trailer, while the generator remains fixed.

Generator Lube Oil (GLO) Skid

The GLO skid is a compact installation of generator lube system equipment on the generator trailer and is positioned on the generator end of the generator trailer. The GLO skid contains the generator lube oil air/oil separator, GLO tank, DC lube pump and GLO filter.

The skid contains transmitters that provide remote system monitoring. The pressure transmitters have instrument valves in their feed lines to simplify maintenance.

The mineral lube oil system for the generator will include:

- GLO Filter
- DC Lube Oil Pump
- Mechanical Lube Pump
- GLO Air/Oil Separator
- GLO Tank
- Generator Cooler Vent Valve
- GLO Fin-Fan Heat Exchanger
- GLO Pressure Control Valve

Switchgear

The TM2500 GEN8 has a self-contained, metal clad switchgear; it is located on the front portion of the generator trailer.

The switchgear houses the following components:

- Generator breaker
- Buses
- Current Transformers
- Voltage Transformers

Generator Ventilation

The generator is supplied with its own ventilation components to provide cooling air solely for the generator. Shaft mounted fans direct cooling air through the generator-unit. The cooling air is then exhausted out of the generator through the exhaust silencer located on top of the generator.

4.3 Control House Trailer

The control house trailer includes a lighted and insulated control house. The control house is equipped with an access door, air conditioner/heater, and a hand held fire extinguisher.

The control house trailer consists of the following components:

- Control House Trailer
- Control House – which includes:
  - Human-Machine Interface (HMI)
  - Generator Control Panel (GCP)
  - Motor Control Center (MCC)
  - Batteries and Chargers

When in the transport configuration, the control house goose neck provides the storage location for the turbine enclosure ventilation fan and the rear platform of the trailer is storage for the generator exhaust silencer.

Control House Trailer

Control house trailer is a two-axle, air ride suspension trailer. At the jobsite, the control house trailer is inter-connected electrically to the turbine and generator trailers. Landing legs are provided to support and level the equipment at the jobsite.

Control House

The control house trailer contains the control house, which houses the Human-Machine Interface (HMI), Generator Control Panel (GCP) and the MCC (Motor Control Center). Additionally, an externally accessed room is provided for the system batteries.

The control house packaged equipment is described below:

HMI - The human machine interface which allows operator interaction to operate and control the package, the HMI is integrated with the control system PLC located in the TCP. A computer with separate workstation and chair is provided for HMI control. Alarm and shutdown events are displayed on the HMI automatically.

GCP - The GCP contains the voltage regulator and switches for controlling generator operation. This panel also contains local controls the Beckwith Integrated Generator Protection System (IGPS) for monitoring the operation of the turbine engine and generator. The fire protection panel and VersaMax modules integrated with the control system PLC. The GCP also houses DC circuit breakers for the distribution of DC voltage throughout the package as needed. The framework of interconnects required for complete package communications are distributed through this panel via interconnect cables.

MCC - The MCC (motor control center) is a free-standing metal cubicle that houses various low-voltage circuit breakers, motor starters, and their controls. It is installed in the control house, and also includes a 30 kVA lighting and distribution transformer.

Batteries and Chargers - The TM2500 GEN8 has a 24 VDC control system battery system and charger, a 24 VDC fire system battery system and charger, and a 125 VDC switchgear and backup generator lube pump motor battery system and charger. The battery systems are fully wired and mounted in racks located in a separate ventilated compartment in the control house. The standup charger unit for all these components is located inside the control house trailer for easy accessibility. The 24

VDC distribution circuit breakers for the fire and gas protection system are located in the battery chargers cabinet.

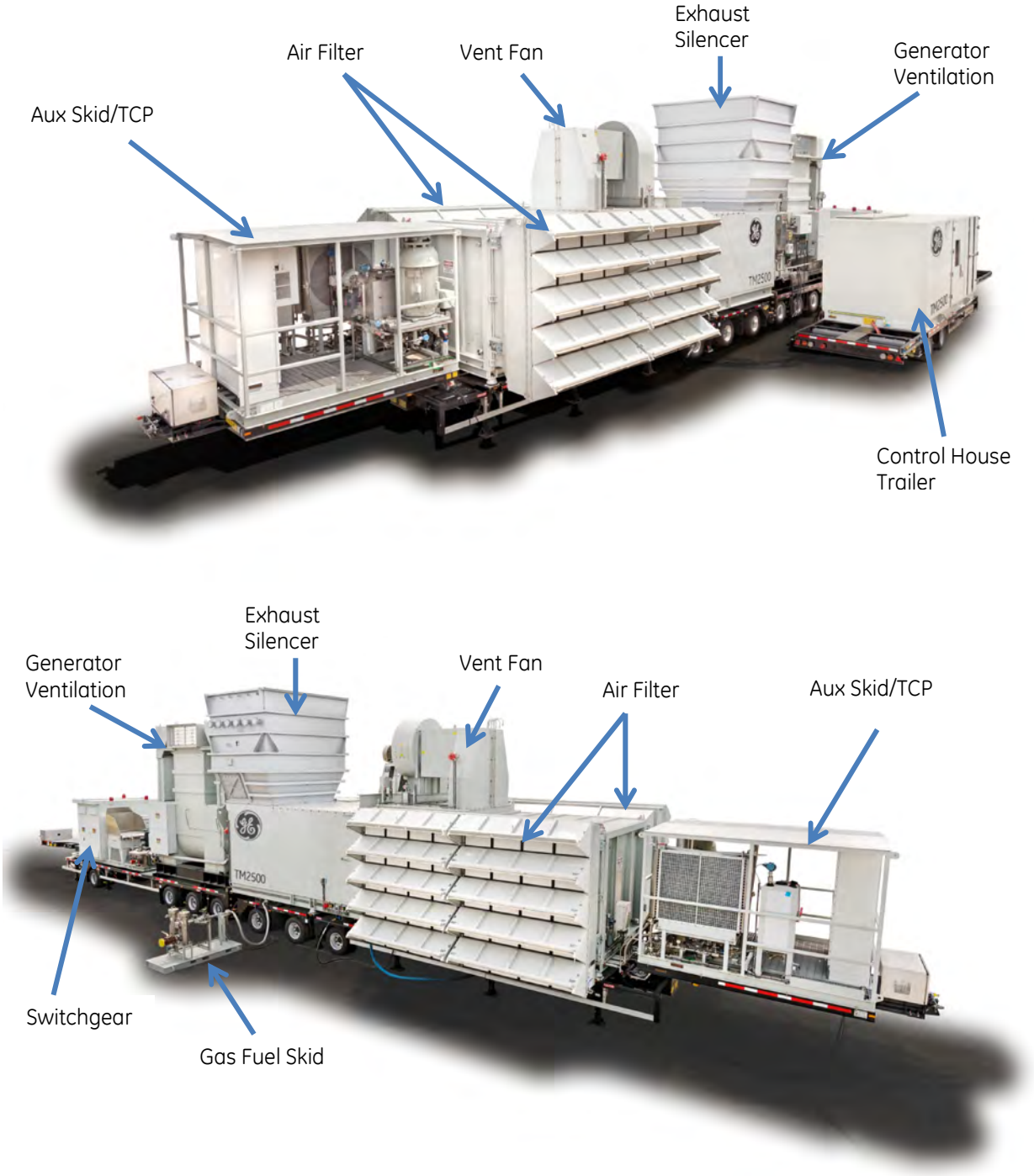


Figure 1 – TM2500 GEN8 Operational Configuration

4.4 Transportation Trailer (optional)

The TM2500 GEN8 MGTG offers the option of ordering a transportation trailer. Additionally, the transport trailer can be factory fitted with a crane to enable the owner/operator the ability to have a self-sufficient package that can be assembled and disassembled with only factory provided components.

The optional transportation trailer is a two-axle air rid suspension trailer. This trailer, if ordered, is used to transport the turbine air filter modules, turbine exhaust silencer, generator filter modules and optional crane.

4.5 Factory Miscellaneous

In addition to the supply of the equipment, for each unit Distributed Power will:

- Conduct standard factory tests of the equipment and conform to carefully established QA practices.
- Test the turbine package and control system, including flushing, and verification of safety alarm and shutdown set points.
- Coordinate drafting, manufacturing, and shipping schedules to meet contractual requirements.
- Prepare the equipment for shipment.
- Ship the equipment, ex-works from Houston, Texas and other manufacturing facility locations.

4.6 Drawing, Documentation and Training

For the site, the documentation provided is:

- Buyer's drawings and six (6) copies of the Operation and Maintenance (O&M) manuals in CD form.
- The Installation and Commissioning (I&C) manual is a one volume publication. Three copies of this manual are shipped to the site at least one month prior to MGTG unit shipment.

  Note: A recommended installation schedule will be prepared by GE, which will define the manpower loading, and classification of the supervisors provided, as well as the schedule of events.

- Three (3) copies of the Renewal Parts manual, which contains lists of recommended parts.
- Field technical direction for performance tests per GE standard test procedures.

(See Section 14 for further details on Customer Drawings and other documentation)

Site personnel training:

- Hosting a Gas Turbine Familiarization and Operator's Training Course for customer personnel at the Distributed Power Jacintoport facility.

(See Section 16 for further details on training)

4.7 Factory Testing

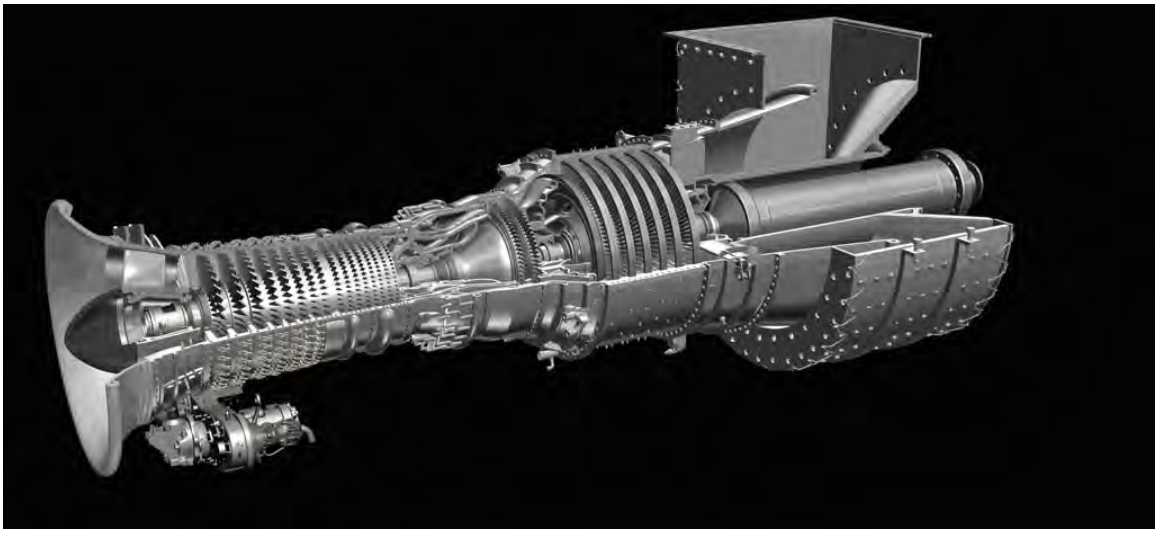
Over the last 20 years, the petroleum industry has saved millions in capital investment costs and field startup time by preassembling and testing equipment modules before shipment to the customer site. Distributed Power has adopted this "factory packaging concept" for our complete line of gas turbine products. Static testing is the base of our standard offering consisting of a rigorous 400-point test. Following minimal disassembly, the unit is crated and prepared for shipment (or customer pickup).

5. Mechanical System Description

5.1 Turbine Engine

The LM2500+G4™ gas turbine is the prime driver of the MGTG set. This engine is a two shaft design with the gas generator separate from the power turbine. This mechanically decoupled design allows the power turbine to operate at a continuous speed of 3,000 rpm (50-Hz applications) or 3,600 rpm (60-Hz applications), regardless of the gas generator speed. Torque developed in the aerodynamically coupled power turbine is transferred to the rotor of the alternating current (AC) generator through a flexible diaphragm coupling. The AC generator operates at a synchronous speed of 3,000 rpm or 3,600 rpm, eliminating the need for a speed reducing gearbox.

The main components of the LM2500+G4™ gas turbine assembly consist of a gas generator, a power turbine, a coupling, and inlet and exhaust components.

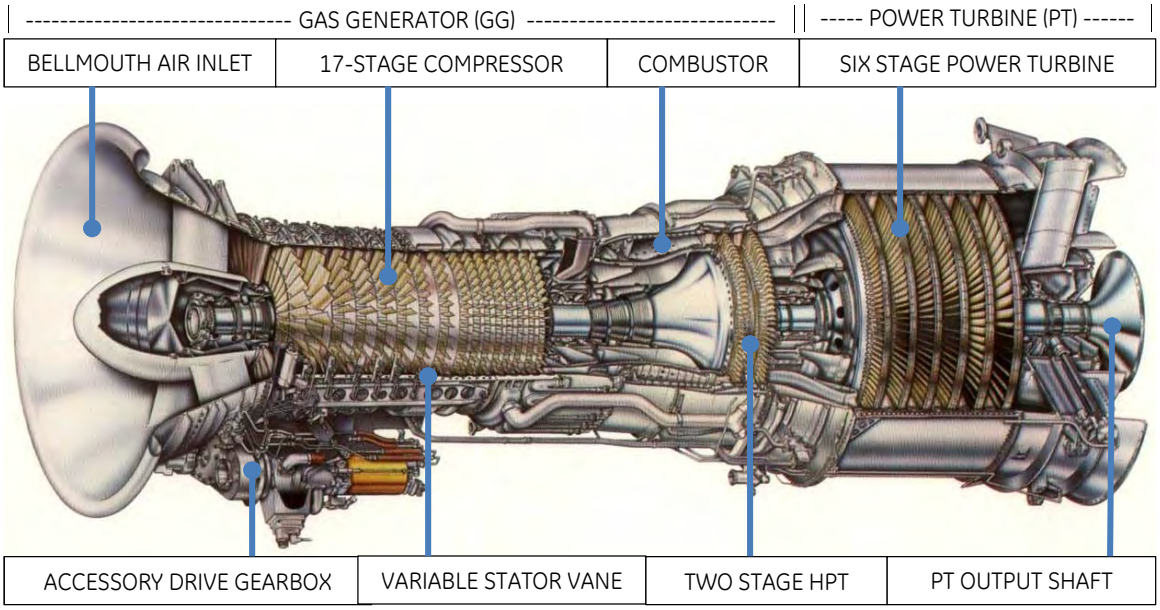


The LM2500+G4™ SAC GG/GT engine comes fully assembled with the following standard equipment installed and tested at the factory:

- GG with 17-stage high pressure compressor (HPC), SAC combustor, and 2-stage high pressure turbine (HPT)
- Six-stage PT (GT only)
- Inlet duct and centerbody (except spare engine)
- Accessory gearbox (AGB), consisting of the transfer gearbox (TGB) assembly and the inlet gearbox assembly (IGB)
- AGB driven lube pump, scavenge pump, hydraulic pump/variable stator vane (VSV) servo valve, and air/oil separator
- Variable-geometry (VG) control system for the VSV system

- Dual fuel system nozzles and manifolds
- Ignition system (igniter and exciter)
- Engine lubrication system (less oil tank, cooler, and filters)
- Set of instrumentation sensors
- Forward adapter (for connecting with flex coupling and driven equipment [GT])

The inlet duct and center body are referred to as the engine inlet components. The gas generator is composed of a variable geometry compressor, an annular combustor, a high-pressure turbine, an accessory drive system, controls and accessories. The power turbine is composed of a six-stage low-pressure turbine rotor, a low-pressure turbine stator, and a turbine rear frame. The high-speed coupling shaft adapter is connected to the power turbine rotor and provides shaft power to drive the generator. The exhaust duct, outer cone, and inner deflector are considered the engine exhaust components.



Mating splines connect the HPC and the HPT rotors. The HP rotor turns clockwise when viewed from aft, looking forward. The inlet duct and center body are the engine inlet components mounted to the compressor front frame (CFF). The structural frames provide support for the HPC rotor, bearings, compressor stator, HPT rotor, and the power turbine (PT) rotor. These include the CFF, compressor rear frame (CRF), and the turbine mid frame (TMF) in the gas generator (GG), and the turbine rear frame (TRF) in the power turbine (PT). The PT connects to the GG via a joining kit to produce the gas turbine assembly.

The LM2500+G4™ gas turbine uses the low-pressure turbine (LPT) to power the output shaft. By eliminating the separate compressor found in many other gas turbines, the LM2500+G4™ design simplifies the engine, improves fuel efficiency and permits coupling, through a flexible dry type coupling connected to the end of the LPT shaft.

Turbine Cycle

- Filtered air enters the bellmouth and flows through guide vanes to the compressor and then travels through the HPC
- The air is compressed in a 24:2 ratio
- Combustor swirlers and fuel nozzles mix air and fuel at the nozzle tip
- Hot combustion gases expand through HPT
- HPT drives HPC
- Flanged end of LPT shaft drives electric generator load
- Exhaust gasses exit engine/package at exhaust flange

The gas turbine engine is comprised of the following major sections:

Air Inlet and Inlet Guide Vane (IGV) Section
The air inlet section consists of a bellmouth and bullet nose, which produce a smooth, non-turbulent flow of air into the compressor. Movable guide vanes at the inlet (IGV) control airflow through the engine for any given core speed.

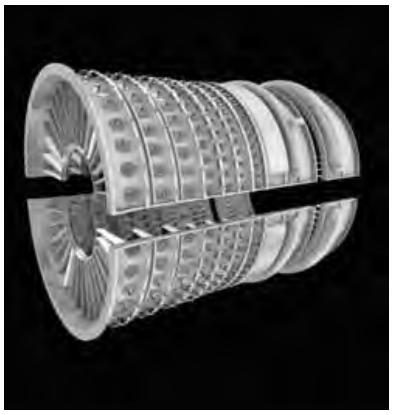
Compressor Front Frame (CFF)
The steel front frame assembly forms a flow path for compressor inlet air, and houses the #3 roller bearing. Struts between the hub and outer case contain lubrication supply and gravity lines. The front frame provides mounting or attachment provisions for the gas turbine front mounts, handling mounts, compressor inlet temperature sensor, and transfer gearbox mounts. Air passages in the frame provide sump and seal pressurization and cooling. The lower frame strut houses a radial drive shaft that transfers power from the inlet gearbox to the accessory gearbox mounted on the bottom of the frame.

High Pressure Compressor (HPC)

The LM2500+G4™ HPC is a 17-stage, axial flow design. Major components include the high pressure compressor rotor (HPCR), high pressure compressor stator (HPCS), and CRF. The purpose of the compressor is to compress air for combustion. Some of the compressed air is also extracted for engine cooling and pressurization.

High Pressure Compressor Rotor (HPCR)

The HPCR is a spool-and-disk bolted joint structure. The rotor is supported at the forward end by a roller bearing in the CFF, and the aft end of the rotor is supported by a roller bearing in the CRF. Close clearances are obtained with metal spray rub coating. Thin squealer tips on the blades and vanes contact the sprayed material. Abrasive action on the tips prevents excessive rub while obtaining minimum clearance.



High Pressure Compressor Stator (HPCS)

The HPCS consists of two forward casing halves and two aft casing halves, each split horizontally and bolted together. They house variable and fixed vanes, and provide a structural shell between the CFF and the CRF. Inlet guide vanes (IGVs) and stages 0 through 6 are variable. Their angular positions change as a function of turbine temperature and speed. This gives the vane airfoil the optimum angle of attack for efficient operation without compressor stall.

Compressor Rear Frame (CRF)

The CRF consists of an outer case, struts, hub, and the B-sump housing. Its outer case supports fuel pre-mixers and an igniter plug. The CRF, in conjunction with the combustor cowl assembly, serves as a diffuser and distributor of compressor discharge air to the combustor.

Combustor

The standard combustor is a single-annular design consisting of four major components: cowl (diffuser) assembly, dome, inner liner, and outer liner. The cowl assembly, in conjunction with the compressor rear frame, serves as a diffuser and distributor for the compressor discharge air. It furnishes uniform airflow to the combustor throughout the operating range, providing uniform combustion and even temperature distribution to the turbine.

High Pressure Turbine (HPT)

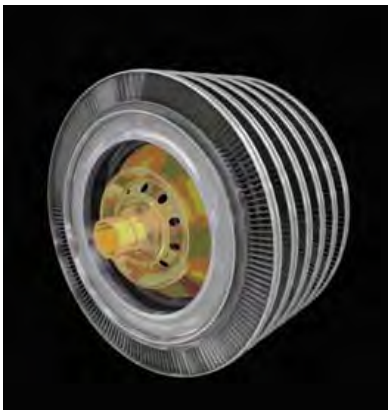
The HPT is an air-cooled, two-stage power turbine that consists of a rotor and two stages of nozzles. The nozzles direct the hot gas from the combustor on to the high pressure turbine rotor (HPTR) blades at the optimum angle and velocity. The HPTR extracts energy from the exhaust gas to drive the HPCR, to which it is mechanically coupled.

Turbine Mid-Frame (TMF)

The turbine mid-frame supports the aft end of the high pressure turbine rotor and the forward end of the power turbine rotor. The frame diffuser provides a smooth flow path for air flowing into the power turbine.

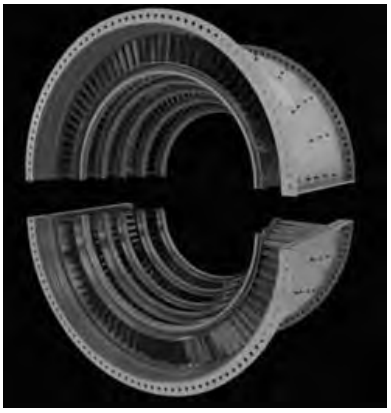
Power Turbine (PT)

The power turbine is a 6-stage aeroderivative design, suited for 3,000-3,600 rpm output speeds. The PT assembly consists of a turbine rotor, stator, rear frame, and drive shaft adapter.



Power Turbine Rotor

The PT rotor is a 6-stage low-pressure turbine rotor. It consists of six disks, each having two integral spacers. Each disk spacer is attached to the adjacent disk spacer by close-fitting bolts. Blades of all six stages contain interlocking tip shrouds for low vibration, and are retained in the disks by dovetails.



Power Turbine Stator

The PT stator consists of two casing halves split horizontally, stages 2 through 6 turbine nozzles, and six stages of blade shrouds. Stages 2 to 3 nozzles have welded segments of six vanes each. Vanes are coated for corrosion and oxidation protection where applicable.

Turbine Rear Frame (TRF)

The TRF consists of an outer casing, eight radial struts, and a stainless steel hub. It forms the PT exhaust flow path and supports the aft end of the PT stator case. It also provides a mounting point for the outer cone of the exhaust system and GT rear supports. The struts contain service lines for lubrication and sump scavenging and venting.

Accessory Drive Section

The accessory drive section consists of an inlet gearbox (IGB), a radial drive shaft, a transfer gearbox (TGB), and an accessory gearbox (AGB). The hydraulic starter, lube and scavenge pump, air-oil separator and hydraulic pump are mounted on the AGB.

Inlet Gearbox (IGB)

Power to drive accessories is extracted from the compressor rotor through a large diameter hollow shaft, which is spline-connected to the turbine rotor. A set of bevel gears in the IGB transfers power to the radial drive shaft, which transmits the power to another set of bevel gears in the TGB. A short horizontal drive shaft transmits the power to the AGB. Internal gears drive various accessory adapters in the AGB.

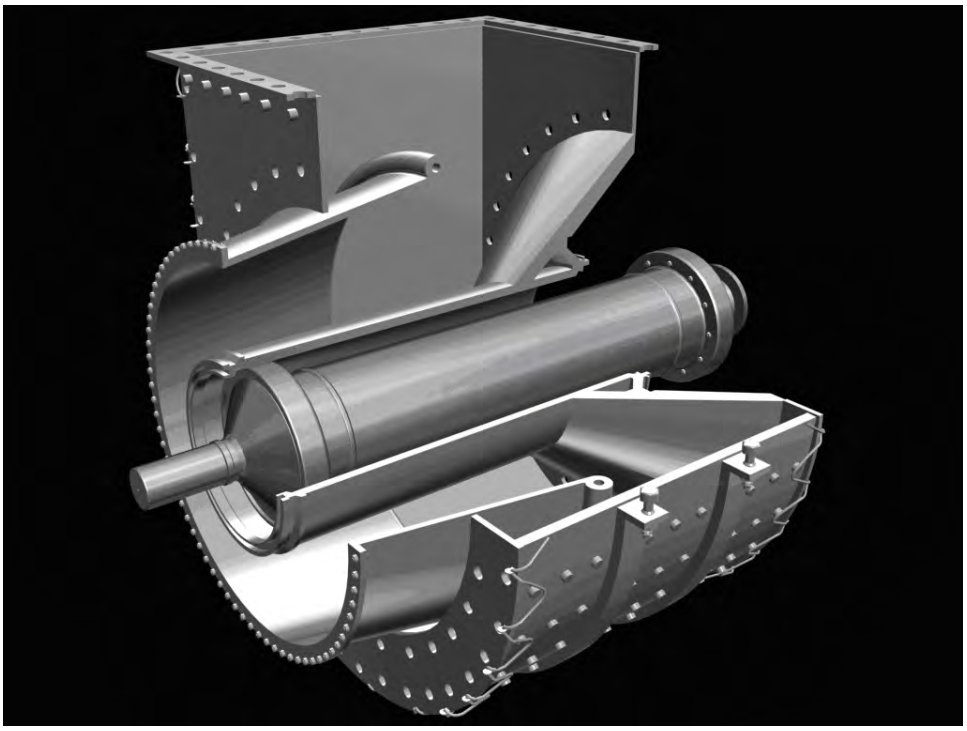
Exhaust System

The exhaust flows through an exhaust collector and a roof mounted exhaust silencer. The standard TM2500 exhaust collector exit is oriented in the upright position.

The exhaust collector provides a direct path into the turbine exhaust silencer. The exhaust collector consists of an inner and outer duct forming a diffusing passage from the power turbine rear frame.

Exhaust system components include:

- Exhaust collector
- Radial exhaust collector system



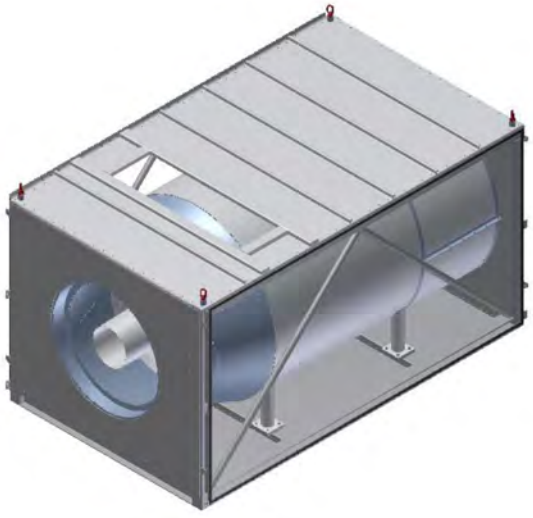
Flexible Coupling

A high-speed flexible coupling shaft connects the low-pressure turbine/power turbine to generator. It consists of a forward adapter which mates with the power turbine, two flexible couplings, a distance piece, and an aft adapter which mates with the generator.

5.2 Clean Air Filters and Silencer Assembly

The air intake system for the TM2500 GEN8 MGTG is a compact, dual aspect filtration system, mounted to a central silencer enclosure, designed to meet the technical requirements of the GE LM2500+G4™ gas turbine. The complete filtration system, for combustion and ventilation air, is a high efficiency package designed to reduce a wide range of airborne contaminants to within specified limits. Typical airborne contaminants include; high concentrations of dust, un-burnt hydrocarbons, and sand.

The combined turbine combustion and ventilation supply air is supplied by silencer enclosure mounted with filter housing panels on each side. The silencer enclosure is a structural, open-sided chamber, permanently mounted to the trailer bed directly upstream of the GT enclosure. An annular silencer is centrally mounted within the chamber to direct airflow towards the turbine inlet, whilst reducing noise break-out to required levels. The silencer enclosure has no serviceable parts and, once installed on the trailer bed, is not intended to be removed. The silencer enclosure is comprised of an enclosure, a FOD (foreign object damage) screen with a nylon FOD sock, and concentric silencer, high efficiency filter elements and controls.



Annular Silencer & Enclosure

Filter House Panels

Filtered air for combustion is provided through the filter house and inlet silencer prior to entering to the inlet of the turbine. Combustion air flows at a nominal rate of 150,000 scfm (4,248 scmm) from the filter elements. The clean air passes through a FOD screen with a nylon FOD sock and through the concentric silencer. From the exit of the concentric silencer, the clean air enters the turbine bell mouth of the turbine engine where it is mixed with fuel and burned in the combustor.

Additionally an external drain valve is located below, in the bottom of the silencer enclosure.

5.3 Enclosure

The basic equipment package is supplied with a weatherproof acoustic enclosure for the turbine. The enclosure is completely assembled and mounted over the equipment prior to testing and shipment. The turbine compartment is fully ventilated and includes access doors.

Turbine Ventilation

Ventilation air for the cooling of the turbine is drawn into the turbine room by one direct driven ventilation fan mounted on the roof structure; Ventilation airflow is drawn by the ventilation fan at a nominal rate of 35,000 scfm (992 scmm), enters the turbine compartment where it circulates around and cools mechanical components. This direct driven ventilation fan assembly draws filtered air from inside the silencer enclosure. Ventilation air is routed through a silencer and back draft fire damper into the turbine enclosure. The backdraft fire damper (on the turbine enclosure roof) is gravity operated and open when the fan is running. The back draft fire dampers are normally closed when the gas turbine is not operating.

Generator Ventilation

The generator is equipped with a separate air treatment module that includes inlet filters, inlet/outlet silencer assemblies, and pressure and temperature sensors. The generator rotor is equipped with fan blades to produce a flow of cooling air through the interior of the generator. The blades draw cool, filtered ambient air into the generator and circulate it around internal parts before expelling the now heated air through the generator exhaust vent.

5.4 Noise Control

The standard equipment enclosure and air inlet silencers reduce the average near-field noise to an average 90 dBA at three feet from the enclosure (five feet above grade).

5.5 Turbine Exhaust

The LM2500+G4™ exhaust flows through an exhaust collector and roof mounted exhaust silencer. The standard TM2500 GEN8 exhaust collector exit is oriented in the upright position.

5.6 Fuel System

The TM2500 GEN8 MGTG set offers dual fuel (gas + liquid) capabilities for SAC combustor through the full load operations and are sequenced and controlled automatically by the control system. TM2500 GEN8 trailer unit is designed to start up on either gas fuel or liquid fuel. The operator's role is to monitor the system during startup and operation, as well as responding to any abnormal conditions or alarms.

Gas Fuel System

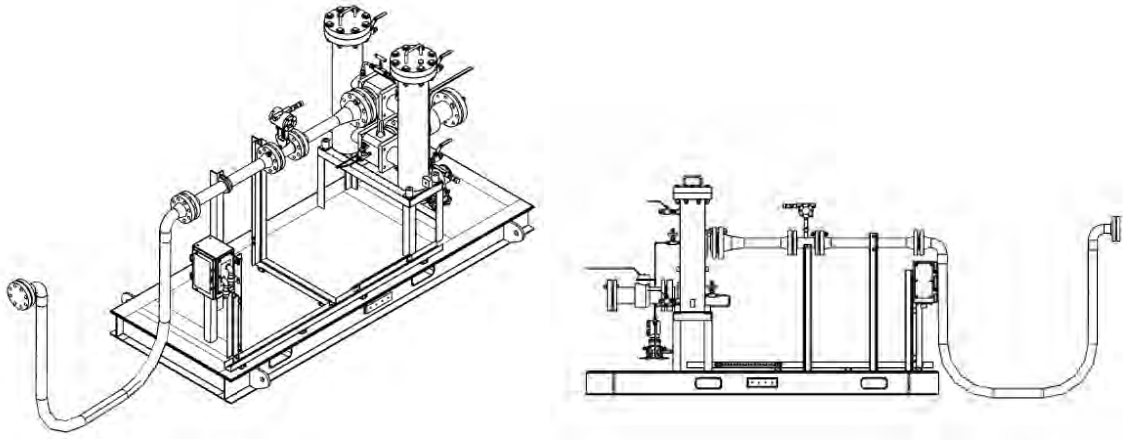
Distributed Power supplied equipment includes the following major components mounted in the turbine enclosure:

- Fuel gas strainer
- Instrumentation (pressure and temperature)
- Primary shutoff valve
- Fuel metering valve(s)
- Secondary shutoff valve
- Fuel gas manifold with 30 dual fuel nozzles
- Pressurization / vent valves
- Gas fuel skid

5.6.1 Gas Fuel Flow

A natural gas fuel system with electronically controlled fuel-metering valve(s) is supplied in the basic package. For full-load operation, the gaseous fuel must be supplied to the main skid unit at an acceptable range depending on engine model and combustor option. Maximum flow and temperature of the customer-supplied gas fuel is monitored and required to be acceptable. Gas fuel enters the gas filter skid at customer connection through a manually operated ball valve that is locked open during normal operation to the duplex filter assembly. The duplex filter includes a transfer valve to permit switching between the two filter elements for service or replacement. Prior to leaving the gas filter skid, gas fuel is routed through a flow transmitter which displays totalized flow on the turbine control system operator screen. Gas fuels must meet the requirements specified in Distributed Power Standard MID-TD-0000-1.

The gas fuel system also features a function that allows for gas fuel venting upon unit shutdown. Once the gas fuel is cut by the two Shutoff Valves, the control system/customer controller opens the External Vent Valve to depressurize the gas supply line. Also, the control system will quickly open and close the External Shutoff Valve to burp the gas pressure between the two Shutoff Valves while the External Vent Valve still remains open to release any trapped gas fuel. The fuel-metering valve varies the fuel flow rate and controls turbine speed, acceleration and power output. The primary and secondary shutoff valves and the vent valve provide “double block and bleed” for gas-tight shutoff when the turbine is stopped.



Gas Fuel Skid

Liquid Fuel System

Distributed Power supplied equipment includes the following major components mounted in the turbine enclosure:

- Pressure and temperature instrumentation
- Fuel metering valve(s)
- Shutoff Valve(s)
- Pressurization Valve
- Fuel Manifold with 30 fuel nozzles
- Control valves for fuel transfer purge

5.6.2 Liquid Fuel Flow

A liquid fuel system with control valve is supplied in the basic package offering. For full-load operation, the liquid fuel must be supplied to the package at the specified range. Liquid fuel must arrive filtered to 5 microns and meet the requirements of MID-TD-0000-2.

5.6.3 Water Injection System

A water injection metering system is provided to reduce NOx emissions for gaseous fuel or liquid fuel operation. Demineralized water is injected into the combustor through ports in the fuel nozzles to produce NOx suppression. Water is supplied to the nozzles by a special water manifold. Water injection can reduce NOx emissions to 25 ppm (51 mg/Nm3) for gaseous fuel and to 42 ppm (86 mg/Nm3) for liquid fuel.

GE provides the necessary controls, metering equipment, and interconnecting piping between the gas fuel skid and the engine. All piping is stainless steel, and the valves are trimmed with stainless steel. The customer must provide a supply of pressurized water and liquid fuel in accordance with the specifications.

5.7 Lube Oil Systems

Turbine Lube Oil System

The purpose of the TLO system is to provide clean, cool oil to lubricate bearings, and also to provide pressurized oil for operation of the turbine's variable geometry (VG) actuators. Turbine lube oil flows from the TLO/HLO tank to an engine-driven pump, which then supplies pressurized oil to the (gas generator) turbine bearings, power turbine bearings, and variable geometry actuators. The LM2500+G4™ turbine is lubricated by an internal pump and lubrication system. There is also an external

lube oil system to filter, cool, and de-aerate the lube oil discharged from the internal system. The external system is fed by a scavenge pump, which is driven by the turbine accessory gearbox whenever the turbine gas generator is rotating.

The turbine uses synthetic lube oil to:

- Lubricate and cool the high-pressure (HP) and low-pressure (LP) rotor bearings and sumps
- Lubricate and cool the transfer gearbox (TGB) and accessory gearbox (AGB)
- Operate the actuators for the variable stator vanes (VSVs)
- Lubricate the over-running clutch for the hydraulic starter motor

The turbine lube oil system has two separate circuits:

- Supply System – Provides clean, cool oil to the turbine bearings
- Scavenge System – Recovers (scavenges) the lube oil from the bearing drain sumps, filters and cools the oil, then returns it to the reservoir

These two systems combine to form a dependable and efficient lubrication system. They are described in more detail below:

Air/Oil Separator

Mounted on the TM2500 GEN8 auxiliary gearbox is a mechanical air-oil separator which is used to separate sump air/oil mixture and vent the sump air into the exhaust duct.

Generator Lube Oil System

The TM2500 GEN8 Generator Lube Oil (GLO) uses mineral oil to lubricate, cool and clean the generator journal and thrust bearings. To prevent damage, the generator bearings must be lubricated when in operation (rotor shaft turning). Lubricating oil must be supplied to the bearing assemblies during startups, at operational speeds, and while the unit is coasting to a stop after shutdown. The generator bearings are pressure-lubricated. The bearing faces are grooved for even oil distribution and the drive-end bearing incorporates thrust pads to limit fore-and-aft movement of the generator rotor. Labyrinth seals and oil slingers are mounted on the generator rotor shaft to prevent oil leakage from the bearing housings. At operational speeds, the bearings are lubricated by oil from a pump-mounted outboard from the assembly and driven by the generator rotor. At startups and shutdowns, lubricating oil is

provided by a DC motor auxiliary pump, which also serves as a backup in case of shaft pump failure.

To ensure that these lubrication requirements are met under all conditions, the GLO system has two types of pumps:
1. An auxiliary 125 VDC lube oil pump
2. Generator driven lube oil pump

Cooling System

The fin-fan heat exchangers utilize an electric fan to force ambient cool air through the heat exchanger coil for the Turbine Lube Oil (TLO), Generator Lube Oil (GLO), and Hydraulic Start systems.

5.8 Starting System

The hydraulic start system turns the engine and is capable of rotating it for engine start, fuel purging, water wash cleaning, and conducting maintenance. The hydraulic starter system has components located on the auxiliary skid and inside the turbine enclosure.

The DC hydraulic starter motor which drives a hydraulic pump assembly consisting of a charge pump, pressurized filter, main pump, and variable SOV-actuated valve; provides pressurized hydraulic fluid to the hydraulic start motor and clutch. This pressurized hydraulic fluid delivers the required pressure to operate the engine installed hydraulic start motor at the Accessory Gearbox (AGB). The hydraulic pressure rotates the starter which provides sufficient torque for starting the turbine. Local gauges allow the operator to monitor the hydraulic charge pump and main system pressures and fluid levels.

5.9 Off-Line Water Wash System

Over time, gas turbines experience a loss of performance due to contaminant deposits on internal components. This loss is indicated by a decrease in power output and an increase in heat rate. These deposits result from the ingestion of air that contains dirt, dust, and hydrocarbon fumes. A large portion of these contaminants is removed by inlet air filtration, but contaminants that pass through the filters have to be removed from the compressor by washing. Optimal turbine performance is achieved by periodically cleaning compressor stages of the gas turbine. The water

wash system provides a mean for washing the turbine when it has been shut down (off-line water washing).

The primary purpose of the water wash system is to remove contaminants from the turbine compressor. During the washing operation, a solution (a water and detergent mix) is sprayed in to the gas turbine at the proper pressure, temperature, and flow rate to wash the compressor. The wash is followed by a rinse cycle, which is designed to remove detergent residue. Washing is performed while the turbine is off–line. Off-line water wash is accomplished by spraying cleaning solution into the bellmouth while the engine is being motored by the starter. After a short wait, the compressor is rinsed with water and allowed to dry. Off-line water wash will usually restore compressor performance

The water wash tank, located on the auxiliary skid on the gooseneck of the turbine trailer, has 2 inlets, a hand controlled valve for water supply, supplied by the customer, and a tank drain valve. Water is manually supplied to water wash tank. The third inlet will allow detergent to be added manually on the top of the tank.

Water Quality Standards

The water shall not contain particles larger than 100 microns absolute, and shall comply with Distributed Power Specification MID-TD-0000-4.

Water Quality Standards:

	Limit	Test Method
Total Matter, ppm, max	100	ASTM D5907
pH	6.5-8.5	ASTM D1293
Sodium + potassium, ppm, max	25	ASTM D4191 & ASTM D4192

5.10 Fire and Gas Protection System

The fire and gas protection system for the MGTG (mobile gas turbine generator) set monitors the turbine-engine enclosure for the presence of fire and accumulation of combustible gas. Aerosol is used as the fire-extinguishing agent for the turbine trailer. The fire and gas detection system consists of an Eagle Quantum programmable microprocessor-controlled panel that receives inputs from thermal spot detectors, combustible gas detectors, and manual release stations.

The fire and gas protection system is comprised of a fire protection panel (FPP), located in the generator control panel (GCP), which is connected to 2 spot thermal detectors, 2 manual release stations, 2 horns and 3 strobe lights. In addition to these instruments, there are 5 gas detectors, a horn acknowledge switch and a fire suppressant release block LOTO hand switch.

Each electric element in the system is monitored for instrument fault conditions and will indicate an alarm condition should an element indicate a fault. Power for this system is drawn for the control system batteries.

The system is activated by one of the following conditions:

- Enclosure temperature exceeds the specified set temperature as detected by one of the spot thermal detectors (rate of rise). This is an automatic release.
- An operator manually releases aerosol fire suppressant via one of the manual pull stations.

Once a fire is detected, the Fire Protection Panel (FPP) will turn on the horn and strobe lights, issue a turbine trip, and activate the aerosol electric generators after a thirty (30) second delay. The RX3i will then trip the fuel pump and turn off the ventilation fan. The Fire Protection Panel will discharge the aerosol suppressant.

6. Optional Equipment

The equipment and services listed in Section 4 and described in Section 5 are included with the TM2500 GEN8 Mobile Gas Turbine Generator set basic price.

Options (to the basic package) include:

1. Power System Stabilizer
2. Primary Frequency Control
3. Remote HMI
4. Remote Monitoring and Diagnostics service
5. Full String Test
6. Air Pulse Filtration
7. Winterization
   - Static Air Filter Anti-Icing system
   - Air Pulse Filter Anti-Icing System
8. Transport Trailer (with or without Crane)

6.1 Power System Stabilizer

The GE EX2100e digital power system stabilizer integrates supplementary control signals to the generator's voltage regulator to control power fluctuations and to help improve the stability of the power system.

6.2 Primary Frequency Control (PFC)

The purpose of PFC is to help provide grid stability by allowing the gas turbine to automatically increase (or decrease load) load when a grid frequency deviation occurs outside of a frequency band, and maintain this increased (or decreased) load while the deviations persist. Primary Frequency Control will control the gas turbine unit to a pre-selected load set point, such that it will respond to frequency excursions that exceed the hysteresis dead band setting by adjusting load in response to frequency change in order to help maintain the grid frequency. PFC can increase the GT output to maximum control limit, but would not allow over-fire or over-load condition to occur.

6.3 Remote HMI

A remote HMI system can be placed virtually anywhere a network communication link to the Control House can be installed. For distances greater than 300 feet, a fiber optic card will be required under the customer scope. The standard remote HMI is a desktop computer version of the HMI installed locally in the Control House. The same Cimplicity HMI application is loaded into both the local HMI and the remote HMI. The ability to configure the remote HMI as a viewer-only is standard.

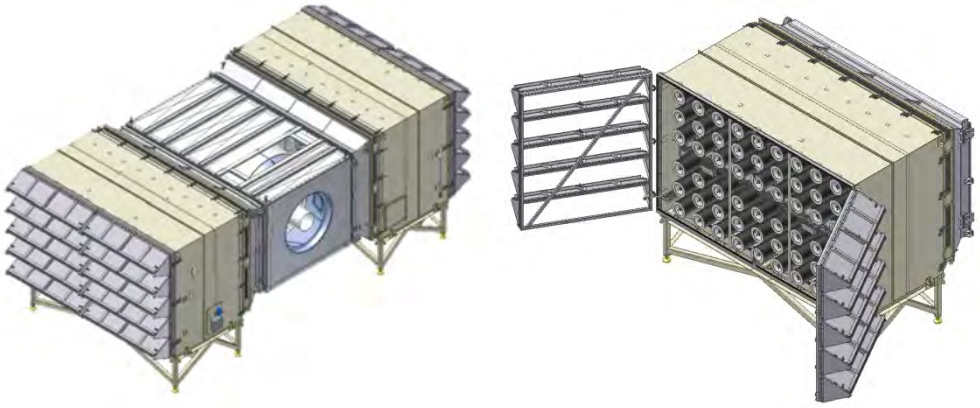
6.4 Remote Monitoring and Diagnostics services

Monitoring and Diagnostics Service helps aeroderivative turbine plant operators improve availability, reliability, operating performance, and maintenance effectiveness. Monitoring of key parameters by factory experts may lead to early detection of equipment problems and avoid expensive secondary damage. Diagnostic programs seek out emerging trends, prompting proactive intervention to avoid forced outages and extended downtime. The ability for GE engineers to view real-time operation accelerates troubleshooting and sometimes eliminates the need for service personnel to visit the plant.

6.5 Full String Test

A full speed, no load test of the LM2500+G4™ gas turbine engine is conducted before shipment, utilizing contract unit controls and facility hardware for generator load applications, inlet air filtration and intercooler circuit components.

6.6 Pulse Filtration



6.7 Winterization

Distributed Power recommends the addition of winterization where ambient operating temperatures fall to (or below) 40°F (4°C).

For temperatures between 40°F (4°C) and 0°F (-18°C), cold temperature assemblies and winterization kits (for heat trace & insulation of the main assemblies/components) are available.

Options include:

- Anti-Icing Static Filter
- Anti-Icing Pulse Filter
- Heat tracing and blanketing:
  - Generator Lube Oil system
  - Liquid Fuel system
  - Gas Fuel system
  - Water Injection system
  - Turbine Lube Oil system
  - Exhaust Drain
  - Hydraulic Start system

For temperatures between -1°F (-18°C) and -39°F (-39°C), cold temperature assemblies and winterization kits (for heat trace, insulation of the main assemblies/components), and cold kit components (mechanical and electrical parts) are available.

Options include:

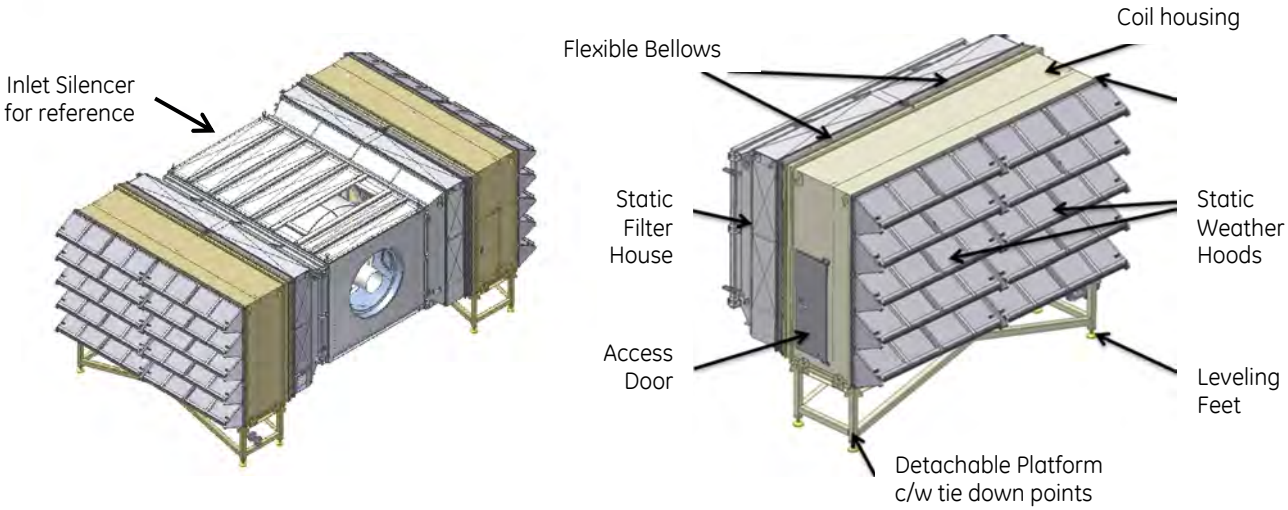
- Includes above changes
- Thermostatic Control Valve changes for TLO/GLO

Cold Steel Generator Option for below -25°F (-32°C) transportation, is also available

For temperatures below -39°F (-39°C), contact Distributed Power for availability.

Anti-icing Systems

An anti-icing system can be provided as an option for ambient temperatures below 43°F (6°C) and relative humidity above 65%. With this option, heating coils are provided at the silencer enclosure inlet prior to the pre filters, with static filtration or after the final filters with pulse filtration to warm the inlet air prior to entering the combustion/ventilation air system. For anti-icing a weather station is added, and the turbine control system provides T0, T2, RH, and an icing conditions present signal as outputs to the customer's control system. A temperature sensor, which is part of a weather station, that also includes a humidity sensor, provides inlet temperature information to the control system, and is only provided if the anti-icing option is purchased.



Static Air Filter with Anti-Icing System

Air Pulse Filtration

The optional air pulse filtration system can be used with or without the optional anti-icing system. The air pulse filtration system uses a canister style filter and cannot be used with the static filters.

The air pulse filtration system option comes with a stand-alone compressor and a control panel that will automatically actuate the system when necessary. The air pulse filtration system also has the ability to self-protect the silencer and turbine inlet from freezing when combined with the downstream anti-icing coils.

6.8 Transport Trailer (with or without crane)

The transport trailer is an optional trailer used to provide storage and transportation location for the turbine air filter modules, turbine exhaust silencer and the generator inlet stacks. This trailer is also available with an optional self-contained mobile crane. The optional crane provides the necessary lifting capability to allow the unit to be self-reliant for installation. The crane is rated and capable of lifting all components required to install the package and can only be used with the prime mover of the trailer connected.

7. Mechanical Outlines

7.1 General Arrangement and Interface drawings

Mobile Gas Turbine Generator Set (Operational Views)
- Isometric View
- Top View
- Side Views
- Trailer End Views

Turbine Trailer
- Isometric View*
- Side Views
- Trailer End Views

Generator Trailer
- Isometric View*
- Side Views
- Trailer End Views

Control House Trailer
- Isometric View*
- Side Views
- Trailer End Views

Transportation Trailer (Optional)
- Isometric View*
- Side Views
- Trailer End Views

*Indicates In Transport View

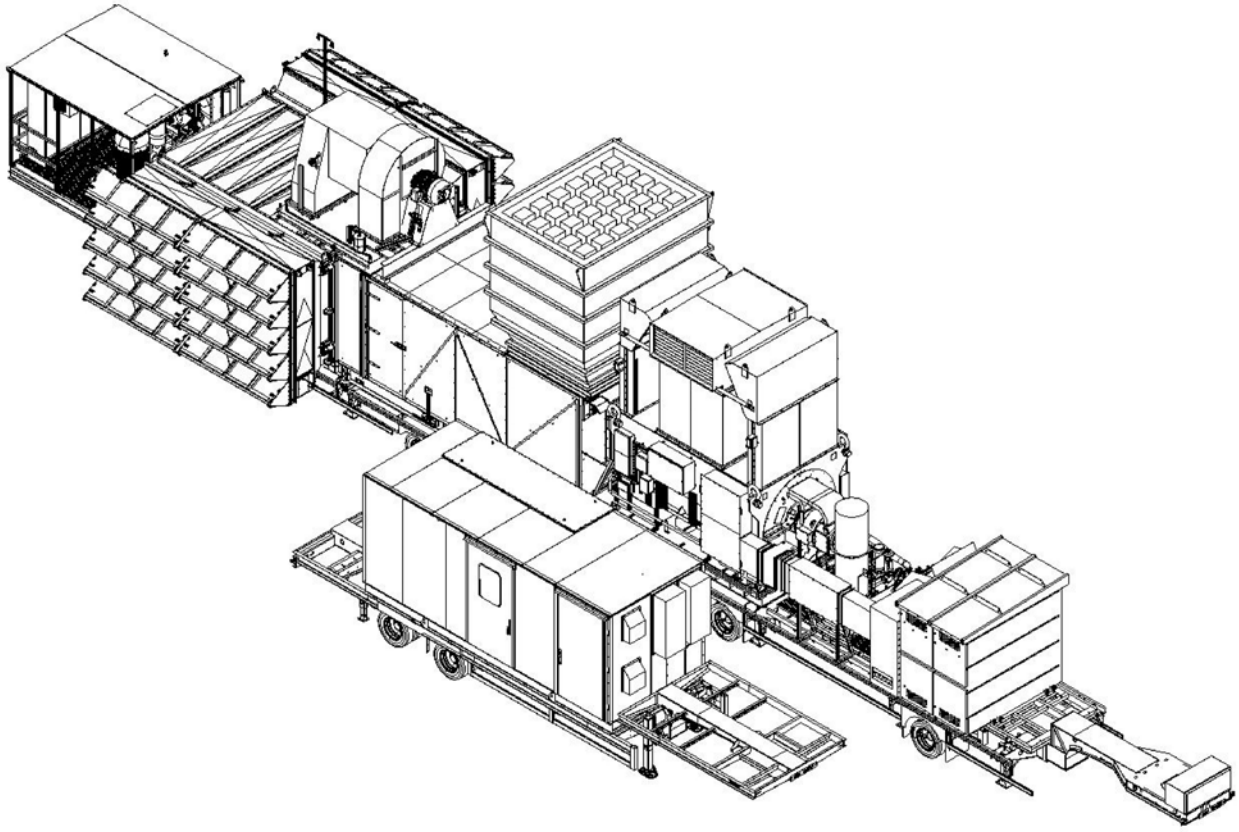


Figure 7.1 Isometric View (Operational)

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

TM2500 GEN8 Mobile Gas Turbine-Generator Set

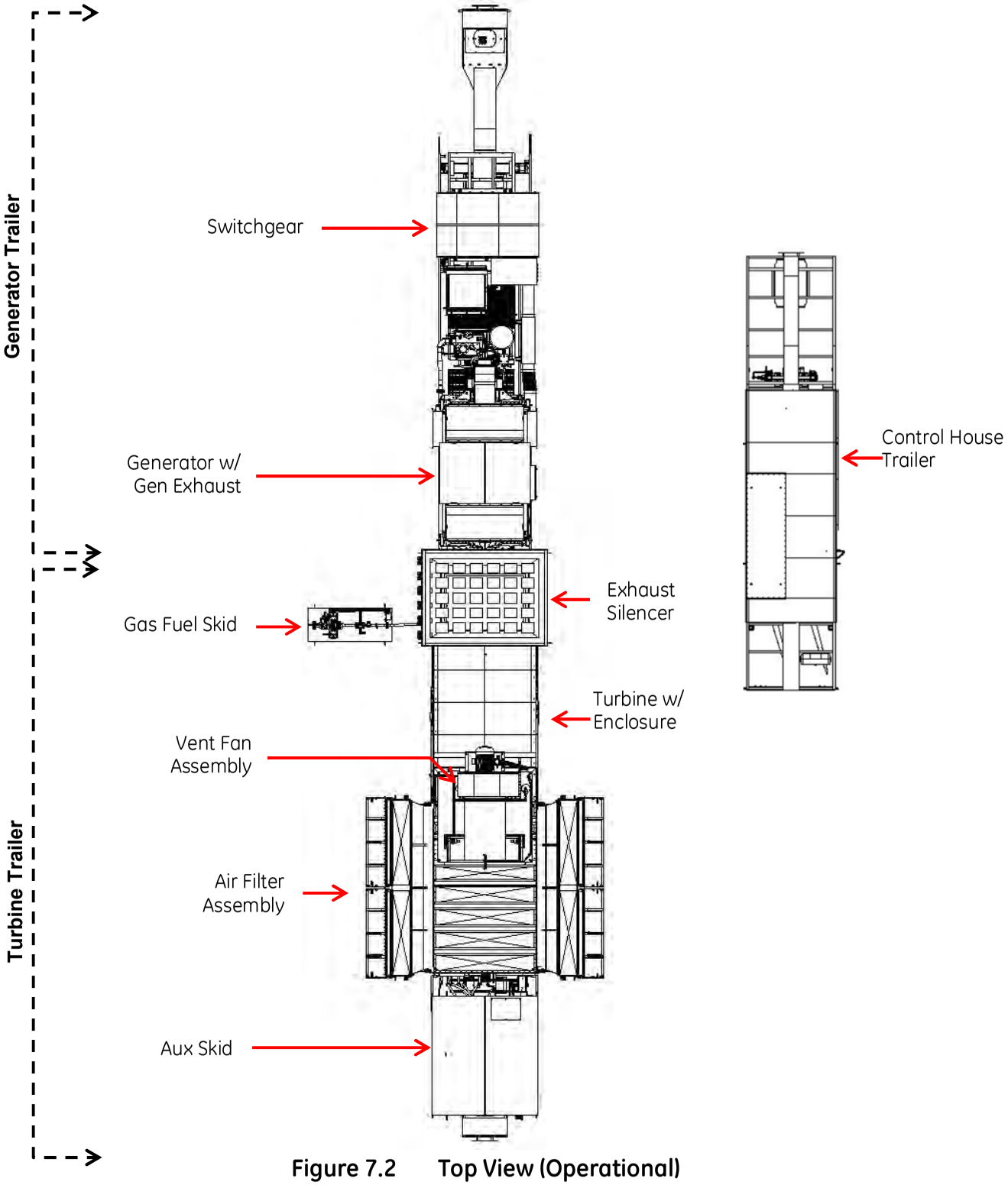


Figure 7.2 Top View (Operational)

For informative purpose only: Views and dimensions may vary according with specific package configuration.

TM2500 GEN8 Mobile Gas Turbine-Generator Set

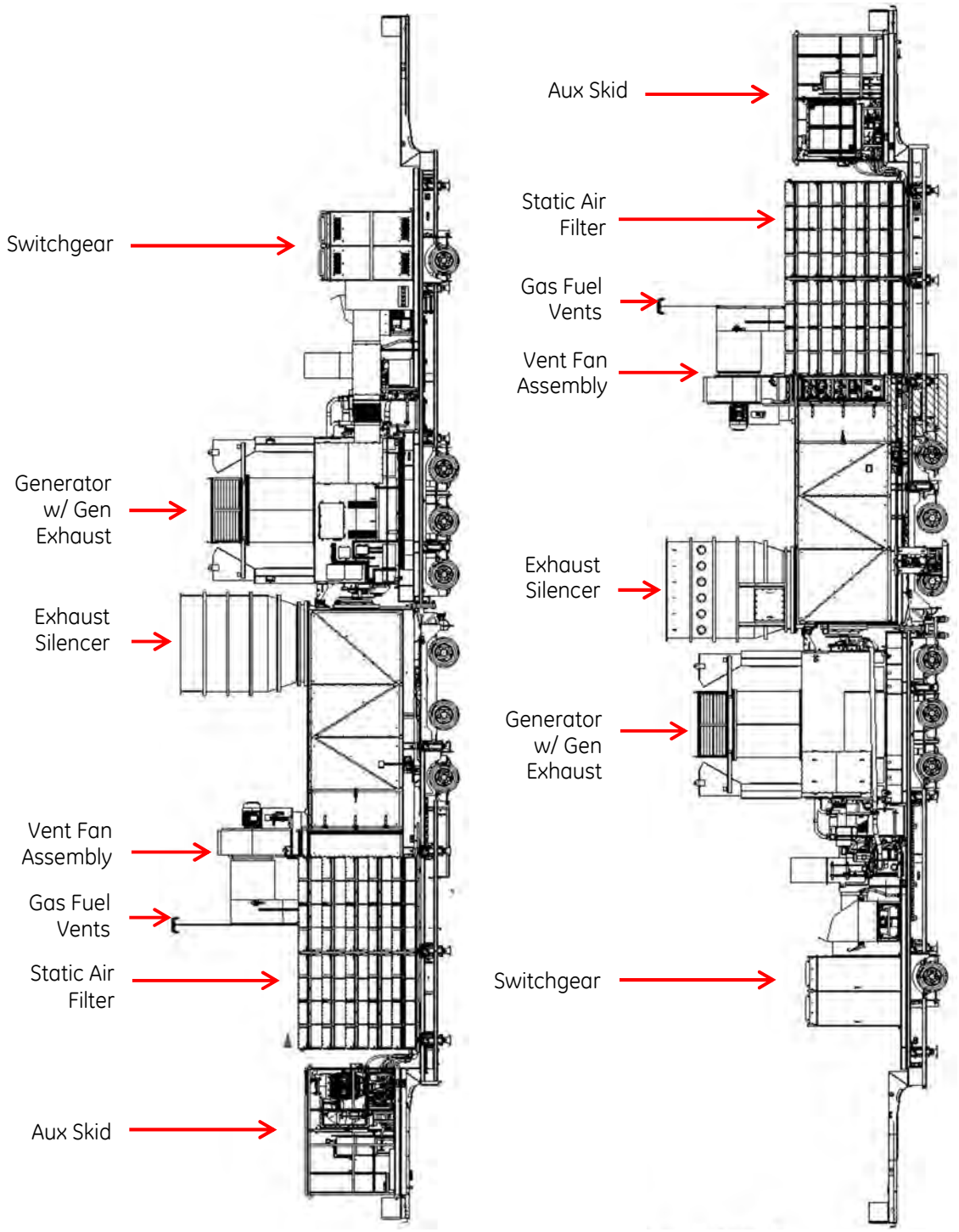


Figure 7.3 Side Views (Operational)

For informative purpose only: Views and dimensions may vary according with specific package configuration.

TM2500 GEN8 Mobile Gas Turbine-Generator Set

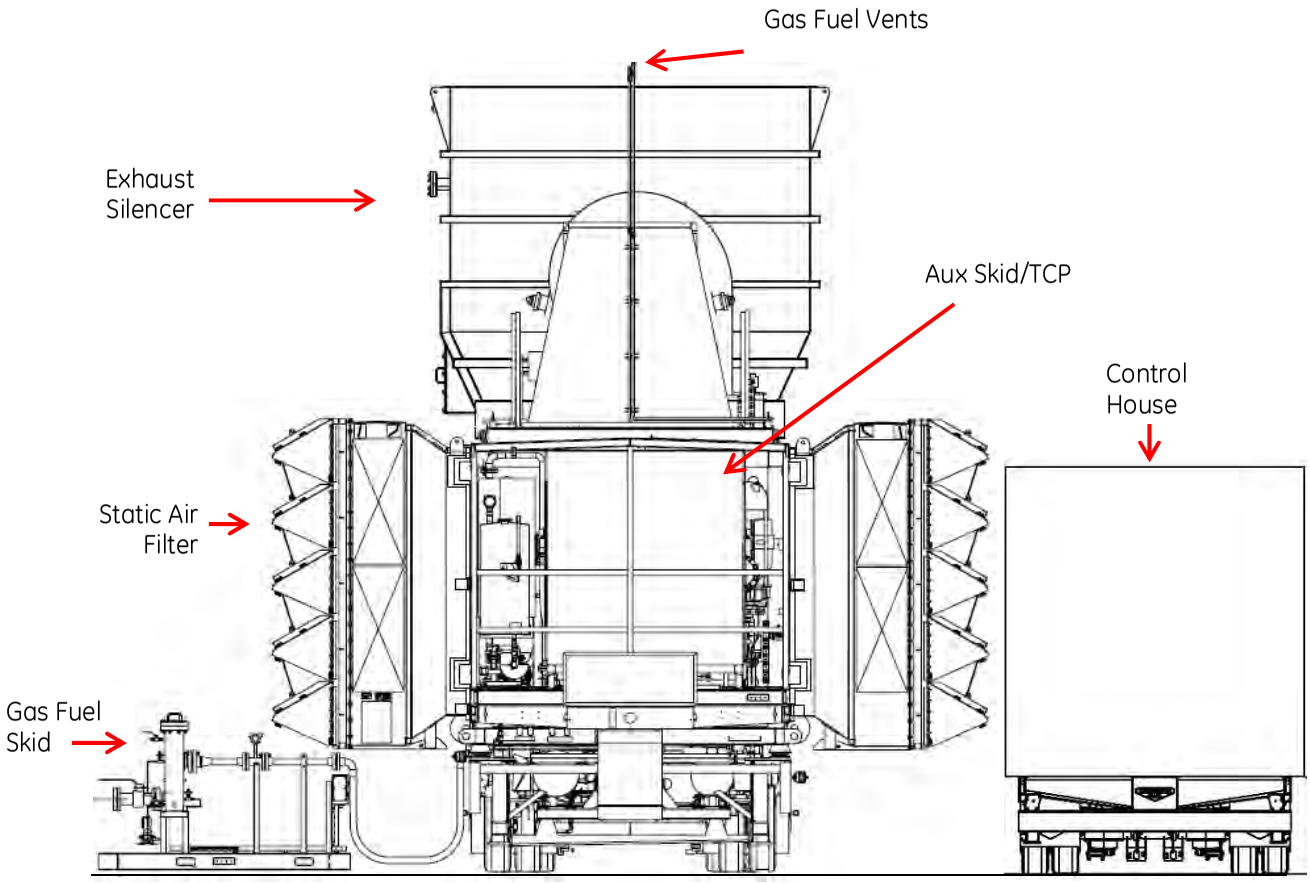


Figure 7.4 Turbine Trailer End View (Operational)

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

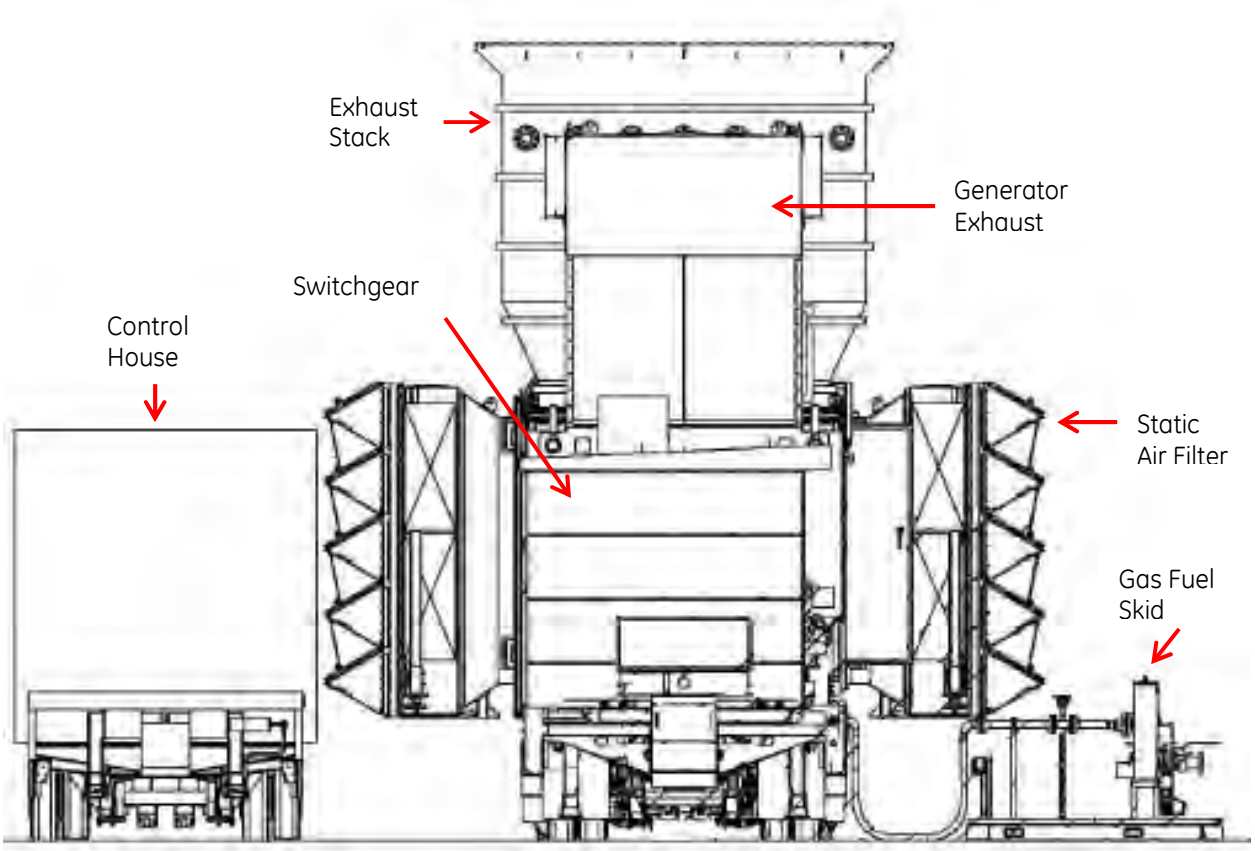


Figure 7.5 Generator Trailer End View (Operational)

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Turbine Trailer

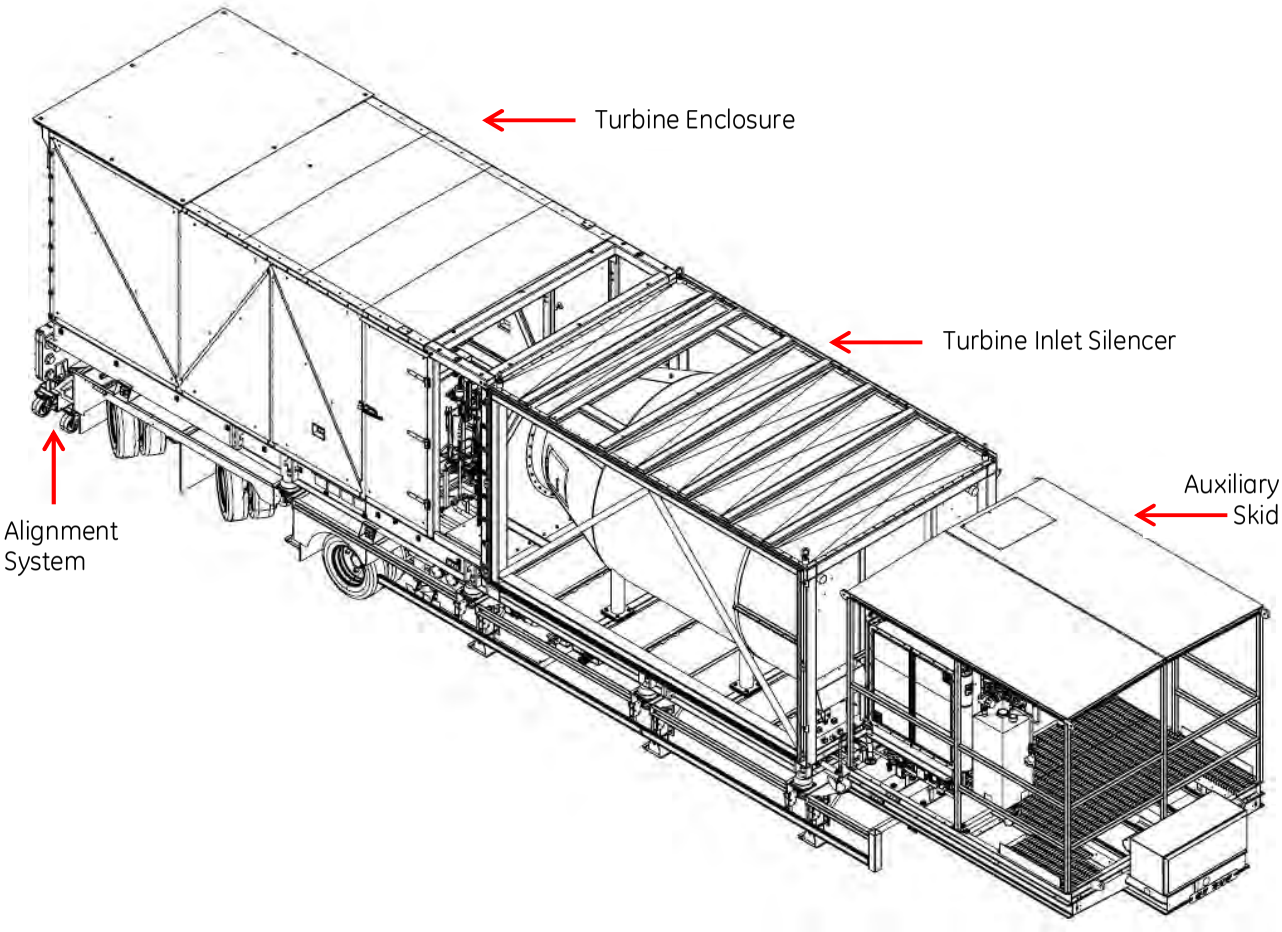


Figure 7.6 Isometric View

For informative purpose only: Views and dimensions may vary according with specific package configuration.

Turbine Trailer

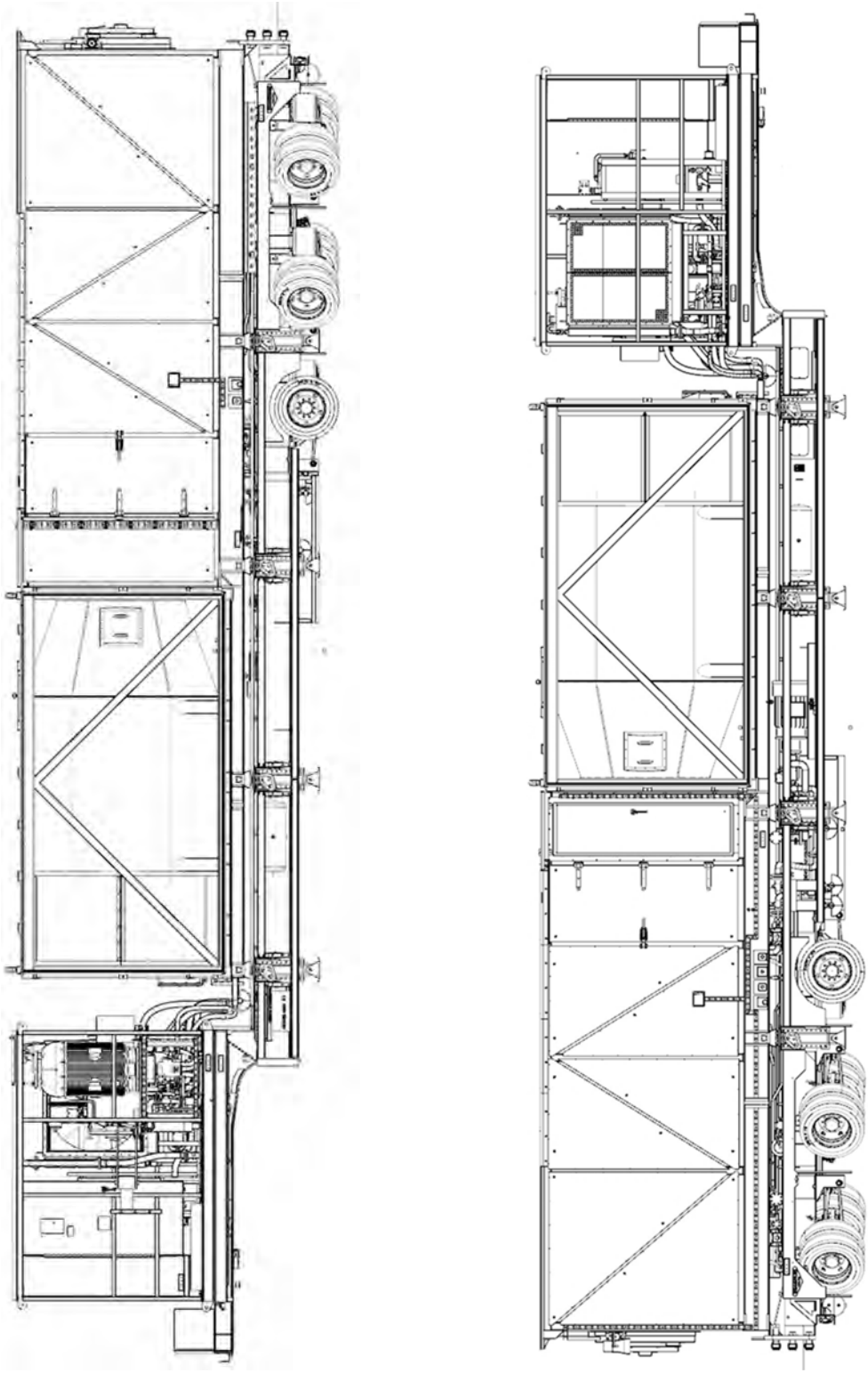


Figure 7.7 Side Views

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Turbine Trailer

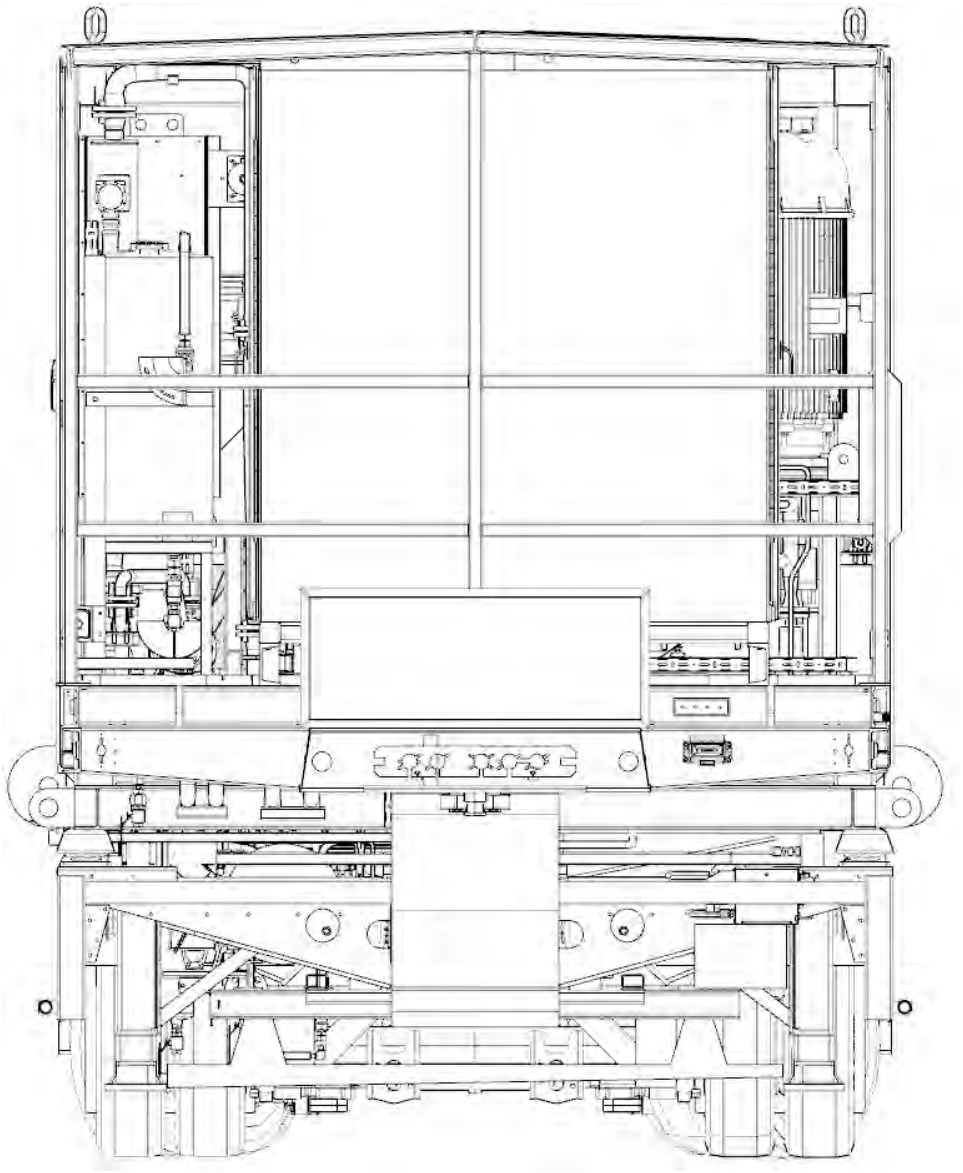


Figure 7.8 Auxiliary Skid End View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Turbine Trailer

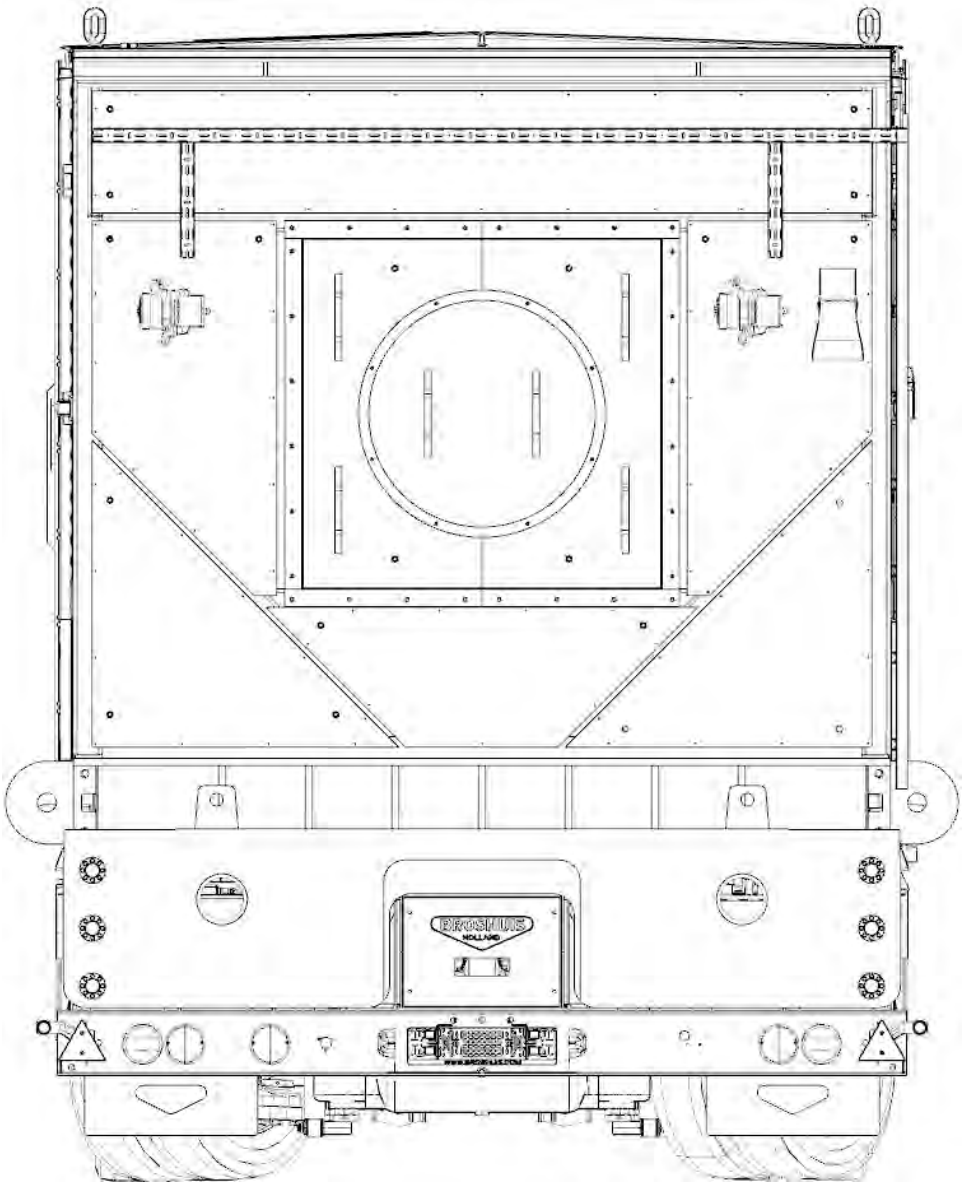


Figure 7.9 Turbine to Generator Docking Plate View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Generator Trailer

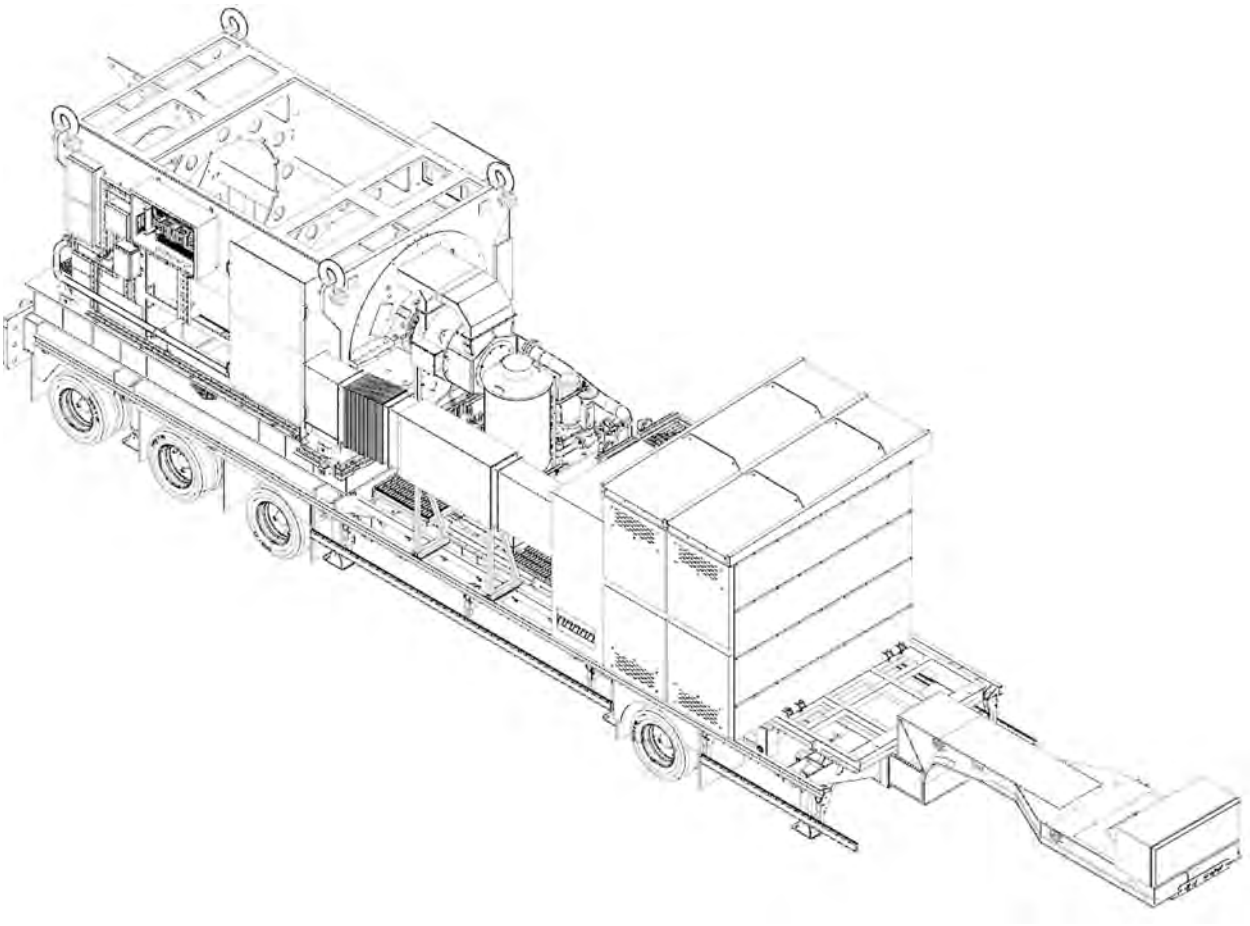


Figure 7.10 Isometric View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Generator Trailer

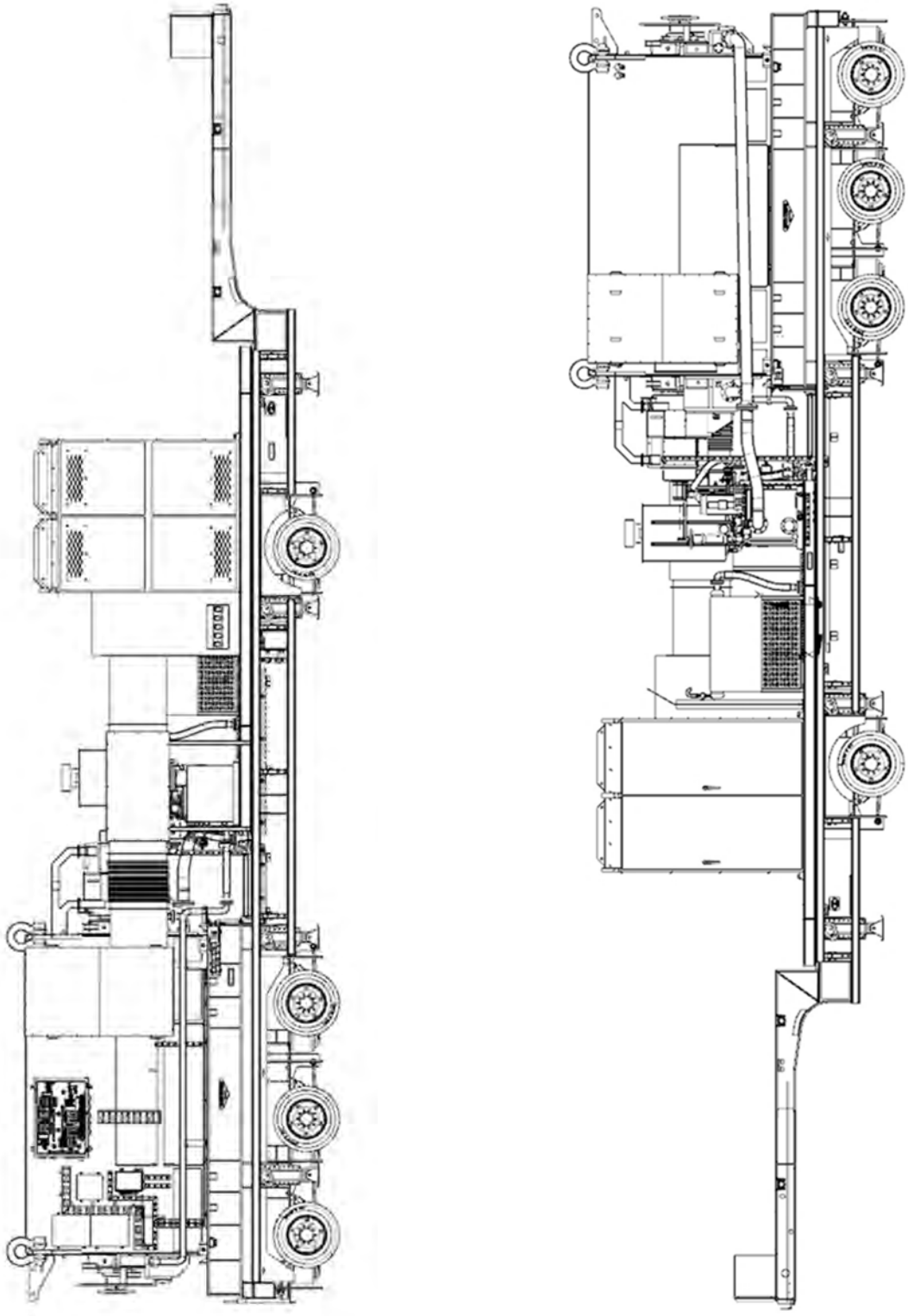


Figure 7.11 Side Views

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Generator Trailer

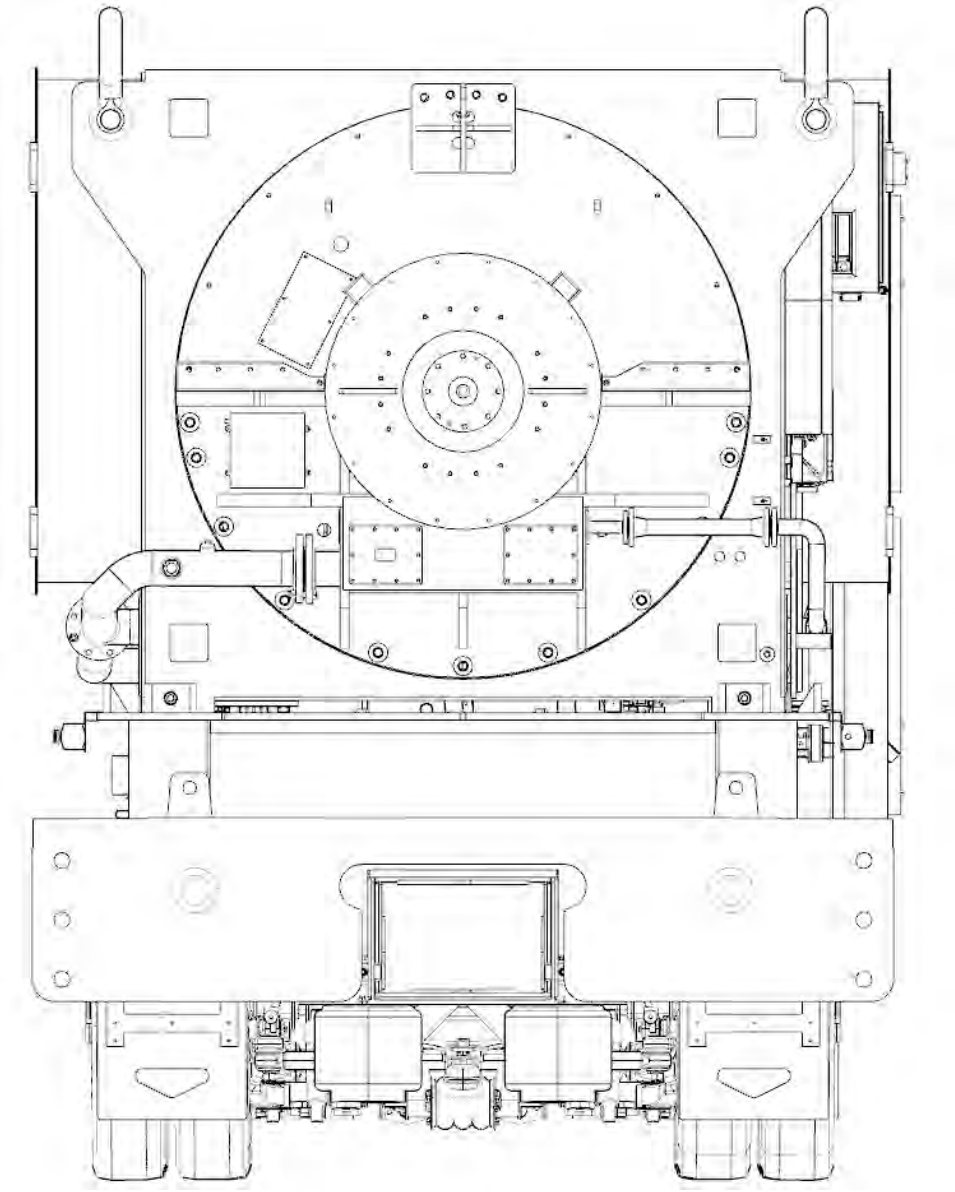


Figure 7.12 Generator to Turbine Docking Plate View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Generator Trailer

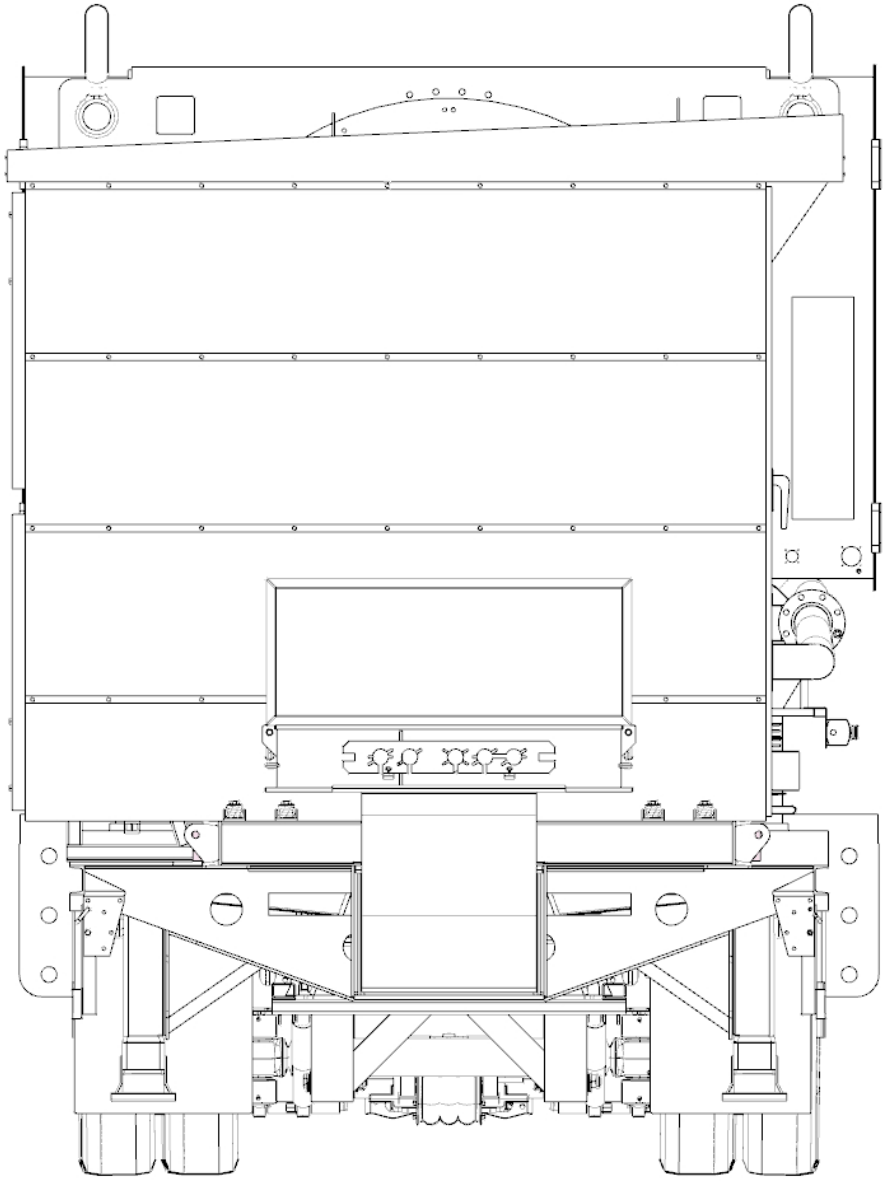
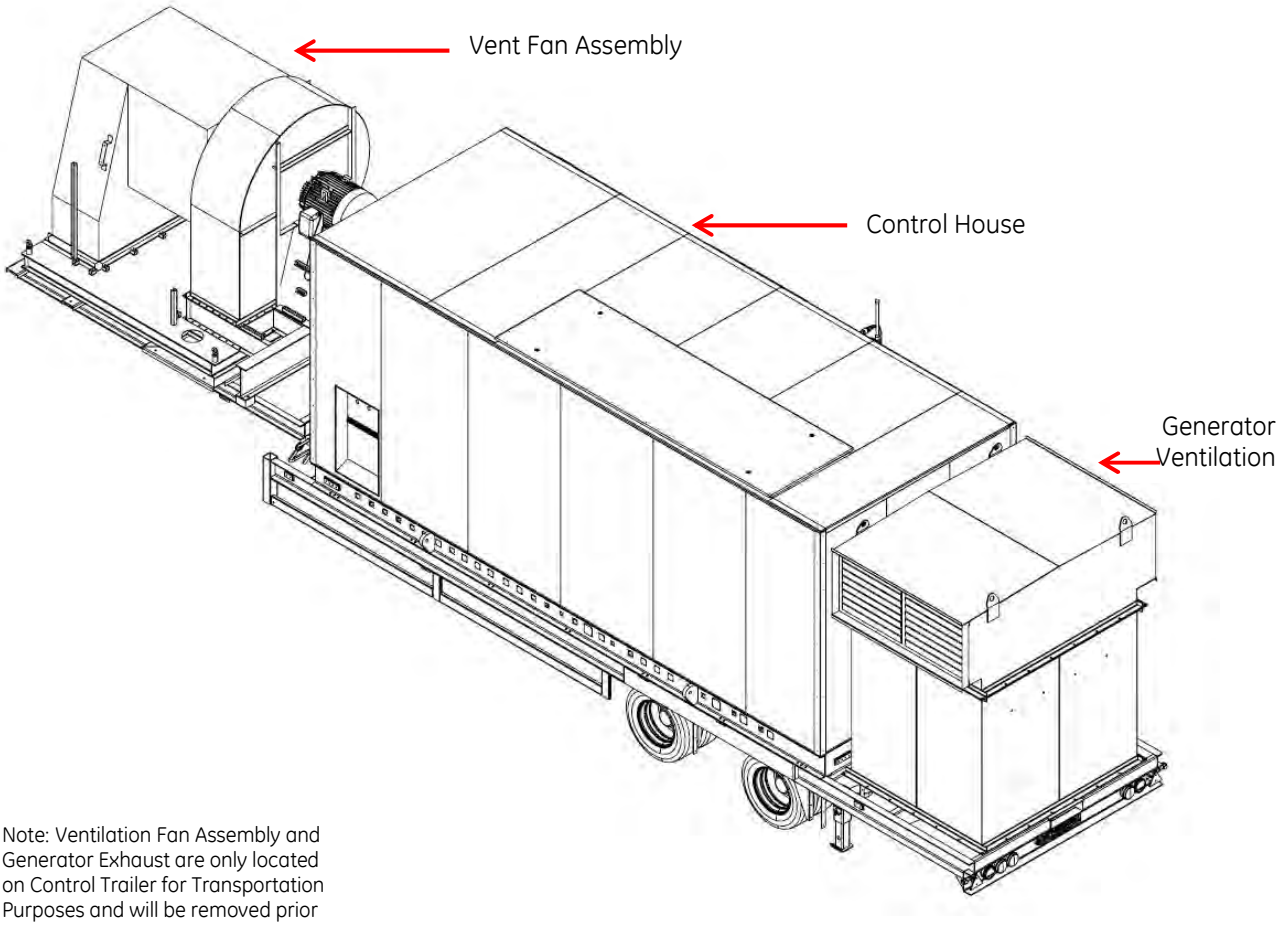


Figure 7.13 Trailer Front View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Control House Trailer



Note: Ventilation Fan Assembly and Generator Exhaust are only located on Control Trailer for Transportation Purposes and will be removed prior to operation.

Figure 7.14 Isometric View (Transport View)

For informative purpose only: Views and dimensions may vary according with specific package configuration.

Control House Trailer

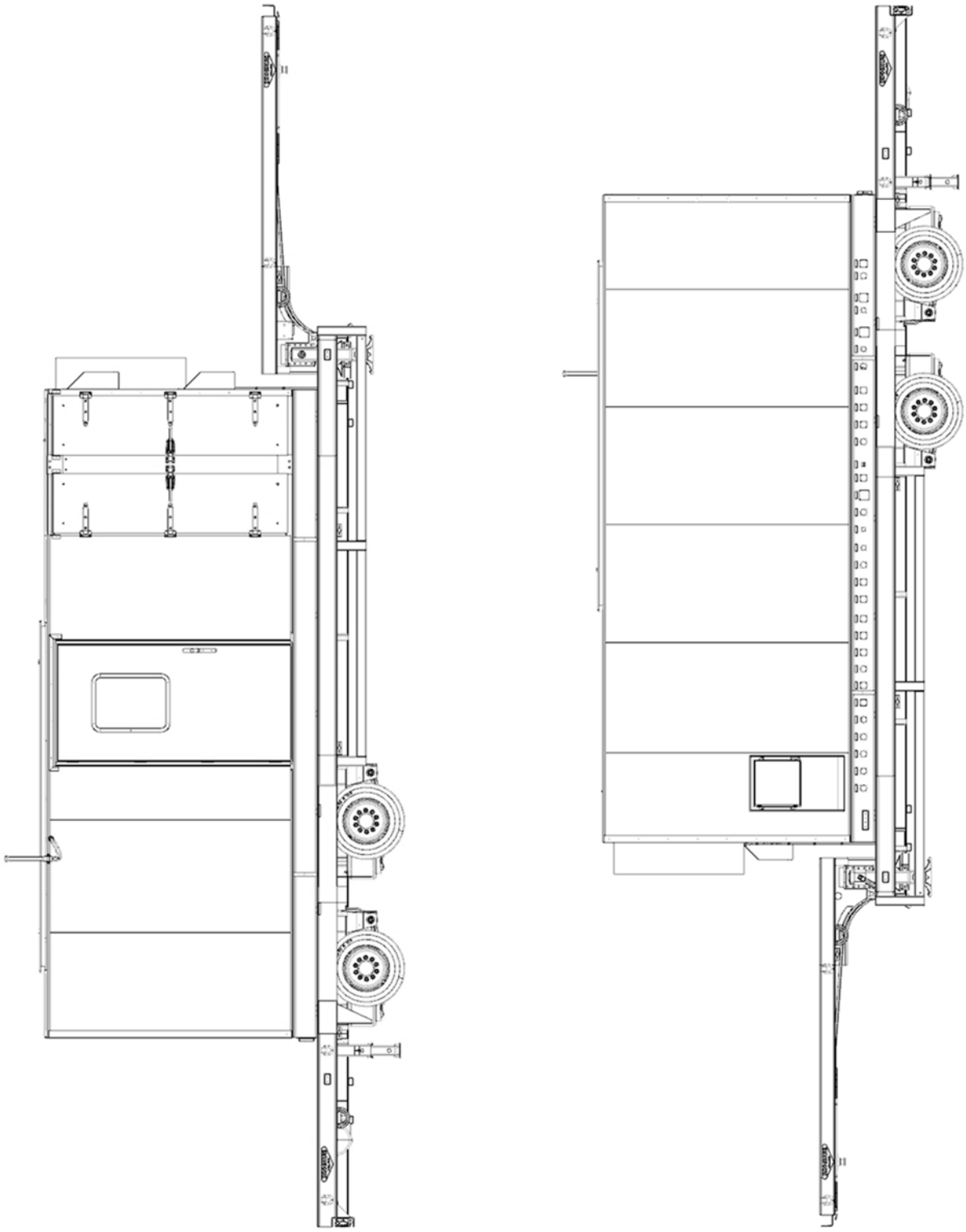


Figure 7.15 Side Views (Transported Assemblies Removed)

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Control House Trailer

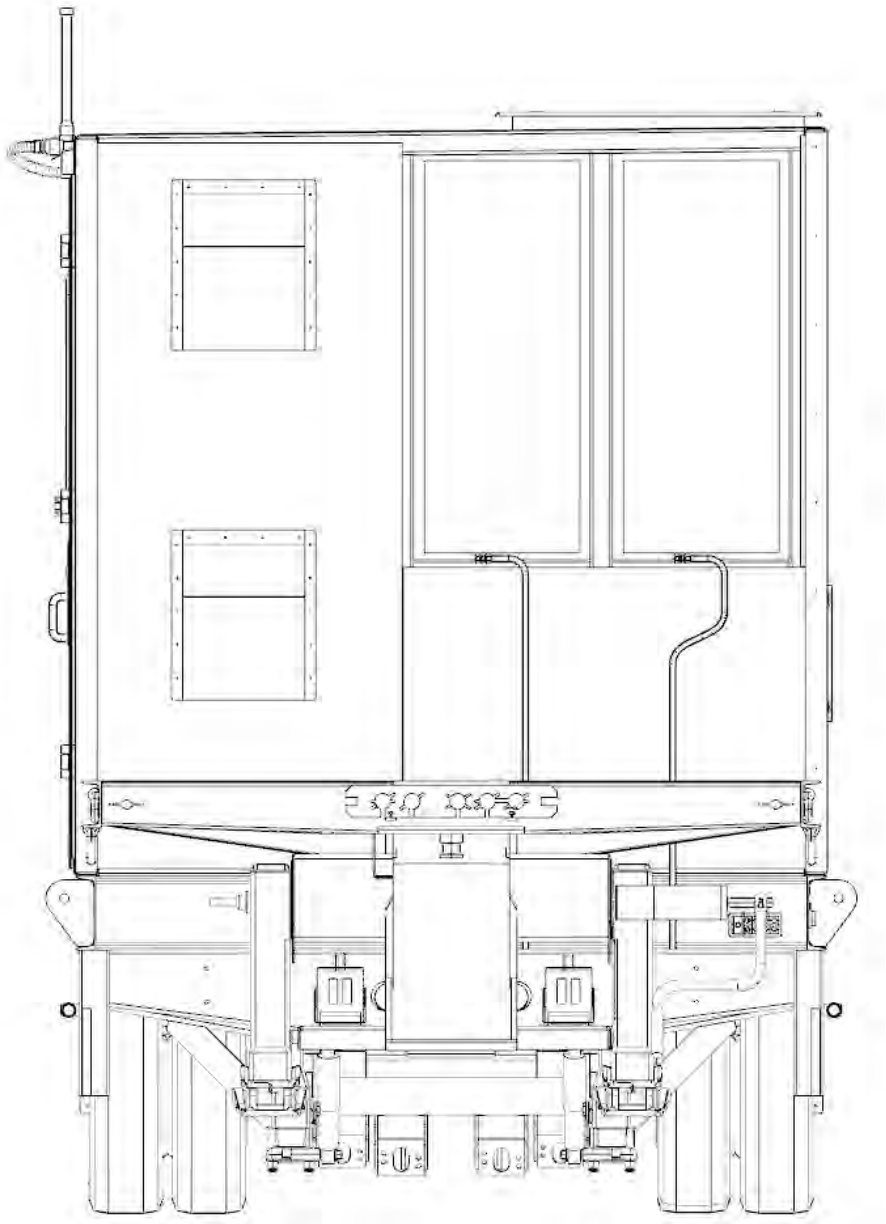


Figure 7.16 Trailer Front View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Control House Trailer

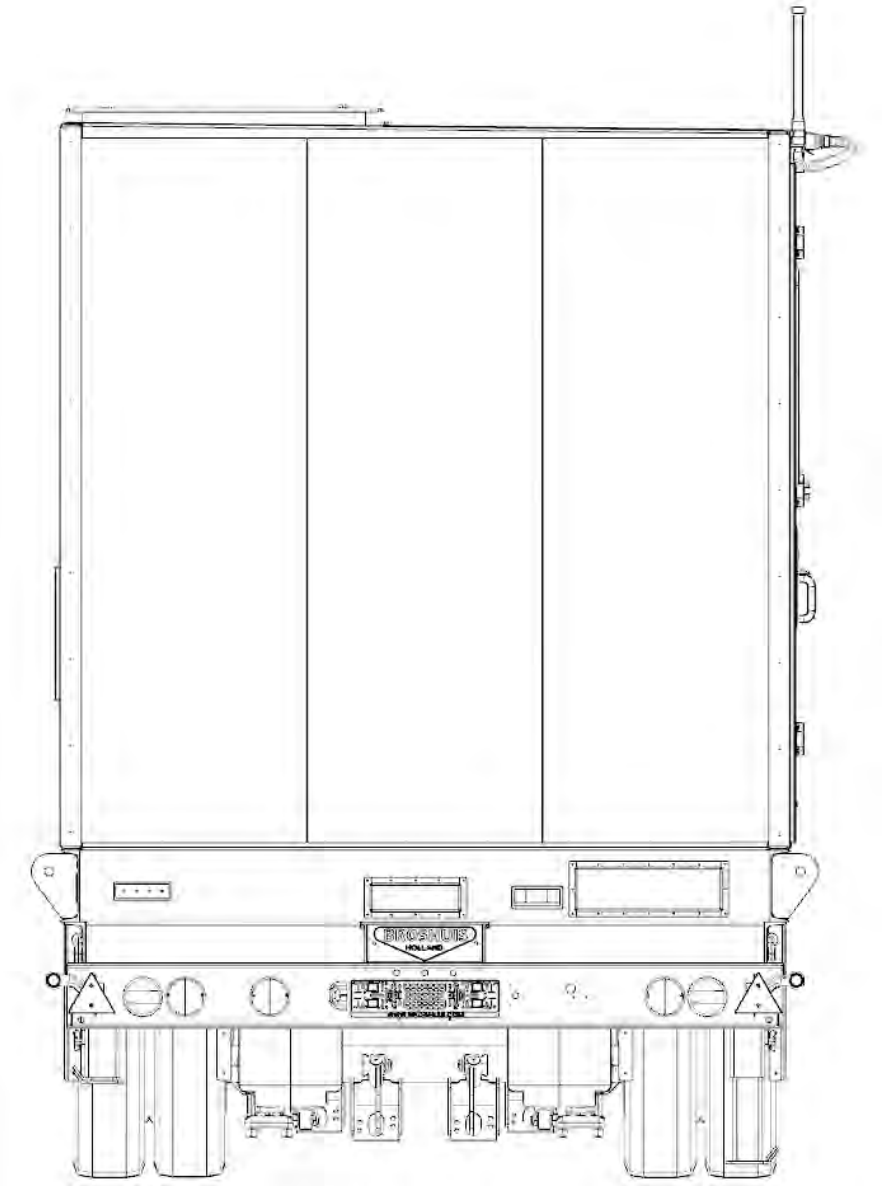


Figure 7.17 Trailer Rear View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Transportation Trailer (Optional)

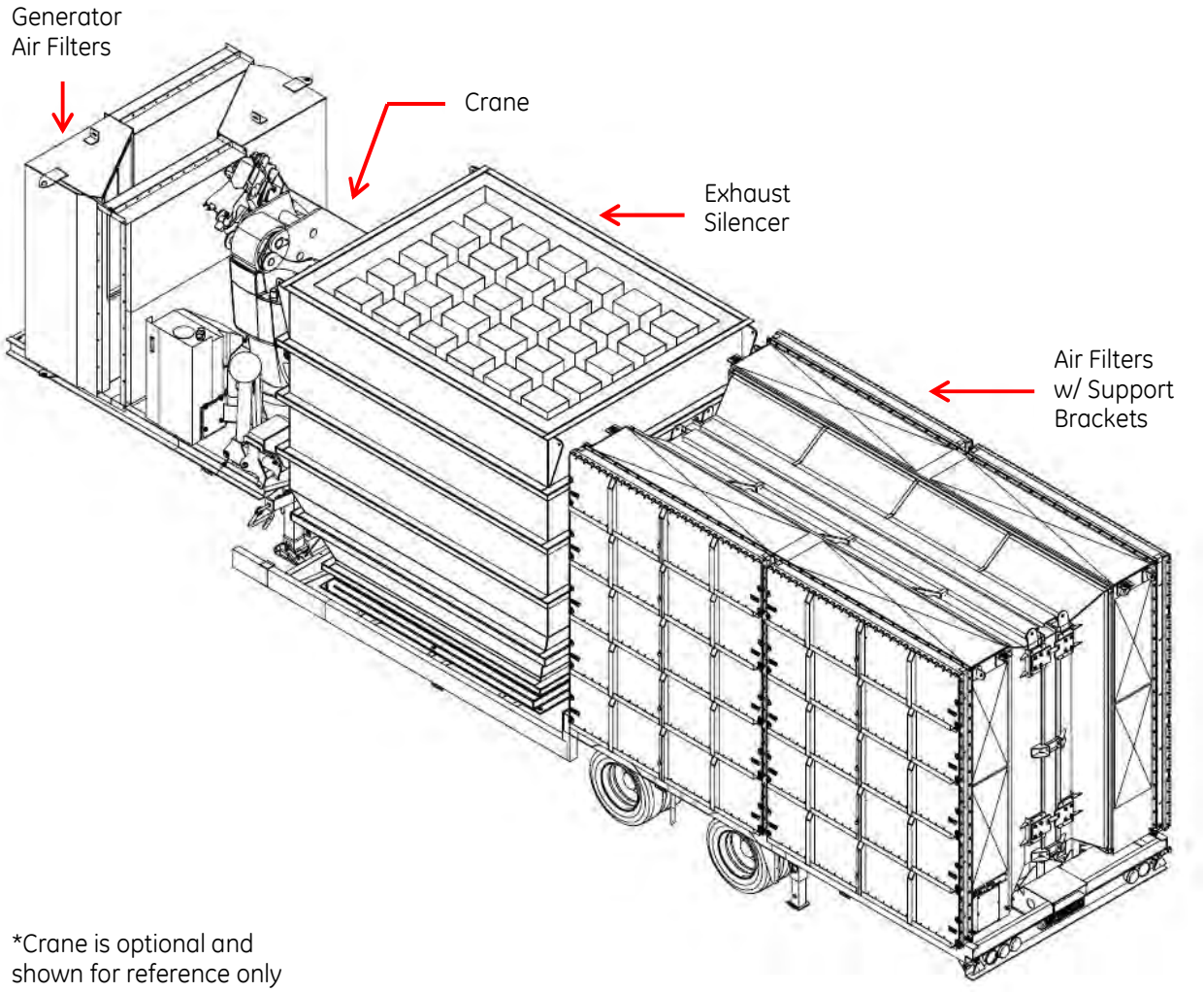


Figure 7.18 Isometric View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Transportation Trailer (Optional)

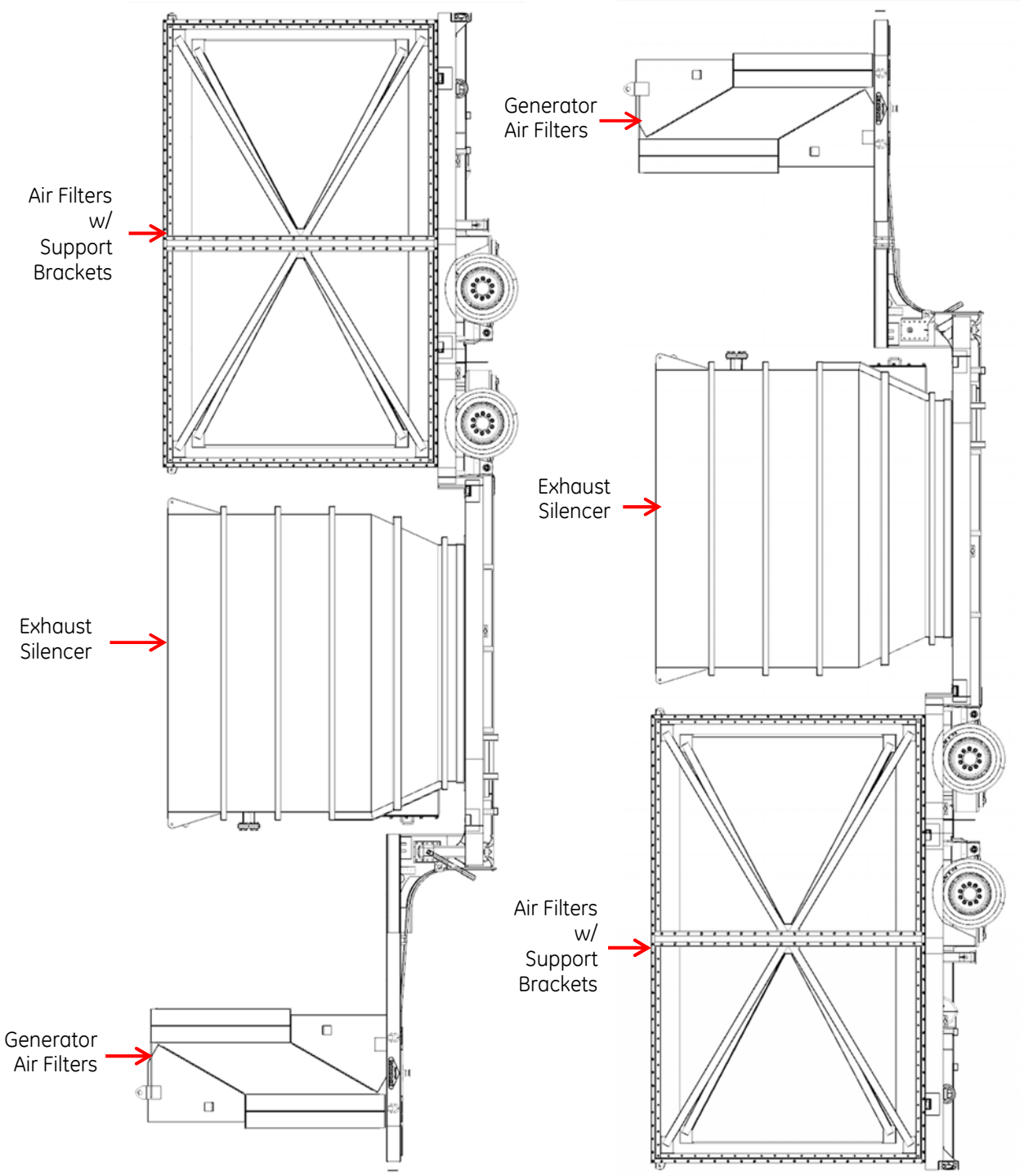


Figure 7.19 Side Views (Crane option not shown)

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

Transportation Trailer (Optional)

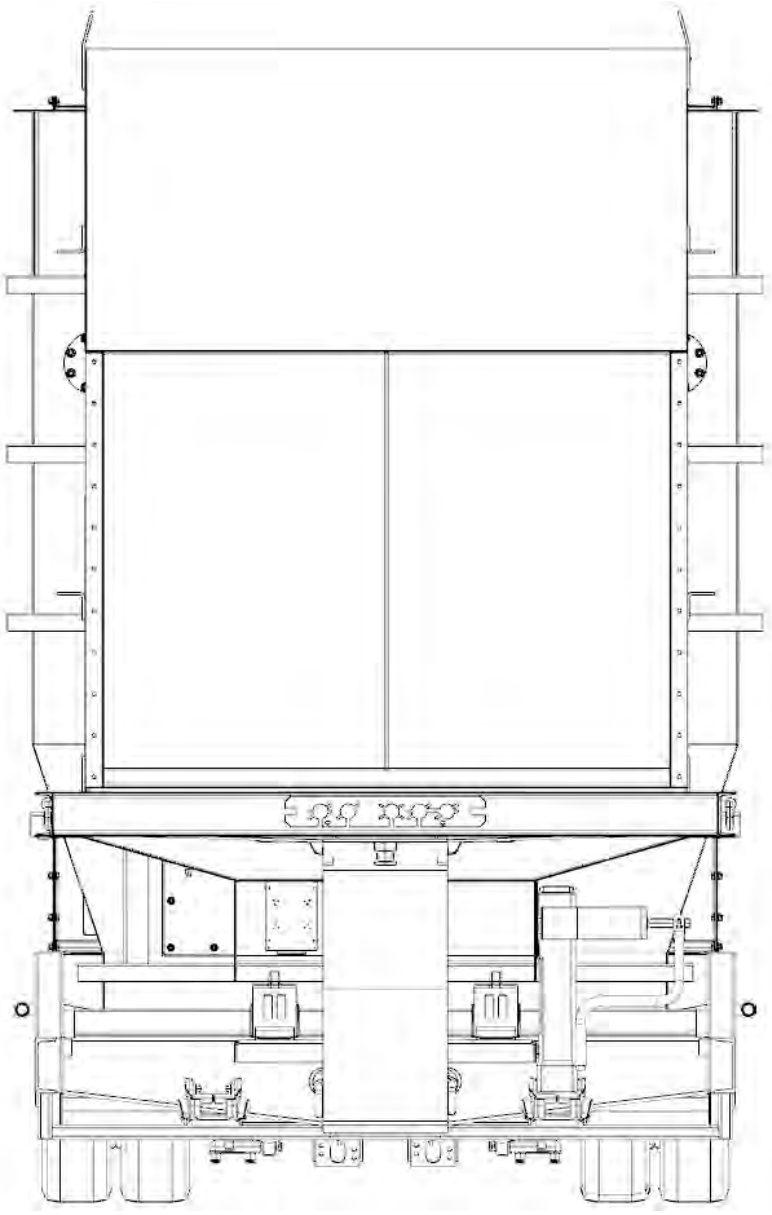


Figure 7.20 Generator Filters End View

For informative purpose only: Views and dimensions may vary according with specific package configuration.

Transportation Trailer (Optional)

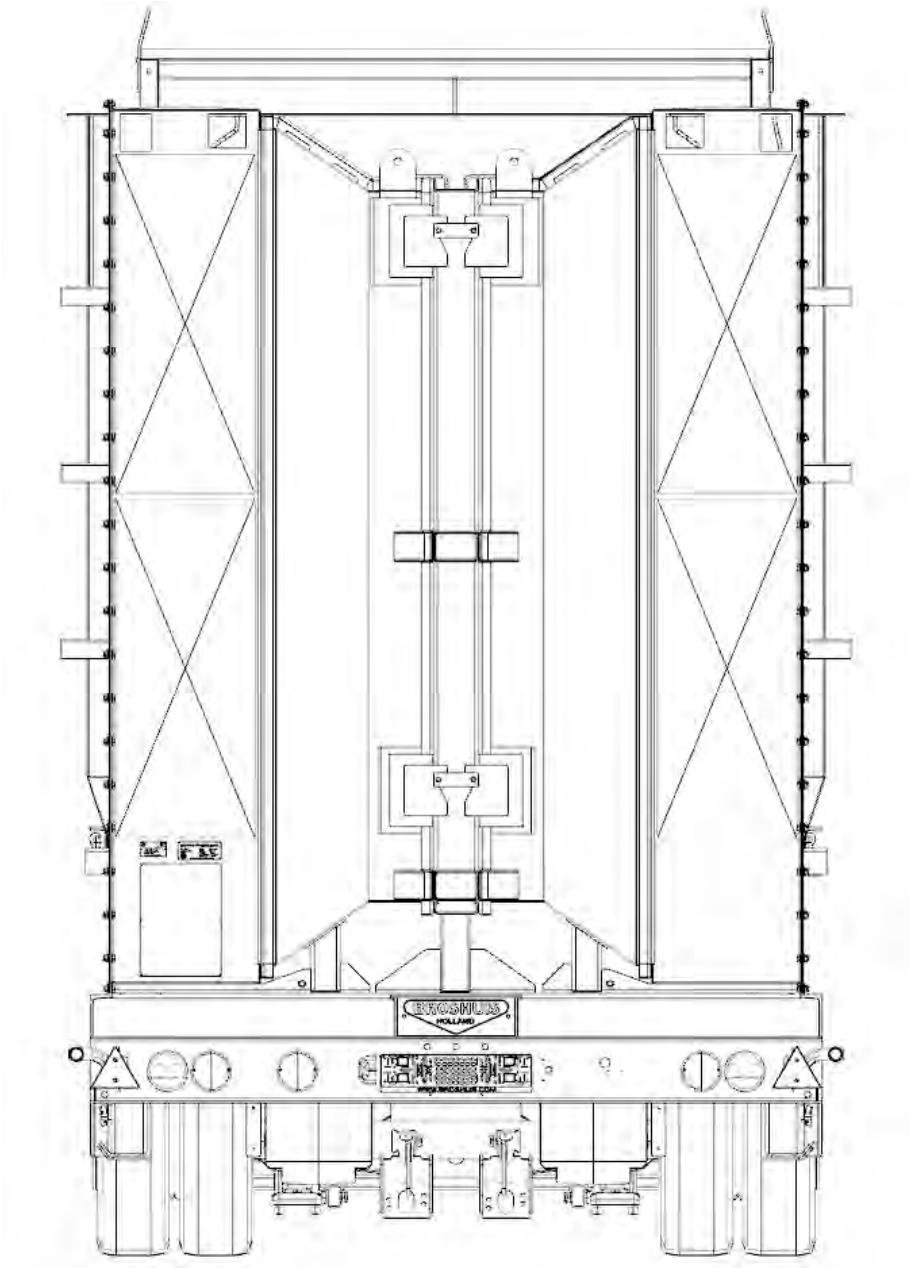


Figure 7.21 Air Filters w/ Support Bracket View

For informative purpose only: Views and dimensions
may vary according with specific package configuration.

8. Electrical Generator System Description

8.1 Generator Design

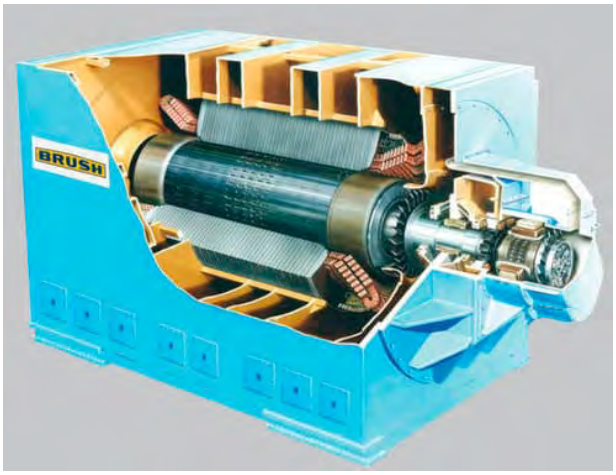
The TM2500 GEN8 MGTG set features a Brush Model BDAX62-170ERT air cooled generator, which is a two-bearing machine equipped, configured with a brushless rotating exciter, flying bridge array and a brushless permanent magnet generator (PMG) on the non-drive end. The rotor is supported by two split-sleeve bearings lubricated by a pressurized mineral oil system.

The generator is complete with the following features:

- Permanent Magnet Generator (aka Pilot Exciter)
- Generator Exhaust
- Rotor Earth Fault Monitor (REFM)
- Oil supply system
- Canopy/Enclosure

Generator Design Data

	13.8kV 60 Hz	**11.5kV 50 Hz**
Terminal Voltage	13,800 Volts	11,500 Volts
Frequency	60 Hz	50 Hz
Speed (rpm)	3,600 rpm	3,000 rpm
Power Factor	0.9	0.9
Standard	IEEE C50.13	IEC 60034-3
Coolant	Air at 15°C	Air at 15°C
Output	38,333kVA (34,500kW)	34,222kVA (30,800kW)



8.2 Generator Codes and Standards

The generator is designed to meet codes and standards applicable to most areas of the world. The primary standards are IEC.60034-3 for the 50 Hz Generator and IEEE C50.13 for the 60 Hz Generator.

8.3 Stator Design

Stator Frame

The stator frame is a rigid structure, fabricated from mild steel plate and designed to withstand the mechanical stresses imposed during operation and under accidental short circuit conditions. Mounting pads are incorporated at appropriate points on the underside, with holes in each pad for installation bolts.

Stator Core

The core is built into a fabricated steel frame and consists of low loss silicon steel segmental stampings insulated by a layer of varnish on both sides. It is clamped firmly between heavy plates, keyed in position under pressure. It is divided into short sections by radial ventilating ducts formed by fingers extending from the tip of each tooth to the back of the core, and welded to a thick stamping at one side of the duct. The stampings are held in line by dovetail keys bolted to the stator frame.

Stator Winding

The stator winding is of the two layer diamond type with coils held in open slots by epoxy resin baked fabric wedges, the two layers having a similar separator. The coils are made in two halves, each half being fully formed before fitting in the stator. The insulation is synthetic resin bonded mica glass tape throughout, the slot portion being pressed hot to its final size. All current carrying joints in the windings are clipped and brazed.

The laminations of the stator winding are transposed in a regular pattern to minimize circulating currents and losses. The completed coils are protected against corona formation by conducting tape in the slot length and with corona relief tape at each end of the core.

In the end winding, the coils are braced with polyester cord synthetic resin bonded packing blocks and supported from the core ends by insulated brackets

Insulation System

The insulation system is based on a resin-rich mica glass tape that produces a high performance insulation system capable of continuous operation at temperatures up to 302°F (150°C) (Class F).

Coil Winding and Connections

Spacer blocks are fitted between adjacent coil sides to produce a strong, resilient, composite structure. Finally, the completed stator is "baked" in an oven to fully cure the insulation. Resistance Temperature Detectors (RTDs) are embedded in the windings at selected points, and anti-condensation heaters are fitted into the stator frame.

To ensure electrical performance, the individual coils and the completed windings are given high-voltage tests.

8.4 Cylindrical Rotor

The cylindrical rotor is manufactured from an integral forging of vacuum poured nickel-chromium-molybdenum alloy steel. The resulting forging is thermally stable, uniform in composition, and has excellent tensile and mechanical properties. As assembly proceeds, slots are machined in the rotor surface, and insulated coils of high-conductivity silver-copper strip are pressed into the slots. Then damper windings and wedges are added.

Finally, end caps of nonmagnetic manganese chromium steel are shrink-fitted to the ends of the rotor body.

8.5 Bearings and Lubrication Oil System

The main bearings are conventional, white metal lined, hydrodynamic elliptical bearings, split on the horizontal center line for ease of inspection and removal. The two halves are bolted and dowelled together.

The generator incorporates pressure lubricated bearings. An orifice in the supply line controls the bearing oil flow. The bearings are sealed with air taken from the generator fans by means of knife edge seals. Drain oil discharges into the bottom of the bearing housing from where it is returned to the lubricating oil system via a drainpipe. The bearings are sealed with air taken from the generator fans and the oil drainpipe is therefore also used to remove air from the bearing.

Bearing and lubrication system:

Non-Main Exciter End (NEE)

- Endframe
- Plain Sleeve
- Elliptical
- Force Lubricated
- Insulated
- Thrust Pad
- Radial Jacking Supply Provision

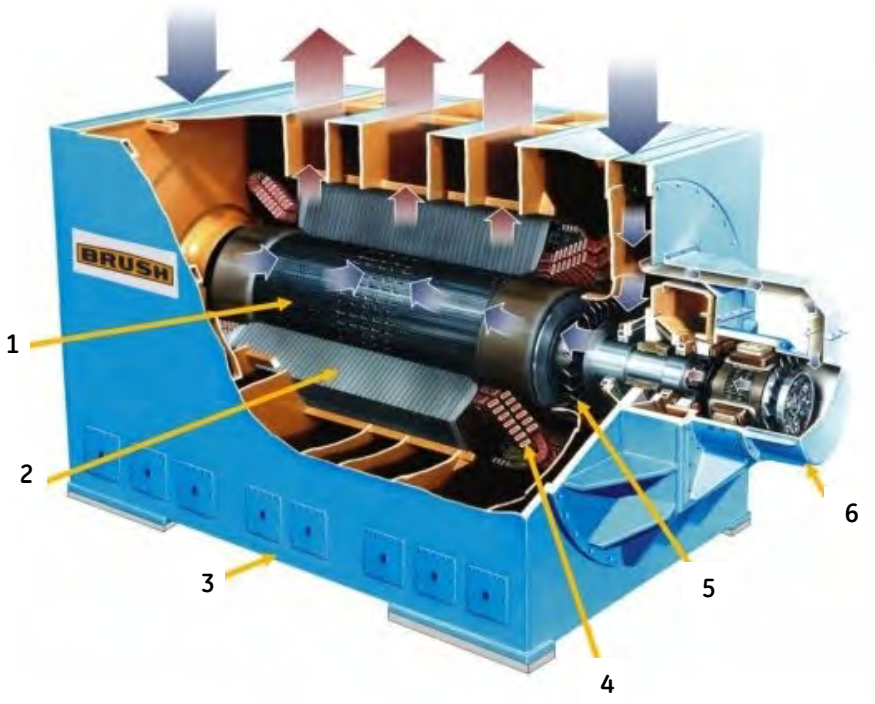
Main Exciter End (EE)

- Endframe
- Plain Sleeve
- Elliptical
- Force Lubricated
- Insulated
- Radial Jacking Supply Provision

8.6 Internal Air Circuit

Air is drawn in at each end of the machine by shaft-mounted fans and divides between the rotor, the stator end windings and the air gap. It then passes through the radial ducts in the stator core and out through the stator frame. Cooling circuits are designed to cool the windings as uniformly as possible. Open ventilated generators are cooled by ambient air drawn into the machine through filters and exhausted through an outlet duct connected to the stator air outlet flange.

Site considerations such as severe desert conditions, extremely salty atmospheres or unsuitably contaminated environments may necessitate the use of a closed air circuit machine, where the hot exhaust air is cooled by the secondary coolant, air, before being returned to the inlet.



Typical Generator Internal Air Circuit

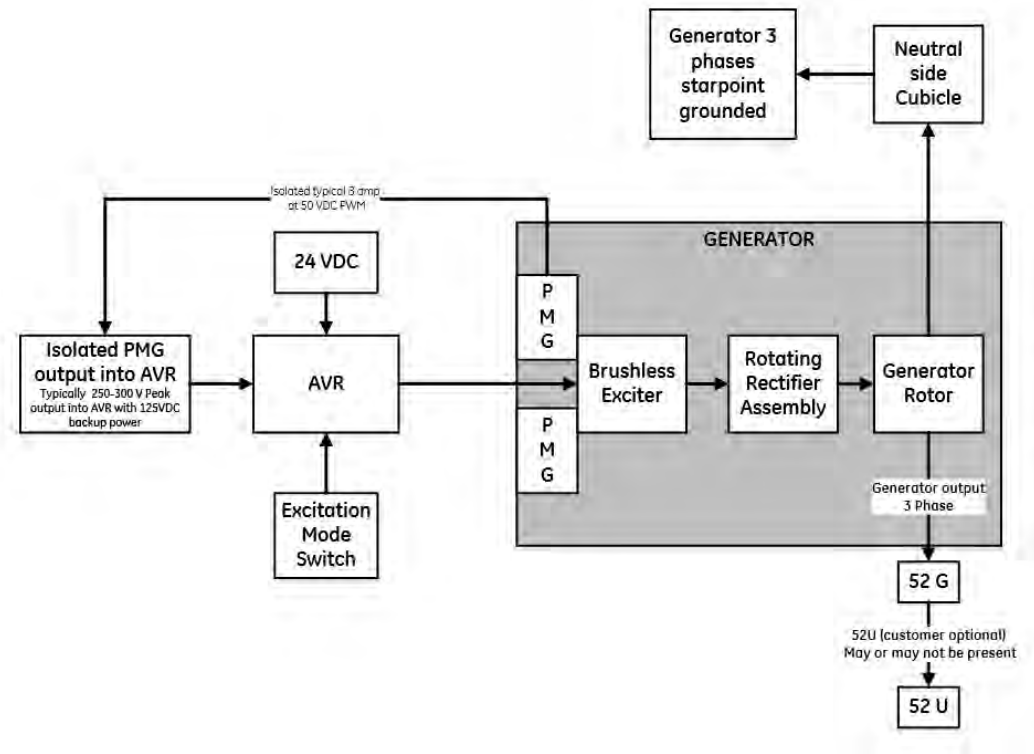
1. Rotor
2. Stator Core
3. Stator Frame
4. Stator Winding
5. Rotor Mounted Cooling Fan
6. Exciter

8.7 Generator Excitation and Regulation

The generator excitation system provides the power required to ramp the generator output voltage up to the rated level during unit startup, and to maintain the voltage at the desired level during fluctuating load conditions.

The generator excitation system contains the following components:

- Permanent Magnet Generator (PMG)
- EX2100e Automatic Voltage Regulator (AVR)
- Brushless Rotary Exciter
- Rotating Rectifier Assembly
- Excitation Mode Switch
- Generator Rotor and Stationary output winding
- Generator-Output Switching and Automatic Synchronization



Generator System

Permanent Magnet Generator

The PMG (occasionally referred to as "pilot exciter") supplies single-phase voltage for the Manual AVR. The PMG consists of a stator coil assembly surrounding a rotor made up of permanent magnets and has rotating components. The PMG windings have been mounted in the exciter housing and the PMG rotor on the generator rotor shaft. The PMG is electrically isolated from the main generator output coil, and its output is only affected by changes in rotor speed loading. This voltage headroom allows almost immediate compensation for sudden changes in the generator load.

EX2100e AVR

The EX2100e Automatic Voltage Regulator (AVR) system maintains the generator output voltage by controlling the excitation of the generator. The AVR also monitors generator excitations and drive generator current output levels to maintain generator operation within the generator capability curve.

Brushless Rotary Exciter

The brushless rotary exciter is an integral part of the AC generator. The exciter armature is mounted on the non-drive end of the generator rotor shaft and enclosed by the stationary exciter field winding. The exciter housing, bolted to the generator end frame, supports both the stationary exciter field windings and the PMG stator windings.

Rotating Rectifier Assembly

The rotating rectifier assembly converts the 3ϕ current from the exciter armature into DC, which polarizes the rotating main field windings of the generator. The rectifier consists of six silicon diodes, each of which connects to one of the three exciter armature leads through a protective fuse. The diodes provide full-wave rectification for each exciter current phase.

Excitation Mode Switch

The voltage regulator excitation selector switch allows the operator to select between MANUAL EXCITATION or AUTOMATIC EXCITATION mode control.

Generator Rotor and Stationary Output Windings

The rotor is fabricated of solid alloy steel forging with copper windings held in slots by wedges. The coils are made of ferrous rectangular bars of copper strip.

Generator Output Switching and Automatic Synchronization

The generator output is connected to the high-voltage bus through the self-contained bus circuit breaker (52G) within the constraints of the synchronizing circuits, customer provided 52U is optional. Through switchgear and transformers (optional), the high-voltage bus is connected to the utility bus and the turbine-generator MCC.

Under normal circumstances the auto synchronizer controls breaker closure. When in manual, the synchronizer provides a permissive to breaker closure. The automatic synchronizer adjusts generator excitation and speed to match with the load, voltage and phase so that the generator frequency and voltage output are exactly in sync with the existing power.

8.8 Generator Accessories

Generator Exhaust

The stator and rotor are cooled by means of air forced around the generator by means of fans mounted on the rotor shaft. The generator receives filtered air from an external air treatment unit. The filters must be properly maintained so that the total pressure drop external to the generator taking into account all ducting, filters (maximum dirty pressure drop), silencers, louvres etc., at the inlet and outlet, must not exceed the specified system design pressure drop. A differential pressure switch is connected across the filter to give a signal to warn the machine operator when renewal of the filter pads is necessary.

Rotor Earth Fault Monitor (REFM)

To continuously monitor the condition of the rotor winding, the rotor earth fault monitor (REFM) uses an electronic unit to detect a single earth fault. This dispenses with the need for brushes and slip rings, resulting in enhanced reliability and reduced maintenance costs. The REFM is an electronic unit designed to provide a brushless generator with an alarm in the event of a rotor earth fault. General practice on generators with brushless excitation is for the rotor (main field) winding to be fully isolated from earth so that, in the event of a single earth fault, the generator could continue running. However, a second earth fault would short circuit part of the winding, necessitating an immediate shutdown and corrective action. Detection of a single earth fault allows the generator to be taken out of service for investigation and repair at the earliest opportunity, usually as part of a planned maintenance program.

Resistance Temperature Detectors (RTDs) and Thermocouples

Resistance temperature detectors (RTDs) or thermocouples are fitted to the generator to monitor temperatures in the various parts of the machine. These detectors or separate temperature switches (thermostats), if specified, are commonly used to initiate trip and alarm functions.

Temperature detectors of the resistance type comprise an element with a non-inductively wound platinum coil having a value of 100Ω at 0°C. Operation of the detector is based on the principle that the resistance of a metallic conductor varies linearly with temperature.

Space Heaters

The purpose of the heaters is to prevent condensation of moisture on the windings and metal which could lead to low insulation resistance or corrosion. The generator heaters are mounted at the ends of the stator. Heaters for the main exciter are mounted between poles at the bottom of the main exciter and are accessible by removing the main exciter endframe.

Vibration Detectors

To gain a true motion of the shaft it is usual to place two probes at 90° to each other on each bearing. The probe signals are sent via signal conditioners, mounted locally to the probes, to the remote monitoring equipment. Non-contacting shaft motion proximity equipment is usually supplied as part of an overall vibration monitoring package.

Lineside and Neutral Cubicles

Lineside and neutral cubicles are bolted onto the outside of the generator for the customer's power and metering connections.

8.9 Integrated Generator Protective System (IGPS)

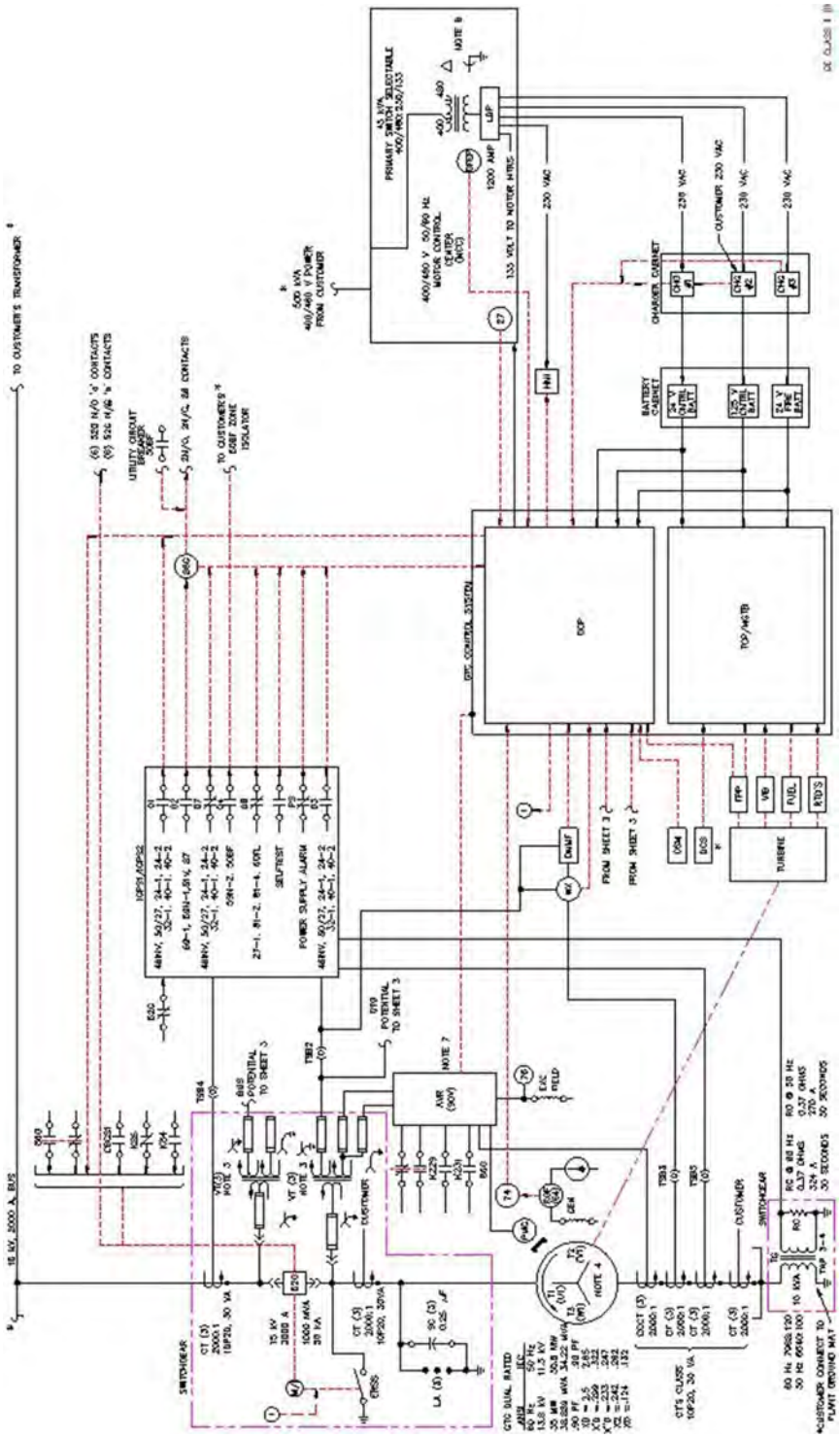
The generator protective relay system is a microprocessor-based design used to provide protection, control, and monitoring of the AC generator, switchgear, and high-voltage bus network. The integrated generator protection system (IGPS) is installed in the Generator Control Panel (GCP).

The IGPS can protect a generator from abnormal voltage and frequency, internal winding faults, system faults, inadvertent energizing, negative sequence current, reverse power, loss-of-field, and over excitation (V/Hz) disturbances, while also providing loss-of-VT-fuse detection, and breaker failure/flashover protection.

Six input contacts can be programmed to block any relay function and/or to trigger to oscillograph recorder. Any of the functions or input contacts can be individually programmed to activate any one or more of the eight programmable output contacts.

9. One Line Diagram

9.1 50 Hz/60 Hz One Line Diagram – Sheet 2



10. Control System Description

Control System Overview

The MGTG set is operated through use of a turbine electronic-control system. This system comprises computerized-control subsystems installed in the TCP (Turbine Control Panel). The microprocessors and digital logic circuitry in these subsystems provide the speed and autonomy of operation required for safe and efficient operational control. The heart of the control system is the GE Intelligent Platforms RX3i Programmable Logic Controller©. The majority of operator interaction with the system will be via the human machine interface (HMI) on the GE supplied computer. When the MGTG is operated at site the operator will normally operate the MGTG set via the HMI (local mode), and occasion (usually for maintenance purposes) the operator can perform certain functions via the GCP (local mode). The MGTG may also be operated from a remote location when in Remote mode; however for this operation, required hardwired customer interconnects must be installed.

The control system manages all critical operations of the TM2500 GEN8 MGTG set including all individual turbine-generator system monitoring and operating indicators, controls, and transmitters as well as the central electronic control system. The TCP and GCP house the majority of the control system equipment additional modules are located in the MGTB. From the GCP, the operator can initiate the turbine-generator's electronic control system to perform automatic startup, fuel management, load assumption, and system operation. Critical parameters are constantly monitored from the control system in the TCP and alarms or shutdowns are initiated automatically, as appropriate, for out-of-tolerance conditions. Automatic fuel control and turbine sequencing are controlled by the logic control system software and hardware. Operator interfaces, such as the HMI (Human machine interface) and local control switches on the GCP allow personnel to monitor and control the TM2500 GEN8 MGTG.

10.1 Turbine Control Panel (TCP)

The TCP located on the gooseneck of the turbine trailer contains the RX3i CPU (central processing unit), switches, and various control system components connected with the MGTG set. Automatic fuel control and turbine sequencing are controlled by the logic in the control system software and hardware. Also, an operator or anyone on site can initiate, as necessary, a manual emergency shutdown at any time. Critical parameters are constantly monitored by the RX3i and alarms or shutdowns are initiated automatically, as appropriate, for out-of-tolerance conditions. This panel contains the vibration monitoring system panel.

Major components located in the TCP are:

- GE-IP RX3i Programmable Logic Controller©.
- VersaMax Remote I/O Controllers
- Woodward Servo Position Controllers
- Bently Nevada 3701 Vibration Monitor System
- Jaquet T401 Tachometer System

Control System

The RX3i PLC is a flexible controller with both local and distributed I/O. CanOPEN, DeviceNet, PROFINET and Ethernet are used to communicate with the different sub-systems such as: distributed I/O, fuel control valves, variable geometry drivers, auxiliary devices and the HMI.

A suite of software tools (CIMPLICITY PROFICY Machine Edition, Woodward Control Assistant) are used for the RX3i and related controls as a common software platform for programming, trending, and analyzing diagnostics. It provides a single source of quality, time-coherent data at the controller and plant level for effectively managing equipment assets.

The controller communicates with networked I/O over one real time network. The controller rack consists of the main processors and two power supplies. A real-time, multitasking operating system is used for the main processor and I/O. Application software is provided in configurable Ladder Diagram, Structured Text, Function Block Diagram, and C. Application software is stored in non-volatile flash user memory.

The RX3i controls both the fuel supply to the engine and the system sequencing. The sequencing and fuel supply functions are described as follows:

Sequencer

The sequencer controls the order and timing of critical events in the operation of the MGTG set. It issues operating commands to the control sub-systems in response to data received from the sensors and detectors in the equipment and MGTG sub-systems.

Fuel Supply Manager

The RX3i fuel control is programmed to maintain a constant turbine speed from no-load to full-load conditions.

The controller also performs the following functions:

- Matches generator output frequency to the active bus for automated synchronization
- Controls the acceleration and deceleration rates of the turbine engine
- Initiates, regulates, and terminates the flow of water injection into the combustor

VersaMax Controller

The VersaMax* PROFINET Scanner (PNS) module interfaces a remote node of VersaMax modules to a PROFINET IO-Controller. The PROFINET Scanner scans the modules in its node, retrieving input data and providing output data, and publishes input data on the PROFINET Network at the configured production rate. The PNS manages PROFINET communication and module configuration between an IO-Controller and modules within the remote node. If network communications are lost, the PNS manages I/O states according to the individual module configurations.

Vibration Monitoring

The Bently-Nevada 3701 vibration monitoring system monitors the vibration levels at critical points along the turbine-generator package and is interfaced to the control system via Ethernet communications and hardwired connections.

10.2 Generator Control Panel (GCP)

This panel contains the voltage regulator and switches for controlling generator operating conditions. This panel contains controls for local turbine operation and the Beckwith Integrated Generator Protection System (IGPS) for monitoring the operation of the turbine engine and generator. Also located in this panel is the fire protection panel, Ex2100e for generator excitation control and circuit breakers for the distribution of the 24VDC control power and 24VDC fire and gas protection system power.

Major components located in the GCP are:

- VersaMax Remote I/O Controllers
- Beckwith M-3425A IGPS (Integrated Generator Protection System)
- GE-IP Ex2100e AVR (Automatic Voltage Controller)
- Eagle Quantum Premier FPP (Fire Protection Panel)
- Woodward DSM (Digital Speed switch)
- SATEC PM-174 DMMF (Digital Multi-Function Meter)

Integrated Generator Protection System (IGPS)

The Beckwith M-3425A IGPS (integrated generator protection system) is a microprocessor-based digital relay system that provides protection, control, and monitoring of the generator.

Ex2100e AVR (Automatic Voltage Regulator)

The GE EX2100e excitation controller is designed to control the excitation of the brushless generator.

Fire and Gas Monitoring

The fire and gas protection system is comprised of an Eagle Quantum Premier FPP (fire protection panel) that is linked to thermal spot temperature detectors, and gas detection sensors inside and outside the turbine compartment. The fire and gas protection system interfaces with the turbine control system to provide the necessary system alarms and shutdowns.

Digital Multi-Function Meter (DMMF)

The SATEC PM174 multifunction generator meter simplified monitoring of generator electrical conditions and power output. Values are relayed via EGD to the main control system for display on the HMI.

10.3 Main Generator Terminal Box (MGTB)

This panel provides the wiring interface between the TCP and GCP panels; it is primarily used for I/O (Input/ Output) wiring related to the generator.

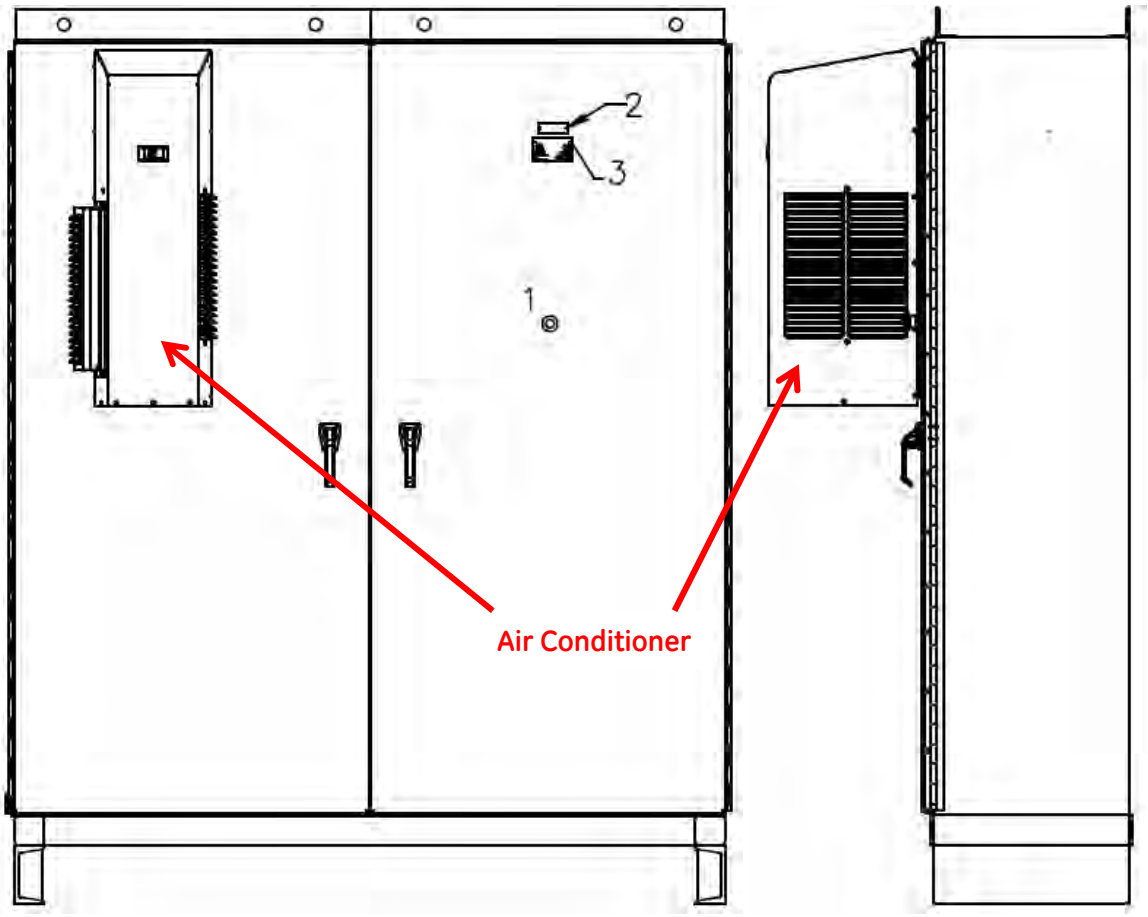
10.4 Operator Interface

The operator interface is commonly referred to as the HMI. It is a PC with a Microsoft® Windows®-based operating system, client/server capability, a PROFICY CIMPLICITY HMI graphics display system. The Human-Machine Interface (HMI) displays turbine operations data on various system screens. It includes operator input and function pushbuttons. Ethernet switches are part of the unit data highway (UDH) connecting the HMI server with the RX3i and other unit control equipment.

System (process) alarms for fault conditions are time tagged at frame rate in the controller(s) and transmitted to the HMI alarm management system. System events are time tagged at frame rate alarms can be sorted according to ID, time, and priority. A standard alarm/event log stores data for 30 days and can be sorted in chronological order or according to the frequency of occurrence.

Data is displayed in English or Metric engineering units with a one second update rate. Operator commands can be issued to increase / decrease a set point or a numerical value can be entered for a new set point.

10.5 Digital Control and Monitoring System



Front View Side View

Turbine Control Panel Tag List		
Item #	**Item Description**	**Tag**
1	SWITCH, EMERGENCY STOP (TCP)	ESTCP
2	NAMEPLATE	
3	IP RATING NAMEPLATE	

Figure 10.1a Turbine Control Panel (TCP)

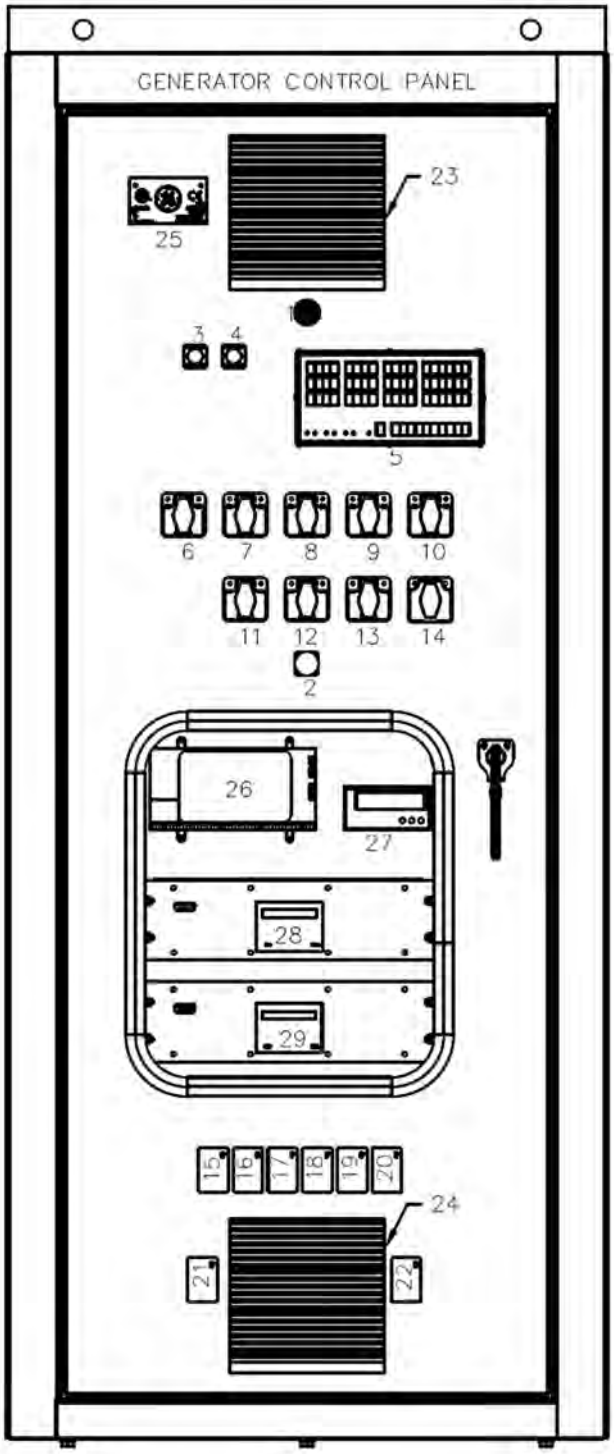


Figure 10.1b Generator Control Panel (GCP)
(See following page for item descriptions)

Generator Control Panel Tag List (GCP)		
Item #	**Item Description**	**Tag**
1	HORN	
2	SWITCH, EMERGENCY STOP (GCP)	ESGCP
3	LAMP, SYNCHRONIZING	SL1
4	LAMP, SYNCHRONIZING	SL2
5	METER, DIGITAL MULTIFUNCTION DISPLAY	DMMF DIS
6	SWITCH, TURBINE START-STOP (GCP)	TSS
7	SWITCH, SYNCHRONIZE	SS
8	RELAY, LOCKOUT (GENERATOR)	86G
9	SWITCH, EXCITATION MODE	EMS
10	SWITCH, AUTOMATIC/MANUAL VOLTAGE REGULATOR ADJUST	AMVAS
11	SWITCH, CIRCUIT BREAKER CONTROL “52G”	CBCS1
12	SWITCH, PF/VAR CONTROL ENABLE	VCES
13	SWITCH, SPEED ADJUST	SAS
14	SWITCH, LOCAL/REMOTE SELECTOR (GCP)	LRS
15	SWITCH BLOCK, TEST , BUS VOLTAGE	TSB1
16	SWITCH BLOCK, TEST , GENERATOR VOLTAGE	TSB2
17	SWITCH BLOCK, TEST , GENERATOR CURRENT METERING	TSB3
18	SWITCH BLOCK, TEST , BUS CURRENT PROTECTION	TSB4
19	SWITCH BLOCK, TEST , GENERATOR CURRENT PROTECTION	TSB5
20	SWITCH BLOCK, TEST , GENERATOR LOCKOUT RELAY (86G)	TSB6
21	SWITCH BLOCK, TEST , SPARE	TSB7
22	SWITCH BLOCK, TEST , SPARE	TSB8
23	FILTER, GENERATOR CONTROL PANEL	FLTR2
24	BLOWER, GENERATOR CONTROL PANEL	BLR2
25	NAMEPLATE	
26	PANEL, FIRE PROTECTION	FPP
27	SYNCHRONIZER, AUTO SPEED-VOLTAGE MATCHING	DSM
28	INTEGRATED GENERATOR PROTECTION SYSTEM (50 Hz)	IGPS1
29	INTEGRATED GENERATOR PROTECTION SYSTEM (60 Hz)	IGPS2

11. Buyer Furnished Equipment and Services

In order to provide a complete operational installation, additional equipment and services, not included in the basic unit scope, must be provided by the buyer or the installer, unless modified by specific agreement. These include, but are not limited to, the following:

11.1 Civil / Structural

- Grounding grid and connections, lightning protection
- Necessary drainage, including sumps and drain piping
- Site facilities
- Support steel works and hangers for gas turbine ducting, silencing and pipe work.

11.2 Mechanical

- In accordance with GE fuel specifications listed in Section 12:
  - Natural Gas: Provide 50°F (28°C) of heating above the dew point. In addition, a gas shutoff valve located remotely from the unit must be provided to shut off the gas supply to the turbine when the unit is not in operation
  - #2 Distillate Oil: Provide storage tanks, filtration/purification systems, and piping to the liquid fuel inlet.
- Demineralized water for the water injection system at required pressure
- Heated fluid for anti-icing system, if included
- Access ladders and platforms as required

11.3 Electrical

- 480 VAC (60 Hz) or 400 VAC (50 Hz) electrical power for gas turbine starting and accessories
- Electrical power connections (power cable or duct) from the generator lineside cubicle to the Buyer's electrical systems
- Electrical control connections from the on-base terminal points to the turbine generator control panel and to the Buyer's systems

- Motor control centers (MCC) auxiliary power transformers distribution panel as necessary for station services such as:
  - Fuel Gas Compressors
  - Distillate Fuel Forwarding Skids
  - All MGTG Package Auxiliary Loads
- The following cables:
  - Power cables from the Buyer 's electrical system to the MCCs Load sharing control
- Power system studies
- Distribution plant control
- Customer remote control (Quoted separately)
- High voltage transformers, cables, and associated equipment
- Balance of plant and energy optimization controls
- Sensing and metering voltage transformers
- Generator controls other than defined in scope of supply
- See the "One Line Diagram" in Section 9 of this document for further definition

11.4 Miscellaneous Services (quoted separately)

- Transport, unload, place and install the equipment
- Construction services including electric power, lighting, temporary heaters, test equipment, compressed air, crane(s) and all required standard tools
- Storage and security for equipment received
- Site labor
- Field supervision (quoted separately)

11.5 Balance of Plant Equipment (as necessary)

- Fuel gas filtration, separation or regulation
- De-aeration and chemical injection equipment
- Heating Medium feed pumps and auto level control assemblies
- Automatic blow down controls
- Non-standard inlet filter house support structures
- Power plant calibration tools
- Spare parts and consumables
- Distillate fuel filtration and purification systems

11.6 Start-Up/Test (quoted separately)

- Operating personnel for starting, preliminary runs and tests
- Lubricating fluid, greases, and supplies for starting, preliminary runs, tests and normal operation thereafter.
- All field performance tests. Such tests to measure quoted guarantees shall be in accordance with General Electric recommended test procedures. Fuel and load for tests are customer owner responsibilities.

Note: Various types of contracts are available from NPAOy, thus the above may not reflect the contracted scope. In case of conflict, the agreed upon Contract with NPAOy prevails.

12. Reference Specifications

Fuel Gases for Combustion in Aeroderivative Gas Turbines	MID-TD-0000-1
Liquid Fuel Requirements for GE Aeroderivative Gas Turbines	MID-TD-0000-2
Requirements for Water and Steam Purity for Injection in Aero Derivative Gas Turbines	MID-TD-0000-3
Compressor Cleaning Water Purity Specification for GE Aircraft Derivative Gas Turbines in Industrial Applications	MID-TD-0000-4
Liquid Detergent for Compressor Cleaning for GE Aircraft Derivative Gas Turbines	MID-TD-0000-5
Lubricating Oil Specification for GE Aircraft Derivative Gas Turbines	MID-TD-0000-6
Water Supply Requirement for Gas Turbine Inlet Air Evaporative Coolers	GEK 107158

13. Maintenance, Special Tools and Spare Parts

13.1 Maintainability Features

The LM2500+G4™ gas turbine is designed for high availability. The principle maintainability features include:

- Modular construction permits replacement of the aero components without total disassembly.
- Multiple borescope ports allow on-condition monitoring without turbine disassembly.
- Condition based maintenance and remote diagnostics will be employed.
- Split casing construction of the low-pressure compressor (LPC) and high-pressure compressor (HPC) allows detailed inspection and partial blade replacement on-site.
- Hot section field maintenance can be done in a few days.
- Accessories are externally mounted for ease of on-site replacement.

13.2 Service Intervals

The expected service intervals for the LM2500+G4™ gas turbine (based upon normal operation) are:

Hours of Operation	Scheduled Maintenance Action	Outage Duration
4,000	Inspection (Every 4,000 hours)	12-16 hours
25,000	On-site Hot Section Replacement	3 days
50,000	Depot Refurbishment*	2-3 days
75,000	On-site Hot Section Replacement	3 days
100,000	Depot Refurbishment*	2-3 days
125,000	On-site Hot Section Replacement	3 days

* Spare or lease engine installed during refurbishment.
Maintenance intervals above are based on gas fuel operation.

13.3 On Condition Maintenance

The LM2500+G4™ gas turbine is designed for easy maintenance. To reduce maintenance time, the LM2500+G4™ gas turbine has a horizontally split compressor casing and external fuel nozzle access. Twenty-one borescope inspection ports permit "on condition maintenance." Under this plan, the engine is given a thorough internal borescope inspection every 6 months. This inspection reveals mechanical problems and wear. Replacement parts are installed only when the inspection shows a specific need, rather than on an arbitrary time schedule. For example, in a hot section repair, individual blades and vanes are replaced as necessary, rather than replacing the entire set (of high-pressure blades or nozzles). This "on condition" repair saves parts, labor and downtime. It eliminates the waste caused by maintenance plans based on clock hours only.

13.4 Preventive Maintenance

GE/NPAOy literature and training stress preventive maintenance. Less downtime and reduced cost-of-ownership are achieved when operators take the following preventive measures:

- Condition monitoring of critical parameters
- Trend analysis of performance
- Visual inspection of auxiliary systems and external wiring
- Borescope inspection
- Water wash
- Filter changes and inspections
- Lube oil sampling

In addition, Distributed Power trains operators to perform routine "condition monitoring," to include:

- Gas generator speed
- Power turbine speed
- Gas generator exhaust gas temperature
- Gas generator discharge pressure
- Vibration
- Oil pressure & temperature

Condition monitoring, in conjunction with borescope inspections, can provide an essential history of engine condition versus operating time. This allows maintenance to be predicted and scheduled for an appropriate time.

13.5 Water Washing

Water washing the turbine helps to recover performance that has been lost over time due to compressor airfoil fouling.

All LM2500® units have a "crank soak" or off-line cycle capability. The engine bell mouth is equipped with a spray manifold for water detergent solutions and rinse water.

13.6 Maintenance Level

On-site and off-site maintenance tasks are divided into categories, or "levels," described below. Downtime for maintenance is reduced by virtue of the LM2500+G4™ gas turbine's modular design. Routine maintenance tasks are done on-site, while major engine repairs are performed at specialized off-site facilities, saving the customer the expense of tooling and equipment.

On-Site Maintenance

Level 1

On-Site External Maintenance - includes protective and corrective tasks such as:

- Adjusting or replacing externally accessible components
- Engine replacement
- Compressor Cleaning (Off-line Water Wash)
- Scheduled Inspections

Level 2

On-Site Internal Maintenance & Module Replacement - requiring partial disassembly of the engine and replacement of components including:

- Compressor blade/vane replacement
- Hot section component replacement
- HPT blade replacement
- Accessory Gearbox

Off-Site Maintenance

Level 3
Off-Site Internal Maintenance - includes all Level 2 capabilities, plus a complete teardown and rebuilding of engine, and replacements of major sub-assemblies (with spare sub-assemblies).

Level 4
Off-Site Overhaul - includes Level 3 capabilities plus complete disassembly of the major sub-assemblies of the gas turbine and rebuilding sub-assemblies with replacement parts. A permanent shop and a test cell are required for a Level 4 overhaul facility.

Distributed Power has full Level 4 maintenance capabilities for customer's needs. We feature full-load testing of the repaired engine to assure maximum field performance.

13.7 Owner's Maintenance

In most cases, the Owner prefers to have their operators trained to perform Level 1 maintenance to the gas turbine, and Levels 2 - 4 maintenance tasks handled by outside contract. However, Distributed Power can train operators for Level 2 maintenance tasks if desired.

13.8 Special Tools

Special tools are required to provide Levels 1 and 2 maintenance activities. These tools are offered at a separate price for customers desiring to perform maintenance themselves. The tooling to remove and install the turbine from the engine compartment is provided by Distributed Power in the basic scope of supply. Lifting pins & rigging required at initial startup are provided without charge if returned to Distributed Power (freight prepaid) after the equipment is installed.

14. Customer Drawings and Documentation

General Overview

Distributed Power prepares a comprehensive drawing package for each gas turbine generator set. The package includes:

- Proposal Drawings **-** Drawings furnished with the proposal to assist Customer evaluation of the product.
- Project Drawings **-** Approval and Information Drawings furnished as part of the project to document the contractual configuration gas turbine generator set. Approval Drawings are submitted for specific customer approval, while Information Drawings are of standard manufactured items in the turbine package furnished for customer information only.

Distributed Power provides all engineering drawings on-line at a secure server, Documentum . Each customer can enter this database and view, print or annotate project drawings. Documentum provides the customer with immediate access to the latest drawings revisions. Documentum speeds job completion and saves weeks of time mailing drawings back and forth.

Distributed Power also provides extensive documentation to help install, commission, operate and maintain the Mobile Gas Turbine Generator set. These unit specific manuals are made available on a secure Internet website, as well as in hardcopy and digital media versions.

This documentation includes:

- Installation and Commissioning Manuals
- Operation and Maintenance Manuals
- Gas Turbine Operation and Maintenance Manuals

14.1 Customer Drawings

Proposal Drawings

These drawings are “Preliminary” in nature. They help to define the product for evaluation, and they form the basis for an Engineering “ODM” (Order Definition Meeting) following contract award.

Distributed Power prepares Proposal drawings to show:

- General Arrangement of the Mobile Gas Turbine Generator set
- Electrical "One Line" Information

Project Drawings

Approval Drawings

After the contract ODM, which defines the project details, Distributed Power updates the general arrangement and one-line drawings and submits them for Customer approval.

General Arrangement Drawings

These drawings define the orientation of the major Distributed Power modules. A general arrangement drawing with Plan and Elevation views is prepared for each of the following major components:

- Mobile Gas Turbine Generator set and Control House trailer
- Turbine Control panel
- Generator Control Panel
- Battery System

The general arrangement drawings include the following information:

- Overall dimensions of the equipment
- Weights and centers of gravity of assemblies
- Access space required for removal or maintenance of major components
- Foundation loads, foundation bolthole locations and sizes, plus any special requirements
- Lifting arrangements and provisions
- Customer piping connections with appropriate dimensions

One Line Electrical Drawings

These drawings are an electrical schematic of the power system from the generator terminals to the purchaser's high voltage bus and ground connections, including the generator excitation and synchronizing systems. Also shown are the protective relays, potential transformers, circuit breaker, and auxiliary/main transformers, some of which may be furnished by others. In cases where the Distributed Power equipment will be interfaced with an existing facility or with customer supplied

devices, a customer's one line drawing must be furnished to Distributed Power for preparation of the Distributed Power one line electrical diagram.

Revisions to Approval Drawings

Customer should mark any requested revisions on one copy of the Approval Drawings and return them to Distributed Power within two weeks. Distributed Power will then reissue drawings showing mutually agreeable corrections. When returning drawings electronically, the customer should make any requested revisions electronically on the Approval Drawings through the Documentum website, and submit them to Distributed Power within two weeks. Distributed Power will then upload revised drawings showing mutually agreeable corrections.

Certified Drawings

Distributed Power certifies only drawings showing anchor bolt locations, foundation loading and customer piping connection locations.

Information Drawings

These drawings cover standard manufacturing items. They provide a reference for construction, maintenance and operations. The drawings are submitted for "information only" and are not subject to approval.

Electrical System Interconnection Plan

This drawing shows recommended sizes for interconnecting cables and corresponding minimum cable lengths between Distributed Power supplied modules and the customer's control room. The Interconnection plan assists the customer in purchasing wire and cable for interconnection and helps in planning the site layout. Point-to-point interconnection wiring diagrams are also provided. These drawings are completed after other system drawings have been finalized.

Flow and Instrument Diagrams (F&ID)

F&IDs are issued for each of the fluid systems in the Distributed Power scope of work. This typically includes the following:

- Fuel System with Water Injection
- Off-Line Water Wash System
- Hydraulic Start System
- Turbine Lube Oil System
- Generator Lube Oil System
- Fire and Gas Protection System
- Ventilation and Combustion Air System
- Laser Alignment System

Each F&ID drawing shows the equipment components, piping, valves and instruments in the system, complete with piping line sizes. The part number of each item on the F&ID is shown on a bill of material, which is part of each F&ID drawing. The F&IDs also show the pressure, temperature and volume limitations of the system, including set points for alarms and shutdowns. Each working fluid in the system is identified and initial fill quantities for fluid reservoirs are shown. For clarity, the F&ID drawings are schematic in nature. Pipe elbows, fittings and similar details are omitted.

Plan and Elevation

This Plan & Elevation drawing provides installation details for operator information. The drawing shows the front of the unit control panel as viewed by the operator, including meters, indicator lights, and switches. Overall dimensions and installation footprint are shown on this drawing. Plan and Elevation drawings include the Turbine Control Panel, Generator Control Panel, and the Battery System.

Drawings with Manuals

In addition to the above drawings, a complete set of system wiring diagrams is included in the operation and maintenance manuals to serve as a reference for field checkout and troubleshooting.

Typical Drawing List for the MGTG Package

Some of the drawings listed in the table below may not be applicable to specific projects.

Typical mechanical, electrical, and reference drawings and their submittal times in weeks are shown in the following tables. Please note that some drawings listed in the following tables may not be applicable to specific projects.

Mechanical Drawings

Drawing Title	Code	Group	Timing
General Arrangement, TM2500 GEN8	CA	1	4
Plot Plan and Foundation Load Table TM2500 GEN8	CI	1	4
Transportation Arrangement, TM2500 GEN8	CI	1	4
Lifting Arrangement, TM2500 GEN8	CI	1	4
Flow & Equipment Symbols, Mechanical	CI	2	5
Flow & Instrument Diagram, Hydraulic Start System	CI	2	5
Flow & Instrument Diagram, Dual Fuel System with Water Injection	CI	2	5
Flow & Instrument Diagram, Ventilation and Combustion Air System	CI	2	5
Flow & Instrument Diagram, Turbine Lube Oil System	CI	2	5
Flow & Instrument Diagram, Generator Lube Oil System	CI	2	5
Flow & Instrument Diagram, Fire & Gas Protection System	CI	2	5
Flow & Instrument Diagram, Off-Line Water Wash System	CI	2	5
Instrument Diagram, Auxiliary Systems	CI	2	5

Electrical Drawings

Drawing Title	Code	Group	Timing
One-Line Diagram	CA	1	4
Three-Line Diagram, Generator Metering	CI	1	4
Electrical Symbols, Abbreviations and Reference Data	CI	1	4
Plan & Elevation, Turbine Control Panel	CI	1	4
Plan & Elevation, Battery System	CI	1	4
Schedule, Motor Control Center	CI	1	4
Generator Protective Relay Settings	CI	2	5
Area Classification Drawing	CI	2	5
Area Classification Report	CI	2	5
Digital Multifunction Meter Settings	CI	2	5
Automatic Voltage Regulator Settings	CI	2	5
SPM-Digital Synchronizer Settings	CI	2	5

Electrical Drawings (continued)

Drawing Title	Code	Group	Timing
Speed Switch Settings	CI	2	5
Schematic Diagram, Motor Control Center	CI	3	6
Schematic Diagram, Discrete Control	CI	3	6
Schematic Diagram, Analog Control	CI	3	6
Schematic Diagram, Circuit Breaker Control	CI	3	6
System Schematic, Generator Excitation	CI	3	6
System Schematic, Lighting & Distribution	CI	3	6
System Schematic, Fire & Gas Protection	CI	3	6
System Schematic, Vibration	CI	3	6
System Schematic, Communication	CI	3	6
Worksheet, Fuel Control & Sequencer Layout	CI	3	6
Worksheet, Control System	CI	3	6
Interconnect Plan, Electrical, Customer	CI	3	6
Interconnect Wiring Diagram	CI	3	6
Interconnect Wiring Diagram, Control House	CI	3	6

Reference Drawings

Drawing Title	Code	Group	Timing
Wiring Diagram, Turbine Control Panel, Control Cubicle	M	-	-
Wiring Diagram, Turbine Control, Termination Cubicle	M	-	-
Wiring Diagram, Turbine Skid	M	-	-
Wiring Diagram, Auxiliary Skid	M	-	-
Wiring Diagram, Air Inlet Filter	M	-	-
Wiring Diagram, Generator Skid	M	-	-
Wiring Diagram, Lineside Cubicle	M	-	-
Wiring Diagram, Neutral Cubicle	M	-	-
Wiring Diagram, Fire & Gas Protection System	M	-	-
Nameplate List, Engraving Schedule & Switch Development	M	-	-

Notes:

1. CA = Customer approval. Customer Approval is limited to errors, omissions, or corrections of standard designs and verification that customer selected options have been included. Customer is allotted 3 weeks (21 calendar days) for review of approval drawings. After this time has passed with no communication of changes from customer, the drawings will be deemed acceptable.

2. CI = Customer information only, not an approval drawing
3. M = Drawings supplied with operation and maintenance manuals. Supplied approximately 30 days after RTS
4. Submittal time is for a contract with standard equipment and is shown in weeks after the post award Customer Kick-Off Meeting (CKOM).
5. Drawing dates for standard equipment only. Custom designed features for specific project requirements may require additional times for drawing submittals.
6. A drawing is considered submitted when uploaded to the online secure internet site
7. For submittal of drawings, there are three groups:
   Group 1 = 4 weeks Group 2 = 5 weeks Group 3 = 6 weeks
8. Distributed Power places customers' drawings on a secure internet site. On this site the drawings can be viewed, printed and annotated by the customer.
9. Distributed Power provides all manuals in CD format for convenient access and distribution. In addition, by using web-based technology GE provides today's customers instant and secure access to their unit's operation and maintenance documentation with easy updates and "real time" information.

14.2 Documentation

Distributed Power provides extensive documentation to help install, commission, operate and maintain the Mobile Gas Turbine Generator set. The above-mentioned documentation includes:

Installation & Commissioning Manual (ICM)

The Installation section of the manual provides detailed instructions on:

- Transporting, receiving and inspecting the equipment
- Assembly of the components
- Scheduling, manpower and tooling

The Pre-Commissioning section of the manual provides detailed instructions on:

- Mechanical and Electrical pre-commissioning activities complete with checklists
- Scheduling, manpower, and tooling

The Commissioning section of the manual provides detailed instructions on:

- Commissioning activities including pre-start testing, rotation test, initial fired start, and auxiliary systems
- Scheduling, manpower, and tooling

The Installation & Commissioning Manual is a one-volume publication. Three copies are shipped to the job site approximately 1 month before shipment of the Gas Turbine Generator.

Operation and Maintenance (O&M) Manuals

A team of engineers, writers, illustrators and editors prepares this multi-volume manual. It is specifically edited for each project to include project specific drawings and details.

The O&M manual is designed as a reference for the operators and technicians in the field. It provides system descriptions, specifications, and procedures for field operation and maintenance. Project details and illustrations are included for the following:

- Product Description
- Turbine and Generator Specifications
- Unit Operating Procedures
- Turbine Operating Sequences
- Generator Operating Data
- Control System Components & Operations
- Fire & Gas Protection System
- Electrical and Mechanical drawings

In addition to the above information, Distributed Power includes vendor's operation and maintenance data on all major systems and components.

Six copies of the O&M manuals in CD form are shipped approximately 30 days after shipment of the Gas Turbine Generator. This allows Distributed Power time to include the latest engineering drawings. The manuals are also available on a secure internet website.

Drawing Quantities and Format

Distributed Power places customers' drawings on Documentum, a secure internet site. On this site the drawings can be viewed, printed and annotated by the customer.

Distributed Power provides all manuals in CD format for convenient access and distribution. In addition, by using web-based technology Distributed Power provides today's customers instant and secure access to their unit's operation and maintenance documentation with easy updates and "real time" information.

15. Extended Scope Equipment and Services

15.1 Extended Scope Equipment

Distributed Power can supply additional equipment upon request to support the turbine generator package.

Continuous Emissions Monitoring System

Distributed Power can provide a Continuous Emissions Monitoring (CEM)/Data Acquisition Historical Storage (DAHS) system for the gas turbine package. The system utilized is an extractive sampling system that is capable of monitoring NOx, CO, CO_2, O_2, and NH_3. The system is provided complete with a walk-in shelter with a wall-mounted air conditioning unit. The system will also consist of the necessary stack probes and sample lines.

Distributed Power can provide the following equipment and services, as an option, if required for the project:

- Uninterrupted Power Supply (UPS) for PLC and analyzers
- Inlet NOx for SCR system/performance measurement
- Opacity monitoring system
- Installation and commissioning supervision
- Training
- Certification testing by a third party tester

Initial Fill Lubricants

GE/NPAOy can provide first fill of lubricants to include the turbine lube oil, generator lube oil (includes low pressure compressor), hydraulic start system oil and chemical water wash.

Oil Type	Specification
Turbine Lube Oil / Hydraulic Oil – Synthetic	MIL-TD-0000-6
Generator Lube Oil – Mineral	ISO-VG32
Water Wash Chemical	MID-TD-0000-5

Auxiliary Transformer – Low Voltage

Distributed Power can provide pad mounted auxiliary transformers for the various plant loads as required. The size of the transformers is dictated by the plant design.

Black Start Generator

Distributed Power can provide a diesel engine driven generator package to provide MGTG start-up capability in the event of a loss of connection to the grid. For black starts, the diesel generator provides AC power for the MGTG hydraulic starter motor, package ventilation fans, and various accessories. In addition to the diesel engine and generator, the black start system includes a breaker cubicle, distribution and control panel, and fuel tank.

15.2 Extended Scope Services

Installation and Commissioning Services

Distributed Power can provide technical advisory supervision services for the Installation and Commissioning of the combustion turbine package. Installation services include supervising the installation of the combustion turbine package by the Owner's construction contractor. Commissioning services will include commissioning supervision of combustion turbine mechanical systems, checkout and commissioning supervision of combustion turbine electrical systems, and checkout and commissioning of the combustion turbine package control system. When contracted for installation and commissioning services, Distributed Power will provide all general hand tools required for the commissioning of the unit.

Engineering Studies

Distributed Power can provide other various engineering support services including complex or new product design, troubleshooting, problem solving, and power plant conceptual layouts. Quite often, Distributed Power will coordinate with third party expertise to meet the project requirements.

Exhaust Emissions Testing

Distributed Power can provide complete and comprehensive combustion turbine exhaust emissions mapping testing services for the project if required. For these services, GE/NPAOy will provide a testing specialist at the jobsite to conduct the typical exhaust emissions testing services including:

- Preliminary O_2 traverse, if required
- Nitrogen oxides (NOx)
- Carbon monoxide (CO)
- Unburned hydrocarbons
- Oxygen (O_2)

A formal site data test report will be provided once the testing is completed.

Extended Scope Systems Training

In conjunction with the training provided by the gas turbine instructors, Distributed Power can provide specialized operator training on each of the extended scope systems.

16. Customer Technical Training

GE Power & Water's Customer Technical Training (CTT) is your key to turning knowledge into power by providing high-quality training that will help you maximize the efficiency of your equipment, minimize the costly mistakes that can jeopardize your plant, and build life-long skills. We offer a variety of training solutions for GE Heavy Duty Gas Turbines, Steam Turbines, Generators, Control Systems, Aeroderivative LM Turbines, and Package Training. Our training courses are conducted by high-caliber instructors who are experts in OEM design, installation, maintenance, and startups.

Training is not one time, one class, one subject matter, but rather a continuous path of learning for plant personnel to gain the knowledge needed to achieve success in running an efficient, well-operated and well-maintained plant. Our instructors, training options, and Learning Paths will help you achieve these goals. Go to CTT's website www.geenergytechnicaltraining.com for further details on course schedules and locations.

16.1 Course Offerings

Gas Turbine Familiarization
Gas Turbine - Level 1 & 2: Hot and Cold Section Maintenance (Open Enrollment only)
Borescope Inspection (Open Enrollment only)
Package Operations & Familiarization
Package Maintenance
Package Controls Systems - Operation, Maintenance, and Troubleshooting
Turbine Controls – Training for Operators, Maintenance Technicians & Engineers
Generator Excitation Maintenance - Operation, Maintenance, and Troubleshooting (Intro and Advanced)
Generator & Electrical Training (Online Course)
Gas Turbine Systems (Online Course)
DLE Familiarization and Mapping Overview (Open Enrollment only)

***** Reference CTT website for a complete list of courses, their available delivery methods and locations.

16.2 Customer Technical Training Locations

All training courses conducted at CTT locations have been founded on decades of experience and are reflective of the latest processes and proven practices. Each year we train over 15,000 students and grow their knowledge within a top notch-learning environment, which includes fully equipped classrooms and labs.

Locations:

- Houston, Texas
- Greenville, South Carolina
- Salem, Virginia
- Schenectady, New York
- Belfort, France
- Dammam, Saudi Arabia
- Seoul, Korea Republic
- Castle Hayne, North Carolina
- Graz, Austria
- Atlanta, Georgia
- San Jose, California

16.3 Training Delivery Methods

Online Courses - Our various online learning solutions will help you train your personnel anytime, anywhere. Once a course is purchased, the student will have unlimited access to the training for 6 months. During this time, students are able to learn at their own pace, and retrain on any modules as they see fit. Online courses are a cost effective, flexible solution for staff members who may not be as experienced and require extra training.

Open Enrollment Training - These courses have been designed to help you maintain a trained work force that is skilled in controls, operations, and maintenance. These courses offer you the opportunity to train at a GE Facility with students from around the world. This training is also a cost effective alternative for customers who have a small staff, or new team members.

On-Site Plant Specific Training - Site-Specific training provides you the opportunity to have a course tailored to your Site-Specific information, as opposed to the Open Enrollment courses which are typically generic in content. Site-Specific training can be conducted on-site, which provides the opportunity for saving on travel expenses and time away from work. However, always available is the option to conduct the training at one of our GE Facilities. This option removes participants from the daily work area and interruptions that can reduce the quality of training.

16.4 Typical Gas Turbine Familiarization

Basic Gas turbine theory and operation and the knowledge required to ensure consistent, trouble-free performance from the engine and its associated equipment.

The Gas Turbine Familiarization course covers the following areas:

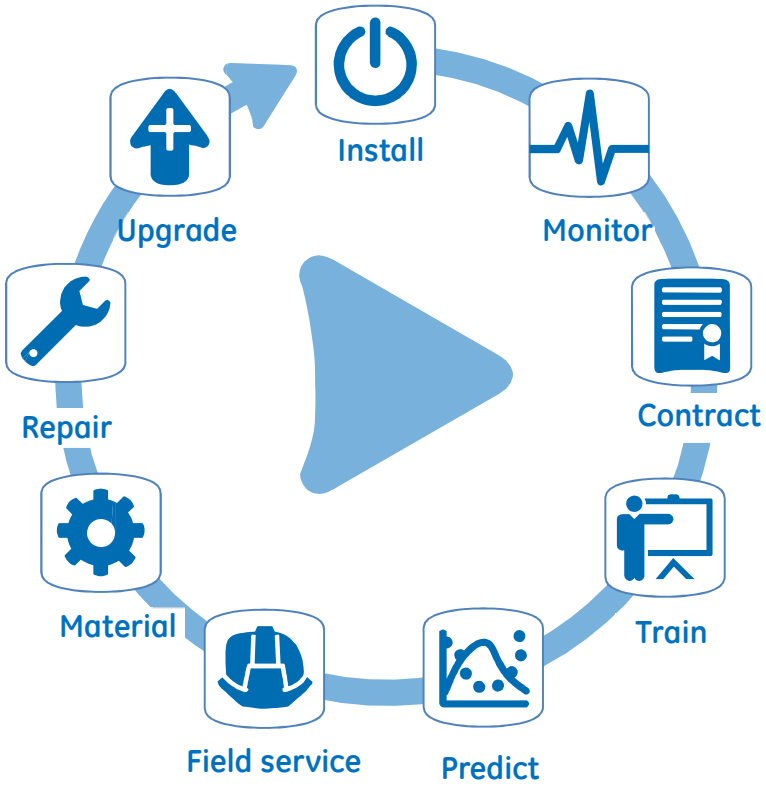
- Introduction and History of the LM2500®/lineage
- Terms and abbreviations
- Frames, Cases and Rotors
- Comparison 2500 versus 2500+
- VSV Control System - Overview, Operation and Limits
- Air Systems - Primary / Secondary / Parasitic
- HP recoup / Thrust Balance
- Fuel Systems
- Sump Pressurization
- Bearings
- Oil System- Component Description / Function / Operation
- Sensors / Instrumentation

Duration: Three (3) consecutive days in length, exclusive of weekends and holidays.
Textbook: Student textbooks are supplied and will be retained by the customer.
Language: English

16.5 Customer Technical Training - Contact Info

For more information about gas turbine and/or package technical training contact your regional NPAOy Sales Person, Service Manager, or Contract Manager.

17. Aftermarket Services



Modern energy production demands reliable, efficient asset operation. By combining innovative technology, service and support, GE/NPAOy brings value across the life cycle of your asset. GE/NPAOy's Distributed Power business delivers results in reduced unplanned downtime, increased workforce efficiencies and reduced operating costs. Whatever your equipment or your task, you're in the hands of established experts.

We bring a powerful combination of skill, expertise and process improvement to worksites across the globe. Helping operators and technicians become more efficient and productive, while increasing engine uptime from the first moment of startup.

17.1 Services Overview

Distributed Power has a full portfolio of offerings to help its customers focus on their core business activities while we do the rest. Our LM2500®/TM2500® Services include:

- Conversions, Modifications, and Upgrades
- Contractual Service Agreements
- Predict
- Material
- Installation and Commissioning
- Remote Monitoring, Diagnostics and Servicing
- Training
- Field Service
- Overhaul and Repair Services

17.2 Installation and Commissioning

Planning and installation from one trusted source - GE/NPAOy can fulfill your project requirements with multiple technologies combined into a single turnkey installation. One convenient package can encompass everything you need, including a reciprocating engine or gas turbine, the catalytic converter, the heat exchanger and all balance-of-plant equipment and controls. Our experienced certified field technicians make sure your engines and turbines are installed according to your requirements.

GE/NPAOy's technical experts also have the ability to help you:

- Develop your balance-of-plant specifications
- Perform engineering and site and design work to meet spatial requirements

Because all installations can be removed for maintenance at the same time, GE/NPAOy's comprehensive packages streamline your service experiences.

17.3 Remote Monitoring, Diagnostics and Servicing

Remote Monitoring and Diagnostic technology to reduce unplanned downtime - Our Remote Monitoring and Diagnostic (RM&D) technology gives you 24/7 access to proactive data analysis. Pressure, temperature and ignition monitoring offer a variety of advantages:

- Guiding service planning
- Managing operations
- Reducing operating costs
- Increasing equipment availability
- Reducing corrective maintenance expenses
- Online monitoring of engine parameters
- Remote software updates

With timely and accurate technical support, our remote monitoring, diagnostics and servicing is provided globally through our service network.

17.4 Contractual Service Agreements

Customized to your specific needs - Multi-Year agreements help protect your investment, and are custom-tailored to your exact needs. Each contract integrates the latest OEM technological knowledge with a full range of remote monitoring diagnostic solutions, field services, original spare parts and repairs.

Service agreement benefits include:

- Full or partial maintenance cost risk transfer
- Predictable costs
- Maintenance planning
- Performance improvement
- Outages aligned with workload
- Greater availability of parts, materials and technicians
- Thermal and operational performance programs
- Condition-based maintenance options
- Lease engine and unit exchange options

Our flexible service agreements meet your maintenance requirements while giving maximum cost control for the life of your equipment.

17.5 Training

Expert training for improved operations - GE/NPAOy's training instructors use extensive engine expertise and decades of industry knowledge to help improve the skillsets of your technicians helping them to work better, faster and smarter.

Training features:

- Highly knowledgeable and skilled technical trainers
- Hands-on activities and in-class exercises to drive retention of the skills and knowledge technicians need
- Advanced technical training in multiple languages
- One-on-one training
- Available at any location for aeroderivative gas turbines or reciprocating engines
- Available on your jobsite
- The latest product information
- Easy-to-read operating manuals
- Electronic assistance
- Easy-to-read operating manuals and service bulletins

Our participant-oriented training programs ensure the best operation and maintenance of your equipment.

17.6 GE's Predictivity™

Real-time data meets real-world demands - GE/NPAOy's Predictivity™ portfolio of Industrial Internet solutions combines machine data, predictive analytic software and GE/NPAOy expertise to proactively manage machine repairs. This data-based solution delivers numerous benefits:

- Eliminates unplanned downtime
- Increases workforce efficiency
- Reduces operating costs
- Uncovers new revenue opportunities

Sensors feed data to predictive analytic solutions, allowing operating teams to intervene and take corrective action with:

Proactive notification
Alerts operating staff at the first sign of an event, so action can be taken quickly

Performance analysis
Enhances sub-system understanding of event risks during engine operation, enabling proactive maintenance scheduling

Root cause identification
Eliminates uncertainty and facilitates faster correction by using engineering expertise to discover the root cause behind the issue

17.7 Field Service

Professional expertise, immediate availability - More than 460 dedicated service technicians are standing by to assist you, all trained on Distributed Power solutions and backed by local support in more than 170 countries. Together, they use the highest-quality parts, tools and technical support to reduce downtime and operating costs while improving plant safety and efficiency.

17.8 Material

Enhanced performance, reliability and durability - GE/NPAOy uses advanced engineering techniques and high-quality materials to manufacture spare parts that get more out of your assets. Every part is thoroughly tested, and backed by our OEM warranty.
We also offer reUp™, a remanufactured parts program for reciprocating engines that returns previously used parts to their original factory specifications. Remanufactured GE parts are guaranteed to work seamlessly with new engine parts, and are backed by the same robust warranty. Our original spare parts ensure maximum service life and reliability for your equipment.

We also offer asset management, including full engine and modular exchanges, and lease offerings.

17.9 Overhaul and Repair Services

Innovative repair, overhaul and upgrade solutions - As the original manufacturer, no one knows your engine throughout its life cycle better than GE/NPAOy. Our Distributed Power business' 12 service centers provide expert solutions to help you maintain and enhance the performance of your reciprocating engines and aeroderivative equipment.

At our centers, you benefit from ongoing innovative repair, overhaul, and upgrade solutions throughout the life cycle of your products. Furthermore, as an OEM, we offer the latest technologies in accordance to standards, hardware and controls upgrades and emissions upgrades.

17.10 Configuration, Modifications and Upgrades

Complete solutions for all-around asset enhancement - Upgrade offerings leverage the latest technology and engineering expertise, allowing you to keep pace with changing market conditions and new industry needs and challenges. By providing added flexibility and capability to your equipment, GE/NPAOy's Conversions, Modifications & Upgrades (CM&Us) will allow you to keep increasing the value of your equipment through its operating life.

GE/NPAOy's engineering skills and expertise is used to develop solutions that:

- Increase output
- Improve efficiency
- Increase availability
- Enhance operational flexibility
- Extend asset life
- Reduce emissions
- Lower operating costs

CM&U solutions are available for turbines, engines, their associated packages and/or balance-of-plant equipment. These customized solutions can help you respond to nearly any changing market condition or operating requirement. From improved performance to changing emissions requirement, GE/NPAOy has the right solution to meet your unique needs.

17.11 Extensive and Experienced Service Network

We have a global presence, with the resources, personnel and materials to solve problems anywhere, in the most efficient way possible. Each of our solutions are backed by research and experience on a level that only GE/NPAOy can offer.

Quick Response Center

The highly skilled technical representatives in our Quick Response Centers (QRC) provide support and can remotely tune your engine to improve emissions and performance levels.

The Quick Response Center offers:

- A Level 1 response team of OEM expert technicians who apply years of expertise to every case
- Over 13 languages for a local presence
- The ability to represent the customer and escalate cases within GE/NPAOy to facilitate a fast return to service
- Event diagnostics
- Remote monitoring tools to enable fast issue resolution

Global Services Distribution Centers

Our global services parts distribution centers act as centralized warehouses, offering local and regional coverage. This means greater parts availability, on-time delivery and faster order fulfillment.

Service Centers

With 12 service centers worldwide, we can provide faster turnaround and exceptional asset support. We offer the only LM service centers globally certified to Aerospace AS9100 quality standard, with services that include:

- Individual component repair
- Complete major assembly overhaul
- Comprehensive testing

Field Services

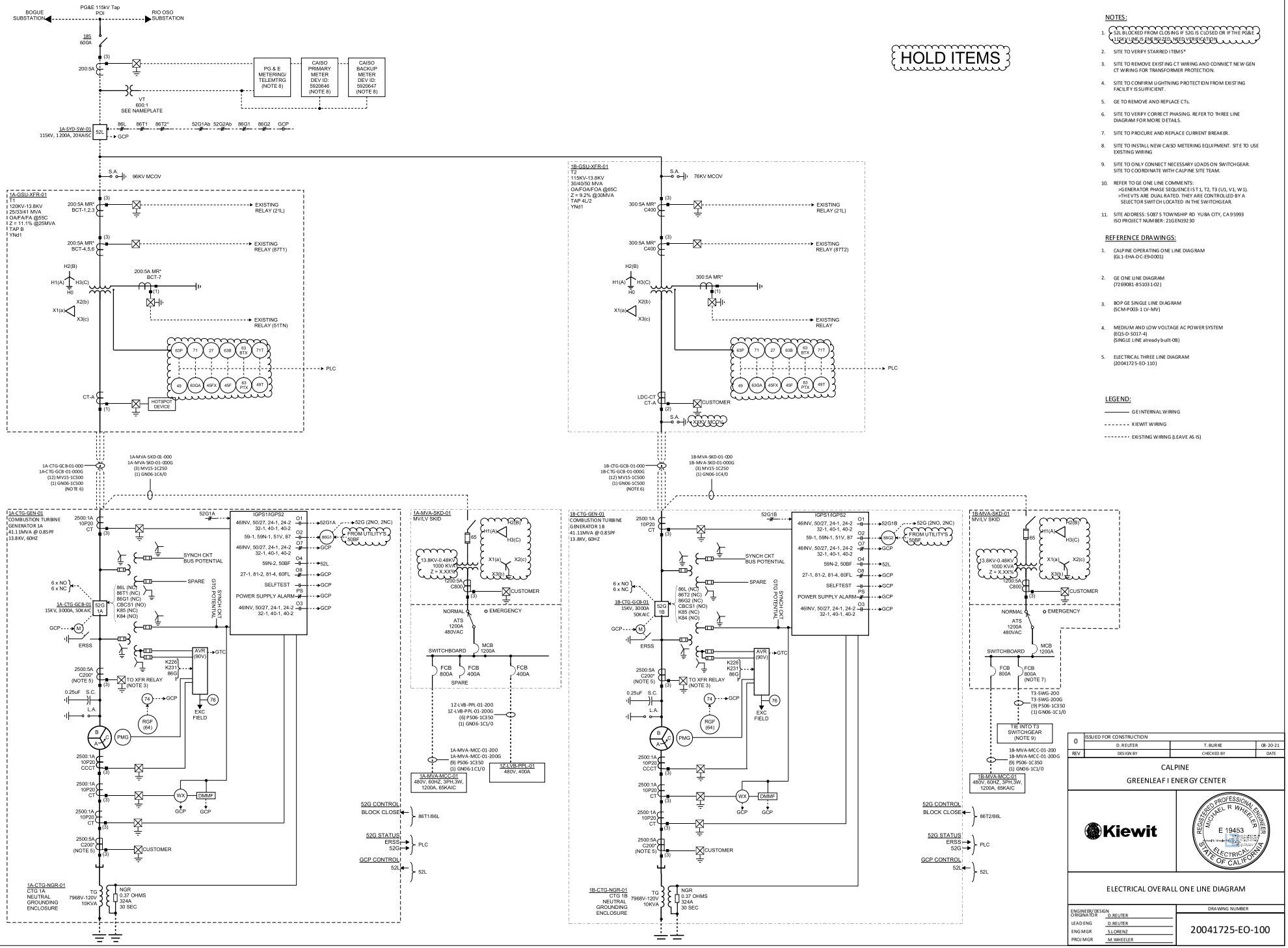
By anticipating service needs throughout the asset life cycle, G/NPAOyE's global field services network reduces downtime and operating costs.

Offerings include:

- Periodic routine inspections of engine and package related to maintenance schedule
- Field service support, when an unplanned event occurs
- Check and inspect of all rotating components
- Performance testing
- Extensive maintenance support during comprehensive service events

ATTACHMENT 3

PROJECT ONE-LINE DIAGRAM



HOLD ITEMS

NOTES:

1. 52L BLOCKED FROM CLOSING IF 52G IS CLOSED OR IF THE PG&E 115kV LINE IS ENERGIZED, WHEN VERIFIED.
2. SITE TO VERIFY STARRED ITEMS*
3. SITE TO REMOVE EXISTING CT WIRING AND CONNECT NEW GEN CT WIRING FOR TRANSFORMER PROTECTION.
4. SITE TO CONFIRM LIGHTNING PROTECTION FROM EXISTING FACILITY IS SUFFICIENT.
5. GE TO REMOVE AND REPLACE CTs.
6. SITE TO VERIFY CORRECT PHASING. REFER TO THREE LINE DIAGRAM FOR MORE DETAILS.
7. SITE TO PROCURE AND REPLACE CURRENT BREAKER.
8. SITE TO INSTALL NEW CAISO METERING EQUIPMENT. SITE TO USE EXISTING WIRING
9. SITE TO ONLY CONNECT NECESSARY LOADS ON SWITCHGEAR. SITE TO COORDINATE WITH CALPINE SITE TEAM.
10. REFER TO GE ONE LINE COMMENTS:
    >GENERATOR PHASE SEQUENCE IS T1, T2, T3 (U1, V1, W1).
    >THE VTS ARE DUAL RATED. THEY ARE CONTROLLED BY A SELECTOR SWITCH LOCATED IN THE SWITCHGEAR.
11. SITE ADDRESS: 5087 S TONNSHIP RD YUBA CITY, CA 95993
    ISO PROJECT NUMBER: 21GEN1923 0

REFERENCE DRAWINGS:

1. CALPINE OPERATING ONE LINE DIAGRAM (GL1-EHA-DC-E9-0001)
2. GE ONE LINE DIAGRAM (7269081-851031-02)
3. BOP GE SINGLE LINE DIAGRAM (SCM-P003-1 LV-MV)
4. MEDIUM AND LOW VOLTAGE AC POWER SYSTEM (EQS-D-5017-4) (SINGLE LINE already built-08)
5. ELECTRICAL THREE LINE DIAGRAM (20041725-EO-110)

LEGEND:

- GE INTERNAL WIRING
- KIEWIT WIRING
- EXISTING WIRING (LEAVE AS IS)

REV	ISSUED FOR CONSTRUCTION		
0	D. REUTER	T. BURKE	08-20-21
REV	DESIGN BY	CHECKED BY	DATE

CALPINE

GREENLEAF I ENERGY CENTER

Kiewit

REGISTERED PROFESSIONAL ENGINEER MICHAEL R WHEELER E 19453 ELECTRICAL STATE OF CALIFORNIA

ELECTRICAL OVERALL ONE LINE DIAGRAM

ENGINEER/DESIGN ORIGINATOR	D. REUTER
LEAD ENG	D. REUTER
ENG MGR	S. LORENZ
PROJ MGR	M. WHEELER

DRAWING NUMBER

20041725-EO-100

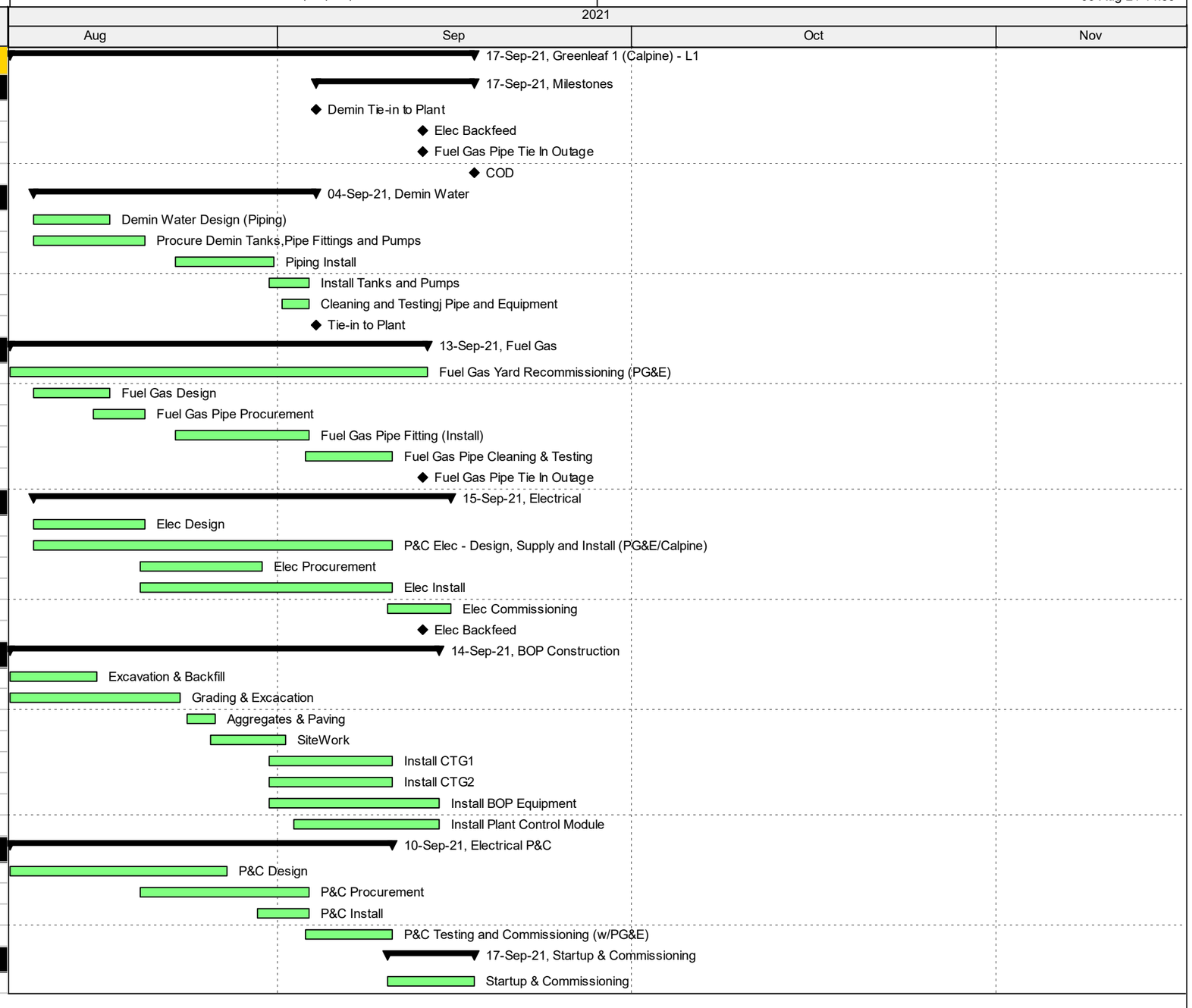
ATTACHMENT 4

PROJECT EQUIPMENT DELIVERY SCHEDULE

Greenleaf 1 (Calpine) - L1

06-Aug-21 14:59

Activity Name	Original Duration	Start	Finish
Greenleaf 1 (Calpine) - L1	29	09-Aug-21	17-Sep-21
Milestones	9	04-Sep-21	17-Sep-21
Demin Tie-in to Plant	0	04-Sep-21	
Elec Backfeed	0	13-Sep-21	
Fuel Gas Pipe Tie In Outage	0	13-Sep-21	
COD	0		17-Sep-21
Demin Water	18	11-Aug-21	04-Sep-21
Demin Water Design (Piping)	5	11-Aug-21	17-Aug-21
Procure Demin Tanks,Pipe Fittings and Pumps	8	11-Aug-21	20-Aug-21
Piping Install	7	23-Aug-21	31-Aug-21
Install Tanks and Pumps	4	31-Aug-21	03-Sep-21
Cleaning and Testingj Pipe and Equipment	3	01-Sep-21	03-Sep-21
Tie-in to Plant	0	04-Sep-21	
Fuel Gas	25	09-Aug-21	13-Sep-21
Fuel Gas Yard Recommissioning (PG&E)	25	09-Aug-21	13-Sep-21
Fuel Gas Design	5	11-Aug-21	17-Aug-21
Fuel Gas Pipe Procurement	5	16-Aug-21	20-Aug-21
Fuel Gas Pipe Fitting (Install)	10	23-Aug-21	03-Sep-21
Fuel Gas Pipe Cleaning & Testing	5	03-Sep-21	10-Sep-21
Fuel Gas Pipe Tie In Outage	0	13-Sep-21	
Electrical	25	11-Aug-21	15-Sep-21
Elec Design	8	11-Aug-21	20-Aug-21
P&C Elec - Design, Supply and Install (PG&E/Calpi	22	11-Aug-21	10-Sep-21
Elec Procurement	7	20-Aug-21	30-Aug-21
Elec Install	15	20-Aug-21	10-Sep-21
Elec Commissioning	4	10-Sep-21	15-Sep-21
Elec Backfeed	0	13-Sep-21	
BOP Construction	26	09-Aug-21	14-Sep-21
Excavation & Backfill	6	09-Aug-21	16-Aug-21
Grading & Excacation	11	09-Aug-21	23-Aug-21
Aggregates & Paving	3	24-Aug-21	26-Aug-21
SiteWork	5	26-Aug-21	01-Sep-21
Install CTG1	8	31-Aug-21	10-Sep-21
Install CTG2	8	31-Aug-21	10-Sep-21
Install BOP Equipment	10	31-Aug-21	14-Sep-21
Install Plant Control Module	8	02-Sep-21	14-Sep-21
Electrical P&C	24	09-Aug-21	10-Sep-21
P&C Design	15	09-Aug-21	27-Aug-21
P&C Procurement	11	20-Aug-21	03-Sep-21
P&C Install	5	30-Aug-21	03-Sep-21
P&C Testing and Commissioning (w/PG&E)	5	03-Sep-21	10-Sep-21
Startup & Commissioning	6	10-Sep-21	17-Sep-21
Startup & Commissioning	6	10-Sep-21	17-Sep-21



Actual Work · Critical Remaining Work · Summary · Remaining Work · Milestone

TASK filter: Activity Type (Proposal).

Target to get the everything delivered to site by 8/30

Aamir, Tim, Shadpoor, Mehrdad

ITEM	Part #	QTY	Supplier & Location	Inventory Status	Pick up Date	Mode	POI	Customs Clearance	Inland Transport	ESTIMATED Site Delivery date	Actual Pick up	Actual Site Delivery date
TM PACKAGE 1	7269088	1	Dockside Logistics Charleston	On stock	23-Aug-21	TRUCK	0	0	7	**30-Aug-21**	23-Aug-21	
TM PACKAGE 2	7268824	1	Morris Exports Houston	On stock	11-Aug-21	TRUCK	0	0	7	**18-Aug-21**	13-Aug-21	18-Aug-2021
UL Kit	8 p/n + 7 p/n	2	Hungary	On stock	17-Aug-21	AIR	4	3	1	**25-Aug-21**	18-Aug-21	
UL Kit - PUMP/MOTOR 1	390A2365P0001 PUMP/M	1	Leistritz ,USA	On stock	18-Aug-21	TRUCK	0	0	5	**23-Aug-21**	19-Aug-21	
Paint	LMPA25 (5 l/unit) LMPA26 (5 l/unit) LMPA03 (20 l /unit)	1 Lot	Hungary	On stock	17-Aug-21	AIR	4	3	1	**25-Aug-21**	18-Aug-21	
Field Lift Kit	851225G0011 LIFT ARRA	1	Transpack Houston	On stock	19-Aug-21	TRUCK	0	0	7	**26-Aug-21**	20-Aug-21	
I&C Tooling Set 1	390A5128P0001	1	Innovative Tooling Houston (FC)	PO placed	27-Aug-21	TRUCK	0	0	4	**31-Aug-21**		
I&C Tooling Set 2	390A5129P0001	1	Innovative Tooling Houston (FC)	PO placed	27-Aug-21	TRUCK	0	0	4	**31-Aug-21**		
Remote HMI Desktop	7269088 box 31/1 has the remote HMI	1	Dockside Logistics Charleston	On stock	20-Aug-21	TRUCK	0	0	5	**25-Aug-21**	19-Aug-21	
Lube Oil Filtration Cart	145E3766L0002 KIT,LUB	1	Hungary	On stock	17-Aug-21	AIR	4	3	1	**25-Aug-21**	18-Aug-21	
Hotlist Items	Several	2	Hungary	On stock	17-Aug-21	AIR	4	3	1	**25-Aug-21**	18-Aug-21	
Hotlist Items	Several	1	Koper	On stock	19-Aug-21	AIR	4	3	1	**27-Aug-21**	18-Aug-21	
Stairs & Platforms	390A3460P0001-R0001	2	Charleston	On stock	20-Aug-21	TRUCK	0	0	7	**27-Aug-21**	19-Aug-21	
Winterization to 0F	Several	1	Coverflex	To Be Order	16-Dec-21	AIR	0	0	10	**26-Dec-21**		
GEPC Generator anti icing kit	390A4247P0001 Generat	2	GEPC	To Be Order		??						
CT (Neutral)	142I /SD/18176MA + a ne	15	GE Grid Florida	PO placed	31-Aug-21	FEDEX	0	0	1	**1-Sep-21**		
CT (Line Side)		6	GE Grid Florida	To Be Order	31-Aug-21	FEDEX	0	0	1	**1-Sep-21**		
Electrical BOP Scope												

MV Skids		2	Houston	On stock	24-Aug-21	TRUCK	0	0	6	**30-Aug-21**		
LV Skids		2	Houston	On stock	20-Aug-21	TRUCK	0	0	6	**26-Aug-21**	20-Aug-21	
Mechanical BOP Scope												
FG Duplex Coalescer Filter 250F		2	Inventory Charleston	On stock	23-Aug-21	TRUCK	0	0	7	**30-Aug-21**		
Spare Filter Elements (O&G)		12	BHGE Bari, Italy	To Be Ordered		AIR						
First fill lubricants & water wash chemical detergents	B-254-1507973	2	Brenntag Houston	To Be Order	27-Aug-21	TRUCK	0	0	5	**1-Sep-21**		

Site Address:

Calpine Green Leaf
5087 S. Township Rd
Yuba City, CA 95993

ATTACHMENT 5

PROJECT SITE GRANT DEED

1/7

WE CERTIFY THIS TO BE A TRUE & CORRECT COPY OF THE ORIGINAL ON FILE IN THE OFFICE OF PLACER TITLE CO.
BY Richard V Carter

Recording requested by
And when recorded mail to:

Thelen Reid & Priest LLP
Two Embarcadero Center, Suite 2100
San Francisco, CA 94111
Attn: Jarrett L. Fugh, Esq.

Mail tax statements to:

Calpine Greenleaf Holdings, Inc.
c/o Calpine Corporation
50 West San Fernando Street
San Jose, CA 95113
Attn: Lisa Bodensteiner, Esq.

Recorded in Official Records, County of Sutter, Lonna B. Smith, Clerk/Recorder
24.00
199813241 09:00am 09/01/98
004 039546 09 06 000001
E03 7 UN 6.00 18.00 0.00 0.00 0.00 0.00 0.00

SPACE ABOVE THIS LINE RESERVED FOR RECORDER'S USE

GRANT DEED
(Unit One)

A. P. N. 21-230-025

Documentary transfer tax is $0

( ) Computed on full value of property conveyed; or
(X) Computed on full value less value of liens and encumbrances remaining at time of sale; or
( ) There is no documentary transfer tax due;
(X) Unincorporated area; ( ) City of _____

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged, GREENLEAF UNIT ONE ASSOCIATES, a California Limited Partnership ("Grantor"), hereby GRANTS to

CALPINE GREENLEAF HOLDINGS, INC., a Delaware corporation

the real property in the County of Sutter, State of California, more particularly described on Exhibit A attached hereto, together with the improvements thereon, but expressly excluding certain equipment and other property listed on Exhibit B attached hereto located on such real property.

IN WITNESS WHEREOF, Grantor has executed this Grant Deed as of August 28, 1998.

"Grantor"

GREENLEAF UNIT ONE ASSOCIATES,
a California Limited Partnership

By: GREENLEAF UNIT ONE ASSOCIATES, INC., a California corporation

By: _____
Name: Eric Pryor
Title: Authorized Agent

STATE OF CALIFORNIA)
) ss.
COUNTY OF Sanfrancisco)

On August 11, 1998, before me, Lisa Maria Perez, personally appeared Eric Pryor, personally known to me (*or proved to me on the basis of satisfactory evidence*) to be the person(s) whose name(s) (*is/are*) subscribed to the within instrument and acknowledged to me that (*he/she/they*) executed the same in (*his/her/their*) authorized capacity(ies), and that by (*his/her/their*) signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS MY HAND AND OFFICIAL SEAL

Lisa Maria Perez
Notary Public

PWR1 LISA MARIA PEREZ PWR1
Comm. # 1051009
NOTARY PUBLIC CALIFORNIA
City and County of San Francisco
My Comm Expires Feb. 24, 1999

Exhibit A

The land situated in the State of California, County of Sutter, Unincorporated Area, and is described as follows:

PARCEL NO. 1

The North half of the Northeast quarter of Section 24, Township 14 North, Range 2 East, M.D.B.& M.

EXCEPTING THEREFROM that portion conveyed to Sutter Butte Canal Company by Deed recorded June 1, 1920 in Book 67 of Deeds, page 348, and described as follows:

A strip of land with parallel sides, 60.00 feet in width lying 30.00 feet of each side of the following described line:

BEGINNING at a point, 60.00 feet West of the Northeast corner of Section 24; thence Southerly 1325.00 feet to a point, 60.00 feet West of and 1325.00 feet South of the Northeast corner of said Section 24.

PARCEL NO. 2

An easement as granted by that certain Agreement dated November 9, 1987 executed by Sutter Extension Water District and between Greenleaf Unit One Associates, a California limited partnership recorded November 12, 1987, in Book 1237 of Official Records at Page 95, Sutter County Records, subject to the terms and provisions as contained therein, described as follows:

Easement for the purpose of constructing, operating, repairing, and maintaining a bridge for the right of vehicular and pedestrian ingress and egress on and over a strip of land with parallel sides 50.00 feet in width across land conveyed to Sutter Butte Canal Company by Deed recorded June 1, 1920 in Book 67 of Deeds at page 348 in the Official Records of Sutter County, California. The center line of said 50.00 foot strip of land is a line running parallel to the Northerly side of Section 24, Township 14 North, Range 2 East, M.D.B.& M. which passes through a point located along the Easterly side of said Section 24, 520.00 feet Southerly from the Northeast corner of said Section 24.

PARCEL NO. 3

That certain Grant of Easement as conveyed by Michael A. Passaglia, Coral B. Passaglia, Lorne M. Cole and Julia A. Cole to Greenleaf Unit One Associates, a California limited partnership, recorded February 9, 1989, in Book 1288 of Official Records at Page 684, Sutter County Records, subject to the terms and provisions as contained therein, described as follows:

A permanent non-exclusive easement to convey storm drainage, process effluent, and other waters, to the extent that Grantee determines, from the Grantee's Land described, surface and subsurface in, through and/or along the following described strip of real property, to wit:

That parcel of land lying within Section 26, Township 14 North, Range 2 East, M.D.B.& M. in Sutter County, California and being described as follows:

The North 10.00 feet of the Northwest quarter of said Section 26.

PARCEL NO. 4

That certain Grant of Easement as conveyed by Margaret E. Welter to Greenleaf Unit One Associates, a California Limited Partnership recorded February 9, 1989, in Book 1288 of Official Records at Page 681, Sutter County Records, subject to the terms and provisions as contained therein, described as follows:

A permanent non-exclusive easement to convey storm drainage, process effluent, and other waters, to the extent that Grantee determines, from the Grantee's Land described surface and subsurface in, through and/or along the following described strip of real property, to wit:

That parcel of land lying with Section 23, Township 14 North, Range 2 East, M.D.B.& M. in Sutter County, California and being described as follows:

The South 20.00 feet of the Southwest quarter of said Section 23.

PARCEL NO. 5

That certain Grant of Easement as conveyed by Harry B. Hunt, Jr., Trustee and Dorothy A. Hunt, Trustee of the Hunt Family Trust of 1980 to Greenleaf Unit One Associates, a California Limited Partnership recorded February 9, 1989, in Book 1288 of Official Records at Page 678, Sutter County Records, and re-recorded March 22, 1995 as Document No. 199503709, Sutter County Records, subject to the terms and provisions as contained therein, described as follows:

A permanent non-exclusive easement to convey storm drainage, process effluent, and other waters, to the extent that Grantee determines, from the Grantee's Land described surface and subsurface in, through and/or along the following described strip of real property, to wit:

That parcel of land lying within Section 24, Township 14 North, Range 2 East, M.D.B.& M. in Sutter County, California and being described as follows:

Parcel A:
The East 15.00 feet of the South half of the Northwest quarter of said Section 24.

Parcel B:
The South 15.00 feet of the Northwest quarter of said Section 24.

PARCEL NO. 6

That certain Grant of Easement as conveyed by Alan K. Brubeck and Lewis W. Brubeck, as Trustee of the Lewis W. Brubeck and Leota Marie Brubeck 1980 Trust to Greenleaf Unit One Associates, a California Limited Partnership recorded February 9, 1989, in Book 1288 of Official Records at Page 675, Sutter County Records, and re-recorded March 22, 1995 as Document No. 199503710, Sutter County Records, subject to the terms and provisions as contained therein, described as follows:

A permanent non-exclusive easement to convey storm drainage, process effluent, and other waters, to the extent that Grantee determines, from the Grantee's Land described surface and subsurface in, through and/or along the following described strip of real property, to wit:

That parcel of land lying within Section 26, Township 14 North, Range 2 East, M.D.B.& M. in Sutter County, California and being described as follows:

The North 10.00 feet of the East half of said Section 26.

AP#(s) 21-230-025

EXHIBIT B

Excluded Equipment and Property

That portion of that certain approximately 49.2 MW gas fired cogeneration facility, located in Sutter County, California and known as Greenleaf Unit One (the "**Unit One Project**"), comprised of the following:

Property

1. Power facility
   Gas Turbine Package (Turbine, Generator, Inlet, Control, Access)
   Steam Turbine Generator
   Transformer
   Heat Recovery Steam Generator
2. Turbine Overhaul 4/96
3. Speedtronic simulator
4. Calpine major maintenance
5. Spare gas turbine starter
6. Gas Turbine Hydraulic
7. Steam Turbine Generator Exciter
8. Boiler Feedpump
9. GE turbine parts
10. Tooling Tower Water Repl
11. Computerized Training Program
12. Balance of Plant Spares
13. Vacuum dehydrator
14. Forklift
15. 60' JLG Manlift
16. Computer Network Server and Auxiliaries
17. Carbon filter
18. Service bulletin #125
19. Steam Turbine Lube Oil Cooler
20. Sensors & brackets
21. Motor & Gearbox Replacement
22. CEM upgrade
23. Utility Tractor and Mower
24. Sodium Hypochorite tank
25. Pressure reducing valve
26. Shop Tools
27. Xerox copier
28. Automatic gas sampler
29. Maxon valve spare
30. Pulse counter
31. Shop Tools (additions by Site)

32. Upgrade gas turbine
33. PC computer
34. Insulation blanket
35. Fire cabinets
36. Company pickup

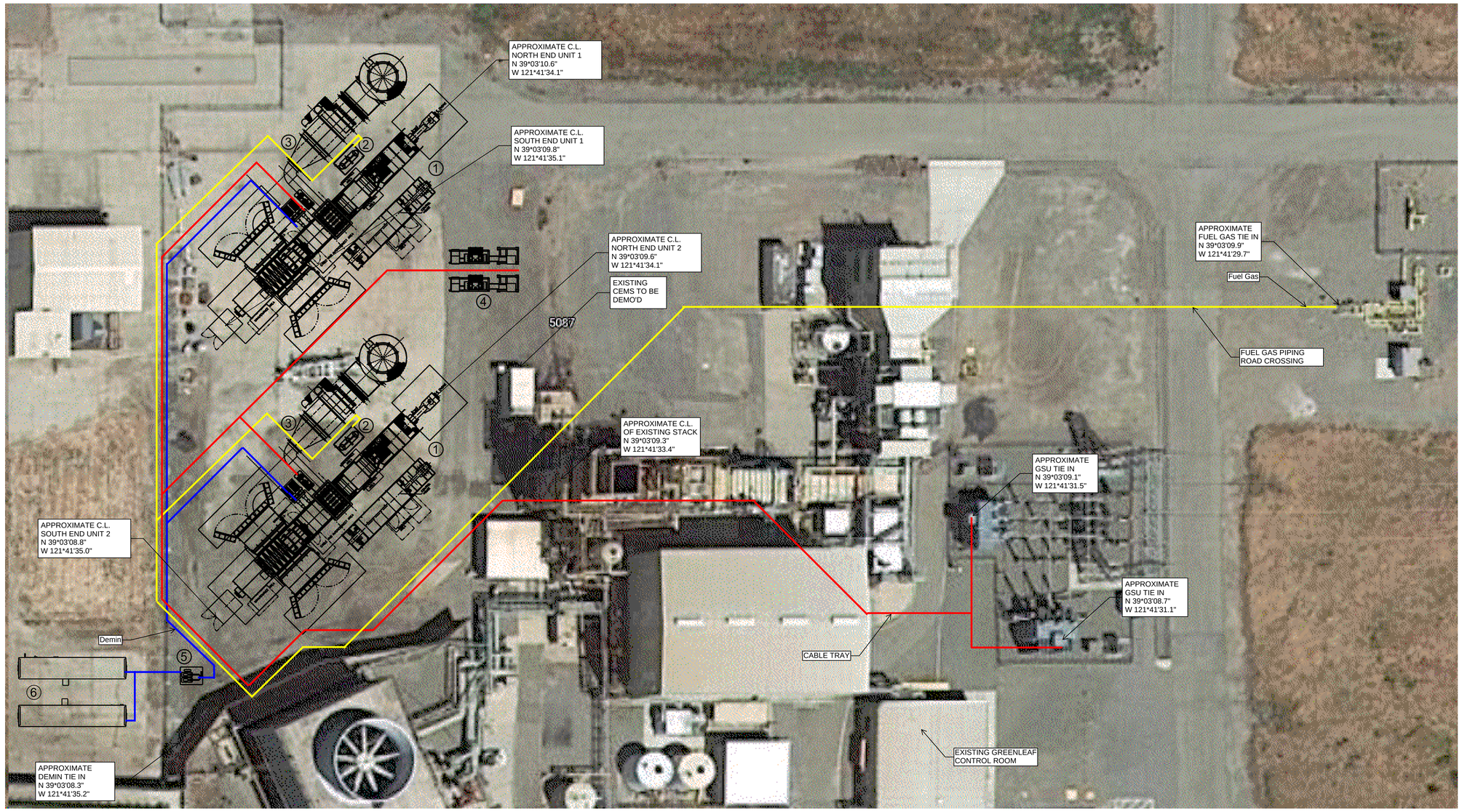
Other Property

All other tangible or intangible personal property (including, without limitation, all fixtures which constitute personal property and all intellectual property rights) used or useful in connection with, or relating to, the Unit One Project.

All property described in this Exhibit B is personal, and not real, property.

ATTACHMENT 6

PLOT PLAN



1. TM2500
2. COALESCING FILTER
3. SCR
4. MV/LV SKIDS
5. DM WATER FORWARDING PUMP SKID
6. DM WATER STORAGE TANK

FEET 0 10 20 / 5 15

N

REV	DESIGN BY	CHECKED BY	DATE
A	N. HIRT	A. KUSNIERKIEWICZ	08-19-21

ISSUED FOR REVIEW

CALPINE

GREENLEAF I ENERGY CENTER

Kiewit

MECHANICAL PLOT PLAN

ENGINEER/DESIGN ORIGINATOR	N. HIRT
LEAD ENG	N. MILLER
ENG MGR	M. WHEELER
PROJ MGR	M. WHEELER

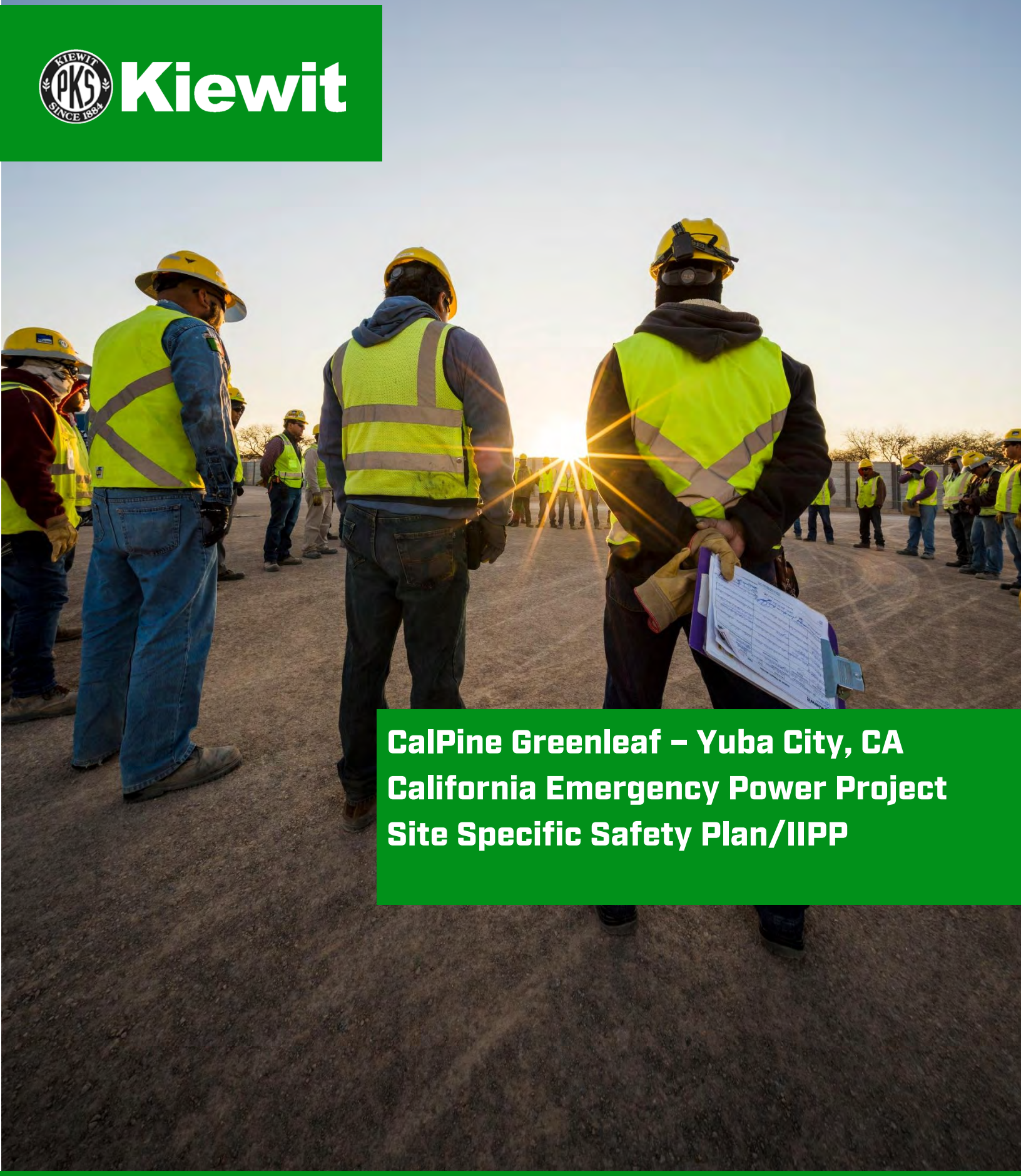
DRAWING NUMBER

20041725-PP-101

ATTACHMENT 7

CONTRACTOR INJURY AND ILLNESS PREVENTION PLAN AND SAFETY PROGRAM

Kiewit



CalPine Greenleaf – Yuba City, CA
California Emergency Power Project
Site Specific Safety Plan/IIPP

August 12, 2021

CONTENTS

1.0 NOBODY GETS HURT

We are committed to the safety of our employees, those involved with our projects, our clients and the public. Our #1 goal is nobody gets hurt and most importantly zero fatalities. It's everyone's responsibility to promote a safety-first mentality and culture.

This Project Site Specific Safety Plan (SSSP) is an integral component of Kiewit's overall Safety Management Playbook. This guide provides an outline of the minimum standards that must be included in your project's SSSP, but the following should always be kept in mind when building your safety plan:

- Project leaders play a big role in our safety culture which must be embedded throughout the job team. As project leaders you will build a safety first culture by setting expectations, building structure, teaching others and most importantly leading by example.
- Each employee — regardless of job or location — has the responsibility to speak up when they see
- anything that causes a safety concern.
- When it comes to protecting our employees, collaboration between our craft and staff is expected and necessary to prevent safety incidents.
- And finally, having the right structure, tools and processes in place as identified in this SSSP is the first step to set your project up for safety success.
- Specific Management Responsibilities
    - The Project Manager (PM) is responsible for ensuring that all contractual requirements, legislative requirements, and Company policy regarding safety performance and documentation for the project are met. The PM is also responsible for the implementation of the safety program on the project. The Project Manager shall ensure construction managers, superintendents, engineers, and foremen understand and enforce safe work practices and attend safety training as required.
    - The Project Safety Manager (PSM) shall manage the safety program. The Project Safety Manager shall be responsible for providing or coordinating safety orientation training, job specific training, safety meetings, first aid facilities and materials, safety reports, incident investigation, case management, safety recognition programs, and conducting routine safety inspections.
    - The Superintendents are responsible for ensuring that all operations perform the work in accordance with the Energy Group Safety Policy, contract requirements, and applicable legislative requirements.

- The Superintendent has the primary responsibility of safety supervision and enforcing safety policies and applicable training with their respective employees.

2.0 ORIENTATION

The safety orientation is an excellent way to get new hires and people that are new to the jobsite on board, shape their safety attitudes, and bring them up to speed on our policies and programs. It's the first official opportunity to educate them on our expectations and the importance of safety.

2.1 ORIENTATION BASICS

1. Orientation attendees must include **ALL** employees new to the project, including all subcontractors.
    a. New Hire Orientation attendees are tracked by the Safety Department and a record of date of Orientation will be kept in the Safety Portion under working files of the Project SharePoint site.
2. Project management expectations are delivered at the orientation by the Project Manager/Construction Manager.
3. Front line supervisors (foreman and superintendents) are encouraged to lead and deliver orientation material working with other key project personnel, such as the project safety manager.
4. The orientation schedule is posted and available to everyone on the project.
5. Orientation leads are expected to be knowledgeable, well-prepared and deliver an engaging training.
6. Orientation location is at the Kiewit Northern California Sacramento office and will be scheduled to support the hiring process.

2.2 CONTENT

1. Ensure your project's orientation plan includes the key elements as listed in this SSSP as well as specific risks and knowledge for your project, including but not limited to:
    a. A practical knowledge and skills assessment delivered by the Project Safety Manager.
    b. JHA Training.
    c. Hands-on tool training plan delivered by the craft Superintendent.

2.3 POST-ORIENTATION ACTIVITIES

1. Newly hired employees will be visually identifiable in the field from other craft by a Green magnet worn on the front brim of the hardhat.
2. A new hire follow-up plan is in place and those responsible follow-up with new hires and follow the plan using the 14-Day Follow-up Program.

**2.0 Orientation is Part of IIPP Communication Program*

**2.0 Orientation is Part of IIPP Compliance Program*

3.0 TRAINING

The importance of training extends beyond our employee's introduction to the job.

1. A comprehensive project training plan has been developed, in place and adequate to cover all project training needs and will be regularly updated, maintained, and rolled out by the Project Safety Manager, Jimmy Stormo.
2. The project training plan is accessible and can be found at the Project SharePoint site.
3. Project training will be scheduled by The Project Safety Manager/Craft Superintendent in advance to ensure the necessary trainers, material and equipment are available.
4. The project training plan adjusts to trends in incidents, project safety assessments and optional observation programs.
5. Project training will be conducted at a location that is appropriate to facilitate learning and retention.
6. Hands-on training will be conducted on a regular basis with engagement from our craft as well as regular review of incidents.
7. Project training will be tracked by the Safety Department and kept in the Safety Department working files on the Project SharePoint sit, updated, and maintained to easily identify any gaps.
8. Training topics may include:
   • Lock-out/tag-out procedures.
   • Safe practices for operating heavy equipment.
   • Good housekeeping.
   • Fire Prevention and Fire Extinguisher operation.
   • Safe procedures for cleaning, repairing, servicing, and adjusting equipment and machinery.
   • Safe access to working areas.
   • Protection from falls.

- Electrical hazards, including working around high voltage lines and systems.
- Proper use of powered tools.
- Guarding of belts and pulleys, gears and sprockets, and machine parts.
- Materials handling.
- Use of elevated platforms, including scissor lifts.
- Slips, falls, and back injuries.
- Valley Fever
- Naturally Occurring Asbestos
- Ergonomic hazards, including proper lifting techniques and working on ladders or in a stooped posture for prolonged periods at one time.
- Personal protective equipment.

4.0 PRE-SHIFT MEETINGS

Every operation will start their shift with a pre-shift meeting.

1. Pre-shift meeting content will focus on that day's operation(s).
2. A clear expectation is set that that supervision and craft engage in all pre-shift meetings.
3. At a minimum, each pre-shift meeting will include:
    a. A completed Job Hazard Analysis (LSA) as outlined in section 5 of this SSSP
    b. Demonstrations on relevant topics as appropriate
    c. Stretch and flex

**Part of IIPP Communication Program*

5.0 JOB HAZARD ANALYSIS

Each operation will have a relevant / documented job hazard analysis (JHA) that is discussed and completed with the entire crew at the beginning of every shift/new operation.

Each crew will complete the following:

1. The JHA standard template – including identification of applicable LSA categories & safeguards.
2. JHAs will be completed with the following:
    a. Hazard/risk mitigations must be provided that are detailed and not generic

b. JHA will be updated when new hazards have been identified
c. Craft will be actively engaged in the JHA process and add content
d. Supervision will ensure everyone understands the JHA
e. The hazard will be signed off by all involved in the operation to include supervision and any additional workers/staff/visitors that are in the area of the work to include equipment operators.

**5.0 Part of IIPP Communication Program*

**5.0 Part of IIPP Hazard Correction Program*

6.0 LIFE SAVING ACTIONS

The Life-Saving Actions (LSA) program allows the project team to be proactive about eliminating significant injuries and fatalities. An effective LSA program ensures job sites identify the potential outcome of all incidents or events, then develop meaningful plans to eliminate those events with potentially high-severity outcomes.

The company's LSA guidelines, LSA toolkits and safeguards can be found on the Corporate Safety SharePoint page.

1. It is the responsibility of the Project Manager, Roger Real, to fully implement the corporate LSA Guidelines.
2. All project staff and craft must know their LSA categories and safeguards for their current work.
3. The project will utilize LSA rodeos, demonstrations, and field training to be added to the training matrix.
    a. LSA training will be conducted during Orientation and when new LCCs are added of identified as needing additional emphasis. The Project Management Team will use observations and assessments to track and identify trends.
    b. Craft must regularly be involved in LSA rodeos, demos, and training.
4. LSAs must be reviewed and discussed as part of each operation.
5. LSAs and their associated safeguards must be identified daily along with the ways to mitigate the risk. This will be accomplished using the LSA form and filled out as part of the pre-shift meeting.
6. LSAs will be integrated into other components of your project's safety tools such as JHAs, PODs, work plans, schedule boards and toolbox talks. Identification of LCCs will be accomplished as part of the review of the Project schedule and known risks of each operation. Currently the LCCS identified for this Project are:

- Lifting and Rigging
- Cranes
- Energy isolation
- Utilities
- Working at Heights
- Human Equipment Interface

**6.0 Part of IIPP Hazard Correction Program*

7.0 FIELD COMPLIANCE

The project will implement the following methods to ensure unsafe behaviors are identified, addressed and communicated:

1. To ensure compliance on the Project a process, such as but not limited to, project safety walks for the foreman meetings and regularly scheduled project manager/construction manager walks will be conducted.
2. The project will ensure all operations have a work plan and that they are modified if change has taken place.
3. The project will have a plan for exceptional housekeeping and access.
4. The project will use the proper tools with safety features installed as identified within the KPC KEG Manual.
5. Employees will be trained by the Project Safety Manager, Craft Superintendent, and Foreman on the importance of ergonomic and body positioning risks. This will be accomplished by using hands-on training as well as toolbox talks and other training materials.
6. The project will procure and install the appropriate signage for the project.
    a. Examples include: Signage promoting the overall project safety program, access / designated walk areas / traffic, LSAs, why I work safe, proper PPE, barricade (red rope) / exclusion zones, emergency / muster station / evacuation, hydration, scaffold, LOTO etc.

**7.0 Orientation is Part of IIPP Compliance Program*

8.0 SAFETY WALKS / TOURS

1. The project will conduct focused LSA inspections and enter them in InEight Compliance. Every tour, weekly safety walk or otherwise should have LSA's as a focus in addition to any other findings. The Project will identify the Focus areas as part of the Safety Walk/Tour schedule.
2. A mix of supervision, craft and subcontractors must participate in walks. The Project will publish a list of those Supervisors/staff that are assigned to the walk. Supervision/staff will identify the craft that will participate in each walk.
3. Findings from walks will be communicated to the field using the POD as well as Foremen Meetings and Pre-shift meetings.
4. Findings and actions from the safety walk will be documented and tracked. The InEight Compliance tool will be used for this action.
5. The project will develop a plan to ensure safety deficiencies are corrected in a timely manner.
6. Weekly inspections will be based on trends from observations program, LSA assessments and incidents.

**8.0 Part of IIPP Hazard Correction Program*

9.0 FOREMAN'S MEETING

Foreman's meetings must be a regular and integral part of the safety program.

1. The foreman's meeting will be held at every week.
2. All foreman [including subs] are expected to attend, are consistently present at the meeting and attendance is tracked by the Construction Manager using sign-in sheets kept by the Safety Department.
3. The foreman meetings will be conducted in a format and at a location that facilitates engagement.
4. Action items will be assigned for follow-up during the meeting.
5. The content for the foreman meeting will be made up of relevant safety topics i.e.
    a. Reviewing LSA deficiencies from the previous week.
    b. Review: Recent safety incident alert, past incidents / lessons learned related to upcoming work, positives, best practices, accountability / responsibilities, safety tour findings, client comments, craft conversation / observations
6. Safety program performance and updates from the foreman's meeting will be communicated to the job by use of POD and Pre-Shift meetings at a minimum of weekly.

**Part of IIPP Communication Program*

10.0 COMPLIANCE

1. The project will follow the corporate fall protection guidelines.
2. The project will identify competent persons where required and they are appropriately trained.
    a. A list of these competent persons will be maintained by the Project Safety Manager and posted in the conference room.
        i. An OSHA "competent person" is defined as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them" [29 CFR 1926.32(f)]. Confined Space, Fall Protection, Scaffolding, Trenching
3. The project will identify “qualified persons” where required and they meet the appropriate requirements.
    a. A list of these qualified persons will be maintained by the Project Safety Manager and posted in the conference room.
        i. "Qualified" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project. 1926.32(m) Designated Operator, Signalman, Spotter, Rigger
4. The project will follow the temporary structures and construction (TSCD) devices manual as listed on Kiewit’s TSCD portal.
5. The project will follow the corporate crane policy manual as listed on Kiewit’s Crane Services portal.
6. The project will follow the Corporate Rigging Manual.

11.0 RECOGNITION / MORALE PROGRAM

The project will develop and execute a recognition program for exemplary safety performance.

1. The following are minimums that need to be addressed in the program.
    a. The job team will be able to understand and can explain the program
    b. Craft will be able to understand how they are being measured
    c. Craft will be involved in developing and providing feedback on the program and rewards
    d. Subcontractors should participate in the program

2. Details of the recognition program are available on the Project SharePoint site and will be based on Project milestones..

**12.0 Orientation is Part of IIPP Compliance Program*

12.0 LEADERSHIP / CULTURE

Our project management teams are expected to lead by example. It's imperative they are engaged, visible, committed to safety, paying close attention to LSA categories and setting a positive safety tone.

1. At least weekly, the project manager, construction manager and operations manager will conduct a field tour verifying their safety expectations are being met and inputting their finding in InEight Compliance.
2. There is good communication from project management, through the field supervision to the craft.
3. Craft feel that safety is the core value and will be addressed ahead of production.
4. Internal / external JV partners function as a team.
5. There is a healthy incident reporting culture on the project.
6. There is a culture of fact finding versus fault finding.

13.0 OBSERVATION PROGRAM

1. Observations will be performed weekly by staff using the InEight Compliance application.
2. Observations will involve interventions, LSA leading indicators and comments.
3. The goal or frequency on staff observations to be completed weekly is 2 per week.
4. Observation data will be used to identify leading and lagging indicators to help highlight focus areas of concern to mitigate.
5. Observation quality will be measured by the safety staff and tracked in InEight Compliance.
6. The project will compare observational trends to lagging / leading indicators i.e., incident rates, LSA assessments, weekly during Foremen meetings and discussed during mass safety meetings.

**15.0 Part of IIPP Hazard Correction Program*

14.0 HOUSEKEEPING AND ACCESS

1. The project will use blue cones and rope to delineate designated walkways on the project.
2. Civil Superintendent is/are responsible for maintaining designated walkways on the project.

3. The project will ensure that a good working surface is in place on your project.
4. The project will have:
    a. Designated trash/waste receptacles will be located throughout the work site.
    b. Flammable material and liquids will be properly stored in flammable lockers.
    c. Receptacles for scrap, metal, wood, cable, hazardous waste, solid waste, etc. will be located throughout the jobsite These will be maintained by the Civil Department every day.
5. The project will conduct a cord and tool roll up inspection every day or before each use as required.
6. Rigging, hardware and equipment will be stored on pallets adjacent to the crane/work being performed.
7. The following people will be responsible for maintaining extreme housekeeping in the following areas:
    a. The Project Construction Manager will be responsible for ensuring the Project Housekeeping meets expectations.
8. Dedicated smoking areas and receptacles for cigarette butts will be provided at least 50’ from any occupied structure and away from areas containing flammable materials..
9. The project will hold our subcontractors accountable to our housekeeping standards.

15.0 STOP WORK RESPONSIBILITY

1. The project will use the Orientation process initially to train all employees and subcontractors on stop work responsibility and again review at the 30-day Follow-Up review.
2. Expectations:
    a. All employees and subcontractors have Listen Up / Speak Up authority.
    b. Management will promote Stop Work Responsibility culture with employees and subcontractors by i.e.: Indoc, toolbox meeting (Give Me 5), mass meetings, the orientation slide deck and the Listen Up, Speak Up program.
    c. Construction Manager/Project Safety Manager is responsible for providing the training for Stop Work Responsibility.
    d. Indoctrination, toolbox meeting (Give Me 5), mass meetings, the orientation slide deck and the Listen Up, Speak Up program will be used by the project team to implement stop work.
    e. The process for stop work responsibility will be measured and communicated by Project Construction/Safety manger during the orientation process.

16.0 PROJECT SAFETY ASSESSMENT

The Project Safety Assessment (PSA) tool / process allows projects and districts to assess how they are doing against what we believe are best

practices to set them up for success and achieve our goal of nobody gets hurt.

1. The PSA will be used during the startup phase of work as a startup checklist to verify adequate program compliance. The Project Manager is responsible for ensuring this happens.
2. The project will complete a limited self-assessment PSA during the second week of the schedule looking at critical elements of the PSA..
3. The project team will work with the district safety manager to decide who will complete the PSA and allow those persons adequate time to prepare for the PSA.
4. The PSA form allows projects to input and track any immediate corrective or action items. District and project safety managers will work with the project on PSA reviews and areas for improvement.
5. The PSA form lives in the InEight Compliance system and can be accessed from the InEight mobile app on your mobile device.
6. Instructions to setup up the InEight Compliance mobile app on your device can be found here.
7. For more details on using the PSA in InEight Compliance, **reference the February 2021 issue of the Safety Post.**

17.0 ADDITIONAL RESOURCES

For questions about this document or the additional resources listed below, contact your district safety manager or regional operations safety director.

1. Every project should have a comprehensive crisis communication plan. The company's crisis management library and crisis plan template can be found here.
2. Procedures for investigation workplace incidents to include Injuries, Property/equipment Damage, and Near Misses as well as hazardous substances exposure are identified in the KEG Incident Investigation Procedure Incident Investigation Procedures All incident will be entered into InEight Compliance.
3. Recordkeeping will be accomplished in the following manner:
    1. Records of health and safety inspections, including the person(s) conducting the inspection, the unsafe conditions and work practices that have been identified and the action taken to correct the identified unsafe conditions and work practices, are recorded, and tracked through completion via the plants computerized maintenance management system.

2. Documentation of safety and health training for each employee, including the team members name or other identifier, training dates, type(s) of training, and training providers are recorded in the plants training records.
3. Inspection records and training documentation will be maintained according to the Following checked schedule: For three years or as required by applicable regulations, except for training records of team members who have worked for less than one year which are provided to the team member upon termination of employment.

4. The following links are to the Corporate Safety SharePoint site:
    a. Claim reporting
    b. COVID-19 resources
    c. Mental health resources
    d. Safety recalls
    e. SDS for Kiewit
    f. Toolbox talk/Give me 5 toolbox libraries

ATTACHMENT 8

SUTTER ENERGY CENTER

WORKER ENVIRONMENTAL AWARENESS PROGRAM

Worker Environmental Awareness Program

Sutter Energy Center

2021

Calpine's Commitment

Calpine is committed to protecting environmental resources associated with the Sutter Energy Center. Calpine has worked with state and federal agencies to identify and avoid sensitive biological resources to the furthest extent possible. Mitigation measures were developed to minimize unavoidable project impacts and will be implemented by all on-site personnel throughout the operation of the Sutter Energy Center.

Any violations of the environmental protection measures developed for the Sutter Energy Center will have serious consequences to individual workers and to the plant operation.

This presentation provides an overview of general work practices, environmental laws and penalties, sensitive biological resources in the plant area, responsibilities of project personnel, potential impacts that might occur and who to contact in such a case. Please complete and hand in the acknowledgment of training form you received at the completion of this presentation.

Cooperation and communication are key to success. Always ask before you act.

Sensitive Biological Resources

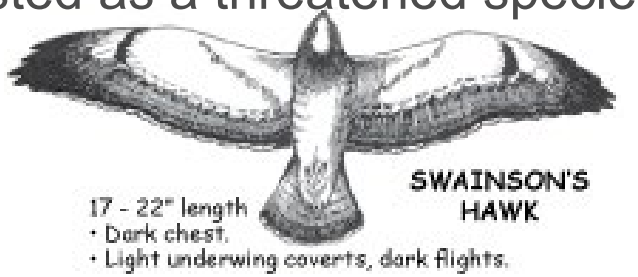
Swainson's Hawk

Giant Garter Snake

Sensitive Biological Resources – Swainson's Hawk

Biological resources surrounding the Sutter Energy Center, such as wildlife, wetlands, and waterways, are protected by state and federal laws.

The Swainson's hawk (Buteo swainsoni) is Listed as a threatened species Swainson's Hawk as seen from below under the California Endangered Species Act. They forage for prey in crop fields and grassland habitats. Most Swainson's hawks winter in Central and South America. From March through September these birds may be found nesting along the Sutter Bypass, Sacramento River, and in large isolated trees along farm roads. Several suitable nest trees are found near the plant site and its associated utilities.



Swainson's hawks are sensitive to loss of forage and nesting areas and may abandon nests when disturbed. They are also vulnerable to collisions with electric transmission lines. Certain maintenance activities along the electric transmission line and gas pipeline may be restricted if an active nest is found within 1/2 mile of the work area.

Sensitive Biological Resources – Giant Garter Snake

Giant Garter Snake *(Thamnophis gigas)* is listed as threatened by both the federal and California Endangered Species Acts. They can be found in the irrigation canals, rice fields, Gilsizer slough, and marshes of the Sutter National Wildlife Refuge. They could be found in any of the canals and rice fields surrounding the plant site, gasline alignment, electric transmission line, and switchyard site that are habitat for the giant garter snake. They spend most of their time in or near water, where they forage for fish and frogs. Giant garter snakes hibernate in animal burrows above floodwaters from October through April.

Giant garter snakes are sensitive to loss of habitat and are vulnerable to earth moving construction equipment, especially during hibernation. Maintenance activities include restrictions on mowing. The mower blades need to be at a height of 6 inches or more to protect the giant garter snakes. No mowing should be done between February 1st and August 15th to protect nesting birds in the tall grasses.

If you see a giant garter snake, make every effort to avoid it and contact the site Environmental Coordinator.

Sensitive Biological Resources – Waterfowl and Migratory Birds

Waterfowl and migratory birds (geese, ducks, herons, shorebirds, cranes, etc.) use the Pacific Flyway, as a major winter migration route.
The bald eagle (Haliaeetus leucocephalus), a California endangered species, forages along the Sacramento River and flooded rice fields in the winter, and the greater sandhill crane (Crus canadensis tabida), a California threatened species, spend winters foraging in the Central Valley.
All these birds have been observed near the Sutter Energy Center, others, such as herons and egrets may forage in the rice fields and irrigation canals.

Waterfowl and migratory birds are vulnerable to collisions with electric transmission lines. Biologists are monitoring the transmission lines for dead birds on an annual basis during operations. If dead birds are found, contact the site Environmental Coordinator.

Sensitive Biological Resources – Salmon, Steelhead, and Splittail

Salmon, steelhead, and splittail occur in the Sutter Bypass. The Sutter Bypass is used during migration by adult spring- and fall-run chinook salmon *(Oncorhynchus tshawytscha),* proposed federal endangered and federal threatened species, respectively. The Central Valley steelhead *(Oncorhynchus mykiss),* proposed as federal threatened, also migrates through the Sutter Bypass to spawning grounds. Juvenile salmon and steelhead use the bypass as rearing habitat on the way to the Pacific Ocean. The Sutter Bypass contains spawning habitat for Sacramento Splittail *(Pogonichthys macrolepidotus),* a proposed threatened species. Fish in the Sutter Bypass are vulnerable to sedimentation from construction activities inside the banks and to adverse changes in water quality. Any maintenance activities on the gas pipeline in this area would require monitoring by a biologist.

Keep all vehicles and debris out of waterways.

Sensitive Biological Resources – Seasonal Wetlands

Seasonal wetlands occur on the power plant site and in the Sutter National Wildlife Refuge. These wetland areas can be difficult to differentiate when they dry up during the summer. Wildlife, especially waterfowl and shorebirds, use wetlands as feeding areas during the winter. Seasonal wetlands can lose their functionality when soils become compacted or plowed. This prevents rainwater from ponding and changes the hydrologic regime of the wetland. The wetland areas on and near the site are protected throughout the year. Biologists are monitoring the wetlands on-site during operations. Maintenance activities require mowing the areas around the Sutter Energy Center and Greenleaf 1 instead of plowing. The mower has to be 6 inches high or more to protect giant garter snakes.

Stay out of exclusion zones. They protect wetlands and sensitive habitats.

Wetlands Exclusion Area

General Work Practices

- Stay in approved activity areas.
- Used approved access roads only.
- Keep out of exclusion areas such as wetlands.
- Cover open trenches at night.
- Do not litter.
- No pets, firearms or hunting.
- No fires .
- Smoke only in designated areas.
- Do not feed or disturb wildlife.
- Clean up and report all hazardous material spills immediately.
- Do not discharge any treated water into unapproved areas.
- Protect waterways and storm drains by implementing protective measures, such as silt fencing.
- Report any of the sensitive wildlife observed in the project area to the Site Manager.
- Report trapped, injured, or dead wildlife to the Site Manager and record on the Wildlife Observation Form. Forms will be available from the Environmental Coordinator and in the control room.
- Keep all equipment and debris out of canals and waterways.

Environmental Laws, Regulations, and Penalties

Many of the resources found near the Sutter Energy Center are protected by state and federal laws.

Endangered Species Act: The Federal Endangered Species Act provides for protection of threatened and endangered plant and animal species. The destruction of their critical habitat that prevents species recovery is also prohibited.

California Endangered Species Act: The California ESA prohibits the take of endangered and threatened wildlife.

Migratory Bird Treaty Act: The Migratory Bird Treaty Act prohibits the take of migratory birds.

California Fish and Game Code: The State Fish and Game Code prohibits take of plants and animals that are fully protected in California, and protects certain areas designated as significant wildlife habitat.

United States Army Corps of Engineers: The Clean Water Act provides protection for designated wetlands and waterways.

These laws and regulations apply to the ongoing operations and maintenance activities at the Sutter Energy Center. Agency enforcement personnel may visit the site at any time to monitor compliance.

Violation of state and/ or federal environmental laws can result in penalties including fines as high as $100,000 and/ or up to one year in jail. Violations can involve corporate and individual penalties.

Environmental Impacts and Mitigation Measures

Types of operation impacts:

- Disturbance of protected wetlands, nesting birds, and giant garter snakes on site could occur from discing instead of mowing. Mowing at least a height of 6 inches is less damaging and is required at Sutter Energy Center from July 15th through January 31st.
- Stormwater runoff must not contain hazardous waste or debris that would affect biological resources in the canals around the site.
- The electric transmission line and HRSG stacks may cause migratory bird collisions. Report all dead birds to the Compliance Manager.

Environmental Impacts and Mitigation Measures Cont.

Mitigation Measures:

- Activity zone limits must be established to protect sensitive habitats.
- Erosion control and revegetation will be implemented in all disturbance areas.
- Excluding a 20 foot firebreak around plant facilities, no mowing or vegetation clearing will be permitted from February 1st to August 15th to protect nesting birds unless specifically authorized by the Compliance Manager.
- Any mowing or vegetation clearing must maintain a minimum of 6 inches of height to protect giant garter snakes.
- Roundup® brand is the only herbicide permitted for use on the Sutter Energy Center site.

Contact Personnel

Control Room
(530) 821-2066

Andrew Gundershaug – General Manager
(530) 821-2072

Grant Royall– Operations Manager
(530) 321-3715

Betty Chu– Environmental Coordinator
(530) 821-5321

Remember: Always ask before you act.

ATTACHMENT 9

GSU SPEC SHEETS

OHIO TRANSFORMER CORPORATION
LOUISVILLE OHIO

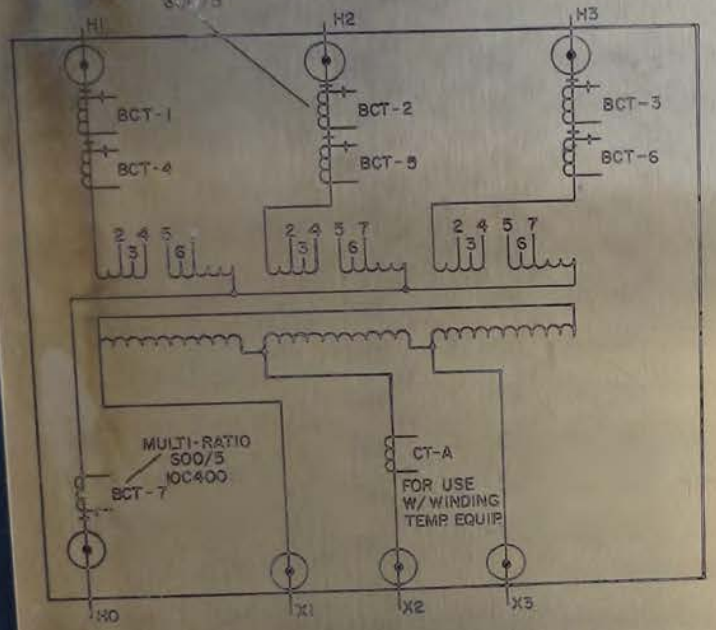
CLASS OA/FA/FA CONT. 55°C. RISE 3 PHASE 60 HERTZ SERIAL NO. 9R1533

25000 KVA SELF COOLED
33333 KVA FORCED AIR COOLED STEP I
41667 KVA FORCED AIR COOLED STEP II

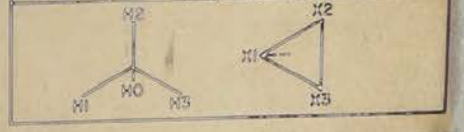
120000 GRD. Y/69280 TO 13800Δ VOLTS

IMPEDANCE VOLTS 11.1% AT 25000KVA 120000 - 13800 VOLTS

(6) MULTI-RATIO, 10C400
600/5



H-WINDING			
VOLTS		AMPS AT	TAP
L-L	L-N	41667 KVA	CHANGER
126000	72748	191	A
123000	71014	196	B
120000	69282	200	C
117000	67550	208	D
114000	65818	211	E
X-WINDING			
13800	——	1743	——



SUITABLE FOR OPERATION WITH THE NEUTRAL EITHER SOLIDLY GROUNDED OR GROUNDED THROUGH AN IMP. WHICH WILL LIMIT THE LOW FREQUENCY AND IMPULSE VOLTAGES FROM NEUTRAL TO GROUND TO VALUES CONSISTENT WITH THE INSULATION LEVELS SHOWN ON THIS NAMEPLATE.

BEFORE INSTALLING OR OPERATING READ WAGNER INSTRUCTION BOOK TU-161
OIL LEVEL BELOW TOP OF MANHOLE FLANGE AT 25°C. IS 10.6 INCHES AND CHANGES 1.33 INCHES PER 10°C. IN OIL TEMPERATURE.
TANK DESIGNED FOR OPERATING PRESSURES OF -5.0 TO +7.5 PSI ALSO FOR VACUUM FILLING.

IMPULSE LEVEL FULL WAVE BIL (KV)

H-WDG.	450
H-WDG. NEUT.	110
X-WDG.	110

APPROX. WEIGHTS IN POUNDS

CORE & COILS	93000
CASE & FITTINGS	89000
OIL 10500 GAL.	70000
TOTAL	252000

MAGNETEK/OHIO TRANSFORMER
LOUISVILLE, OHIO

ORIGINAL MFG. WAGNER

MOT. JN 111801 NPC-385

CLASS OA/FOA/FOA
INSTR BOOK # GTC 11813
NAMEPLATE # B-392
GALLONS OIL 8676 400
IMPEDANCE % AT 50000 KVA, 115000 TO 13800 VOLTS
BIL H1,H2,H3 550 KV, LV 110KV, HO 110KV
179500
LIGHTNING ARRESTER (3 TOTAL)
HIGH VOLTAGE
SAME AS PHASE A
PHASE B
PHASE C
LOW VOLTAGE
LIGHTNING ARRESTER (3 TOTAL)
X3
CONNECTIONS
LOAD TAP CHNGR
POS.5 CONNECTS
21 TO 26
VOLTS
50000 KVA AMPS
POS.
CONNECTS
WDG DELTA
13800
2092
Haza
Will
or c

ATTACHMENT 10

GREENLEAF 1 SELF-CERTIFICATION INFORMATION PROVIDED FROM DWR

Email from GE to DWR Responding to Questions from Joseph Hughes of CEC regarding more specific Emission Questions

From: Soltanzadeh, Behzad@DWR
To: Quintero, Jorge@DWR; Aziz, Musa@DWR; Kristen Kelley; Black, David (consultant)@DWR
Subject: Fwd: Data Requests for GE- TM2500 Emissions
Date: Tuesday, August 24, 2021 12:14:28 PM
Attachments: image005.png
image008.png
PP157A_LM2X_TM2500_5-8-10_Minute-Start_PP157A_06_01_2020.pdf
PP29C_TM2500 GT Purge_Times_PP29C_04_01_2018.pdf
PP63C_LM_Gas_Turbine_Stopping_Modes_PP63C_05_01_2021.pdf

Get Outlook for iOS

From: Houseknecht, Charles F (GE Gas Power) <charles.houseknecht@ge.com>
Sent: Tuesday, August 24, 2021 1:24:37 AM
To: Meyers, Anthony@DWR <Anthony.Meyers@water.ca.gov>; Knight, Eric@Energy <Eric.Knight@energy.ca.gov>; Soltanzadeh, Behzad@DWR <Behzad.Soltanzadeh@water.ca.gov>; Hughes, Joseph@Energy <Joseph.Hughes@energy.ca.gov>
Cc: Noe, Greg (GE Gas Power) <greg.noe@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>; McAdams, Robin (GE Gas Power) <Robin.McAdams@ge.com>; Leblanc jr, Timothy (GE Gas Power) <Timothy.Leblancjr@ge.com>; Remington, Ty (GE Gas Power) <ty.remington@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>; Nomani, Aamir (GE Gas Power) <muhammad.nomani@ge.com>; Wojcik, Cherine (GE Gas Power) <Cherine.Wojcik@ge.com>; Pintea, Mihai (GE Gas Power) <Mihai.Pintea@ge.com>
Subject: FW: Data Requests for GE- TM2500 Emissions

Behzad / Tony,

Please find below and attached the information requested for the TM2500 Emissions. Please let us know if you any additional questions.

Regards,
Chuck Houseknecht
North America Portfolio Leader, Projects
GE Gas Power Systems

T +1 518 265 9635

1 River Road, Bldg. 40-304| Schenectady, NY, 12345, USA
General Electric Company

From: Kessler, Daniel (GE Gas Power) <dan.Kessler@ge.com>
Sent: Monday, August 23, 2021 10:21 PM
To: Houseknecht, Charles F (GE Gas Power) <charles.houseknecht@ge.com>
Cc: Noe, Greg (GE Gas Power) <greg.noe@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>; McAdams, Robin (GE Gas Power) <Robin.McAdams@ge.com>; Leblanc jr, Timothy (GE Gas Power) <Timothy.Leblancjr@ge.com>; Remington, Ty (GE Gas Power) <ty.remington@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>; Nomani, Aamir (GE Gas Power) <muhammad.nomani@ge.com>; Wojcik, Cherine (GE Gas Power) <Cherine.Wojcik@ge.com>; Pintea, Mihai (GE Gas Power) <Mihai.Pintea@ge.com>
Subject: RE: Data Requests for GE

Chuck,
Here is the information requested. I have compiled the answers from the team and added the emissions items.

1. Stack height (28 ft?)
   These units are equipped with Dalhman exhaust stack with a heigh of 26' 1-1/4".
2. steady state emissions for PM10/2.5, SOx, and VOC
   Data below is an estimate using Roseville, but generally applies to all. There are slightly different CO emissions per site and Roseville has the highest. I included 30F, 60F, 100F so you can see that the higher CO levels occur at cold days. This could help in the waiver process. Our guarantee states that CO is guaranteed at 259ppm for 18-115F and down to 50% load. As the ambient temperature cools, our CO production increases. For hot days like the 100F reference, we do not expect as much CO. VOC is a function of CO so same applies there. See attached PP157 and 29 regarding start times and purge.

Tamb	F	100	100	100	100	100	100	100	100	100	100	100	60	60	60	60	60	60	60	60	60	30	30	30	30	30	30	30	30	30	30
GTG Load	%	100	95	90	85	80	75	70	65	60	55	50	100	95	90	85	80	75	70	65	60	55	50	100	95	90	85	80	75	70	65	60	55	50
PWR	kW	27229	25868	24506	23145	21783	20422	19060	17699	16337	14976	13615	35395	33625	31855	30085	28316	26546	24776	23007	21237	19467	17697	37023	35172	33320	31469	29618	27767	25916	24065	22214	20363	18511
HR	Btu/kWh LHV	9847	9956	10080	10217	10364	10533	10750	10997	11280	11609	11996	9431	9475	9523	9588	9689	9813	9981	10175	10392	10646	10944	9342	9330	9382	9427	9498	9607	9761	9946	10155	10392	10674
HI	MMBTU/hr lhv	268.1	257.5	247.0	236.5	225.8	215.1	204.9	194.6	184.3	173.9	163.3	333.8	318.6	303.3	288.5	274.3	260.5	247.3	234.1	220.7	207.2	193.7	345.9	328.2	312.6	296.7	281.3	266.8	253.0	239.3	225.6	211.6	197.6
NOX	ppm	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
CO	ppm	51	52	54	54	51	47	45	41	41	43	47	146	158	133	125	125	122	115	106	100	93	94	249	211	187	175	174	174	164	155	145	135	142
UHC	ppm	31	31	32	32	31	28	27	25	24	26	28	88	83	80	75	75	73	69	64	60	56	57	149	127	112	105	104	104	98	93	87	81	85
VOC	ppm	6.1	6.3	6.4	6.5	6.1	5.7	5.4	5.0	4.9	5.1	5.6	17.5	16.6	16.0	15.0	15.0	14.7	13.8	12.8	12.0	11.1	11.3	29.8	25.4	22.5	21.0	20.9	20.9	19.6	18.6	17.4	16.2	17.1
PM10	lb/hr	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Sulfur	grains/100 SCF	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
NOX	lb/hr as NO2	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7
CO	lb/hr	33.2	34.0	34.9	35.1	33.1	30.8	29.0	26.9	26.5	27.9	30.4	94.8	90.0	86.5	81.3	81.0	79.5	74.5	69.1	64.9	60.3	61.2	161.7	137.3	121.6	113.6	113.2	113.2	106.4	100.6	94.1	87.7	92.5
UHC	lb/hr as CH4	11.4	11.7	12.0	12.0	11.3	10.6	9.9	9.2	9.1	9.6	10.4	32.5	30.8	29.7	27.9	27.8	27.3	25.5	23.7	22.2	20.7	21.0	55.4	47.1	41.7	39.0	38.8	38.8	36.5	34.5	32.3	30.1	31.7
VOC	lb/hr as CH4	2.3	2.3	2.4	2.4	2.3	2.1	2.0	1.8	1.8	1.9	2.1	6.5	6.2	5.9	5.6	5.6	5.5	5.1	4.7	4.4	4.1	4.2	11.1	9.4	8.3	7.8	7.8	7.8	7.3	6.9	6.5	6.0	6.3
PM10	lb/hr	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
SOX	lb/hr as SO2	0.20	0.20	0.19	0.18	0.17	0.16	0.16	0.15	0.14	0.13	0.12	0.25	0.24	0.23	0.22	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.26	0.25	0.24	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15

3. Startup and shutdown emissions for NOx, CO, PM10/2.5, SOx, and VOC
   Startup and shutdown data are estimates assuming a 10-minute start and normal shutdown of 9 minutes. Note that the 9 minutes is to fuel chop. The full shutdown sequence will include a cooldown crank time of 15min (fuel is off during this time). So the total shutdown is 24 minutes in duration. The full sequence is 4 minutes to ramp down to sync idle, 5 minutes at sync, fuel chop occurs, then a 15 min cooldown crank.

GE Power

TM2500-G4 Startup & Shutdown Estimated Emissions - Gas Fuel Operation

Event	Duration (min)	Heat Input (MMBTU - HHV)	NOx (lb)	CO (lb)	VOC (lb)	PM10/PM2.5 (lb)	SOX as SO2 (lb)
Start: 10min GT Exhaust	10.0	19.6	3.1	19.4	0.8	0.5	0.1
Shutdown: GT Exhaust	9.0	23.4	3.4	21.6	0.9	0.6	0.3

*Must Meet GE Gas Fuel Spec (MID-TD-0000-1 LATEST REVISION)
* Fast Start per GE Procedures. Normal shutdown per GE procedures.
NOTE 1: VOC's are defined as non-methane, non-ethane, 50% saturated. Mass rate reported as methane.
NOTE 2: Calculations executed using the gas below with margined heat input
NOTE 3: Fuel composition contains <5% C3+
NOTE 4: Scope includes GT Exhaust with out SCR/CON and Stack with SCR/CON
NOTE 5: Intentionally blank
NOTE 6: Shutdown is defined to end when fuel is shut off. Excludes cooldown crank time.
NOTE 7: SOX is reported as SO2. For stack calculations, SOX is converted to sulfates and sulfate salts. These are counted as PM and not included in SOX numbers here.

Gas Fuel Composition

	Volume %	Weight %
Hydrogen	0.0000	0.0000
Methane	95.0000	89.1611
Ethane	0.0000	3.5183
Ethylene	0.0000	0.0000
Propane	0.5000	1.2899
Propylene	0.0000	0.0000
Butane	0.2500	0.8501
Butylene	0.0000	0.0000
Butadiene	0.0000	0.0000
Pentane	0.1500	0.6331
Cyclopentane	0.0000	0.0000
Hexane	0.0500	0.2521
Heptane	0.0000	0.0000
Carbon Monoxide	0.0000	0.0000
Carbon Dioxide	1.0000	2.5747
Nitrogen	1.0500	1.7208
Water Vapor	0.0000	0.0000
Oxygen	0.0000	0.0000
Hydrogen Sulfide	0.0000	0.0000
Ammonia	0.0000	0.0000
LHV, BTU/lb	20495	
HHV, BTU/lb	22733	
NOx Scalar	0.991	
Specific Gravity	0.5901	
MWI, (Btu/SCFI/SQRT[R]	52.06	
LHV, BTU/scf	930.1	
HHV, BTU/scf	1026.7	
Fc, SCF/MMBtu HHV	1027.5	
Fd, SCF/MMBtu HHV	8856.0	

4. Startup and shutdown durations **(see above answer).**
5. Restarts and shutdown procedures.
   Please reference PP63. It covers the various stopping modes and how to avoid the 4 hour lockout. The following table from the O&M gives another helpful view of this info.

Table 7-7. Gas Turbine Hot Restart Conditions and Required Actions

	START Initiated within 6 minutes of GG reaching 300 rpm	MOTOR Initiated within 6 minutes of GG reaching 300 rpm	START or MOTOR NOT Initiated within 6 minutes of GG reaching 300 rpm
Normal Shutdown with 5 minutes idle	Normal start permitted	Motor(1) 2000-2400 rpm 12-15 minutes or Slow Motor(2). Normal start permitted any time during motoring or after motoring is complete.	Soft Start(1) recommended
Hung or Failed Start or Trip when T48 <1150°F (621.1°C) for over 8 minutes	Normal start permitted	Motor(1) 2000-2400 rpm 12-15 minutes or Slow Motor(2). Normal start permitted any time during motoring or after motoring is complete.	Soft Start(1) recommended
Emergency Shutdown with T48 >1150°F (621.1°C)	Normal start permitted	Motor(1) 1000-1200 rpm for 12-15 minutes minimum, then continue until T48 <400°F (204°C). Normal start permitted within 6 minutes after motoring cycle completed. or Slow Motor(2) followed by Soft Start(1).	Soft Start(1) required or 4 hour lockout required
Emergency Shutdown No motoring (ESN)	Soft Start(1) or 4 hour lockout required after cause of trip is determined.		

(1) **SOFT START**. Confirm free rotation by applying 20 lb ft (27 N-m) of torque to AGB manual drive shaft. Within 6 minutes, Motor @ 1600-1200 rpm for 20 minutes, then begin normal purge and start cycle. Risk of HPC/HPT rubs if Soft Start is not completed.

(2) **SLOW MOTOR**. If compressor is not already rotating, confirm free rotation by applying 20 lb ft (27 N-m) of torque to AGB manual drive shaft. Within 6 minutes, Motor @ 80-120 rpm for up to 4 hours. Risk of HPC/HPT rubs if Slow Motor is not completed. Continuous Slow Motor can be used to prevent lock-up.

(3) Scavenge temp >340°F (171°C) during all Motoring.

6. Exhaust Velocity:
   Exhaust velocity out of the GE supplied stack will vary over ambient conditions and GTG loads. Both the GT exhaust and the package ventilation air exit out of the GTG stack. The performance runs show the GT exhaust mass flow rate. The approximate airflow for ventilation is 35,000 SCFM with an exit temperature around 180F. Typical baseload velocity at ISO is around 218 ft/s and at hot day it is around 190 ft/s.

Thanks
Dan

From: Houseknecht, Charles F (GE Gas Power) <charles.houseknecht@ge.com>
Sent: Monday, August 23, 2021 7:10 PM
To: Kessler, Daniel (GE Gas Power) <dan.Kessler@ge.com>
Cc: Noe, Greg (GE Gas Power) <greg.noe@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>
Subject: FW: Data Requests for GE

Dan,

Below is the follow-up email customer sent after our call today on the Emissions.

Regards,
Chuck Houseknecht
North America Portfolio Leader, Projects
GE Gas Power Systems

T +1 518 265 9635

1 River Road, Bldg. 40-304| Schenectady, NY, 12345, USA
General Electric Company

From: Soltanzadeh, Behzad@DWR <Behzad.Soltanzadeh@water.ca.gov>
Sent: Monday, August 23, 2021 4:35 PM
To: Meyers, Anthony@DWR <Anthony.Meyers@water.ca.gov>; Houseknecht, Charles F (GE Gas Power) <charles.houseknecht@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>; Knight, Eric@Energy <Eric.Knight@energy.ca.gov>; Hughes, Joseph@Energy <Joseph.Hughes@energy.ca.gov>
Cc: McAdams, Robin (GE Gas Power) <Robin.McAdams@ge.com>; Nomani, Aamir (GE Gas Power) <muhammad.nomani@ge.com>
Subject: EXT: FW: Data Requests for GE

Thank you all for attending this meeting today, please see the highlighted information needed. As we discussed GE will provide this by 0900 PST tomorrow.

Behzad,

From: Soltanzadeh, Behzad@DWR
Sent: Monday, August 23, 2021 9:39 AM
To: 'Houseknecht, Charles F (GE Gas Power)' <charles.houseknecht@ge.com>; McAdams, Robin (GE Gas Power) <Robin.McAdams@ge.com>; Smith, Kelmer (GE Gas Power) <kelmer.smith@ge.com>
Cc: 'Remington, Ty (GE Gas Power)' <ty.remington@ge.com>; Meyers, Anthony D. (ameyers@water.ca.gov) <ameyers@water.ca.gov>
Subject: FW: Data Requests for GE
Importance: High

Chuck and GE Team,

The following information is what we need this afternoon to move this project forward. I have invited a representative from California Energy Commission (Joseph Hughes) to answer any question you may have. Please note that there is an extremely short fuse on this and we need this information if not today tomorrow morning!

From: Hughes, Joseph@Energy <Joseph.Hughes@energy.ca.gov>
Sent: Monday, August 23, 2021 9:20 AM
To: Meyers, Anthony@DWR <Anthony.Meyers@water.ca.gov>; Soltanzadeh, Behzad@DWR <Behzad.Soltanzadeh@water.ca.gov>
Subject: Data Requests for GE

Per our discussion with Calpine for the Greenleaf1 project, we will need the following information from GE to include in the DOE waiver:

1. Stack height (28 ft?)
2. steady state emissions for PM10/2.5, SOx, and VOC
3. Startup and shutdown emissions for NOx, CO, PM10/2.5, SOx, and VOC
4. Startup and shutdown durations
5. Exhaust Velocity

Thanks,
Joey

GE Performance Guarantee - 1582023 DWR Calpine Greenleaf

GUARANTEE R0

PROJECT: DWR CALPINE

LOCATION:YUBA CITY, CALIFORNIA , USA

UNIT NET, KW	27125
BTU/KW-HR, LHV	9862
KJ/KW-HR, LHV	10405

EMISSIONS ARE VALID FOR T2 WITHIN 9°F TO 118°F AND A GTG LOAD DOWN TO 50% AS DEFINED IN STEADY STATE CONDITIONS FOR EMISSIONS GUARANTEE

NOX: 25 PPMVD AT 15% O2
(50 mg/Nm3, AT 15% O2)
CO: 203 PPMVD AT 15% O2
(254 mg/Nm3)

Pintea, Mihai
Performance Engineer
Date: 08/06/2021

NOT VALID WITHOUT SIGNATURE

VALID UNTIL 11/30/2021

BASIS OF GUARANTEE:	BASE LOAD, GAS FUEL NOZZLE SYSTEM NO BLEED OR EXTRACTED POWER
ENGINE:	(1) GE TM2500+G4
FUEL:	20126 BTU/LB / (46814 kJ/kg) LHV, SITE GAS FUEL
FUEL SPEC:	MID-TD-0000-1 LATEST REVISION
FUEL TEMP:	77.0°F /(25°C)
FUEL PRESS:	520 PSIG+/-20 PSIG (3585 KPAG+/-138 KPAG)
GENERATOR:	GEPC A040
GENERATOR OUTPUT	13.8 kV, 60 Hz
POWER FACTOR:	0.85
AMBIENT TEMP:	100°F / (37.8°C)
AMBIENT RH:	50.0%
INLET CONDITIONING:	NONE
ALTITUDE:	7.0 ft / (2.134 m)
INLET FILTER LOSS:	5.8 inH_2O / (147.32 mmH_2O)
EXHAUST LOSS:	6.2 inH_2O / (157.48 mmH_2O)
NOX CONTROL:	**Water**
INJECTION RATE:	14301 lb/h (6487 kg/h)
INJECTION TEMP:	100 F (37.8 ˚C)
ENGINE CONDITION:	NEW AND CLEAN ≤ 200 SITE FIRED HOURS
FIELD TEST METHODS	
PERFORMANCE:	GE POWER & WATER SGTGPTM
NOX:	EPA METHOD 20
CO:	EPA METHOD 10

BASIS OF GUARANTEE IS NOT FOR DESIGN, REFER TO PROJECT DRAWINGS FOR DESIGN REQUIREMENTS.
SI VALUES ARE FOR REFERENCE PURPOSES ONLY.

THIS GUARANTEE SUPERSEDES ANY
PREVIOUS GUARANTEES PRESENTED

GUARANTEE R0
PROJECT: DWR CALPINE
LOCATION:YUBA CITY, CALIFORNIA , USA

NOISE GUARANTEE IS FOR A SINGLE TM2500 GAS TURBINE PACKAGE AND EXCLUDES BOP

NEAR FIELD NOISE:
90 DB(A) ARITHMETIC AVERAGE SOUND PRESSURE LEVEL (dB REF 20 MICROPASCALS, RMS) OF LOCATIONS AROUND THE PACKAGE (VERTICAL DISTANCE OF 5FT. (1.5M) ABOVE PACKAGE BASE AT A HORIZONTAL DISTANCE OF 3FT. (1M) FROM THE EXTERIOR PLANE OF EQUIPMENT AS TESTED IN A FREE-FIELD CONDITION OVER A HARD REFLECTING GROUND PLANE, OPERATING AT BASE LOAD)

Pintea, Mihai
Performance Engineer
Date: 08/06/2021

NOT VALID WITHOUT SIGNATURE

VALID UNTIL 11/30/2021

BASIS OF GUARANTEE:	BASE LOAD, GAS FUEL NOZZLE SYSTEM NO BLEED OR EXTRACTED POWER
ENGINE:	(1) GE TM2500+G4
FUEL:	20126 BTU/LB / (46814 kJ/kg) LHV, SITE GAS FUEL
FUEL SPEC:	MID-TD-0000-1 LATEST REVISION
FUEL TEMP:	77.0°F /(25°C)
FUEL PRESS.:	520 PSIG+/-20 PSIG (3585 KPAG+/-138 KPAG)
GENERATOR:	GEPC A040
GENERATOR OUTPUT	13.8 kV, 60 Hz
POWER FACTOR:	0.85
AMBIENT TEMP:	100°F / (37.8°C)
AMBIENT RH:	50%
INLET CONDITIONING:	NONE
ALTITUDE:	7.0 ft / (2.134 m)
INLET FILTER LOSS:	5.8 inH2O / (147.32 mmH2O)
EXHAUST LOSS:	6.2 inH2O / (157.48 mmH2O)
NOX CONTROL:	Water
INJECTION RATE:	14301 lb/h (6487 kg/h)
INJECTION TEMP:	100 F (37.8 ˚C)
ENGINE CONDITION:	NEW AND CLEAN £ 200 SITE FIRED HOURS
FIELD TEST METHODS	
PERFORMANCE:	GE POWER & WATER SGTGPTM
NOX:	EPA METHOD 20
CO:	EPA METHOD 10

BASIS OF GUARANTEE IS NOT FOR DESIGN, REFER TO PROJECT DRAWINGS FOR DESIGN REQUIREMENTS.
SI VALUES ARE FOR REFERENCE PURPOSES ONLY.

THIS GUARANTEE SUPERSEDES ANY
PREVIOUS GUARANTEES PRESENTED

GE GAS POWER

AUXILIARY LOADS FOR EQUIPMENT SUPPLIED BY GE AS INDICATED IN PROPOSAL

Normal Operating Auxiliary Loads for 1xTM2500 50Hz on NG with WI

August 6, 2021

STANDARD LOADS		
DESCRIPTION	**QTY**	**KW**
NOX WATER INJECTION PUMP	1	44.76
TURBINE ENCLOSURE VENT FAN	1	59.7
TURBINE LUBE OIL/HYDRAULIC OIL HEAT EXCHANGER FAN	1	5.6
GENERATOR LUBE OIL HEAT EXCHANGER FAN	1	5.6
LIGHTING AND DISTRIBUTION PANEL (230/133 3PH 4W 25 CKT)	1	10
LIGHTING AND DISTRIBUTION PANEL	1	45
TOTAL STANDARD LOADS:		**171**

BOP LOADS		
DESCRIPTION	**QTY**	**KW**
BOP LOADS	0	0
TOTAL OPTIONAL LOADS:		**0**

TOTAL LOADS: 170.66

Steady State Conditions for Emissions Guarantee

1.	Power Output (electrical)	±10.0% / Min
2.	T2 Compressor Inlet air temperature	± 2.5°F / 5.0 Min
3.	Heat Value - gaseous fuel per unit volume	±0.25% / Min
4.	Pressure - gaseous fuel as supplied to engine	± 10 PSIG / 5.0 Min

Conditions for Near Field Noise Guarantee

1. Based on arithmetic average of sound pressure levels at locations around the package.
2. GTG auxiliary trailer must be located less than 6-ft of the main unit.
3. Intentional left blank
4. Intentional left blank
5. Intentional left blank
6. Intentional left blank
7. Intentional left blank
8. Per unit basis.
9. Start-up and Shut-down excluded.
10. GE Power & Water GTG package scope of supply only, customer supplied equipment is not included.
11. GE Power & Water GTG package scope of supply only, GE Power & Water supplied BOP equipment is not included.
12. If GE Power & Water supplies BOP equipment, then GE Power & Water is to advise best location.

Estimated Average Engine Performance NOT FOR GUARANTEE, REFER TO PROJECT F&ID FOR DESIGN

GE Gas Power

Performance By: **Pintea, Mihai**
Project Info:

Engine: **TM2500+G4 -TM2500-G4-A-0220-L3**
Deck Info: **GE166B - 8al.scp**
Generator: **GEPC A040, 60Hz, 13.8 kV, 0.85 PF**
Fuel: **Site GAS FUEL**

Date: 06/08/2021
Time: 10:52:38

Case	**100**
Ambient Conditions	
Dry Bulb Temp., °F	100
Wet Bulb Temp., °F	83.2
Relative Humidity, %	50
Elevation a.s.l., ft	7
Barometric Press., psi	14.686
Engine Inlet	
Comp. Inlet Temp., °F	100
Comp. Inlet RH, %	50
Type	None
Chill/Heat Cap., kBTU/h	None
Pressure Losses	
Inlet Press. Loss, inH2O	5.8
Exh. Press. Loss, inH2O	6.2
GTG Load, %	**100**
Gen. Output, Gross, kW	**27296**
HR, btu/(kW*h)	**9725**
Aux Load, kW	170.66
Gen. Output, Unit Net, kW	**27125**
G-HR, Unit Net, btu/(kW*h)	**9862**
Comp. Inlet Temp., °F	100
Fuel Flow	
Fuel Number	801-3084
Fuel Name	Pacific Gas S153
Fuel LHV, BTU/lb	20126
Heat Input, MMBTU/h	265.50
Fuel Flow, lb/s	3.66
Vol. Fuel Flow, scfm	5038.8
Fuel Temp., °F	77
NOx Control	**Water**
Diluent Injection	
Diluent Flow, lb/h	14301
Diluent Temp., °F	100
Exhaust Parameters	
Exhaust Temp., °F	982.7
Exhaust Flow, lb/s	178.1
Energy (Ref 0R), BTU/s	67755
Emissions (ESTIMATED, NOT FOR GUARANTEE)	
NOx, Ref % O2, ppmvd	25
Aero Energy Fuel Number	801-3084
Hydrogen, %Volume	0
Methane, %Volume	95.9693
Ethane, %Volume	0.2912
Ethylene, %Volume	0
Propane, %Volume	0.0086
Propylene, %Volume	0
Butane, %Volume	0.0047
Butylene, %Volume	0
Butadiene, %Volume	0
Pentane, %Volume	0.0008
Cyclopentane, %Volume	0
Hexane, %Volume	0.005
Heptane, %Volume	0
CarbonMonoxide, %Volume	0
Carbon Dioxide, %Volume	0.1161
Nitrogen, %Volume	3.6045
Water Vapor, %Volume	0
Oxygen, %Volume	0
HydrogenSulfide, %Volume	0
Ammonia, %Volume	0
LHV, BTU/lb	20126
HHV, BTU/lb	22348
NOx Scalar	0.949
Specific Gravity	0.5716
MWI, (Btu/SCF)/SQRT(R)	50.308
LHV, BTU/scf	882
HHV, BTU/scf	978
Exh Wght % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	1.2077
N2, %	70.9396
O2, %	14.021
CO2, %	5.3324
H2O, %	8.4943
SO2, %	0
CO, %	0.0019
HC, %	0.0002
NOX, %	0.0029
Exh Mole % Dry (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	0.9684
N2, %	81.11
O2, %	14.0352
CO2, %	3.881
H2O, %	0
SO2, %	0
CO, %	0.0022
HC, %	0.0003
NOX, %	0.0029
Exh Mole % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	0.8413
N2, %	70.4675
O2, %	12.1936
CO2, %	3.3718
H2O, %	13.1211
SO2, %	0
CO, %	0.0019
HC, %	0.0003
NOX, %	0.0025
Exhaust Parameters	
Sp. Heat, BTU/(lb*°R)	0.285
Exh Mol Wght, lb/lb-mol	27.828
Exh. Flow, ACFM	398392.5
Exh. Flow, SCFM	145685.3

Estimated Average Engine Performance NOT FOR GUARANTEE, REFER TO PROJECT F&ID FOR DESIGN

GE Gas Power

Performance By: **Pintea, Mihai**
Project Info:

Engine: **TM2500+G4 -TM2500-G4-A-0220-L3**
Deck Info: **GE166B - 8al.scp**
Generator: **GEPC A040, 60Hz, 13.8 kV, 0.85 PF**
Fuel: **Site GAS FUEL**

Date: **06/08/2021**
Time: **10:52:38**

Case	**100**
Ambient Conditions	
Dry Bulb Temp., °C	37.8
Wet Bulb Temp., °C	28.4
Relative Humidity, %	50
Elevation a.s.l., m	2.13
Barometric Press., kPa	101.23
Engine Inlet	
Comp. Inlet Temp., °C	37.8
Comp. Inlet RH, %	50
Type	None
Chill/Heat Cap., MJ/h	None
Pressure Losses	
Inlet Press. Loss, mmH2O	147.32
Exh. Press. Loss, mmH2O	157.48
GTG Load, %	**100**
Gen. Output, Gross, kW	**27296**
HR, kJ/(kW*h)	**10260.46**
Aux Load, kW	170.66
Gen. Output, Unit Net, kW	**27125**
G-HR, Plant Net, kJ/(kW*h)	**10405**
Comp. Inlet Temp., °C	37.8
Fuel Flow	
Fuel Number	801-3084
Fuel Name	Pacific Gas $153
Fuel LHV, kJ/kg	46813
Heat Input, MW	77.81
Fuel Flow, kg/s	1.66
Vol. Fuel Flow, Nm3/hr	8561
Fuel Temp., °C	25.0
NOx Control	**Water**
Diluent Injection	
Diluent Flow, kg/h	6487
Diluent Temp., °C	37.78
Exhaust Parameters	
Exhaust Temp., °C	528
Exhaust Flow, kg/s	80.8
Energy (Ref 0R), kW	71485.59
Emissions (ESTIMATED, NOT FOR GUARANTEE)	
NOx, Ref % O2, mg/Nm3	51.3
Aero Energy Fuel Number	801-3084
Hydrogen, %Volume	0
Methane, %Volume	95.9693
Ethane, %Volume	0.2912
Ethylene, %Volume	0
Propane, %Volume	0.0086
Propylene, %Volume	0
Butane, %Volume	0.0047
Butylene, %Volume	0
Butadiene, %Volume	0
Pentane, %Volume	0.0008
Cyclopentane, %Volume	0
Hexane, %Volume	0.005
Heptane, %Volume	0
CarbonMonoxide, %Volume	0
Carbon Dioxide, %Volume	0.1161
Nitrogen, %Volume	3.6045
Water Vapor, %Volume	0
Oxygen, %Volume	0
HydrogenSulfide, %Volume	0
Ammonia, %Volume	0
LHV, kJ/kg	46814
HHV, kJ/kg	51982
NOx Scalar	0.949
Specific Gravity	0.5716
MWI, (kJ/Nm3)/SQRT(K)	0.952
LHV, kJ/Nm3	34745
HHV, kJ/Nm3	38498
Exh Wght % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	1.2077
N2, %	70.9396
O2, %	14.021
CO2, %	5.3324
H2O, %	8.4943
SO2, %	0
CO, %	0.0019
HC, %	0.0002
NOX, %	0.0029
Exh Mole % Dry (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	0.9684
N2, %	81.11
O2, %	14.0352
CO2, %	3.881
H2O, %	0
SO2, %	0
CO, %	0.0022
HC, %	0.0003
NOX, %	0.0029
Exh Mole % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)	
AR, %	0.8413
N2, %	70.4675
O2, %	12.1936
CO2, %	3.3718
H2O, %	13.1211
SO2, %	0
CO, %	0.0019
HC, %	0.0003
NOX, %	0.0025
Exhaust Parameters	
Sp. Heat, kJ/(kg**K)	1.195
Exh Mol Wght, kg/kmol	27.828
Exh. Flow, ACFM	398392.5
Exh. Flow, SCFM	145685.3

Narrative of how and when the engine-generator will be made BACT compliant as soon as practicable

Description of plan for how and when the engine-generator will be made BACT compliant as soon as practicable.

The Department of Water Resources (DWR) intends to purchase Selective Catalytic Reduction (SCR) systems and oxidation catalysts for the Calpine and Roseville TM2500s as soon as practicable. Due to the expedited schedule to procure, construct and commission the temporary natural gas power generators to deliver net peak energy before October 31, 2021, DWR explicitly included a future contract option to purchase and install SCRs and oxidation catalysts post the initial TM2500 commissioning. As part of the DWR/GE procurement "CONTRACT FOR SALE OF EQUIPMENT AND SERVICES" for the Calpine Greenleaf 1 (August 10, 2021) and Roseville Energy Park (August 11, 2021) projects, DWR included future SCR/COR Catalyst scope that can be executed via Change Order within Article 9 of the Performance Guarantees:

> ***Future SCR/COR***
> *A SCR/COR Catalyst may be included in this Contract at some point in the future via a Change Order at a price to be agreed. At that point, subject to the Best Available Control Technology still being available, a SCR/COR would be capable of reducing the TM2500 Unit emissions from the as-guaranteed value for NOx and CO in Seller's Performance Guarantee in Attachment 6 (Performance Guarantee) down to the NOx, CO, and VOC levels indicated in the "Future SCR/COR Table" below.*
>
> ***Future SCR/COR Table***
> *VOC: 2 PPM @ 15% 02*
> *CO: 6 PPM @ 15% 02*
> *NOx: 5 PPM @ 15% 02*

SCRs and COR Catalysts are advanced active emissions control technologies that are not off-the-shelf products and require specialized engineering design before manufacture, delivery, and installation. There is a ten (10) to twelve (12) month lead time for delivery and it takes one (1) to two (2) months for installation. In September 2021, DWR will start negotiations with General Electric Co. to procure the SCRs and oxidation catalysts for the two Calpine Greenleaf 1 and two Roseville Energy Park TM2500s. DWR will be able to provide more detailed specifications for these emission control technologies in the Spring of 2022. Emission control equipment commissioning is anticipated by Fall/Winter of 2022.

DWR Attestation Letter for Providing As-Builts After Units Commissioned

CALIFORNIA NATURAL RESOURCES AGENCY GAVIN NEWSOM, Governor

DEPARTMENT OF WATER RESOURCES
DIVISION OF OPERATIONS & MAINTENANCE
1416 9th Street
Sacramento, CA 95814

August 27, 2021

Drew Bohan, Executive Director
California Energy Commission
715 P Street
Sacramento, CA 95814-5512

Re: Letter of Attestation for As-Built Engineering Drawings and Manufacturer's Cut Sheets for Calpine Greenleaf 1 and Roseville Energy Park TM2500s

Dear Mr. Bohan,

Pursuant to Governor Newsom's July 30, 2021 State of Emergency Proclamation, the Department of Water Resources (DWR) has contracted with General Electric Company and Kiewit Power Constructors, Inc. for the procurement, design, construction, and commissioning of temporary natural gas power generators to deliver net peak energy before October 31, 2021. Two 30MW TM2500 generation units will be installed at Calpine's Greenleaf 1 site and another two 30MW TM2500 generation units will be installed at the Roseville Energy Park. DWR will be the temporary owner of the units located on leased properties, and the units will be operated by Calpine and Roseville Electric respectively per our lease agreements. Due to the expedited schedule and suspension of the typical CEC licensing process, DWR attests as the owner of the TM2500 units, it will provide all as-built engineering drawings and manufacturer's cut sheets for the installed power generator packages and all associated appurtenances after commissioning. As-built engineering drawings and manufacturer's cut sheets will be provided to both the site operators and the CEC as soon as it becomes available.

Sincerely,

Ted Craddock

Ted Craddock, Deputy Director
State Water Project
Department of Water Resources

GE Turbine/Generator

Near Field Noise Map

GE ENERGY
AERO
16415 Jacintoport Blvd.
Houston, TX 77015
Engineer: Quoc nguyen

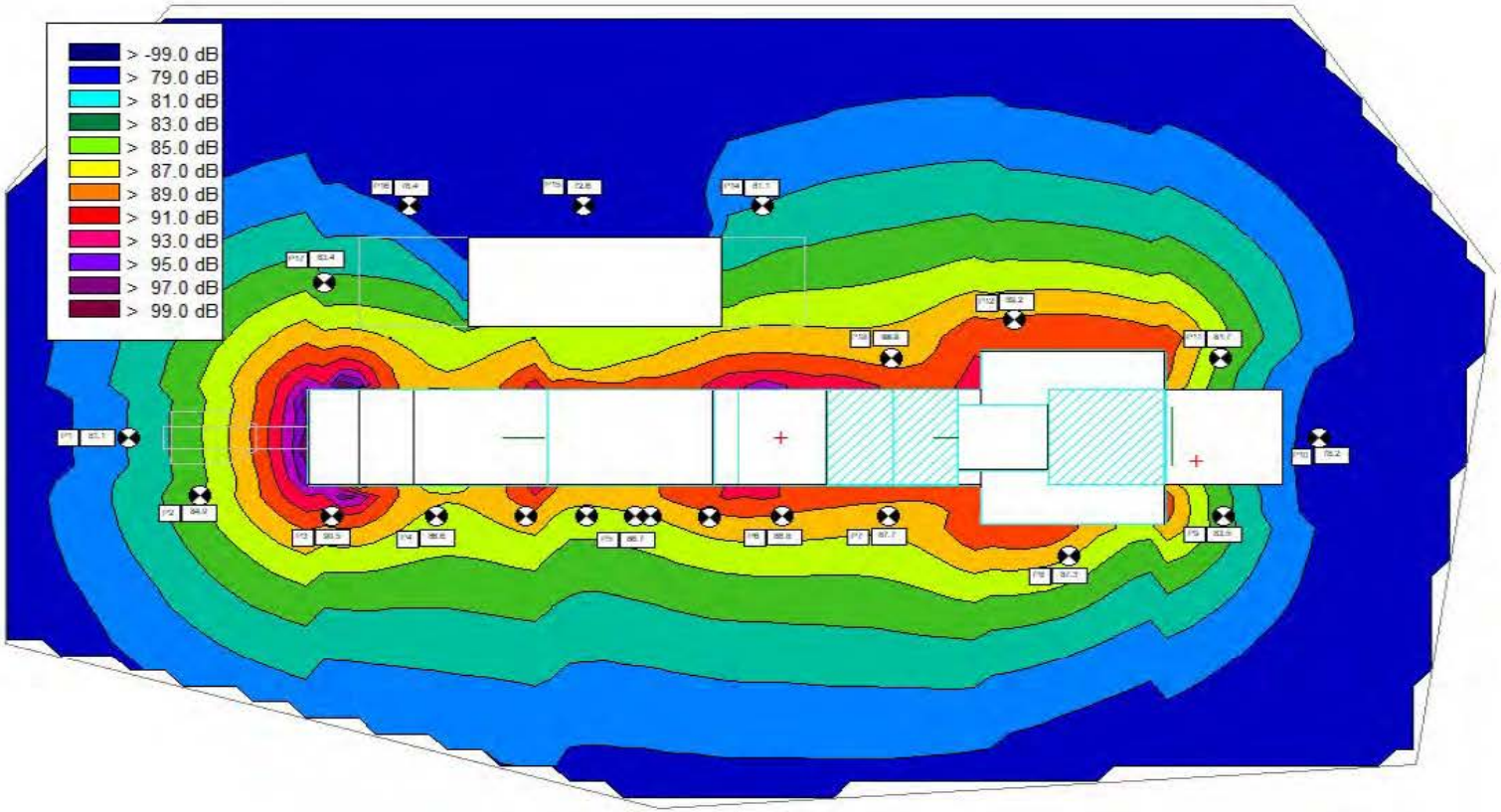
CUSTOMER	Chuck Houseknecht
PROJECT	Calpine Green Leaf 1 / City of Roseville / Midway Starwood
PURPOSE	Provide noise map SPL and PWL to sale/application
DATE	19-Aug-21
Assumption: TM2500 Gen 8 Growth 60hz gas fuel 90 dbA NF guarantee	

Name	Sound Power Level PWL Day (dB(A))									A	lin
	31.5	63	125	250	500	1000	2000	4000	8000		
TM2500	84.6	97.1	105.4	105.4	105.7	104.2	104.8	100	89.3	112.6	128.1
GLO	70	81.7	102.5	101	96.2	92.3	93	89.5	82.6	105.9	119.9
TURBINE EXHAUST	78.8	90.4	95.9	99.2	94.4	91.5	92.3	89.8	78.5	103.1	121.3
FAN	65.9	80.1	83.9	86.1	89.8	88.9	85.5	78.9	67.5	94.6	109.6
AUX	49.7	65	76.3	83.6	79	77.2	77.7	72.9	64.2	86.9	97.6
TURBINE	76.3	92.5	98.4	99.2	95.6	95.2	93.9	94.5	82.2	104.7	121.7
TURBINE CHASSIS	66	85.3	92.4	91.3	89.8	90.2	88.5	92.8	80.5	99.1	114.2
TURBINE BASE	70.1	81.9	90.6	90.1	86.3	87.9	86.1	86.4	74.2	96.3	113.2
TURBINE ENCLOSURE	74.5	91.1	96	97.8	93.6	92.2	91.3	86.9	73.9	102.3	120
AIR_FILTER	72.3	85.7	93.1	91.4	100.5	99.9	102.7	94.3	83	106.7	116.5
AIR FILTER CHASSIS	63.5	74.1	81.5	83.2	100.3	99.8	102.6	93.8	79.9	106.1	109.3
AIR FILTER INLET FACES	68.6	82.5	89.2	84.6	84.4	82.6	85.7	83.9	79.9	94	112.4
AIR FILTER HOUSE	68.7	82.4	90.3	89.5	85.3	82.4	84.9	79	66.4	94.8	112.7
GEN_TB_COUPLING	67.4	81.2	87.2	89	93.5	91.7	90.5	87.4	79	98.4	111.4
GEN	81.3	91.7	95.7	94.3	100.9	99	96.2	93.1	81.8	105.4	123
GEN CHASSIS	68	81.9	89.7	86	88.2	86.8	82.7	78.7	68.7	94.6	112.1
GENERATOR VENT OUTLET	72.1	86	85.3	82.5	83.8	82.6	82.8	79.3	69.7	92.2	115.1
GENERATOR VENT INLET	79.5	84.9	90.4	89.8	90.4	87.7	89.6	87.3	76.7	97.5	119.8
GENERATOR CASING	73.4	87.1	89.9	89.8	99.6	97.8	94	90.8	78.8	103.3	116.8
GENERATOR BASE	64.6	79.8	85.1	83.2	88.2	85.9	81.9	75.8	64.8	92.8	109.1
Generator Exciter	53.8	62.3	71.6	73.6	86.7	85.9	82.8	79.4	69.1	90.7	97.1

GE ENERGY
AERO
16415 Jacintoport Blvd.
Houston, TX 77015
Engineer: Quoc nguyen

CUSTOMER	Chuck Houseknecht
PROJECT	Calpine Green Leaf 1 / City of Roseville / Midway Starwood
PURPOSE	Provide noise map SPL and PWL to sale/application
DATE	19-Aug-21
Assumption: TM2500 Gen 8 Growth 60hz gas fuel 90 dbA NF guarantee	

Receiver	dBA	dB								
	Receiver reading	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000Hz	2000 Hz	4000 Hz	8000 Hz
Near Field										
G3	88.2	102	100.9	94.8	85.6	87	81.7	77.7	75	65.4
G4	86.1	103.4	103	95.5	86	82.9	78.4	74.5	70.9	62.3
G5	87	103.9	103.7	96	87.2	83.3	79.8	76	72.6	64.2
G6	88.6	104	104	97	89.1	84.9	81.3	78.1	75.5	67.2
P1	81.1	91.6	89.5	94.6	83.2	74.2	67.3	66.4	61.8	54.8
P2	84.9	94.5	92.8	98	87.4	78.3	72	71.2	67.5	61.2
P3	90.5	97.4	95.6	102.6	94.3	84	77.6	76.9	74.1	69.3
P4	86.6	99.8	98	96.8	88.3	83.3	78.2	75.1	72.3	64.6
P5	86.7	103.8	103.7	95.9	86.8	83	79.4	75.5	72.1	63.6
P6	88.8	104	104.4	98.1	90.6	83.9	80.3	77.9	76.8	67
P7	87.7	102.8	103.2	96.5	88.7	82.4	79.4	78.4	76.9	66.7
P8	87.3	98.5	98.7	91.9	81.6	83.7	80.3	81.8	74.2	66.2
P9	83.5	94.7	93.7	88.4	80.2	79.8	76.4	78.2	69.8	59.5
P10	78.2	91.5	90.3	84.1	75.2	73.8	70.9	72.7	64.3	52.8
P11	84.7	94.8	93.6	88.4	79.9	81.2	77.8	79.6	71.1	60.2
P12	89.2	99.4	99.9	92.8	83.6	85.8	82.4	83.8	76.2	66.4
P13	88.3	102.4	103.4	96.9	89.5	83	80.1	79.1	77.4	67.2
P14	81.1	96.3	96.3	89.6	81.4	75.9	73.1	73.1	69.1	58.9
P15	72.6	93.6	90.7	84.9	73.4	65.4	60.6	60.8	52.6	41.7
P16	78.4	93.7	90.7	90.7	80.8	73.1	66.9	64.6	61	55.4
P17	83.4	95	92.9	95.3	86	78.3	72.9	70.8	67.7	61.2


> -99.0 dB
> 79.0 dB
> 81.0 dB
> 83.0 dB
> 85.0 dB
> 87.0 dB
> 89.0 dB
> 91.0 dB
> 93.0 dB
> 95.0 dB
> 97.0 dB
> 99.0 dB

Proof of Installation Contract

STATE OF CALIFORNIA - DEPARTMENT OF GENERAL SERVICES

STANDARD AGREEMENT

STD 213 (Rev. 04/2020)

AGREEMENT NUMBER	PURCHASING AUTHORITY NUMBER (If Applicable)
4600014215	

1. This Agreement is entered into between the Contracting Agency and the Contractor named below:

CONTRACTING AGENCY NAME
Department of Water Resources

CONTRACTOR NAME
Kiewit Power Constructors Co.

2. The term of this Agreement is:

START DATE
August 3, 2021

THROUGH END DATE
August 2, 2023

3. The maximum amount of this Agreement is:

[redacted]

4. The parties agree to comply with the terms and conditions of the following exhibits, which are by this reference made a part of the Agreement.

Exhibits		Title	Pages
	Exhibit A	Scope of Work	8
	Att. 1	Sample Service Request	1
	Att. 2	Sample Letter of Authorization	3
+ -	Exhibit B	Budget Detail and Payment Provisions	2
+ -	Att. 1	Rate Sheet	7
+ -	Att. 2	Liquidated Damages Terms for Project Site	1
+ -	Att. 3	DIR Registration Certification	1
+ -	Att. 4	Equipment Rates	1
+ -	Exhibit C	General Conditions	65
+ -	Exhibit D	Additional Provisions (Rev. 1/21)	6
+ -	Att. 1	Travel and Per Diem (DWR 9580, Rev 9/19)	2
+ -	Att. 2	Std. 18, Standard California Nondiscrimination Construction Specifications (Rev. 01/95)	2
+ -	Att. 3	Protection of Confidential and Sensitive Information (Rev. 2/16)	2
+ -	Att. 4	Non-Disclosure Certificate (Rev. 2/15)	1
+ -	Att. 5	DVBE Activity Report Form (DWR 9553, Rev 8/14)	2
+ -	Att. 6	Small Business and DVBE Subcontractor Payment Certification (DWR 9683, Rev 1/21)	1

STATE OF CALIFORNIA - DEPARTMENT OF GENERAL SERVICES
STANDARD AGREEMENT
STD 213 (Rev. 04/2020)

AGREEMENT NUMBER	PURCHASING AUTHORITY NUMBER (If Applicable)
4600014215	

Exhibits	Title	Pages
+ - Att. 7	Site Owner Waiver and Release	1

Items shown with an asterisk (*), are hereby incorporated by reference and made part of this agreement as if attached hereto.
These documents can be viewed at https://www.dgs.ca.gov/OLS/Resources

IN WITNESS WHEREOF, THIS AGREEMENT HAS BEEN EXECUTED BY THE PARTIES HERETO.

CONTRACTOR

CONTRACTOR NAME (if other than an individual, state whether a corporation, partnership, etc.)
Kiewit Power Constructors Co.

CONTRACTOR BUSINESS ADDRESS	CITY	STATE	ZIP
8900 Renner Boulevard	Lenexa	KS	66219

PRINTED NAME OF PERSON SIGNING	TITLE
Chris Turnbull	President

CONTRACTOR AUTHORIZED SIGNATURE	DATE SIGNED
Chris Turnbull	8/17/2021

STATE OF CALIFORNIA

CONTRACTING AGENCY NAME
Department of Water Resources

Approved as to legal form and sufficiency:
Ann K. B. Carroll
for Asst. General Counsel, DWR

CONTRACTING AGENCY ADDRESS	CITY	STATE	ZIP
1416 Ninth Street, Room 1115	Sacramento	CA	95814

PRINTED NAME OF PERSON SIGNING	TITLE
Ted Craddock	Deputy Director, State Water Project

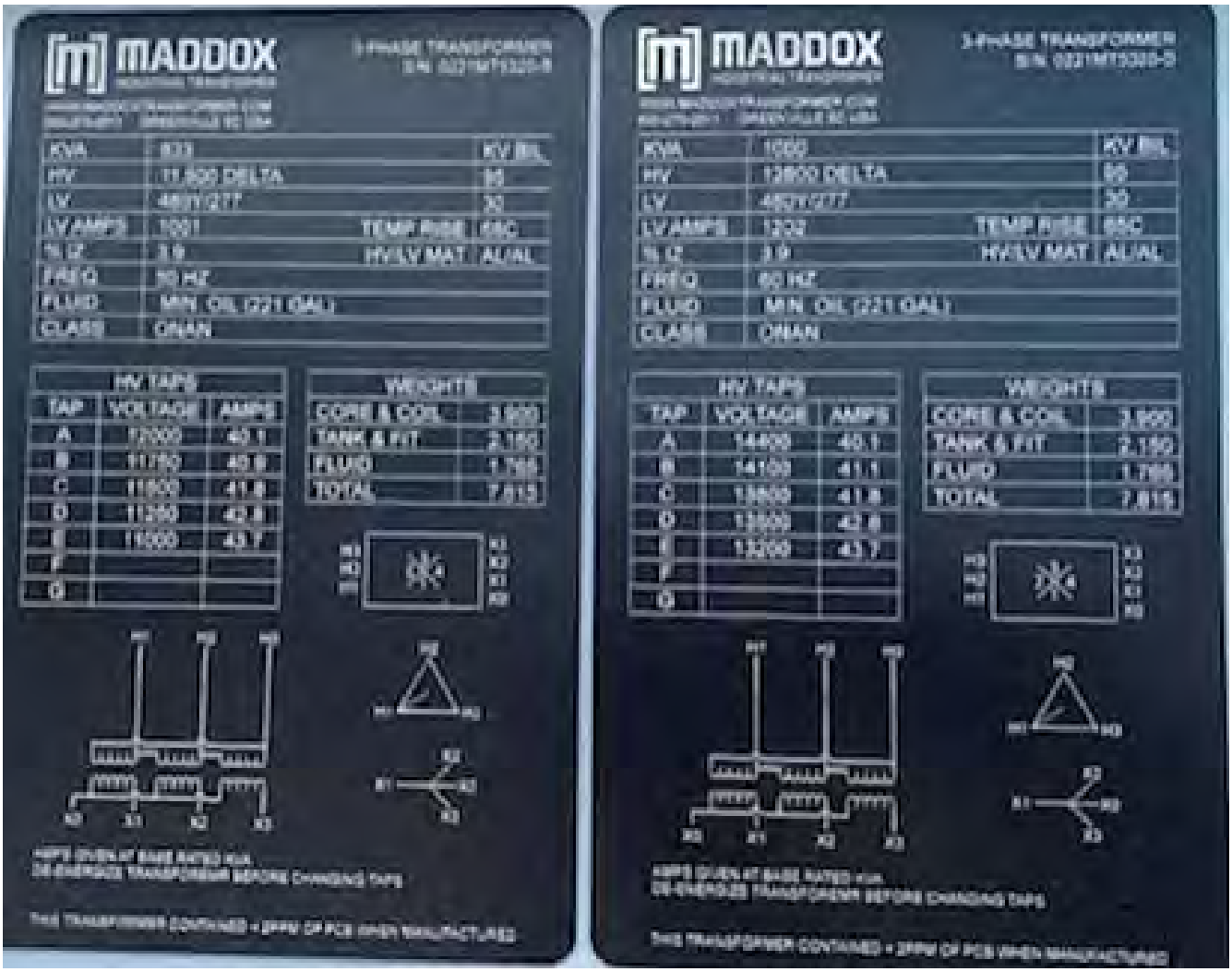
CONTRACTING AGENCY AUTHORIZED SIGNATURE	DATE SIGNED
Ted Craddock	8/17/2021

CALIFORNIA DEPARTMENT OF GENERAL SERVICES APPROVAL	EXEMPTION (If Applicable)
	Executive Order 7-30-21 DGS Approval Not Required

Transformer Nameplates

Volume of Oil

UAT-2A (259 Gallons)



UAT-1 (221 Gallons)

ATTACHMENT 11

CONTRACTOR HAZARDOUS MATERIALS BUSINESS PLAN FOR CONSTRUCTION

Kiewit

KPC-DWR-002

25 August 2021

State of California
Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

RE: Calpine Greenleaf

SUBJ: SPAP Calpine Greenleaf – Hazardous Materials

To Whom It May Concern:

The California Hazardous Materials Program is based on Health and Safety Code § 25505 and is applicable when hazardous materials are stored above these thresholds: 200 standard cubic feet, 500 pounds and 55 gallons. For the construction phase, Kiewit will not have hazardous materials onsite above reportable thresholds. If this changes, Kiewit will submit the plan per State requirements and notify Department of Water Resources.

Sincerely,

Brad Traverse
EPC Project Manager/Sponsor
Kiewit Power Constructors Co.

cc: Tony Meyers
Behzad Soltanzadeh
Musa Aziz
Dan Rocole
Brad Traverse
Nathan Schoening
Mike Wheeler
Steve Lorenz

KIEWIT POWER CONSTRUCTORS CO.
8950 Renner Boulevard, Lenexa, KS 66219
(913) 928-7800 (913) 689-4800 fax

ATTACHMENT 12

PACKAGE UNIT NOISE STUDY FOR GREENLEAF 1 SITE

Hessler Associates, Inc.
WORLDWIDE CONSULTING IN ENGINEERING ACOUSTICS

Engineering Offices:
5096 N Silver Cloud Dr.
St. George, UT 84770 USA
703-303-0341
www.hesslernoise.com

TECHNICAL MEMORANDUM

Title:	Acoustical Modeling Assessment
Project:	Calpine Greenleaf I TM2500 Installation
Location:	Yuba City, CA
Prepared For:	Kiewit
Prepared By:	David M. Hessler, P.E., INCE
Revision:	0
Issue Date:	August 26, 2021
Reference No:	TM-2211-082621-0 Greenleaf
Attachments:	Plot 1 Sound Contours per Current Plans A Source Sound Power Level Information (General Electric)

1.0 Introduction

A noise modeling analysis has been carried out to determine what sound levels can be expected in the vicinity of the Calpine Greenleaf I power plant site near Yuba City, CA from the planned installation of two GE TM2500 trailer mounted gas turbine generators adjacent to the Greenleaf plant. These mobile units are being brought in to quickly augment the power from the existing Calpine facility.

This report briefly summarizes the modeling methodology and expected sound emissions from the TM2500 units.

2.0 Modeling Methodology and Inputs

2.1 Modeling Methodology

The power augmentation equipment has been modeled in three dimensions using the Cadna/A® software program, which was developed by Datakustik, GmbH specifically for power industry applications. Once the physical structures of the facility and its surroundings are created, the

model is populated with noise sources, represented as points, areas or lines as appropriate. Snapshots from the completed model are shown below. The structures associated with both the existing Greenleaf plant and the adjacent Sutter combined cycle facility have been included to take into account their effect on sound propagation in various directions.

Figure 2.1.1 Model Snapshot Looking NE

Figure 2.1.2 Model Snapshot Looking SW towards Sutter Combined Cycle Plant

The sound pressure level at any point of interest is calculated from the sum of all individual sources in strict accordance with ISO 9613-2 *Acoustics – Attenuation of sound during propagation*

outdoors. A mid-range ground absorption coefficient, A_g, of 0.5 has been used for the entire model space. The terrain around the site is essentially flat.

2.2 Modeling Inputs

Much more important than the modeling software and propagation details, however, are the source input levels. In this case, sound power levels for all sub-components of each unit were supplied by General Electric in the attached table dated 8/19/21 (**Attachment A**). It should be noted that all subsequent results rely on the validity and accuracy of this information.

3.0 Analysis Results

The calculated A-weighted sound contours from the two TM2500 units during full load operation are shown in **Plot 1**. The specific sound levels at the nearest potentially sensitive residences and at the east site boundary are tabulated below.

Table 3.0.1
Predicted Sound Levels at Potentially Sensitive Receptors

Design Point	Location	Facility Sound Level, dBA	Facility Sound Level, dBC
1	Residence 3500' to the NW on Pierce Rd.	42	61
2	Residence 3100' to the NE on Township Rd.	43	63
3	Residence 2700' to the NE on Township Rd.	45	63
4	Residence 1700' to the NE on Township Rd.	49	67
5	Eastern Site Boundary at Gate, Informational	55	72

The contours in Plot 1 are taken out to a very low value of 40 dBA for informational purposes, but the threshold for any potentially adverse noise impact may be essentially taken as 45 dBA. A sound level of 45 dBA is a common design goal and regulatory limit for *nighttime* sound emissions. This value originates from guidelines[1] published many years ago by the U.S. Environmental Protection Agency (EPA), where a maximum day-night average (Ldn) sound level of 55 dBA is recommended for "outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use." The descriptor Ldn is a mathematically derived quantity based on 24 hourly average (Leq) levels with a 10 dB factor applied to nighttime levels to account for the greater sensitivity to noise at night. In much simpler terms, an Ldn of 55 dBA essentially translates to 55 dBA during the day and 45 dBA at night.

[1] U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," EPA/ONAC 550/9-74-004, March, 1974.

In this instance, the TM2500 units are principally intended to operate and supply peaking power in the afternoon when a 55 dBA design goal would be generally appropriate. Our understanding is that any nighttime operation, when it would be desirable to keep the sound level at or below 45 dBA, will be unlikely or rare at best. Consequently, so long as operations are commonly confined to the daytime hours (normally defined as 7 a.m. to 10 p.m.) the A-weighted sound levels at the nearest potentially sensitive receptors, which are generally in the 42 to 49 dBA range, satisfy the EPA guidelines.

A-weighting makes an adjustment to the actual frequency spectrum of a sound, mainly in the lower frequencies, to match the sensitivity of the human ear in order to make the numerical sound level generally consistent with how it is subjectively perceived. C-weighting, on the other hand, applies only a very small adjustment to the lower frequencies making it sensitive to those frequencies and, consequently, it has become a standard metric for low frequency noise – particularly with reference to simple cycle combustion turbines, which can generate sufficient low frequency sound to cause rattles and perceptible vibrations in distant structures. ANSI B133.8-2011 (R2017) *Gas Turbine Installation Sound Emissions* recommends limiting the low frequency content from combustion turbine plants to no more than 75 to 80 dBC to avoid such issues. Many years of field experience with gas turbine noise[2] suggests that lower C-weighted levels are more advisable depending on the setting and other circumstances. In this case, for a rural area where the turbines are normally going to operate only during the day, a design goal of 65 dBC is recommended. As can be seen from Plot 1 and the design point results tabulated above, this target is expected to be met at all nearby residences except at the nearest house (DP-4) where a level of 67 dBC is predicted. This minor overage relative to an ideal design target of 65 dBC does not mean that an adverse low frequency noise impact is inevitable, but rather that there is, in theory, a very slight chance of disturbance.

4.0 Conclusions

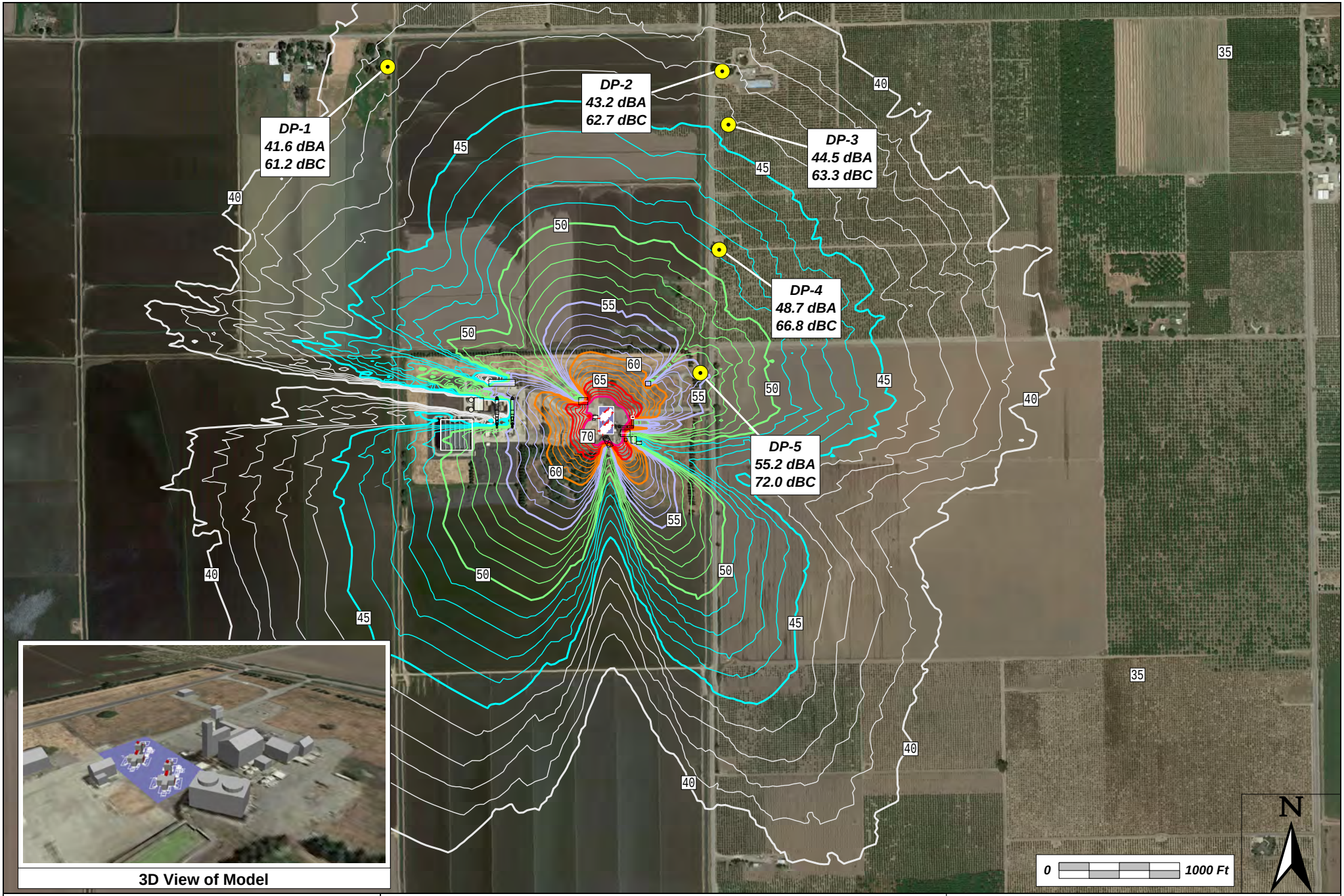
The expected sound emissions from the proposed installation of two GE TM2500 mobile gas turbine generators at the existing Calpine Greenleaf I site have been modeled based on acoustical data received from General Electric. The anticipated sound levels at the nearest potentially sensitive receptors are tabulated below.

[2] Summarized in the peer reviewed article: Hessler, G. F, "Proposed criteria in residential communities for low-frequency noise emissions from industrial sources", *Noise Control Engineering Journal* **52** (4), 2004 Jul–Aug.

Table 4.0.1
Predicted Sound Levels at Potentially Sensitive Receptors

Design Point	Location	Facility Sound Level, dBA	Facility Sound Level, dBC
1	Residence 3500' to the NW on Pierce Rd.	42	61
2	Residence 3100' to the NE on Township Rd.	43	63
3	Residence 2700' to the NE on Township Rd.	45	63
4	Residence 1700' to the NE on Township Rd.	49	67
5	Eastern Site Boundary at Gate, Informational	55	72

Since the units will most likely operate in peaking service during the day, the predicted levels satisfy the EPA's design goal of 55 dBA for audible sound. A recommended ideal design target for low frequency sound of 65 dBC is expected to be met at all of the nearest residences except the closest house to the northeast where a level of 67 dBC is predicted. This minor overage does not mean that an adverse low frequency noise impact is inevitable, but rather that there is, in theory, a very slight chance of disturbance.



3D View of Model

Project: **Calpine Greenleaf Energy Center**	*Description:* **Plot 1**	*Legend:* Design Point
Prepared for: **Kiewit**	**Predicted Sound Contours (dBA) of Mobile Units in Operation**	
Date: August 26, 2021 / *Drawing #:* KG-Rev-B-1-1		

GE ENERGY
AERO
16415 Jacintoport Blvd.
Houston, TX 77015
Engineer: Quoc nguyen

CUSTOMER	Chuck Houseknecht
PROJECT	Calpine Green Leaf 1 / City of Roseville / Midway Starwood
PURPOSE	Provide noise map SPL and PWL to sale/application
DATE	19-Aug-21
Assumption: TM2500 Gen 8 Growth 60hz gas fuel 90 dbA NF guarantee	

Label	Name	Sound Power Level PWL Day (dB(A))									A	lin
		31.5	63	125	250	500	1000	2000	4000	8000		
	TM2500	84.6	97.1	105.4	105.4	105.7	104.2	104.8	100	89.3	112.6	128.1
1	GLO	70	81.7	102.5	101	96.2	92.3	93	89.5	82.6	105.9	119.9
2	TURBINE EXHAUST	78.8	90.4	95.9	99.2	94.4	91.5	92.3	89.8	78.5	103.1	121.3
3	FAN	65.9	80.1	83.9	86.1	89.8	88.9	85.5	78.9	67.5	94.6	109.6
4	AUX	49.7	65	76.3	83.6	79	77.2	77.7	72.9	64.2	86.9	97.6
4.5.7	TURBINE	76.3	92.5	98.4	99.2	95.6	95.2	93.9	94.5	82.2	104.7	121.7
4	TURBINE CHASSIS	66	85.3	92.4	91.3	89.8	90.2	88.5	92.8	80.5	99.1	114.2
5	TURBINE BASE	70.1	81.9	90.6	90.1	86.3	87.9	86.1	86.4	74.2	96.3	113.2
7	TURBINE ENCLOSURE	74.5	91.1	96	97.8	93.6	92.2	91.3	86.9	73.9	102.3	120
8,9	AIR_FILTER	72.3	85.7	93.1	91.4	100.5	99.9	102.7	94.3	83	106.7	116.5
8	AIR FILTER CHASSIS	63.5	74.1	81.5	83.2	100.3	99.8	102.6	93.8	79.9	106.1	109.3
9	AIR FILTER INLET FACES	68.6	82.5	89.2	84.6	84.4	82.6	85.7	83.9	79.9	94	112.4
	AIR FILTER HOUSE	68.7	82.4	90.3	89.5	85.3	82.4	84.9	79	66.4	94.8	112.7
11	GEN_TB_COUPLING	67.4	81.2	87.2	89	93.5	91.7	90.5	87.4	79	98.4	111.4
	GEN	81.3	91.7	95.7	94.3	100.9	99	96.2	93.1	81.8	105.4	123
16	GEN CHASSIS	68	81.9	89.7	86	88.2	86.8	82.7	78.7	68.7	94.6	112.1
13	GENERATOR VENT OUTLET	72.1	86	85.3	82.5	83.8	82.6	82.8	79.3	69.7	92.2	115.1
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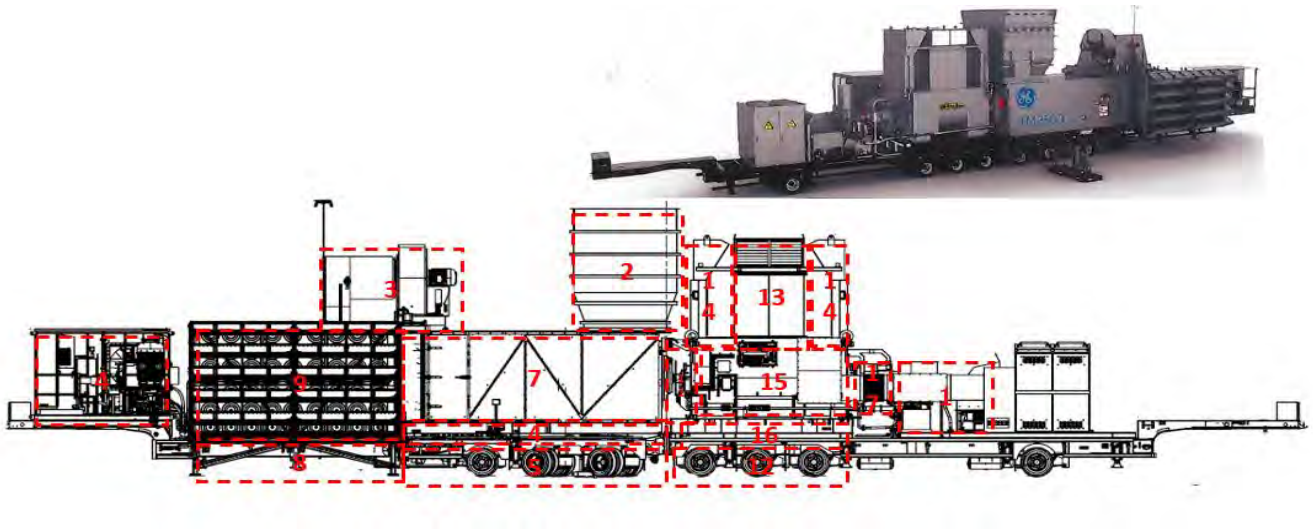
16	GENERATOR BASE	64.6	79.8	85.1	83.2	88.2	85.9	81.9	75.8	64.8	92.8	109.1
17	Generator Exciter	53.8	62.3	71.6	73.6	86.7	85.9	82.8	79.4	69.1	90.7	97.1



ATTACHMENT 13

CULTURAL RESOURCES ADDITION TO WEAP

Cultural Resources

Any trace of past human activity greater than 50 years old may be an important cultural resource. Places or sites where these traces occur are a part of a proud heritage that belongs to all of us. In the Yuba City vicinity, there are archaeological remains that date back over 10,000 years of Native American history. Sutter County also contains remnants of early farming and ranching activities. Significant cultural resources represent historical events, engineering achievements, and art or architecture styles that define what Americans have experienced. Because these achievements define what we are and affect what we become, the past belongs to us all and we all have a responsibility to help preserve significant cultural resources.

Archaeological and historical sites are anon-renewable resource. Though we are always creating new cultural resources for people of the future to interpret or preserve for posterity, historical and archaeological sites, once destroyed, cannot be recreated.

Unfortunately, you could scrape, dig, or bulldoze right through a buried archaeological site without even knowing it, because the remains of prehistoric settlements are so fragmentary. Here's what to look for:

- Discolored soil, particularly gray-black soil with a 'greasy' feel to it, in an area of lighter colored soils.
- Any animal or human bone. Native American graves are of great concern to Native Americans. Possession of Native American artifacts or human remains from a Native American grave is a felony (PRC 5097.99).
- A thin layer, or series of layers, particularly dark layers containing charcoal or ash, in an excavation side wall.
- Any unusual concentration of rocks, particularly if they seem to form a pattern (such as a campfire).
- A concentration of small, broken rock, particularly obsidian or flint with sharp edges.
- A concentration of historic-era trash, including broken glass, china, crockery, and metal pieces

The kinds of cultural resources that may be discovered at the Greenleaf 1 SAPS site include prehistoric artifacts such as grinding stones, arrowheads, and stone flakes, and historic artifacts such as glass bottles, metal objects, animal bones and possibly building foundations. Human skeletons may also be exposed.

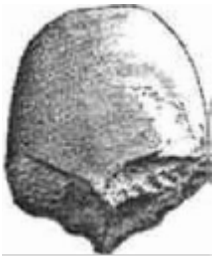
In addition, cultural materials and locations attributed to Hispanic, Asian, and other ethnic or racial groups may also be considered important cultural resources.

Examples of Cultural Resources

The following are examples of cultural resources that could be uncovered in the project area. The first seven examples are all stone tools shaped for specific functions.

Hammer Stone

The first example is a small **hammer stone**. Hammer stones were used for a wide range of tasks and may show wear at one or both ends.



Flaked Cobble

Flaked cobbles were used for scraping, digging, or cutting. They can occur in a variety of shapes and sizes with a smooth end for holding.

Scraper

Scrapers had a variety of uses including preparing animal skins, shaping wood, or preparing food. Depending on their function, scrapers come in many shapes and sizes.

Chips

Lithic debitage, or **chips**, are the waste material of tool making. Chips are often found in a pile where the toolmaker was working.

Flaked knives

Flaked knives are very distinctive and easily identified by shape and flaking pattern. Flaked knives can be found in a large number of shapes and sizes.

Arrowheads

Projectile points are also very distinctive, and are commonly referred to as **arrowheads**. Projectile points can range in size from one to six inches long and several inches wide.

Mortar and Pestle

The mortar and pestle were used together as a grinding tool. They were used to prepare foods, pigments, medicines, and potions.

Other historic artifacts that may be present include glass bottles, ceramics, metal cans and other metal objects, including wire, nails, and building hardware, as well as the remains of former building foundations and underground utilities.

Your Responsibility

When a cultural resource is found, it is your responsibility to stop work and notify the Environmental Coordinator (EC) immediately. The EC will consult with a qualified archaeologist as soon as possible to evaluate the find. Mark the location of the find and block off access to it until the archaeologist arrives. You can use readily available materials such as barrier fencing, barrier tape, or traffic cones to ensure that construction workers and equipment do not enter the area of the find until it has been evaluated. The area of the find must be protected from potential damage to cultural resources that could be caused by construction activities.

It is illegal for you to collect any objects, including old bottles, from public land according to the California Public Resources Code (sections 5097.5 and 5097.9). Disturbing Native American burial sites is a felony under California Public Resources Code Section 5097.99. In addition, the deliberate destruction and removal of cultural resources on private land is prohibited under the conditions of Calpine's permit from the CEC. The following state and federal laws and regulations affect the management of cultural resources:

- Archaeological Resources Protection Act
- National Historic Preservation Act
- California Environmental Quality Act
- California Public Resources Code (Sections 5097.5, 5097.9, and 5097.99)

Violations of these regulations can result in federal indictment, and are punishable by civil and criminal penalties, including both fines and/or imprisonment, and could result in the revocation of project certifications, and shut-down of the project at the direction of the appropriate state agency.

Only authorized personnel may handle cultural resources. Notify the EC if you think you may have found a cultural resource. Do not touch or move the object.

If you have any questions about these procedures, please ask the EC for more information.

ATTACHMENT 14

SWPPP WAIVER FOR GREENLEAF 1

State Water Resources Control Board

EROSIVITY WAIVER CERTIFICATION

For exclusion from the Storm Water Construction General Permit
for small construction activity (between 1 and 5 acres of soil disturbance)

Department of Water ResourcesDivision of
Mohammed Shahid
1416 9th Street Room 452 5
Sacramento CA 95814

Site Information:
Calpine Greenleaf Site
Tony DiNicola
5029 S Township Rd
Yuba City CA 95993

Waiver Approved: August 20, 2021
Waiver Number: 5S51W005182
Waiver valid through: November 01, 2021

The State Water Resources Control Board (State Water Board) issues this Erosivity Waiver Certification (Waiver), to the Legally Responsible Person (LRP) who certified that coverage under the Storm Water Construction General Permit (CGP) is not required for the project/site location described above. The LRP certified the Waiver is valid because construction activity will take place during a period when the value of the rainfall erosivity factor (R) is less than five. This Waiver only applies to the project/site location described above.

Approval of this Waiver does not relieve the LRP of permitting requirements for other regulated construction activities/discharges. Construction activity covered under this Waiver must still comply with any applicable State regulations and/or local storm water requirements and ordinances. Appropriate erosion and sediment control best management practices must be implemented to prevent violations of water quality standards.

In accordance with the Erosivity Waiver requirements set forth in Section II(B)(7) of the CGP, construction activity must begin and reach final stabilization within the time period submitted to the State Water Board.

Construction Start: August 19, 2021 Construction End: November 01, 2021

If construction activity extends beyond the certified Construction End date for any reason, the rainfall erosivity R factor must be recalculated in SMARTS using the original Construction Start date and a new projected ending date. The R factor must be recalculated 30 days prior to November 01, 2021

If, upon recalculation, the R factor remains less than 5, the LRP must save the information in SMARTS and recertify the new Construction End date; or

If the R factor is 5 or greater, the LRP must submit Permit Registration Documents (PRDs) as specified by the Storm Water CGP before the end of the certified waiver period to obtain permit coverage. The recalculation must occur 30 days prior to November 01, 2021 and PRDs must be submitted by November 01, 2021

Failure to submit PRDs as required or to discharge without a permit may subject you to penalties. You may become liable to pay up to $10,000 a day pursuant to California Water Code Section 13385 and $10 per gallon per day for any amount over 1,000 gallons not cleaned up. You may be assessed an additional penalty of a minimum of $1,000 pursuant to Sections 13399.25-3399.43 for each violation. The matter may be referred to the Attorney General or District Attorney for other civil and/or criminal liabilities (Section 13385).

If you have any questions please contact the Storm Water Help Desk at stormwater@waterboards.ca.gov or 1-866-563-3107.

ATTACHMENT 15

WILDLIFE OBSERVATION FORM FOR GREENLEAF 1

Greenleaf 1 Wildlife Observation Form

WILDLIFE OBSERVATION FORM
To Record Animals in Greenleaf 1 Areas

To be filled out by personnel who find active or inactive nest sites and burrows, dens, and dead or injured wildlife, or other biological resources during daily operational activities.

Name:

Date:

Location of Observation:

Wildlife Species:

Condition of Wildlife:
Alive ☐ Dead ☐

Suspected cause of injury or mortality?

If injured, where is the animal currently?

Disposition and Date (if applicable):

Is the resource in danger of operational (or other) impacts?

Comments: