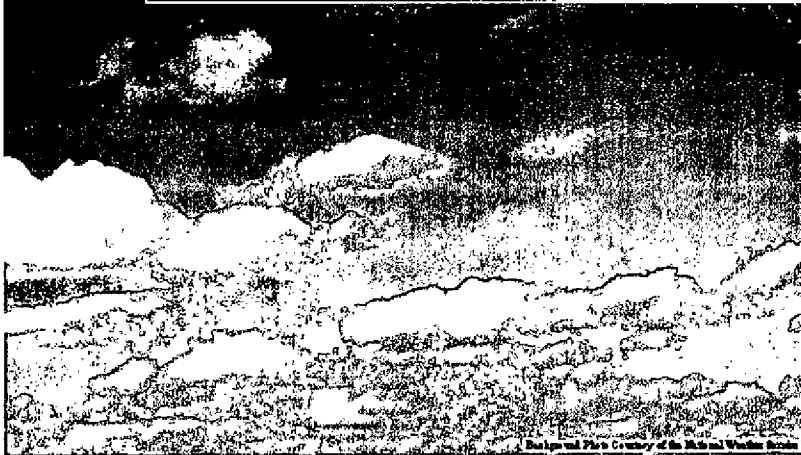


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*Application for Air Construction Permit for the
Replacement of Pump Engine 5 and
Installation of Standby Generators 5 and 6
Alexander Orr, Jr. Water Treatment Plant
Miami, Florida*



SERVE - CONSERVE

*Miami-Dade Water and Sewer Department
December 15, 2004*

Contents

Table of Contents	Page i
Acronyms	iii

DEP Application for Air Permit Form 62-210.900(1)

Report - Application for Air Construction Permit for the Replacement of Pump Engine 5 and Installation of Standby Generators 5 and 6at the Alexander Orr, Jr. Water Treatment Plant, Miami, Florida

Section	Page
1 Introduction	1-1
2 Facility Information	2-1
2.1. Facility Description	2-1
2.2. Standard Industrial Classification Codes (SIC)	2.1
2.3. Facility Location	2-1
2.4. Facility Category	2-2
3 Project Information	3-1
3.1. Project Scope	3-1
3.2. Installation of the Additional Standby Generator Units	3-1
3.3. Modification of the Existing Standby Generator Units	3-3
3.4. Replacement of High-Service Pump Engine No. 5	3-5
4 Project Emissions	4-1
4.1. Project Emissions	4-1
4.2. Past Facility Emissions	4-1
4.2.1. Emissions Testing for Existing Units	4-1
4.2.2. Existing Unit Operations	4-1
4.2.3. Annual Emissions for Existing Units	4-4
4.3. Potential Emissions	4-6
4.3.1. Reduction of Standby Generator NOx Emissions Rate	4-7
4.3.2. Reduction of Generator Cumulative Fuel Cap	4-7
4.3.3. 4.3.3 Potential Emissions From Pump Engine # 5	4-7
4.4. Summary of Facility Emissions	4-9
5 Rule Applicability	5-1
5.1. Rule Applicability	5-1
5.2. State Regulations	5-2
6 Air Pollution Control Techniques	6-1
6.1. Air Pollution Control Techniques.....	6-1
6.2. Air Pollutants	6-1

Contents (Cont.)

6.2.1. Nitrogen Oxides (NOx) Emissions	6-1
6.2.2. Carbon Monoxide (CO) Emissions.....	6-2
6.2.3. Sulfur Oxides (SOx) Emissions	6-2
6.2.4. Particulate Matter (PM/PM10) Emissions	6-2
6.2.5. Volatile Organic Compound (VOC) Emissions.....	6-3
6.3. Emission Controls	6-3
6.4. Compliance Procedures	6-4
7 Source Impact Analysis	7-1
8 Conclusion	8-1
Tables
Page
3-1 Proposed/Amended Emission Units	3-1
3-2 Summary of Exhaust and Operating Characteristics of the Existing EMD Model 20-645F4B Standby Generator Sets	3-3
3-3 Summary of Exhaust and Operating Characteristics of the Proposed EMD Model 20-645F4B Standby Generator Sets	3-4
4-1 Summary of Past Emissions Test Results	4-1
4-2 04/1998 - 03/2000 Monthly Hours of Operation	4-2
4-3 04/1998 - 03/2000 Monthly Fuel Consumption/Production Rate	4-3
4-4 PUMP ROOM EMISSIONS – ACTUAL	4-4
4-5 LIME PLANT EMISSIONS – ACTUAL	4-5
4-6 STANDBY GENERATOR (EMD) EMISSIONS – ACTUAL	4-5
4-7 Comparison of Facility Emissions, Existing and Proposed	4-6
4-8 Replacement Pump Engine No. 5 - Caterpillar Model G3608 LE	4-8
4-9 Potential Annual Emissions Replacement Pump Engine 5	4-8
4-10 PUMP ROOM EMISSIONS – PROPOSED	4-9
4-11 LIME PLANT EMISSIONS – PROPOSED	4-10
4-12 STANDBY GENERATOR (EMD) EMISSIONS – PROPOSED	4-10
Figures	
2-1 Alexander Orr Water Treatment Plant Location	2-2
3-1 General Motors Electro-Motive Division Model 20-645F4B Generator	3-2
3-2 EMD 20-645F4B (South District WWTP)	3-2
3-3 Existing Standby Generator Bank (Alexander Orr, Jr. WTP)	3-4
3-4 Caterpillar G3608 Engine	3-5
Attachments	
A Facility Plot Plan	A
B Process Flow Diagram	B

Contents (Cont.)

C	Precautions to Prevent Emissions of Unconfined Particulate Matter	C
D	List of Emission Units and/or Activities that are Considered Insignificant	D
E	Fuel Analysis and Specification	E
F	Operation and Maintenance Plan	F

Acronyms

acfm	actual cubic feet per minute
ARC	ambient reference concentration
BACT	Best Achievable Control Technology
bhp	brake horsepower
bhp-hr	brake horsepower-hour
BSFC	brake-specific fuel consumption
CAA	Clean Air Act
CO ₂	carbon dioxide
CO	carbon monoxide
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLM	Federal Land Manager
FP&L	Florida Power & Light Company
fps	feet per second
ft	foot (or feet)
g/bhp-hr	gram(s) per brake horsepower-hour
g/s	gram(s) per second
GEP	good engineering practice
H ₂ SO ₄	sulfuric acid
HAP	hazardous air pollutant
HC	hydrocarbon
HNO ₃	nitric acid
IC	internal combustion
IR	fuel injection timing retard
ISC	Industrial Source Complex
°K	degrees Kelvin
km	kilometer (s)
kW	kilowatt
kW-hr	kilowatt-hour
LNG	liquefied natural gas
LPG	liquefied petroleum gas
µg/m ³	microgram(s) per cubic meter
m	meter
m ³ /s	cubic meter(s) per second

Acronyms (Cont.)

MIA	Miami International Airport
m/s	meter(s) per second
NAAQS	National Ambient Air Quality Standards
NH ₃	ammonia
NO	nitric oxide
NO _x	nitrogen oxides
NO ₂	nitrogen dioxide
PAH	polycyclic aromatic hydrocarbon
PEC	purchased equipment cost
PM-10	particulate matter less than 10 microns in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
RACT	Reasonably Available Control Technology
RBLCL	RACT/BACT/LAER Clearinghouse
rpm	revolutions per minute
scfm	standard cubic feet per minute
SCR	selective catalytic reduction
SO ₂	sulfur dioxide
SO ₃	sulfite
SO ₄	sulfate
UTM	Universal Transverse Mercator
VOC	volatile organic compound
MDWASD	Miami-Dade Water and Sewer Department
WTP	water treatment plant
WWTP	wastewater treatment plant

SECTION 1

Introduction

In accordance with Chapter 62-210 F.A.C., Miami-Dade Water and Sewer Department (MDWASD) is applying for a Title V Air Construction Permit to permit the installation of two additional diesel-fueled standby generator sets (hereafter "generator" and "generator set" may be used interchangeably) to the existing bank of four such generators and to repermit the replacement of high-service pump engine no. 5 permitted under Title V Air Construction Permit Number 0250314-005-AC and extended under Number 0250314-007-AC at its Alexander Orr, Jr. Water Treatment Plant (WTP) in Miami, Florida.

This increase in the number of generators will provide the backup power generation capacity required to ensure uninterrupted water supply and pressure to that portion of Miami-Dade County's population served by the facility.

Alexander Orr, Jr. WTP is currently served by four large (over 1 MW) standby generators. This bank of four General Motors Electro-Motive Division (EMD) Model 20-645F4B generators provides backup power for the bulk of the plant and, in conjunction with backup diesel- and natural gas-fired high-service pump engines, can run the entire water treatment plant in the event of an emergency, power loss from Florida Power & Light (FP&L), or in the event that FP&L requests the plant to come off the power grid, fully or partially, during periods of high power demand, a situation that is normally referred to as "peak shaving". Currently all four of the EMD generators must be online simultaneously to provide adequate electrical capacity for the plant. The additional generators are needed to provide a reserve capacity and for planned future plant expansions and upgrades.

As a part of this permit application, MDWASD proposes to amend the permitted emission rate for NO_x emissions from the existing EMD generators from 4.12 lb/MMBtu to 3.50 lb/MMBtu. This requested reduction is based on an analysis of the results of emissions tests performed annually since 1996 and better reflects the actual NO_x emissions from these units. MDWASD proposes that this amended rate be applied to the entire bank of six existing and proposed EMD 20-645F4B generators.

Note that a separate emergency generator is currently being constructed at Alexander Orr, Jr. WTP under Air Construction Permit Number 0250314-007-AC. This 900 kW-rated generator is powered by a Caterpillar Model 3508 TA-130 diesel-fueled engine and is not part of the above-mentioned bank of standby generators. It provides redundant emergency back-up power to the high-service pump room only, mainly for pump and pump engine control purposes, in the event of a failure of the main standby generator system.

This permit application also seeks to repermit the replacement of existing high-service pump engine no. 5 as originally permitted under Air Construction Permit 0250314-005-AC and extended under Air Construction Permit 0250314-007-AC. This permit was issued for the removal of pump engines nos. 1 through 5 and the installation of new pump engines nos. 3, 4, and 5 (pump engines nos. 1 and 2 not to be replaced). Replacement of the existing diesel-fueled engine-driven pumps will ensure uninterrupted water supply and pressure to the South Miami-Dade County population. As of December 2004, the installation of pumps nos. 3 and 4 is nearly complete and a draft operating permit revision

SECTION 1 Introduction (Cont.)

covering these units has been issued by FDEP. Replacement of pump engine no. 5 cannot begin until pump engines nos. 3 and 4 are fully operational, as existing pump engines nos. 5 and 6, in conjunction with the electric high-service pumps, provide needed pumping capacity to the water distribution system for the parts of Miami-Dade County served by the plant. For this reason, installation of pump engine no. 5 will not begin by the August 7, 2005 expiration of Air Construction Permit 0250314-007-AC and is included in this permit application

An air quality impact analysis is not required in support of this application. The total proposed facility emissions will not exceed Prevention of Significant Deterioration (PSD) increments. The proposed standby generator units are being added to an existing collectively regulated group of emission units and the annual cumulative operation of these units, including the proposed units, will be reduced from the level permitted under Air Operating Permit Number 0250314-001-AV, as discussed in this report. The additional proposed generators are needed for increased electrical capacity of the backup system and not increased annual usage. The annual usage, based on fuel consumption records, has historically been well below the permitted operational limit and is anticipated to remain so.

Questions regarding the application can be addressed to the individual listed below at Miami-Dade Water and Sewer Department in Miami, Florida:

Mr. Richard M. O'Rourke, P.E.
Miami-Dade Water and Sewer Department
P.O. Box 330316 Miami, Florida 33233-0316
Telephone: (786) 552-8123
FAX: (786) 552-8640

Facility Information

2.1 Facility Description

The facility, the Alexander Orr, Jr. Water Treatment Plant, is a municipally-owned water treatment plant providing potable water to the public. The Miami-Dade Water and Sewer Department (MDWASD) is the largest public utility in the Southeast United States and the sixth largest in the country, providing direct services to approximately 410,000 retail customers. Additionally, wholesale water and/or wastewater service is provided to 18 municipalities in the county. Miami-Dade County's current population of 2 million is expected to reach the 3 million mark by the year 2015.¹ The Alexander Orr, Jr. WTP produces approximately half the water supply for the MDWASD system.

The layout of the Alexander Orr, Jr. WTP is shown in Figure 2-2. The Plant is a lime softening water treatment plant that consists of lime softening tanks, a filter gallery, and chlorine contact basins, along with the associated lime recalcining plant (sludge thickening tanks, lime kiln, and lime silos), pump rooms (east and west), reservoir storage, maintenance and control facilities, and standby power system (generators, pump engines, switchgear, and fuel tanks).

There are three major sources of emissions at the plant: the lime recalcining plant, the diesel- and/or natural gas-fueled engine-driven pumps (ongoing removal and replacement under Air Construction Permit Number 0250314-007-AC), and the standby diesel-fueled engine-driven generator sets. The lime recalcining plant produces lime (CaO) by pyrolysis of CaCO₃ (precipitate from the water treatment process) in a kiln. The diesel- and/or natural gas-fueled engine-driven pumps provide high-pressure service directly to the water distribution system. Emergency generators at the pump room and at the lime kiln and an emergency kiln rotation engine provide redundancy to the standby generators for critical functions.

2.2 Standard Industrial Classification Codes (SIC)

Industry Group No.	49	Electric, Gas, and Sanitary Services
Industry No.	4941	Water Supply

2.3 Facility Location

The Alexander Orr, Jr. WTP is located at 6800 SW 87 Avenue, Miami, Miami-Dade County, Florida, as shown in Figure 2-1. UTM coordinates are: Zone 17; 565.9 km E and 2843.3 km N. The area immediately surrounding the plant consists of a mixture of residential, commercial, and light industrial uses. The plant is bound to the south by the intersection of the Don Shula Expressway and Sunset Drive, and to the east by SW 87th Avenue. The plant is located approximately 7 miles south of the Miami International Airport, and is approximately 10 miles southwest of downtown Miami.

¹ <http://www.miamidade.gov/wasd/report.asp>



Figure 2-1 Alexander Orr Water Treatment Plant Location²

2.4 Facility Category

This facility is classified as a Major or Title V Source of air pollution because emissions of at least one regulated air pollutant; such as nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO₂), particulate matter (PM/PM₁₀), or volatile organic compounds (VOC); exceeds 100 tons per year (TPY).

This facility is not within an industry included in the list of the 28 Major Facility Categories per Table 62-212.400-1, F.A.C. However, because overall facility emissions

² <http://maps.yahoo.com>.

SECTION 2 Facility Information (Cont.)

are greater than 250 TPY for at least one criteria pollutant, it is a Major Facility with respect to Rule 62-212.400, Prevention of Significant Deterioration (PSD).

This project is exempt from the requirements of Rule 62-212.400, F.A.C., Prevention of Significant Deterioration (PSD) as discussed in this report. The additional emission units included in this project are proposed to be subject to a specific emission limiting standard for purposes of Title V permitting as described within this report.

Project Information

3.1 Project Scope

The scope of this project is to install two additional diesel-fueled engine-driven standby generators to an existing bank of four collectively-regulated standby generators of the same manufacturer. Electrical switchgear is in place to accommodate the fifth generator and another switchgear component will be installed for the sixth.

Further, as a part of this permit application, MDWASD proposes to amend the permitted emission rate for NO_x emissions from the existing EMD generators from 4.12 lb/MMBtu to 3.50 lb/MMBtu. This reduction is based on an analysis of the results of emissions tests performed annually since 1996 and better reflects the actual NO_x emissions from these units. MDWASD proposes that this amended rate be applied to the entire bank of existing and proposed EMD 20-645F4B generators.

This permit application also seeks to repermit the replacement of high-service pump engine no. 5 as originally permitted under Air Construction Permit 0250314-005-AC and extended under Air Construction Permit 0250314-007-AC.

The emission units proposed or amended by this permit application are:

Emissions Unit No.	Emissions Unit Description
009	Existing Diesel Engine Generator # 1, EMD model No. 20-645F4B
010	Existing Diesel Engine Generator # 2, EMD model No. 20-645F4B
011	Existing Diesel Engine Generator # 3, EMD model No. 20-645F4B
012	Existing Diesel Engine Generator # 4, EMD model No. 20-645F4B
024 (proposed)	Proposed Diesel Engine Generator # 5, EMD model No. 20-645F4B
025 (proposed)	Proposed Diesel Engine Generator # 6, EMD model No. 20-645F4B
020	Caterpillar Model G3608 LE engine driving Pump # 5

3.2 Installation of the Additional Standby Generator Units

MDWASD is proposing to add two new General Motors Electro-Motive Division (EMD) Model 20-645F4B diesel-fueled standby generator sets to the existing bank of four such generators at its Alexander Orr, Jr. WTP in Miami, Florida. MDWASD expects to complete installation and initial compliance testing of proposed generator # 5 within two years of issuance of this requested air construction permit. Proposed generator # 6 and the required switchgear expansion is in the initial planning stage and construction is anticipated to begin within four years of the issuance date of this requested permit.

SECTION 3 Project Information (Con't.)

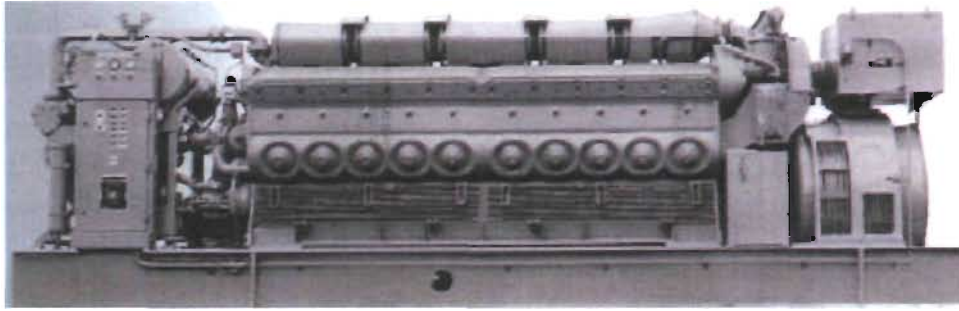


Figure 3-1 General Motors Electro-Motive Division Model 20-645F4B Generator

Each model 20-645F4B generator set is rated to produce 2,865 kilowatts (kW) of electric power at continuous full-load operating conditions, and is driven by a 4,000-brake horsepower (bhp) diesel-fired prime mover. These 2-cycle, 20 cylinder engines are turbocharged and normally operate at 900 revolutions per minute (rpm). They are capable of operating at load conditions ranging from 20 percent to 110 percent (peaking duty for durations not to exceed 2 hours). The engines burn low-sulfur diesel fuel, which has a sulfur content of 0.05 weight percent.

The proposed 20-645F4B generators will be modified at the factory to reduce NO_x emissions. These modifications to the standard 20-645F4B for the control of NO_x emissions consist of utilizing injectors with fixed timing, changing the fuel injection timing, and using 4-pass combustion air aftercoolers to increase intake air cooling. The engines will be fitted with CBOI (constant beginning of injection) injectors by EMD. The standard injector used by EMD is designed so that as engine loads increase, the point at which fuel injection into the cylinder begins is advanced. The CBOI injector has fixed timing and there is no advance based on engine load. The standard injection timing on an EMD engine is 0 degrees before top dead center (BTDC) and advances under load. CBOI injectors, as their name implies, have the injection timing fixed at 1 degree BTDC. The intercoolers cool the turbocharged intake air before it enters the air box and the cylinders. The standard EMD intercooler is a 2-pass heat exchanger. In order to achieve additional cooling and assist in NO_x reduction, these engines are fitted with 4-pass intercoolers.



Figure 3-2 EMD 20-645F4B (South District WWTP)

Additionally, the engine will also burn low sulfur (0.05 weight %) diesel fuel, representative of BACT for sulfur dioxide (SO₂). Use of these combustion control techniques is anticipated to reduce the emissions of NO_x in the engine exhaust by approximately 52 percent from uncontrolled levels.

The two proposed EMD 20-645F4B standby generator sets are located within individual enclosure structures. Exhaust silencers are mounted horizontally on top of each enclosure structure and the exhaust

SECTION 3 Project Information (Con't.)

stacks terminate vertically with a rain cap fitted to the end of the exhaust. The stacks have a 21-inch inside diameter and terminate approximately 21 feet above ground level.

Tables 3-2 and 3-3 summarize the operating characteristics of the proposed and the existing generator sets. Table 3-2 demonstrates that brake-specific fuel consumption (BSFC) increases as the engine loads are decreased.

Table 3-2. Summary of Exhaust and Operating Characteristics of the Proposed EMD Model 20-645F4B Standby Generator Set Miami-Dade WASD Alexander Orr, Jr. WTP	
Number of Units	2 Proposed
Generator Capacity	
Peaking (110% load-2 hours max)	3,150 kW
Continuous (full load-100%)	2,865 kW
Brake Specific Fuel Consumption (lb/bhp-hr)	
Peaking-110%	0.346, each
Full Load-100%	0.346, each
Partial Load-75%	approx. 0.363
Partial Load-50%	approx. 0.381
Operating Speed	900 rpm
Exhaust Characteristics – Vertical Exhaust	
Height	21 ft
Diameter	1.75 ft
Flow	21,350 acfm
	148 fps
Temperature	635°F

3.3 Modification of the Existing Standby Generator Units

Currently, Alexander Orr, Jr. WTP is equipped with four EMD Model 20-645F4B standby generator sets. Each 20-645F4B generator set consists of a 4,000 hp diesel-fueled internal combustion engine prime mover coupled to a 2,865 kW electrical generator. Commercial operation of these generators began in 1987.

Exhaust emissions from the existing 20-645F4B engines are reduced by combustion modifications consisting of fuel injection timing retardation and turbocharger aftercoolers. This combination was determined to be Best Achievable Control Technology (BACT) for nitrogen oxides (NO_x) as part of a PSD review conducted for the facility. In addition, the engines will continue to burn low sulfur (0.05 weight %) diesel fuel, which is representative of BACT for sulfur dioxide (SO₂). The combination of low-sulfur diesel fuel and combustion modifications is representative of BACT for particulate matter with a diameter less than 10 micrometers (PM-10). Use of the BACT was designed to reduce emissions of NO_x in the engine exhaust by approximately 28 percent from uncontrolled (pre-BACT) levels.

SECTION 3 Project Information (Con't.)



Figure 3-3 Existing Standby Generator Bank (Alexander Orr, Jr. WTP)

All existing EMD 20-645F4B standby generator sets are located within individual enclosure structures. Exhaust silencers and stacks are mounted horizontally on top of each enclosure structure. The stacks have a 21-inch inside diameter and terminate approximately 18 feet above ground level.

Table 3-3. Summary of Exhaust and Operating Characteristics of the Existing EMD Model 20-645F4B Standby Generator Sets Miami-Dade WASD Alexander Orr, Jr. WTP	
Number of Units	4
Generator Capacity	
Peaking (110% load-2 hours max)	3,150 kW, each
Continuous (full load-100%)	2,865 kW, each
Brake Specific Fuel Consumption (lb/bhp-hr)	
Peaking-110%	0.353, each
Full Load-100%	0.353, each
Partial Load-75%	N/A
Operating Speed:	900 rpm
Exhaust Characteristics – Horizontal Exhaust	
Height	18 ft
Diameter	1.75 ft
Flow	23,000 acfm
	148 fps
Temperature	735°F

As part of this permit application, MDWASD proposes to lower the allowable emission rate for NO_x emissions from the existing EMD generators from 4.12 lb/MMBtu allowable under Air Operating Permit Number 0250314-001-AV to 3.50 lb/MMBtu. This reduction is based on an analysis of the results of emissions tests performed annually since 1996 and

SECTION 3 Project Information (Con't.)

better reflects the actual NOx emissions from these units. MDWASD proposes that this amended rate be applied to the entire bank of existing and proposed EMD 20-645F4 generators.

3.4 Replacement of High-Service Pump Engine No. 5

Pump engine no. 5 (E.U. ID No. 005) began service in August 1951, driving a 40 million gallons per day (mgd) pump. This diesel-fueled engine and associated pump is to be removed and replaced by Caterpillar Model G3608LE TA-130 engine and a Flowserve Model 600LNEC1150 high-service pump rated at 40 mgd.

The Model G3608LE TA-130 engine is an eight-cylinder engine in Caterpillar's G3600 series natural gas-fueled engines. Caterpillar characterizes this series as high horsepower, high torque engines that are designed for reliable operation, fuel economy, and low emissions. The Model G3608LE TA-130 has an in-line cylinder arrangement, with a bore and stroke of 11.81 x 11.81 in. and displacement of 10,350 cu. in. This is a turbocharged engine, and power output at the design aftercooler operating temperature of 130° F ranges from 1555 bhp to 2225 bhp at 700 rpm to 1000 rpm.

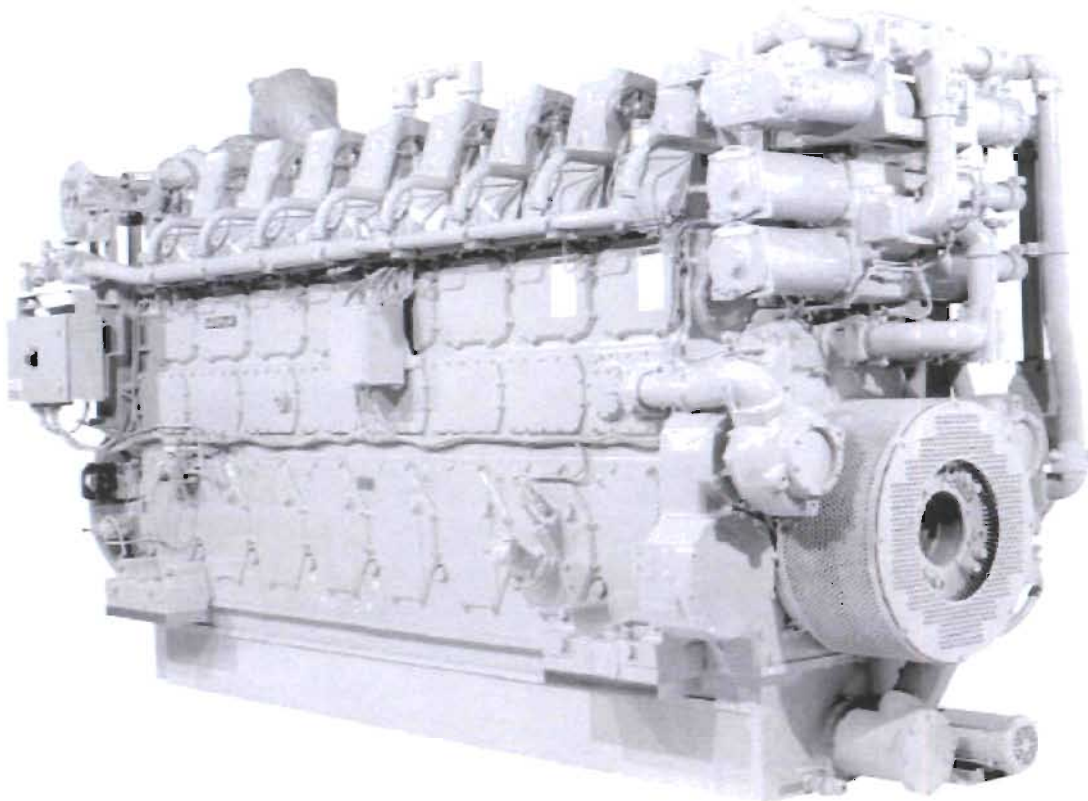


Figure 3-4 Caterpillar G3608 Engine

The removal of the existing Worthington pump engine no. 5 (E.U. 005) and its replacement with the Caterpillar G3608 (E.U. 020) was previously authorized by Air

SECTION 3 Project Information (Con't.)

Construction Permit 0250314-005-AC and extended under Air Construction Permit 0250314-007-AC. Because of the contractor difficulties experienced with the replacement of this engine, MDWASD is proposing in this application to repermit this removal and replacement. The removal of the existing engine is anticipated to start within two years of the issuance of this requested permit once other required permits are obtained, the installation contract is rebid, and the winning bidder is given a Notice to Proceed. MDWASD then expects to complete the installation and initial compliance testing of the Caterpillar G3608 engine within two years of beginning actual removal of the existing Worthington pump engine no. 5 or roughly four years from the issuance date of this requested air construction permit.

Project Emissions

4.1 Project Emissions

The emissions associated with this project are the typical pollutants from combustion of diesel fuel oil or natural gas in internal combustion reciprocating engines. The primary pollutants associated with this project are Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Sulfur Oxides (SO_x), Particle Matter (PM), Particle Matter, less than 10 microns (PM₁₀), and Volatile Organic Compounds (VOC).

Pump engine no. 5 will replace an existing diesel fuel oil-fired internal combustion reciprocating engine with a natural gas-fired internal combustion reciprocating engine and is expected to emit much less NO_x and CO on a lb/hr basis than the existing engine. This is confirmed by the past actual to future potential analysis, which also demonstrates that the project is not subject to the requirements of PSD.

4.2 Past Facility Emissions

A two-year period from April 1998 to March 2000 was used for the estimation of past facility-wide actual emissions. This was the most recent period in which all diesel- and natural gas-fired pump engines were operational, and is most reflective of operations prior to the start of the modifications to the east pump room permitted under Air Construction Permit Number 0250314-007-AC. The estimated actual annual emissions for the existing units shown below are based upon average operating hours, fuel consumption or lime production as applicable, emission tests as available, and reference emission factors.

4.2.1 Emissions Testing for Existing Units

Emissions tests of the existing units were conducted in 1997 and 1998 for the determination of nitrous oxides and visible emissions. The test results for nitrous oxides (NO_x) emission are summarized in Table 4-1 below:

EU	001	003	004	005	006	007	009	010	011	012
1997	2.12	1.83	2.95	2.60	1.84	7.21	3.71	3.66	3.04	3.12
1998	2.26	2.36	2.57	2.29	1.34	14.70	2.76	2.63	2.69	2.96
Average	2.19	2.10	2.76	2.45	1.59	10.96	3.24	3.15	2.87	3.04

The average value of test results for the two tests conducted will be used for the purpose of determining the annual NO_x emissions of the existing units over the two year period being evaluated, as tests were also taken over a two year period, and are more representative of operations than just one test result.

4.2.2 Existing Unit Operations

Monthly operations of the existing units over a two-year period from April 1998 to March 2000 were selected for the estimate of past actual emissions. This was the most-recent

SECTION 4 Project Emissions (Cont.)

period that all emission units were operational which is most reflective of normal operations prior to modifications to the east pump room. Also, during this period, the bank of four EMD standby generators ran an average of 9201 hours per year cumulatively. This number is representative of the annual usage of the standby generators as rolling 12-month use varied from 5,511 to 15,664 cumulative hours per year during the period from December 1995 to December 2002.

Tabulations of the monthly operating hours and fuel consumption over this period as reported in the 1998, 1999 and 2000 Annual Operating Reports for Air Pollutant Emitting Facility, Alexander Orr, Jr. Water Treatment Plant are shown in Tables 4-2 and 4-3 below:

Table 4-2 Miami-Dade Water and Sewer Department Alexander Orr Water Treatment Plant 04/1998 - 03/2000 Monthly Hours of Operation												
Month	Source											
	1	2	3	4	5	6	7	8	9	10	11	12
	Diesel Engine #1	Diesel Engine #2	Diesel Engine #3	Diesel Engine #4	Diesel Engine #5	Diesel Engine #6	Lime Kiln	Two 1000 ton Lime Silos	Standby Diesel Gen. #1	Standby Diesel Gen. #2	Standby Diesel Gen. #3	Standby Diesel Gen. #4
Apr-1998	17.5	-	90.5	143.5	58.0	702.0	719	719	121	344	263	256
May-1998	-	-	32.0	191.0	77.0	680.0	512	744	-	427	168	474
Jun-1998	-	-	19.0	171.0	138.0	625.0	648	720	-	512	129	486
Jul-1998	7.5	-	19.5	144.0	65.0	733.0	732	744	-	224	260	331
Aug-1998	27.0	-	129.0	180.0	356.0	744.0	651	744	121	332	54	112
Sep-1998	61.0	-	172.0	283.0	693.0	688.0	663	720	143	-	94	38
Oct-1998	7.0	-	177.5	261.0	733.0	745.0	745	745	163	-	109	-
Nov-1998	-	-	221.0	150.5	709.5	717.0	720	720	516	8	-	-
Dec-1998	-	-	216.0	71.0	137.0	744.0	744	744	401	107	459	-
Jan-1999	-	-	236.0	75.0	538.0	732.0	744	744	552	552	-	156
Feb-1999	3.0	-	76.0	135.0	100.0	641.0	669	672	420	494	-	165
Mar-1999	-	-	233.5	74.0	64.0	716.0	744	744	480	477	6	186
Apr-1999	5.0	-	230.0	24.0	62.0	720.0	719	719	121	344	263	256
May-1999	26.0	-	306.0	-	109.0	741.0	744	744	-	427	168	474
Jun-1999	40.0	-	102.0	-	149.0	684.0	444	720	-	512	129	486
Jul-1999	24.0	-	54.0	45.0	75.0	744.0	715	744	-	224	260	331
Aug-1999	3.0	-	101.5	87.0	159.0	719.0	743	744	121	332	54	112
Sep-1999	12.0	-	121.0	9.0	123.0	720.0	701	720	143	-	94	38
Oct-1999	-	-	76.0	-	141.0	741.0	743	745	163	-	109	-
Nov-1999	-	-	-	156.0	199.0	676.0	717	720	516	8	-	-
Dec-1999	14.0	-	-	226.0	114.0	660.0	744	744	401	107	459	-
Jan-2000	7.0	-	-	251.0	100.0	744.0	744	744	408.0	86.0	27.0	20.0
Feb-2000	24.0	-	-	254.0	92.0	613.0	669	672	391.0	63.0	5.0	9.0
Mar-2000	7.0	-	-	155.0	36.0	620.0	744	744	523.0	53.0	15.0	10.0
Annual Average Operating Hours	142.5	0.0	1306.3	1543.0	2513.8	8424.5	8359.0	8760.0	2852.0	2816.5	1562.5	1970.0

SECTION 4 Project Emissions (Cont.)

Table 4-3
Miami-Dade Water and Sewer Department
Alexander Orr Water Treatment Plant
04/1998 - 03/2000 Monthly Fuel Consumption/Production Rate

Source EU	1	2	3	4	5	6	7	8	9	10	11	12		
Month	Calculated Fuel Consumption (10 ³ gal Diesel)					10 ⁶ ft ³ CH ₄		Lime Production (tons)		Fuel Consumption (10 ³ gal Diesel)				
	Diesel Engine #1	Diesel Engine #2	Diesel Engine #3	Diesel Engine #4	Diesel Engine #5	Diesel Engine #6	Lime Kiln	Two 1000 ton Lime Silos	Standby Diesel Gen. #1	Standby Diesel Gen. #2	Standby Diesel Gen. #3	Standby Diesel Gen. #4		
Apr-1998	0.543	0.000	2.806	4.449	3.480	10.965	6.31	25.14	3,696	3,696	17.303	49.192	37.609	36.608
May-1998	0.000	0.000	0.992	5.921	4.620	4.916	5.88	17.64	2,580	2,580	0.000	61.061	24.024	67.782
Jun-1998	0.000	0.000	0.589	5.301	8.280	3.734	5.57	24.95	3,589	3,589	0.000	73.216	18.447	69.498
Jul-1998	0.233	0.000	0.605	4.464	3.900	8.070	6.79	29.62	4,345	4,345	0.000	32.032	37.180	47.333
Aug-1998	0.837	0.000	3.999	5.580	21.360	10.440	6.10	22.95	3,302	3,302	17.303	47.476	7.722	16.016
Sep-1998	1.891	0.000	5.332	8.773	41.580	2.945	6.45	23.22	3,378	3,378	20.449	0.000	13.442	5.434
Oct-1998	0.217	0.000	5.503	8.091	43.980	8.504	7.20	30.20	4,426	4,426	23.309	0.000	15.587	0.000
Nov-1998	0.000	0.000	6.851	4.666	42.570	3.989	6.44	28.64	4,199	4,199	73.788	1.144	0.000	0.000
Dec-1998	0.000	0.000	6.696	2.201	8.220	9.919	6.93	26.76	3,917	3,917	57.343	15.301	65.637	0.000
Jan-1999	0.000	0.000	7.316	2.325	32.280	-7.260	2.94	27.83	4,093	4,093	78.936	78.936	0.000	22.308
Feb-1999	0.093	0.000	2.356	4.185	6.000	-1.344	5.83	24.63	3,630	3,630	60.060	70.642	0.000	23.595
Mar-1999	0.000	0.000	7.239	2.294	3.840	2.808	5.33	28.03	4,130	4,130	68.640	68.211	0.858	26.598
Apr-1999	0.155	0.000	7.130	0.744	3.720	10.494	6.31	26.20	3,846	3,846	17.303	49.192	37.609	36.608
May-1999	0.806	0.000	9.486	0.000	6.540	-0.383	5.88	26.24	3,841	3,841	0.000	61.061	24.024	67.782
Jun-1999	1.240	0.000	3.162	0.000	8.940	4.562	5.57	17.35	2,522	2,522	0.000	73.216	18.447	69.498
Jul-1999	0.744	0.000	1.674	1.395	4.500	8.959	6.79	28.95	4,254	4,254	0.000	32.032	37.180	47.333
Aug-1999	0.093	0.000	3.147	2.697	9.540	26.739	6.10	28.52	4,185	4,185	17.303	47.476	7.722	16.016
Sep-1999	0.372	0.000	3.751	0.279	7.380	48.739	6.45	26.22	3,844	3,844	20.449	0.000	13.442	5.434
Oct-1999	0.000	0.000	2.356	0.000	8.460	55.479	7.20	28.17	4,136	4,136	23.309	0.000	15.587	0.000
Nov-1999	0.000	0.000	0.000	4.836	11.940	41.300	6.44	27.03	3,967	3,967	73.788	1.144	0.000	0.000
Dec-1999	0.434	0.000	0.000	7.006	6.840	12.756	6.93	27.32	4,009	4,009	57.343	15.301	65.637	0.000
Jan-2000	0.168	0.000	0.000	6.024	4.200	7.055	7.90	24.797	3,634	3,634	44.998	9.485	2.978	2.206
Feb-2000	0.576	0.000	0.000	6.096	3.864	2.482	6.48	25.645	3,768	3,768	41.957	6.760	0.537	0.966
Mar-2000	0.168	0.000	0.000	3.720	1.512	6.643	6.92	28.392	4,178	4,178	37.910	3.842	1.087	0.725
Annual Average	4.285	0.000	40.495	45.524	148.773	141.256	75.37	312.221	45734.5	45734.5	375.746	398.360	222.378	280.870

An annual average of these monthly fuel consumption figures for the two year period will be used in conjunction with the average NOx emission test results for each engine or emission factors obtained from the EPA Factor Inventory REtrieval (FIRE³) to estimate actual emissions for the period.

³ Factor Information REtrieval (FIRE) Data System is a database containing EPA's recommended emission estimation factors for criteria and hazardous air pollutants.

SECTION 4 Project Emissions (Cont.)

4.2.3 Annual Emissions for Existing Units

Estimated annual emissions for the existing units based upon average annual operating hours (Table 4-2), fuel consumption or lime production as applicable (Table 4-3), emission tests for NOx (Table 4-1), and emission factors from the EPA FIRE database for other pollutants are provided in Tables 4-4, 4-5, and 4-6 below:

Rating (bhp)	Annual Operating Hours	Fuel (10 ³ gal/yr; or MMCF)	Emissions Reference	NOx	CO	Sox	PM	PM ₁₀	VOC (as TOC)
PUMP ROOM EMISSIONS – ACTUAL									
Table 4-4									
Emission Unit Data				Criteria Pollutants (ton/year)					
Pump Engine # 1			Factor	2.19	111	7.08	9.55	7.85	13.7
825	142.5	4.3	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Pump Engine # 1 Emissions				0.65	0.24	0.02	0.02	0.02	0.03
Pump Engine # 3			Factor	2.10	111	7.08	9.55	7.85	13.7
825	1306.3	40.5	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Pump Engine # 3 Emissions				5.87	2.25	0.14	0.19	0.16	0.28
Pump Engine # 4			Factor	2.76	111	7.08	9.55	7.85	13.7
825	1543.0	45.5	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Pump Engine # 4 Emissions				8.67	2.53	0.16	0.22	0.18	0.31
Pump Engine # 5			Factor	2.45	111	7.08	9.55	7.85	13.7
1590	2513.8	148.8	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Pump Engine # 5 Emissions				25.15	8.26	0.53	0.71	0.58	1.02
Pump Engine # 6			Factor	1.59	7.50	0.60	2.20	2.00	1.40
2113	8424.5	141.3	Units	lb/MMBtu	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr
LNG use (MMscf)		75.4							
Pump Engine # 6 Emissions				78.53	66.75	5.34	19.58	17.80	12.46
Pump Room Emissions (Actual)				118.87	80.02	6.19	20.72	18.74	14.10

SECTION 4 Project Emissions (Cont.)

Rating (kW or ton/year lime)	Annual Operating Hours	Fuel (10 ³ gal/yr, or MMCF)	Emissions Reference	NOx	CO	SOx	PM	PM ₁₀	VOC (as TOC)
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LIME PLANT EMISSIONS – ACTUAL

Table 4-5

Emission Unit Data				Criteria Pollutants (ton/year)					
Lime Kiln			Factor	10.96	2.20	0.60	4.21	4.21	2.80
45735	8359.0	312.22	Units	lb/hr	lb/ton	lb/MMBtu	lb/hr	lb/hr	lb/MMBtu
Lime Kiln Emissions				45.81	50.31	0.09	17.60	17.60	0.44
Lime Silos			Factor				0.25	0.18	
45735	8760.0	--	Units				lb/ton	lb/ton	
Lime Silos Emissions				--	--	--	5.72	4.12	--
Lime Plant Standby Engine			Factor	4.41	111.00	7.08	9.55	7.85	13.70
250 kW	10.5	0.3	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Lime Plant Standby Engine Emissions				0.10	0.02	0.00	0.00	0.00	0.00
Lime Plant Emissions (Actual)				45.90	50.33	0.09	23.31	21.71	0.44

Rating (bhp)	Annual Operating Hours	Fuel (10 ³ gal/yr)	Emissions Reference	NOx	CO	SOx	PM	PM ₁₀	VOC (as TOC)
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STANDBY GENERATOR (EMD) EMISSIONS – ACTUAL

Table 4-6

Emission Unit Data				Criteria Pollutants (ton/year)					
EMD # 1			Factor	3.24	111	7.08	9.55	7.85	13.7
4000	2852	375.7	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
EMD # 1 Emissions				84.00	20.85	1.33	1.79	1.47	2.57
EMD # 2			Factor	3.15	111	7.08	9.55	7.85	13.7
4000	2817	398.4	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
EMD # 2 Emissions				86.58	22.11	1.41	1.90	1.56	2.73
EMD # 3			Factor	2.87	111	7.08	9.55	7.85	13.7
4000	1563	222.4	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
EMD # 3 Emissions				44.04	12.34	0.79	1.06	0.87	1.52
EMD # 4			Factor	3.04	111	7.08	9.55	7.85	13.7
4000	1970	280.9	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
EMD # 4 Emissions				58.92	15.59	0.99	1.34	1.10	1.92
Total EMD Emissions (actual)				273.54	70.89	4.52	6.10	5.01	8.75

SECTION 4 Project Emissions (Cont.)

4.3 Potential Emissions

Potential emissions for the facility are calculated based on unregulated full use of the high-service pump engines, emissions-regulated full capacity production at the lime recalcining plant, and limited use of standby and emergency generators as discussed in this report. These potential emissions are tabulated in Tables 4-10, 4-11, and 4-12.

Table 4.7, below, shows that NO_x, at an average of 438.31 tons per year plant-wide and 273.53 tons per year for the standby generator bank, is the criteria pollutant of principal concern. Under Air Operating Permit Number 0250314-001-AV, issued in August 8, 2000, and continued in subsequent operating permit revisions, the generator bank is subject to a cumulative cap on fuel usage of 1,415,000 gallons in any consecutive 12-month period. The high-service pump engines are unregulated and potential emissions are based on full usage of 8760 hours/year/engine. The 900 kW generator is for emergency purposes only and is limited to 500 hours/year usage.

**Table 4-7 Comparison of Facility Emissions, Existing and Proposed
Miami-Dade Water and Sewer Department
Alexander Orr, Jr. Water Treatment Plant
Addition of Two New GM-EMD Diesel-Fueled 20-645F4B Standby Generators and
Replacement of Pump Engine No. 5 With New Caterpillar Natural Gas-Fueled G3608 Engine**

	Existing Annual Emissions ¹				Proposed Annual Emissions				Net Annual Increase/ (Decrease) in Tons
	Pump Room Total	Lime Plant Total	Standby Generator Total	Total Existing Emissions	Pump Room Total ²	Lime Plant Total ³	Standby Generator Total ⁴	Total Proposed Emissions	
Nitrogen Oxides (NO _x)	118.87	45.90	273.54	438.31	140.15	83.26	229.43	452.84	14.53
Carbon Monoxide (CO)	80.02	50.33	70.89	201.24	127.74	60.39	52.73	240.86	39.62
Sulfur Oxides (SO _x)	6.19	0.09	4.52	10.80	5.73	0.20	3.36	9.29	(1.51)
PM, Total	20.72	23.31	6.10	50.13	21.43	44.03	4.54	70.00	19.87
PM ₁₀ , Total	18.74	21.71	5.01	45.46	19.58	44.03	3.73	67.34	21.88
VOC, Total	14.10	0.44	8.75	23.29	24.71	0.90	6.51	32.12	8.83

Notes:

- Existing emissions are based on the average of a 24-month period from April 1998 to March 2000.
- Assumes full pump engine usage (8760 hr/yr) and partial Pump Room Generator usage (500 hr/yr) as permitted.
- Assumes full Lime Kiln capacity (150 ton/day).
- Assumes cumulative fuel cap of 950,000 gal/yr and emission factor of 3.50 lb/MMBtu.

SECTION 4 Project Emissions (Cont.)

4.3.1 Reduction of Standby Generator NOx Emissions Rate

A review of the results of emissions testing conducted annually over the past seven years has indicated that actual NOx emissions from the EMD generators are significantly lower than the rate of 4.12 lbs NOx/MMBtu used in the original permit application. That rate was based on manufacturer's specifications and the addition of engine modifications. As mentioned, the Alexander Orr, Jr. WTP EMD engines are equipped with NOx-reducing modifications including timing retard and upgraded intercoolers.

Accordingly, MDWASD proposes to utilize an emissions rate of 3.50 lbs NOx/MMBtu for the EMD generators. This is a 15% reduction of the original 4.12 lbs NOx/MMBtu rate and would apply to both the existing and proposed EMD generators. Based on this new figure and the fuel cap of 1,415,000 gallons, potential NOx emissions from the EMD generator bank, including the proposed units, would be reduced over 100 tons per year to 301.7 tons NOx/year.

4.3.2 Reduction of Generator Cumulative Fuel Cap

Under the current air operating permit the standby generator bank at Alexander Orr, Jr. WTP is subject to a fuel usage cap for all standby generators combined of 1,415,000 gallon of diesel fuel in any consecutive 365-day period. In order to further reduce emissions, particularly NOx emissions, from the facility MDWASD proposes to decrease this cap to 950,000 gallon. In conjunction with the reduced emissions rate discussed above NOx potential emissions from the standby generator bank of six EMD generators, including the two new proposed units, is 229.43 tons/year as shown in Table 4-7 above. This is a total decrease in NOx emissions for the generator bank of 44.11 tons/year. Decreasing generator bank NOx emissions while maintaining the needed full-use capability for the high service pumps engines enables the facility total emissions to remain below PSD review trigger levels.

4.3.3 Potential Emissions From Pump Engine # 5

Table 4-8 summarizes the manufacturer supplied operating parameters for the G3608LE TA-130 in regular text, with the interpolated values provided in italics for loads of 2020, 1920 and 1840 bhp:

SECTION 4 Project Emissions (Cont.)

Table 4-8 Replacement Pump Engine No. 5 - Caterpillar Model G3608 LE							
Engine Rating Data	% load	100%	91.7%	86.3%	82.7%	75%	50%
Engine Power (w/o fan)	bhp	2225	2040	1920	1840	1669	1113
BSFC	BTU/bhp-hr	6810	6885	<u>6933</u>	6966	7035	7550
Air Flow (scfm @ 77°F, 13.9 psia)		6136	5663	5356	5152	4715	3143
Exh. Flow (scfm @ stack T, 14.5 psia)		14867	13783	13080	12612	11610	8048
Exhaust Stack Temp (F°)		847	854	859	862	868	918
Fuel Flow (scfh 4 @ 60°F, 14.7 psia)		16743	15488	<u>14674</u>	14132	12972	9281
Engine Emissions Data							
NOx (as NO ₂)	g/bhp-hr	0.70	<u>0.70</u>	<u>0.70</u>	<u>0.70</u>	0.70	0.70
	lb/hr	3.43	3.15	<u>2.96</u>	2.84	2.57	1.72
CO	g/bhp-hr	1.90	<u>1.90</u>	<u>1.90</u>	1.90	1.90	1.90
	lb/hr	9.31	8.54	<u>8.04</u>	7.70	6.98	4.66
HC (Total)	g/bhp-hr	5.95	<u>6.07</u>	<u>6.14</u>	6.19	6.30	6.50
	lb/hr	29.16	27.26	<u>25.97</u>	25.10	23.16	15.94
HC(Non-Methane)	g/bhp-hr	0.89	<u>0.91</u>	<u>0.92</u>	0.93	0.95	0.98
	lb/hr	4.36	4.09	<u>3.90</u>	3.78	3.49	2.40

The replacement engine is anticipated to operate between 86.3 to 82.7 percent load on average under normal conditions. Based on this normal operating range, the maximum emission rates of the pollutants provided in the table are underlined and will be used in determining the annual potential emissions for these units. The bold values in the table are maximum values possible during transient pumping operations and are used for a maximum hour emission rate of a pollutant.

Table 4-9 summarizes the emissions from the Replacement Pump Engine No. 5 - Caterpillar Model G3608 LE TA-130 with no operating restrictions placed on the unit, operating under average annual loading and pumping conditions.

Table 4-9 Potential Annual Emissions Replacement Pump Engine 5				
Hours of Operation				8,760
Fuel Consumption in MCF/hr				13.312
Annual Fuel consumption in MMCF				111.06
Annual Heat Input (MMBtu) based on 1050/ MMCF				116,615
	Emission Factor	Units	Source, SCC ⁴	Annual Emissions in Tons
Nitrogen Oxides (NOx)	2.96	Lbs/Hr	Manufacturer	13.00
Carbon Monoxide (CO)	8.04	Lbs/Hr	Manufacturer	35.20
PM, Filterable	1.00E+01	Lbs/MMCF	20300201	0.56
PM ₁₀ , Filterable	1.00E+01	Lbs/MMCF	20300201	0.56
Sulfur Oxides (SOx)	6.00E-01	Lbs/MMCF	20300201	0.03
Volatile Organic Compounds (VOC)	1.16E+02	Lbs/MMCF	20300201	6.40
Notes:				
Emissions Factors based on Manufacturer. EPA FIRE database Source Classification Codes				
Emissions (tons/yr) = (emission factor [lbs/unit]) x (units) / 2000 lbs/ton				

⁴ Source Classification Code, 20300201 is SCC for Internal Combustion Engines, Commercial/Institutional, Natural Gas, Reciprocating

SECTION 4 Project Emissions (Cont.)

4.4 Summary of Facility Emissions

Table 4-7, above, summarizes facility emissions for the Alexander Orr, Jr. WTP. The proposed project results in total facility emissions beneath the significant emission levels per Table 62-212.400-2, F.A.C. This project will emit negligible quantities of sulfuric acid mist (H₂SO₄ mist or SAM), fluorides, beryllium, mercury and lead. Therefore the proposed additional standby generator is not subject to PSD review.

Rating (bhp)	Annual Operating Hours	Fuel (10 ³ gal/yr; or MMCF)	Emissions Reference	NOx	CO	Sox	PM	PM ₁₀	VOC (as TOC)	
PUMP ROOM EMISSIONS – PROPOSED										
Table 4-10										
Emission Unit Data				Criteria Pollutants (ton/year)						
900 kW Generator				Factor	37.46	3.10	7.08	0.31	0.31	13.70
1332	500.0	33.3	Units	lb/hr	lb/hr	lb/10 ³ gal	lb/hr	lb/hr	lb/10 ³ gal	
900 kW Generator Emissions				9.37	0.78	0.12	0.08	0.08	0.23	
New Pump Engine # 3				Factor	4.35	2.55	0.60	10.00	10.00	116.00
810	8760.0	43.9	Units	lb/hr	lb/hr	lb/MMscf	lb/MMscf	lb/MMscf	lb/MMscf	
Pump Engine # 3 Emissions				19.05	11.17	0.01	0.22	0.22	2.54	
New Pump Engine # 4				Factor	4.35	2.55	0.60	10.00	10.00	116.00
810	8760.0	43.9	Units	lb/hr	lb/hr	lb/MMscf	lb/MMscf	lb/MMscf	lb/MMscf	
Pump Engine # 4 Emissions				19.05	11.17	0.01	0.22	0.22	2.54	
New Pump Engine # 5				Factor	2.96	8.04	0.60	10.00	10.00	116.00
2225	8760.0	111.1	Units	lb/hr	lb/hr	lb/MMscf	lb/MMscf	lb/MMscf	lb/MMscf	
Pump Engine # 5 Emissions				12.96	35.22	0.03	0.56	0.56	6.44	
Pump Engine # 6				Factor	18.20	7.50	0.60	2.20	2.00	1.40
2113	8760.0		Units	lb/hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	lb/10 ³ hp-hr	
Pump Engine # 6 Emissions				79.72	69.41	5.55	20.36	18.51	12.96	
Pump Room Emissions (proposed)				140.15	127.74	5.73	21.43	19.58	24.71	
PUMP ROOM NET CHANGE				21.29	47.72	-0.46	0.71	0.84	10.62	

SECTION 4 Project Emissions (Cont.)

Rating (kW or ton/year lime)	Annual Operating Hours	Fuel (10 ³ gal/yr; or MMCF)	Emissions Reference	NOx	CO	SOx	PM	PM ₁₀	VOC (as TOC)
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LIME PLANT EMISSIONS – PROPOSED **Table 4-11**

Emission Unit Data				Criteria Pollutants (ton/year)					
Lime Kiln			Factor	18.80	2.20	0.60	9.80	9.80	2.80
54750	8760.0	630.7	Units	lb/hr	lb/ton	lb/MMBtu	lb/hr	lb/hr	lb/MMBtu
Lime Kiln Emissions				82.34	60.23	0.19	42.92	42.92	0.88
Lime Silos			Factor				0.25	0.25	
54750	8760.0	–	Units				lb/hr	lb/hr	
Lime Silos Emissions				–	–	–	1.10	1.10	–
Lime Plant Standby Engine			Factor	4.41	111.00	7.08	9.55	7.85	13.70
250 kW	100.0	3.0	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Lime Plant Standby Engine Emissions				0.91	0.17	0.01	0.01	0.01	0.02
Lime Plant Emissions (Proposed)				83.26	60.39	0.20	44.03	44.03	0.90

LIME PLANT NET CHANGE	37.35	10.07	0.11	20.72	22.32	0.46
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Rating (bhp)	Annual Operating Hours	Fuel (10 ³ gal/yr)	Emissions Reference	NOx	CO	SOx	PM	PM ₁₀	VOC (as TOC)
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STANDBY GENERATOR (EMD) EMISSIONS – PROPOSED **Table 4-12**

Emission Unit Data				Criteria Pollutants (ton/year)					
EMDs # 1 - 6 (cumulative)			Factor	3.50	111	7.08	9.55	7.85	13.7
24000	N/A	950.0	Units	lb/MMBtu	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal	lb/10 ³ gal
Cumulative EMD Emissions (6 units)				229.43	52.73	3.36	4.54	3.73	6.51
Total EMD Emissions (proposed)				229.43	52.73	3.36	4.54	3.73	6.51

EMD NET CHANGE	-44.11	-18.17	-1.16	-1.56	-1.28	-2.24
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Rule Applicability

5.1 Rule Applicability

The proposed project is subject to preconstruction review requirements under the provisions of Chapter 403, Florida Statutes, and Chapters 62-4, 62-204, 62-210, 62-212, 62-214, 62-296, and 62-297 of the Florida Administrative Code (F.A.C.).

This facility is located in an area designated, in accordance with Rule 62-204.340, F.A.C., as attainment for the criteria pollutants ozone, PM₁₀, carbon monoxide, sulfur dioxide, and nitrogen dioxide; designated as unclassifiable for lead; and also designated as a maintenance area for ozone.

The proposed project is not subject to review under Rule 62-212.400, F.A.C., Prevention of Significant Deterioration (PSD) as previously discussed in this report.

Rule 62-4.030, F.A.C., prohibits modification of any existing emissions unit without first receiving a permit. It further specifies that a permitted installation may only be modified in a manner that is consistent with the terms of such a permit. Rule 62-210.200, F.A.C., defines "modification" to mean generally a change that results in an increase in actual emissions of air pollutants. As discussed above, emissions will increase, although not significantly. Rules 62-210.300(1) and 62-212.300(1)(a), F.A.C., also reiterate the requirement for construction permits.

The NO_x RACT requirement under Rule 62-296.570(4)(b)7, F.A.C. applies to the diesel oil-fired emergency pump room generator unit. Therefore, this unit will be subject to the unit-specific RACT NO_x emissions limitation of 4.75 lb/million BTU. The standby generator bank is subject to a more stringent permitted standard for NO_x emissions.

The emission units affected by this permit shall comply with all applicable provisions of the Florida Administrative Code (including applicable portions of the Code of Federal Regulations incorporated therein) and, specifically, the following Chapters and Rules.

SECTION 5 Rule Applicability (Cont.)

5.2 State Regulations

Chapter 62-4	Permits.
Rule 62-204.220	Ambient Air Quality Protection
Rule 62-204.240	Ambient Air Quality Standards
Rule 62-204.800	Federal Regulations Adopted by Reference
Rule 62-210.200	Definitions
Rule 62-210.300	Permits Required
Rule 62-210.350	Public Notice and Comments
Rule 62-210.370	Reports
Rule 62-210.550	Stack Height Policy
Rule 62-210.650	Circumvention
Rule 62-210.700	Excess Emissions
Rule 62-210.900	Forms and Instructions
Rule 62-212.300	General Preconstruction Review Requirements
Rule 62-213	Operation Permits for Major Sources of Air Pollution
Rule 62-296.320	General Pollutant Emission Limiting Standards

Air Pollution Control Techniques

6.1 Air Pollution Control Techniques

Emissions from this project are those that typically result from combustion of diesel fuel oil or natural gas internal combustion reciprocating engines: NO_x, CO, SO₂, PM/PM₁₀, and VOC. Combustion control is the technique used to control emissions from the two proposed additional diesel engine driven standby generators.

6.2 Air Pollutants⁵

Most of the pollutants from IC engines are emitted through the exhaust. However, some total organic compounds (TOC) escape from the crankcase as a result of blowby (gases that are vented from the oil pan after they have escaped from the cylinder past the piston rings) and from the fuel tank because of evaporation. Nearly all of the TOCs from diesel CI engines enter the atmosphere from the exhaust. Crankcase blowby is minor because TOCs are not present during compression of the charge. Evaporative losses are insignificant in diesel engines due to the low volatility of diesel fuels. In general, evaporative losses are also negligible in engines using gaseous fuels because these engines receive their fuel continuously from a pipe rather than via a fuel storage tank and fuel pump.

The primary pollutants from internal combustion engines are oxides of nitrogen (NO_x), hydrocarbons and other organic compounds, carbon monoxide (CO), and particulates, which include both visible (smoke) and non-visible emissions. Nitrogen oxide formation is directly related to high pressures and temperatures during the combustion process and to the nitrogen content, if any, of the fuel. The other pollutants, HC, CO, and smoke, are primarily the result of incomplete combustion. Ash and metallic additives in the fuel also contribute to the particulate content of the exhaust. Sulfur oxides also appear in the exhaust from IC engines. The sulfur compounds, mainly sulfur dioxide (SO₂), are directly related to the sulfur content of the fuel.

6.2.1 Nitrogen Oxides (NO_x) Emissions

Nitrogen oxide formation occurs by two fundamentally different mechanisms. The predominant mechanism with internal combustion engines is thermal NO_x which arises from the thermal dissociation and subsequent reaction of nitrogen (N₂) and oxygen (O₂) molecules in the combustion air. Most thermal NO_x is formed in the high-temperature region of the flame from dissociated molecular nitrogen in the combustion air. Some NO_x, called prompt NO_x, is formed in the early part of the flame from reaction of nitrogen intermediary species, and HC radicals in the flame. The second mechanism, fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen.

⁵ Text of this section is adapted from *Compilation of Air Pollutant Emission Factors (AP-42)*, Volume I. Stationary Point and Area Sources, Chapter 3 Stationary Internal Combustion Sources, Fifth Edition.

SECTION 6 Air Pollution Control Techniques (Cont.)

Gasoline, and most distillate oils, have no chemically-bound fuel N₂ and essentially all NO_x formed is thermal NO_x.

Essentially all NO_x formed in diesel fueled reciprocating engines occurs through the thermal NO_x mechanism. The rate of NO_x formation through the thermal NO_x mechanism is highly dependent upon the stoichiometric ratio, combustion temperature, and residence time at the combustion temperature. Maximum NO_x formation occurs through the thermal NO_x mechanism near the stoichiometric air-to-fuel mixture ratio since combustion temperatures are greatest at this air-to-fuel ratio.

6.2.2 Carbon Monoxide (CO) Emissions

Carbon monoxide is a colorless, odorless, relatively inert gas formed as an intermediate combustion product that appears in the exhaust when the reaction of CO to CO₂ cannot proceed to completion. This situation occurs if there is a lack of available oxygen near the hydrocarbon (fuel) molecule during combustion, if the gas temperature is too low, or if the residence time in the cylinder is too short. The oxidation rate of CO is limited by reaction kinetics and, as a consequence, can be accelerated only to a certain extent by improvements in air and fuel mixing during the combustion process.

Carbon monoxide is emitted from combustion processes due to incomplete fuel combustion. Incomplete combustion occurs when insufficient oxygen exists near the fuel molecule or when quenching of combustion occurs, thus preventing complete conversion of fuel carbon-to-carbon dioxide. Proper combustion design and operation ensure that CO emissions are minimized. The previous figure also illustrates the effect of fuel to air ratio on CO emissions. CO emissions are lowest under combustion conditions that are slightly lean of the stoichiometric ratio because sufficient oxygen is present for complete oxidation of the fuel carbon while temperature is at its greatest. Under fuel rich conditions, there is not sufficient oxygen for complete combustion. CO emissions increase slightly under the leanest combustion conditions because of lower combustion temperatures and lower fuel mixture flammability.

6.2.3 Sulfur Oxides (SO_x) Emissions

Sulfur oxide emissions are a function of only the sulfur content in the fuel rather than any combustion variables. In fact, during the combustion process, essentially all the sulfur in the fuel is oxidized to sulfur dioxide (SO₂). The oxidation of SO₂ yields sulfur trioxide (SO₃), which reacts with water to give sulfuric acid (H₂SO₄), a contributor to acid rain. Sulfuric acid also reacts with basic substances to give sulfates, which are fine particulates that contribute to PM-10 and visibility reduction.

6.2.4 Particulate Matter (PM/PM10) Emissions

White, blue, and black smoke may be emitted from IC engines. Liquid particulates appear as white smoke in the exhaust during an engine cold start, idling, or low load operation. These are formed in the quench layer adjacent to the cylinder walls, where the temperature

SECTION 6 Air Pollution Control Techniques (Cont.)

is not high enough to ignite the fuel. Blue smoke is emitted when lubricating oil leaks, often past worn piston rings, into the combustion chamber and is partially burned. Proper maintenance is the most effective method of preventing blue smoke emissions from all types of IC engines. The primary constituent of black smoke is agglomerated carbon particles (soot). Particulate matter is formed in internal combustion engines primarily through combustion of fuel oil and lubricating oil. The particulate matter emitted from IC engines will mainly be less than 10 microns in diameter (PM_{10}).

6.2.5 Volatile Organic Compound (VOC) Emissions

In diesel fueled IC engines, hydrocarbon emissions are present in exhaust gas because of incomplete combustion of fuel. Partially burned hydrocarbons can occur because of poor air and fuel homogeneity due to incomplete mixing, before or during combustion; incorrect air/fuel ratios in the cylinder during combustion due to maladjustment of the engine fuel system; excessively large fuel droplets (diesel engines); and low cylinder temperature due to excessive cooling (quenching) through the walls or early cooling of the gases by expansion of the combustion volume caused by piston motion before combustion is completed. Emissions of VOC are similar to CO emissions: higher at operating conditions richer and leaner than the stoichiometric ratio.

6.3 Emission Controls

EMD controls emissions by controlling combustion process. In the proposed standby generator installation, EMD uses efficient inlet air coolers (also referred to as an intercooler or aftercooler when used to cool compressed air charge from either a turbocharger or blower) to reduce the temperature of the intake air used in combustion to reduce the formation of thermal NO_x emissions.

The proposed additional generators include combustion control modifications to the standard 20-645F4B for the control of NO_x emissions, that include utilizing injectors with fixed timing, changing the fuel injection timing and using more efficient combustion air aftercoolers to increase the cooling of the air. The injectors to be used on this engine are called CBOI (constant beginning or injection) injectors by EMD. The standard injector used by EMD is designed so that as engine loads increase, the point at which fuel injection into the cylinder starts advances. The CBOI injector has fixed timing and there is no advance based on engine load. The standard injection timing on an EMD engine is 0 degrees before top dead center (BTDC). In order to achieve the proper operation with the CBOI injectors, the timing on these engines is set for 1 degree BTDC. The intercoolers cool the combustion air before it enters the air box and the cylinders. The standard EMD intercooler is a 2-pass type heat exchanger. In order to achieve additional cooling and assist in NO_x reduction, these engines have 4-pass intercooler. Additionally, the engine will also burn low sulfur (0.05 weight %) diesel fuel, this is representative of BACT for sulfur dioxide (SO₂). The combination of low-sulfur diesel fuel and combustion modifications is representative of BACT for particulate matter with a diameter less than 10 micrometers (PM_{10}). Use of these combustion control techniques will reduce the

SECTION 6 Air Pollution Control Techniques (Cont.)

emissions of NO_x in the engine exhaust by approximately 28 percent from uncontrolled levels.

6.4 Compliance Procedures

MDWASD proposes that the diesel-fueled standby generators be subject to an operating limit of 950,000 gallons per year and NO_x RACT emission limitation of 3.50 lb/million BTU. The initial testing of the proposed fifth and sixth generators will be conducted upon completion of installation, after notification of the FDEP, and submitted to the FDEP for the initial demonstration of compliance with the NO_x RACT emission limitation.

Subsequent NO_x emissions testing will be conducted of a unit whenever operated more than 400 hours annually, in accordance with Rule 62-296.570(4)(b)7. The engines are subject to the general visible emissions limitation of less than 20% opacity of Rule 62-296.320(4)(b), F.A.C. and to demonstrate compliance with the visibility limitation, testing will be conducted annually.

SECTION 7

Source Impact Analysis

A source impact analysis was not conducted for this project because it is not subject to the requirements of PSD.

SECTION 8

Conclusion

Based on the foregoing technical evaluation and other available information, the proposed project will comply with all applicable state and federal air pollution regulations. The FDEP should issue a draft permit to MDWASD for the installation of two additional EMD standby generators at the Alexander Orr, Jr. WTP.

This new engines will be subject to the requirements of the facility-wide specific conditions of Section II of the permit. The diesel-fueled engine-driven standby generator will be subject to an operating limit of 950,000 gallons of fuel per year and the NOx RACT emission limitation of 3.50 lb/million BTU.

This evaluation was prepared on December 14, 2004 with staff members of the Miami-Dade Water and Sewer Department by:

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Department of Environmental Protection

Division of Air Resource Management

APPLICATION FOR AIR PERMIT - LONG FORM

I. APPLICATION INFORMATION

Air Construction Permit – Use this form to apply for an air construction permit for a proposed project:

- subject to prevention of significant deterioration (PSD) review, nonattainment area (NAA) new source review, or maximum achievable control technology (MACT) review; or
- where the applicant proposes to assume a restriction on the potential emissions of one or more pollutants to escape a federal program requirement such as PSD review, NAA new source review, Title V, or MACT; or
- at an existing federally enforceable state air operation permit (FESOP) or Title V permitted facility.

Air Operation Permit – Use this form to apply for:

- an initial federally enforceable state air operation permit (FESOP); or
- an initial/revised/renewal Title V air operation permit.

Air Construction Permit & Revised/Renewal Title V Air Operation Permit (Concurrent Processing Option)

– Use this form to apply for both an air construction permit and a revised or renewal Title V air operation permit incorporating the proposed project.

To ensure accuracy, please see form instructions.

Identification of Facility

1. Facility Owner/Company Name: Miami-Dade Water and Sewer Department	
2. Site Name: Alexander Orr, Jr. Water Treatment Plant	
3. Facility Identification Number: 0250314	
4. Facility Location... Street Address or Other Locator: 6800 SW 87th Avenue City: Miami County: Miami Dade Zip Code: 33173	
5. Relocatable Facility? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	6. Existing Title V Permitted Facility? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Application Contact

1. Application Contact Name: Richard M. O'Rourke, P.E.	
2. Application Contact Mailing Address... Organization/Firm: Miami-Dade Water and Sewer Department Street Address: P.O. Box 330316 City: Miami State: FL Zip Code: 33233-0316	
3. Application Contact Telephone Numbers... Telephone: (305) 552 - 8123 ext. Fax: (786) 552 - 8640	
4. Application Contact Email Address: rorou01@miamidade.gov	

Application Processing Information (DEP Use)

1. Date of Receipt of Application:	12-27-04 (1-5-05 in tally)
2. Project Number(s):	0250314-009-AC
3. PSD Number (if applicable):	
4. Siting Number (if applicable):	

APPLICATION INFORMATION

Purpose of Application

This application for air permit is submitted to obtain: (Check one)

Air Construction Permit

Air construction permit.

Air Operation Permit

- Initial Title V air operation permit.
- Title V air operation permit revision.
- Title V air operation permit renewal.
- Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is required.
- Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is not required.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit (Concurrent Processing)

- Air construction permit and Title V permit revision, incorporating the proposed project.
- Air construction permit and Title V permit renewal, incorporating the proposed project.

Note: By checking one of the above two boxes, you, the applicant, are requesting concurrent processing pursuant to Rule 62-213.405, F.A.C. In such case, you must also check the following box:

- I hereby request that the department waive the processing time requirements of the air construction permit to accommodate the processing time frames of the Title V air operation permit.

Application Comment

The Alexander Orr, Jr. WTP is considered a major source of air pollution and is required to obtain a Title V Air Operating Permit (Chapter 62-213, FAC). The FDEP issued Final Operating Permit No. 0250314-001-AV on August 8, 2000.

Air Construction Permit 0250314-007-AC is currently open for the replacement of three existing pump engines and the pump room generator and the FDEP is currently processing Air Operating Permit Revision No. 0250314-008 for these units.

This permit application seeks to obtain a construction permit for the addition of two new standby generators to the existing bank of four similar units at the Alexander Orr, Jr. WTP. The additional generators are needed to ensure adequate electrical capacity to supply the plant during power failures and other circumstances including severe weather warnings and events of potential electric utility power losses or reductions as well as during periods of load-sharing with the local utility.

Additionally, this application proposes to lower the currently permitted cumulative fuel usage cap on the bank of standby generators and to lower the allowable NOx emissions rate based on past emissions test results from the units.

Finally, this application seeks to repermit the installation of Pump Engine # 5 as originally permitted under Air Construction Permit 0250314-005-AC and Air Construction Permit 0250314-007-AC.

APPLICATION INFORMATION

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
009	Diesel Engine Generator # 1, EMD model No. 20-645F4B	AC1D	\$ 0.00
010	Diesel Engine Generator # 2, EMD model No. 20-645F4B	AC1D	\$ 0.00
011	Diesel Engine Generator # 3, EMD model No. 20-645F4B	AC1D	\$ 0.00
012	Diesel Engine Generator # 4, EMD model No. 20-645F4B	AC1D	\$ 0.00
024 (proposed)	Diesel Engine Generator # 5, EMD model No. 20-645F4B	AC1D	\$ 0.00
025 (proposed)	Diesel Engine Generator # 6, EMD model No. 20-645F4B	AC1D	\$ 0.00
020	2090 brake hp natural gas fired Caterpillar Model G3608 LE engine driving Pump # 5	AC1D	\$ 0.00

Application Processing Fee

Check one: Attached - Amount: \$ _____ Not Applicable

APPLICATION INFORMATION

Owner/Authorized Representative Statement

Complete if applying for an air construction permit or an initial FESOP.

1. Owner/Authorized Representative Name : Jorge S. Rodriguez, P.E.
2. Owner/Authorized Representative Mailing Address... Organization/Firm: Miami-Dade Water and Sewer Department Street Address: P.O. Box 330316 City: Miami State: FL Zip Code: 33233
3. Owner/Authorized Representative Telephone Numbers... Telephone: (786) 552 - 8112 Fax: (786) 552 - 8626
4. Owner/Authorized Representative Email Address: <u>rsj@miamidade.gov</u>
5. Owner/Authorized Representative Statement: <i>I, the undersigned, am the owner or authorized representative of the facility addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other requirements identified in this application to which the facility is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit.</i>  Signature _____ Date <u>12/21/04</u>

APPLICATION INFORMATION

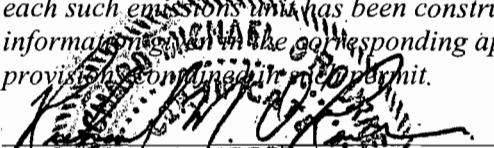
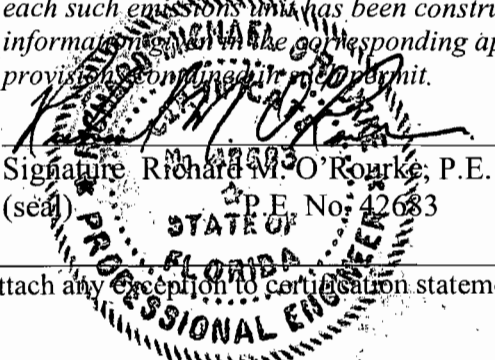
Application Responsible Official Certification

Complete if applying for an initial/revised/renewal Title V permit or concurrent processing of an air construction permit and a revised/renewal Title V permit. If there are multiple responsible officials, the "application responsible official" need not be the "primary responsible official."

1. Application Responsible Official Name:
2. Application Responsible Official Qualification (Check one or more of the following options, as applicable): <input type="checkbox"/> For a corporation, the president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one or more manufacturing, production, or operating facilities applying for or subject to a permit under Chapter 62-213, F.A.C. <input type="checkbox"/> For a partnership or sole proprietorship, a general partner or the proprietor, respectively. <input type="checkbox"/> For a municipality, county, state, federal, or other public agency, either a principal executive officer or ranking elected official. <input type="checkbox"/> The designated representative at an Acid Rain source.
3. Application Responsible Official Mailing Address... Organization/Firm: Street Address: City: State: Zip Code:
4. Application Responsible Official Telephone Numbers... Telephone: () - ext. Fax: () -
5. Application Responsible Official Email Address:
6. Application Responsible Official Certification: <p>I, the undersigned, am a responsible official of the Title V source addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other applicable requirements identified in this application to which the Title V source is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit. Finally, I certify that the facility and each emissions unit are in compliance with all applicable requirements to which they are subject, except as identified in compliance plan(s) submitted with this application.</p> <p>_____ Signature</p> <p>_____ Date</p>

APPLICATION INFORMATION

Professional Engineer Certification

1. Professional Engineer Name: Richard M. O'Rourke, P.E. Registration Number: 42683
2. Professional Engineer Mailing Address... Organization/Firm: Miami-Dade Water and Sewer Department Street Address: P.O. Box 330316 City: Miami State: FL Zip Code: 33233-0316
3. Professional Engineer Telephone Numbers... Telephone: (786) 552 - 8123 ext. Fax: (786) 552 - 8640
4. Professional Engineer Email Address: rorou01@miamidade.gov
5. Professional Engineer Statement: <i>I, the undersigned, hereby certify, except as particularly noted herein*, that:</i> <i>(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this application for air permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and</i> <i>(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.</i> <i>(3) If the purpose of this application is to obtain a Title V air operation permit (check here <input type="checkbox"/> , if so), I further certify that each emissions unit described in this application for air permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance plan and schedule is submitted with this application.</i> <i>(4) If the purpose of this application is to obtain an air construction permit (check here <input checked="" type="checkbox"/> , if so) or concurrently process and obtain an air construction permit and a Title V air operation permit revision or renewal for one or more proposed new or modified emissions units (check here <input type="checkbox"/> , if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.</i> <i>(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here <input type="checkbox"/> , if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information submitted in the corresponding application for air construction permit and with all provisions contained in the permit.</i> Signature:  Richard M. O'Rourke, P.E. (seal) P.E. No: 42683  Date: 21 DEC 2004

* Attach any exception to certification statement.

II. FACILITY INFORMATION

A. GENERAL FACILITY INFORMATION

Facility Location and Type

1. Facility UTM Coordinates... Zone 17 East (km) 565.9 North (km) 2843.3		2. Facility Latitude/Longitude... Latitude (DD/MM/SS) 25 / 42 / 28.0 Longitude (DD/MM/SS) 80 / 20 / 11.0	
3. Governmental Facility Code: 3	4. Facility Status Code: A	5. Facility Major Group SIC Code: 49	6. Facility SIC(s): 4941
7. Facility Comment : Facility treats up to 241.7 million gallons per day and up to 74,136 million gallons annually of raw water using lime softening, filtration, recarbonation, and disinfection for public water supply. A bank of generators provides standby electrical power for continuous plant operations. Engine driven pump sets are used to maintain pressure & convey water. A rotary kiln recovers the water softening process solids for conversion back in to quick lime for process reuse on site. Emergency generators at the pump room and kiln and an emergency kiln rotation engine provide redundancy to the standby generators for critical functions.			

Facility Contact

1. Facility Contact Name: Tom Segars, Superintendent of Water Production
2. Facility Contact Mailing Address... Organization/Firm: Miami-Dade Water & Sewer Department Street Address: 700 W. Second Ave. City: Hialeah State: FL Zip Code: 33010
3. Facility Contact Telephone Numbers: Telephone: (305) 888 - 2522 ext. Fax: (305) 889 - 0156
4. Facility Contact Email Address: asega@miamidade.gov

Facility Primary Responsible Official

Complete if an "application responsible official" is identified in Section I. that is not the facility "primary responsible official."

1. Facility Primary Responsible Official Name:
2. Facility Primary Responsible Official Mailing Address... Organization/Firm: Street Address: City: State: Zip Code:
3. Facility Primary Responsible Official Telephone Numbers... Telephone: Fax:
4. Facility Primary Responsible Official Email Address:

FACILITY INFORMATION

Facility Regulatory Classifications

Check all that would apply following completion of all projects and implementation of all other changes proposed in this application for air permit. Refer to instructions to distinguish between a “major source” and a “synthetic minor source.”

1. <input type="checkbox"/> Small Business Stationary Source	<input type="checkbox"/> Unknown
2. <input type="checkbox"/> Synthetic Non - Title V Source	
3. <input checked="" type="checkbox"/> Title V Source	
4. <input checked="" type="checkbox"/> Major Source of Air Pollutants, Other than Hazardous Air Pollutants (HAPs)	
5. <input type="checkbox"/> Synthetic Minor Source of Air Pollutants, Other than HAPs	
6. <input type="checkbox"/> Major Source of Hazardous Air Pollutants (HAPs)	
7. <input type="checkbox"/> Synthetic Minor Source of HAPs	
8. <input type="checkbox"/> One or More Emissions Units Subject to NSPS (40 CFR Part 60)	
9. <input type="checkbox"/> One or More Emissions Units Subject to Emission Guidelines (40 CFR Part 60)	
10. <input type="checkbox"/> One or More Emissions Units Subject to NESHAP (40 CFR Part 61 or Part 63)	
11. <input type="checkbox"/> Title V Source Solely by EPA Designation (40 CFR 70.3(a)(5))	
12. Facility Regulatory Classifications Comment:	
<p>This facility is classified as a Major or Title V Source of air pollution because emissions of at least one regulated air pollutant; such as nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO₂), particulate matter (PM/PM₁₀), or volatile organic compounds (VOC); exceeds 100 tons per year (TPY).</p> <p>This facility is not within an industry included in the list of the 28 Major Facility Categories per Table 62-212.400-1, F.A.C. However, because overall facility emissions are greater than 250 TPY for at least one criteria pollutant, it is a Major Facility with respect to Rule 62-212.400, Prevention of Significant Deterioration (PSD).</p> <p>This project is exempt from the requirements of Rule 62-212.400, F.A.C., Prevention of Significant Deterioration (PSD) as discussed in the attached report. The additional emission units included in this project are proposed to be subject to a specific emission limiting standard for purposes of Title V permitting as described in this application and within the attached report.</p>	

FACILITY INFORMATION

List of Pollutants Emitted by Facility

1. Pollutant Emitted	2. Pollutant Classification	3. Emissions Cap [Y or N]?
NOX Nitrogen Oxides	A	Y
CO Carbon Monoxide	B	N
SO2 Sulfur Dioxide	B	N
PM Particulate Matter	B	N
VOC Volatile Organic Compounds	B	N

FACILITY INFORMATION

B. EMISSIONS CAPS

Facility-Wide or Multi-Unit Emissions Caps

1. Pollutant Subject to Emissions Cap	2. Facility Wide Cap [Y or N]? (all units)	3. Emissions Unit ID Nos. Under Cap (if not all units)	4. Hourly Cap (lb/hr)	5. Annual Cap (ton/yr)	6. Basis for Emissions Cap
NOX	N	009, 010, 011, 012 and two new (EU 024 and 025 proposed)		229.4	ESCPSD

7. Facility-Wide or Multi-Unit Emissions Cap Comment:

Currently, the existing units Nos. 009, 010, 011 and 012 have a maximum allowable rate NOx emission of 4.12 lb/MMBtu each, and 403 tons per 12-consecutive month period by the conditions of the PSD-FL-249; there are no limits on the hours of operation, but the maximum fuel consumption allowed to be burned is 1,415,000 gals/year. Based on an analysis of past emissions test results, the facility requests to change the maximum allowable NOx emission rate for the existing units 009, 010, 011 and 012 to 3.50 lbs/MMBtu and to also apply that rate to the proposed units. In order to meet the requested 229.4 TPY limit for this group of emission units, MDWASD requests that the annual fuel consumption limit be reduced from 1,415,000 to 950,000 gallons.

FACILITY INFORMATION

C. FACILITY ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Facility Plot Plan: (Required for all permit applications, <u>except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought</u>) <input checked="" type="checkbox"/> Attached, Document ID: <u> A </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Process Flow Diagram(s): (Required for all permit applications, <u>except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought</u>) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Precautions to Prevent Emissions of Unconfined Particulate Matter: (Required for all permit applications, <u>except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought</u>) <input checked="" type="checkbox"/> Attached, Document ID: <u> C </u> <input type="checkbox"/> Previously Submitted, Date _____

Additional Requirements for Air Construction Permit Applications

1. Area Map Showing Facility Location: <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable (existing permitted facility)
2. Description of Proposed Construction or Modification: <input checked="" type="checkbox"/> Attached, Document ID: <u> Report </u>
3. Rule Applicability Analysis: <input checked="" type="checkbox"/> Attached, Document ID: <u> Report </u>
4. List of Exempt Emissions Units (Rule 62-210.300(3)(a) or (b)1., F.A.C.): <input checked="" type="checkbox"/> Attached, Document ID: <u> D </u> <input type="checkbox"/> Not Applicable (no exempt units at facility)
5. Fugitive Emissions Identification (Rule 62-212.400(2), F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
6. Preconstruction Air Quality Monitoring and Analysis (Rule 62-212.400(5)(f), F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
7. Ambient Impact Analysis (Rule 62-212.400(5)(d), F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
8. Air Quality Impact since 1977 (Rule 62-212.400(5)(h)5., F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
9. Additional Impact Analyses (Rules 62-212.400(5)(e)1. and 62-212.500(4)(e), F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
10. Alternative Analysis Requirement (Rule 62-212.500(4)(g), F.A.C.): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

FACILITY INFORMATION

Additional Requirements for FESOP Applications

1. List of Exempt Emissions Units (Rule 62-210.300(3)(a) or (b)1., F.A.C.):
 Attached, Document ID: _____ Not Applicable (no exempt units at facility)

Additional Requirements for Title V Air Operation Permit Applications

1. List of Insignificant Activities (Required for initial/renewal applications only):
 Attached, Document ID: _____ Not Applicable (revision application)

2. Identification of Applicable Requirements (Required for initial/renewal applications, and for revision applications if this information would be changed as a result of the revision being sought):
 Attached, Document ID: _____
 Not Applicable (revision application with no change in applicable requirements)

3. Compliance Report and Plan (Required for all initial/revision/renewal applications):
 Attached, Document ID: _____
Note: A compliance plan must be submitted for each emissions unit that is not in compliance with all applicable requirements at the time of application and/or at any time during application processing. The department must be notified of any changes in compliance status during application processing.

4. List of Equipment/Activities Regulated under Title VI (If applicable, required for initial/renewal applications only):
 Attached, Document ID: _____
 Equipment/Activities On site but Not Required to be Individually Listed
 Not Applicable

5. Verification of Risk Management Plan Submission to EPA (If applicable, required for initial/renewal applications only) :
 Attached, Document ID: _____ Not Applicable

6. Requested Changes to Current Title V Air Operation Permit:
 Attached, Document ID: _____ Not Applicable

Additional Requirements Comment

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EMISSIONS UNIT INFORMATION

Section [1] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [1] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:

One (1) standby generator set of an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 009

4. Emissions Unit Status Code: A	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:

Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

EMISSIONS UNIT INFORMATION

Section [1] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [1] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:
2. Maximum Production Rate:
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)
4. Maximum Incineration Rate: pounds/hr tons/day
5. Requested Maximum Operating Schedule: hours/day weeks/year days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).

EMISSIONS UNIT INFORMATION

Section [1] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [1] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____
4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable
5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable
6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date: : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.
7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [1] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [1] of [7]

Additional Requirements Comment

EMISSIONS UNIT INFORMATION

Section [2] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [2] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)
- The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.
- The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)
- This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).
- This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.
- This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:
One (1) standby generator set of an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 010

4. Emissions Unit Status Code: A	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:
Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

EMISSIONS UNIT INFORMATION

Section [2] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [2] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:	
2. Maximum Production Rate:	
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)	
4. Maximum Incineration Rate: pounds/hr tons/day	
6. Requested Maximum Operating Schedule:	
hours/day weeks/year	days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).	

EMISSIONS UNIT INFORMATION

Section [2] of [7]

C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)**Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1			
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a horizontal stack located on top of the enclosure structure.					
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:					
5. Discharge Type Code: H		6. Stack Height: 18 feet		7. Exit Diameter: 1.75 feet	
8. Exit Temperature: 735 °F		9. Actual Volumetric Flow Rate: 23000 acfm		10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm			12. Nonstack Emission Point Height: 18 feet		
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3			14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)		
15. Emission Point Comment:					

EMISSIONS UNIT INFORMATION

Section [2] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION

Segment Description and Rate: Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

EMISSIONS UNIT INFORMATION

Section [2] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			EL
CO			NS
SOX			NS
PM10			NS
VOC			NS

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control:
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
7. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: (7.08 lb/gal)(0.05 %S)(2 lb SO ₂ /lb S) = 0.00708 lb SO ₂ /gal = 7.08 lb SO ₂ /1000 gal (950,000 gals/yr)* (6.9 lbs/1000 gals) (1 ton/ 2000 lb) = 3.36 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
8. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [2] of [7]

POLLUTANT DETAIL INFORMATION

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Annual Verification using EPA Method 9 VE testing	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

EMISSIONS UNIT INFORMATION

Section [2] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [2] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____
4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable
5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable
6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date: : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.
7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [2] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [2] of [7]

Additional Requirements Comment

[Empty rectangular box for comment]

EMISSIONS UNIT INFORMATION

Section [3] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [3] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:
One (1) standby generator set of an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 011

4. Emissions Unit Status Code: A	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:
Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

EMISSIONS UNIT INFORMATION

Section [3] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [3] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:
2. Maximum Production Rate:
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)
4. Maximum Incineration Rate: pounds/hr tons/day
7. Requested Maximum Operating Schedule: hours/day weeks/year days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).

EMISSIONS UNIT INFORMATION

Section [3] of [7]

**C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)****Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1			
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a horizontal stack located on top of the enclosure structure.					
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:					
5. Discharge Type Code: H		6. Stack Height: 18 feet		7. Exit Diameter: 1.75 feet	
8. Exit Temperature: 735 °F		9. Actual Volumetric Flow Rate: 23000 acfm		10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm			12. Nonstack Emission Point Height: 18 feet		
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3			14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)		
15. Emission Point Comment:					

EMISSIONS UNIT INFORMATION

Section [3] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION**Segment Description and Rate:** Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

EMISSIONS UNIT INFORMATION

Section [3] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			EL
CO			NS
SOX			NS
PM10			NS
VOC			NS

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control:
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
9. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: (7.08 lb/gal)(0.05 %S)(2 lb SO ₂ /lb S) = 0.00708 lb SO ₂ /gal = 7.08 lb SO ₂ /1000 gal (950,000 gals/yr)* (6.9 lbs/1000 gals) (1 ton/ 2000 lb) = 3.36 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
10. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

POLLUTANT DETAIL INFORMATION

Section [3] of [7]

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Annual Verification using EPA Method 9 VE testing	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

EMISSIONS UNIT INFORMATION

Section [3] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [3] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____
4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable
5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable
6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date: : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.
7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [3] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [3] of [7]

Additional Requirements Comment

EMISSIONS UNIT INFORMATION

Section [4] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [4] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:

One (1) standby generator set of an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 012

4. Emissions Unit Status Code: A	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:

Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

EMISSIONS UNIT INFORMATION

Section [4] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [4] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:
2. Maximum Production Rate:
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)
4. Maximum Incineration Rate: pounds/hr tons/day
8. Requested Maximum Operating Schedule: hours/day weeks/year days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).

EMISSIONS UNIT INFORMATION

Section [4] of [7]

**C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)****Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a horizontal stack located on top of the enclosure structure.			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:			
5. Discharge Type Code: H	6. Stack Height: 18 feet		7. Exit Diameter: 1.75 feet
8. Exit Temperature: 735 °F	9. Actual Volumetric Flow Rate: 23000 acfm		10. Water Vapor: %
11. Maximum Dry Standard Flow Rate: dscfm		12. Nonstack Emission Point Height: 18 feet	
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3		14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:			

EMISSIONS UNIT INFORMATION

Section [4] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION

Segment Description and Rate: Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control: .
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
11. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: (7.08 lb/gal)(0.05 %S)(2 lb SO ₂ /lb S) = 0.00708 lb SO ₂ /gal = 7.08 lb SO ₂ /1000 gal (950,000 gals/yr)* (6.9 lbs/1000 gals) (1 ton/ 2000 lb) = 3.36 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

EMISSIONS UNIT INFORMATION

Section [1] of [7]

**C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)****Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a horizontal stack located on top of the enclosure structure.			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:			
5. Discharge Type Code: H	6. Stack Height: 18 feet	7. Exit Diameter: 1.75 feet	
8. Exit Temperature: 735 °F	9. Actual Volumetric Flow Rate: 23000 acfm	10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm		12. Nonstack Emission Point Height: 18 feet	
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3		14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:			

EMISSIONS UNIT INFORMATION

Section [1] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION**Segment Description and Rate:** Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

EMISSIONS UNIT INFORMATION

Section [1] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			EL
CO			NS
SOX			NS
PM10			NS
VOC			NS

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control:
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
5. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: (7.08 lb/gal)(0.05 %S)(2 lb SO ₂ /lb S) = 0.00708 lb SO ₂ /gal = 7.08 lb SO ₂ /1000 gal (950,000 gals/yr)* (6.9 lbs/1000 gals) (1 ton/ 2000 lb) = 3.36 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [1] of [7]

POLLUTANT DETAIL INFORMATION

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Annual Verification using EPA Method 9 VE testing	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
12. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [4] of [7]

POLLUTANT DETAIL INFORMATION

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Annual Verification using EPA Method 9 VE testing	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

EMISSIONS UNIT INFORMATION

Section [4] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [4] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

<p>1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable</p>
<p>5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable</p>
<p>6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.</p>
<p>7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable</p>

EMISSIONS UNIT INFORMATION

Section [4] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [4] of [7]

Additional Requirements Comment

EMISSIONS UNIT INFORMATION

Section [5] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [5] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:

One (1) additional standby generator set added to an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 024 (proposed)

4. Emissions Unit Status Code: A	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:

Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

The installation of proposed generator # 5 will begin soon after issuance of the requested air construction permit and MDWASD expects to complete installation and initial compliance testing in two years.

EMISSIONS UNIT INFORMATION

Section [5] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [5] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:	
2. Maximum Production Rate:	
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)	
4. Maximum Incineration Rate: pounds/hr tons/day	
9. Requested Maximum Operating Schedule:	
hours/day weeks/year	days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).	

EMISSIONS UNIT INFORMATION

Section [5] of [7]

C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)

Emission Point Description and Type

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a vertical stack located on top of the enclosure structure.			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:			
5. Discharge Type Code: V	6. Stack Height: 21 feet	7. Exit Diameter: 1.75 feet	
8. Exit Temperature: 635 °F	9. Actual Volumetric Flow Rate: 22350 acfm	10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm		12. Nonstack Emission Point Height: 18 feet	
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3		14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:			

EMISSIONS UNIT INFORMATION

Section [5] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION**Segment Description and Rate:** Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

EMISSIONS UNIT INFORMATION

Section [5] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			EL
CO			NS
SOX			NS
PM10			NS
VOC			NS

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control:
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
13. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: (7.08 lb/gal)(0.05 %S)(2 lb SO ₂ /lb S) = 0.00708 lb SO ₂ /gal = 7.08 lb SO ₂ /1000 gal (950,000 gals/yr)* (6.9 lbs/1000 gals) (1 ton/ 2000 lb) = 3.36 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
14. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [5] of [7]

POLLUTANT DETAIL INFORMATION

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Perform Initial VE Compliance monitoring using EPA Method 9	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

EMISSIONS UNIT INFORMATION

Section [5] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [5] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

<p>1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)</p> <p><input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)</p> <p><input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)</p> <p><input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____</p>
<p>4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)</p> <p><input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____</p> <p><input checked="" type="checkbox"/> Not Applicable</p>
<p>5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)</p> <p><input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____</p> <p><input type="checkbox"/> Not Applicable</p>
<p>6. Compliance Demonstration Reports/Records</p> <p><input type="checkbox"/> Attached, Document ID: _____</p> <p> Test Date(s)/Pollutant(s) Tested: _____</p> <p><input type="checkbox"/> Previously Submitted, Date: : _____</p> <p> Test Date(s)/Pollutant(s) Tested: _____</p> <p><input type="checkbox"/> To be Submitted, Date (if known): _____</p> <p> Test Date(s)/Pollutant(s) Tested: _____</p> <p><input checked="" type="checkbox"/> Not Applicable</p> <p>Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.</p>
<p>7. Other Information Required by Rule or Statute</p> <p><input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable</p>

EMISSIONS UNIT INFORMATION

Section [5] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [5] of [7]

Additional Requirements Comment

EMISSIONS UNIT INFORMATION

Section [6] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [6] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:

One (1) additional standby generator set added to an existing bank of four (4), model 20E4B as below.

3. Emissions Unit Identification Number: 025 (proposed)

4. Emissions Unit Status Code: C	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:

Manufacturer: Electro-Motive Division (EMD) of General Motors
Model Number: 20-645F4B

10. Generator Nameplate Rating: 2.865 MW

11. Emissions Unit Comment:

This emission unit consists of a 4,000 Bhp diesel fueled internal combustion prime mover coupled to a 2,865 KW generator.

Proposed generator # 6 and the required switchgear expansion is in the initial planning stage and construction is anticipated to begin within four years of the issuance date of this requested

EMISSIONS UNIT INFORMATION

Section [6] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

None

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [6] of [7]

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate:	
2. Maximum Production Rate:	
3. Maximum Heat Input Rate: 131,100 mmBtu/yr (combined)	
4. Maximum Incineration Rate: pounds/hr tons/day	
10. Requested Maximum Operating Schedule:	
hours/day weeks/year	days/week hours/year
6. Operating Capacity/Schedule Comment: The maximum heat input rate is for all standby generators combined (existing and proposed) and is based on: (950,000 Gal) * (138 MMBtu/1000 gal) = 131,100 MMBtu/yr. The operation of all standby generators will be limited by a fuel consumption limitation of 950,000 gallons for all standby generators combined, i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).	

EMISSIONS UNIT INFORMATION

Section [6] of [7]

**C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)****Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram: EMDs		2. Emission Point Type Code: 1	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: Generator with a vertical stack located on top of the enclosure structure.			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:			
5. Discharge Type Code: V	6. Stack Height: 21 feet	7. Exit Diameter: 2.75 feet	
8. Exit Temperature: 635 °F	9. Actual Volumetric Flow Rate: 22350 acfm	10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm		12. Nonstack Emission Point Height: 18 feet	
13. Emission Point UTM Coordinates... Zone: 17 East (km): 565.9 North (km): 2,843.3		14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:			

EMISSIONS UNIT INFORMATION

Section [6] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION

Segment Description and Rate: Segment 1 of 1

1. Segment Description (Process/Fuel Type): Diesel fueled internal combustion engines (emissions related to thousand gallons burned).		
2. Source Classification Code (SCC): 2-02-004-01		3. SCC Units: Thousand gallons burned (all liquid fuels).
4. Maximum Hourly Rate:	5. Maximum Annual Rate: 950 (combined)	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: 0.05	8. Maximum % Ash:	9. Million Btu per SCC Unit: 138
10. Segment Comment: The maximum annual rate of 950,000 gallons/year is for all standby generators combined i.e. EU 009, 010, 011, 012 and two new (EU 024 and 025 proposed).		

EMISSIONS UNIT INFORMATION

Section [6] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			EL
CO			NS
SOX			NS
PM10			NS
VOC			NS

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NOX Nitrogen Oxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: lb/hr 229.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 3.50 lbs/MMBtu Reference: Requested by Applicant (based on testing)	7. Emissions Method Code: 1
8. Calculation of Emissions: (950,000 gals/yr) * (138 MMBtu/1000 gals) * (3.50 lbs NOx/MMBTU) * (1 ton/ 2000 lb) = 229.4 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all EMD standby generators. Fuel usage by the standby generators is historically well below that and is expected to decrease further once the new pump engines are on-line. At 100% engine load, each model 20-645F4B engine has a fuel consumption of approximately 197.1 gallons per hour.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: CO	2. Total Percent Efficiency of Control:
3. Potential Emissions: 52.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 116 lbs/1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (116 lbs CO/1000 gals) * (1 ton/ 2000 lb) = 52.7 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO ₂ Sulfur Dioxides	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.4 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
15. Emission Factor: 7.08 lbs / 1000 gal Reference: Fuel Specification	7. Emissions Method Code: 2
8. Calculation of Emissions: $(7.08 \text{ lb/gal})(0.05 \%S)(2 \text{ lb SO}_2/\text{lb S}) = 0.00708 \text{ lb SO}_2/\text{gal} = 7.08 \text{ lb SO}_2/1000 \text{ gal}$ $(950,000 \text{ gals/yr}) * (6.9 \text{ lbs}/1000 \text{ gals}) (1 \text{ ton}/2000 \text{ lb}) = 3.36 \text{ TPY}$	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: PM 10 Particulate Matter 10	2. Total Percent Efficiency of Control:
3. Potential Emissions: 3.7 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
16. Emission Factor: 7.85 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (7.85 lbs/1000 gals) * (1 ton/ 2000 lb) = 3.73 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION –
 POTENTIAL/ESTIMATED FUGITIVE EMISSIONS**

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: VOC Volatile Organic Compounds	2. Total Percent Efficiency of Control:
3. Potential Emissions: 6.5 tons/year	4. Synthetically Limited? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5. Range of Estimated Fugitive Emissions (as applicable): Not Applicable to tons/year	
6. Emission Factor: 13.7 lbs / 1000 gals Reference: SCC 20200401 EPA FIRE VER 6.24	7. Emissions Method Code: 3
8. Calculation of Emissions: (950,000 gals/yr) * (13.7 lbs/1000 gals) * (1 ton/ 2000 lb) = 6.51 TPY	
9. Pollutant Potential/Estimated Fugitive Emissions Comment: Potential emission in tons per year is based on annual fuel consumption limitation of 950,000 gallons for all standby generators.	

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: ESCPSD	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: 3.50 lbs NO _x / MMBTU	4. Equivalent Allowable Emissions:
5. Method of Compliance: Annual emission testing for NO _x using EPA Method 7 or 7E of the exhaust gas via rack probe placed into engine exhaust (stack) outlet.	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [6] of [7]

POLLUTANT DETAIL INFORMATION

[1] of [1]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: 2 min/hour	
4. Method of Compliance: Perform Initial VE Compliance monitoring using EPA Method 9	
5. Visible Emissions Comment: Exceptional conditions during deadline (emergency) start and initial loading until units reach normal operating conditions and temperatures.	

EMISSIONS UNIT INFORMATION

Section [6] of [7]

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number:	Serial Number:
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [6] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____
4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable
5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable
6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date: : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.
7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [6] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [6] of [7]

Additional Requirements Comment

[Empty rectangular box for comment]

EMISSIONS UNIT INFORMATION

Section [7] of [7]

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application - Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [7] of [7]

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section:
Pump Engine No. 5 (Natural Gas)

3. Emissions Unit Identification Number: 020

4. Emissions Unit Status Code: C	5. Commence Construction Date:	6. Initial Startup Date:	7. Emissions Unit Major Group SIC Code: 49	8. Acid Rain Unit? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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9. Package Unit:
Manufacturer: Caterpillar
Model Number: G3808 LE-130

10. Generator Nameplate Rating: MW

11. Emissions Unit Comment:
Pump engine no. 5 (EU 005), which began service in August 1951, will be replaced by this new unit. This replacement, along with pump engines nos. 3 and 4, was permitted under 0250314-005-AC and 0250314-007-AC. As of December 2004 final installation is ongoing on nos. 3 and 4 with initial compliance testing not yet scheduled.. As the existing no. 5 unit provides vital backup pumping capacity it cannot be replaced until the others are fully operational necessitating this repermitting.

EMISSIONS UNIT INFORMATION

Section [7] of [7]

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:

2. Control Device or Method Code(s):

EMISSIONS UNIT INFORMATION

Section [7] of [7]

**C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)****Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram:		2. Emission Point Type Code:	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking:			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:			
5. Discharge Type Code:	6. Stack Height: feet		7. Exit Diameter: feet
8. Exit Temperature: °F	9. Actual Volumetric Flow Rate: acfm	10. Water Vapor: %	
11. Maximum Dry Standard Flow Rate: dscfm		12. Nonstack Emission Point Height: feet	
13. Emission Point UTM Coordinates... Zone: East (km): North (km):		14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:			

EMISSIONS UNIT INFORMATION

Section [7] of [7]

D. SEGMENT (PROCESS/FUEL) INFORMATION**Segment Description and Rate:** Segment 1 of 1

1. Segment Description (Process/Fuel Type): Natural gas powered internal combustion engine (emissions related to thousand cubic feet burned). Maximum hourly rate is based on brake specific fuel consumption of 6885 BTU/bhp-hr at 2040 bhp and annual fuel rate is based on 6933 BTU/bhp-hr at 1920 bhp at 1050 MMBtu/MMscf.		
2. Source Classification Code (SCC): 1-02-006-02	3. SCC Units: Million Cubic Feet Burned (all gaseous fuels)	
4. Maximum Hourly Rate: 0.0134	5. Maximum Annual Rate: 111.05	6. Estimated Annual Activity Factor: 1.00
7. Maximum % Sulfur: 0.00	8. Maximum % Ash: 0.00	9. Million Btu per SCC Unit: 1050
10. Segment Comment: Maximum hourly rate of the engine is 0.0134 MMscf/hr. The Maximum annual rate is based the nominal capacity of 0.0127 MMscf/hr and 8760 hrs/yr or 111.05 MMscf/yr.		

EMISSIONS UNIT INFORMATION

Section [7] of [7]

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX			NS
CO			NS
PM			NS

**F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION -
 ALLOWABLE EMISSIONS**

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions __ of __

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions __ of __

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions __ of __

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

EMISSIONS UNIT INFORMATION

Section [7] of [7]

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation 1 of 1

1. Visible Emissions Subtype: VE 20	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Allowable Opacity: Normal Conditions: 20 % Exceptional Conditions: 40 % Maximum Period of Excess Opacity Allowed: min/hour	
4. Method of Compliance: Perform Initial VE Compliance monitoring using EPA Method 9.	
5. Visible Emissions Comment:	

EMISSIONS UNIT INFORMATION

Section [7] of [7]

H. CONTINUOUS MONITOR INFORMATION**Complete if this emissions unit is or would be subject to continuous monitoring.****Continuous Monitoring System:** Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	<input type="checkbox"/> Rule <input type="checkbox"/> Other
4. Monitor Information... Manufacturer: Model Number:	Serial Number:
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment: Not Applicable	

EMISSIONS UNIT INFORMATION

Section [7] of [7]

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> B </u> <input type="checkbox"/> Previously Submitted, Date _____
2. Fuel Analysis or Specification (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> E </u> <input type="checkbox"/> Previously Submitted, Date _____
3. Detailed Description of Control Equipment (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: <u> N/A </u> <input type="checkbox"/> Previously Submitted, Date _____
4. Procedures for Startup and Shutdown (Required for all operation permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date _____ <input checked="" type="checkbox"/> Not Applicable
5. Operation and Maintenance Plan (Required for all permit applications, <u>except Title V air operation permit revision applications</u> if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) <input checked="" type="checkbox"/> Attached, Document ID: <u> F </u> <input type="checkbox"/> Previously Submitted, Date _____ <input type="checkbox"/> Not Applicable
6. Compliance Demonstration Reports/Records <input type="checkbox"/> Attached, Document ID: _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> Previously Submitted, Date: : _____ Test Date(s)/Pollutant(s) Tested: _____ <input type="checkbox"/> To be Submitted, Date (if known): _____ Test Date(s)/Pollutant(s) Tested: _____ <input checked="" type="checkbox"/> Not Applicable Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.
7. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

Section [7] of [7]

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(6) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(5)(h)6., F.A.C., and Rule 62-212.500(4)(f), F.A.C.) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

Additional Requirements for Title V Air Operation Permit Applications

1. Identification of Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____
2. Compliance Assurance Monitoring <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
3. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
4. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Not Applicable
5. Acid Rain Part Application <input type="checkbox"/> Certificate of Representation (EPA Form No. 7610-1) <input type="checkbox"/> Copy Attached, Document ID: _____ <input type="checkbox"/> Acid Rain Part (Form No. 62-210.900(1)(a)) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously Submitted, Date: _____ <input type="checkbox"/> Not Applicable

EMISSIONS UNIT INFORMATION

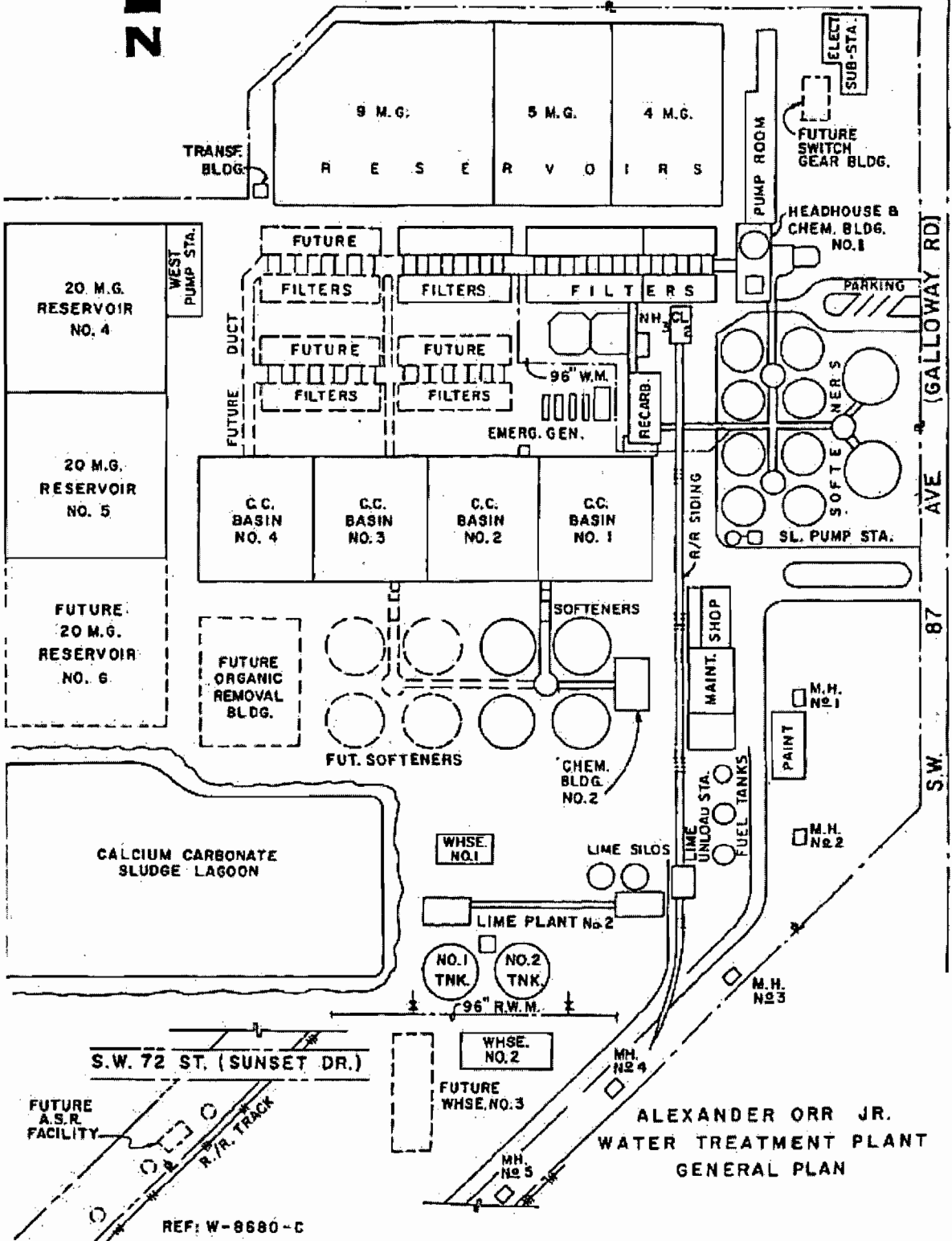
Section [7] of [7]

Additional Requirements Comment

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Attachment A
Facility Plot Plan

Attachment A: Facility Plot Plan— Alexander Orr, Jr. Water Treatment Plant
 S.W. 64th ST. (HARDEE DR)

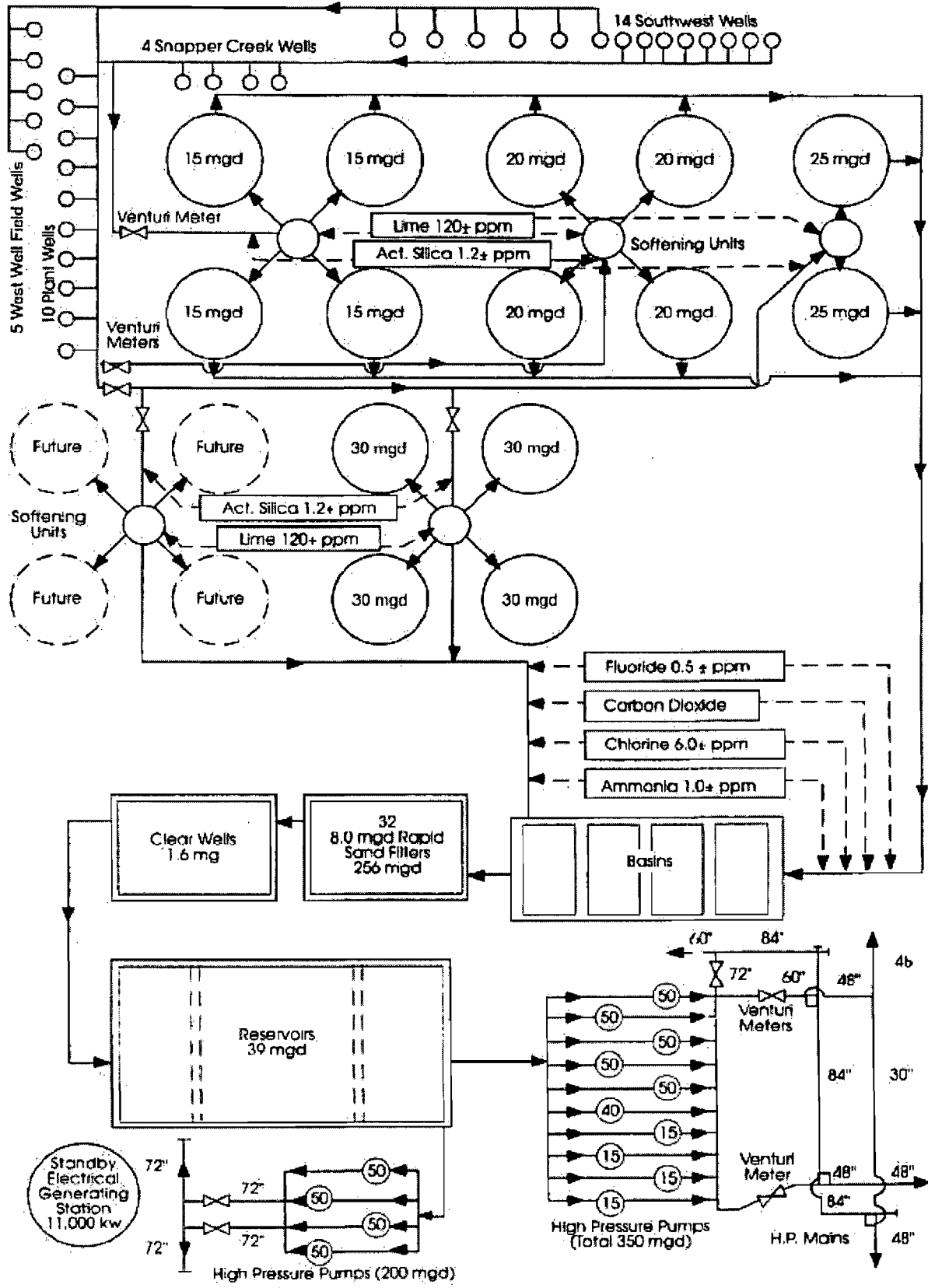


ALEXANDER ORR JR.
 WATER TREATMENT PLANT
 GENERAL PLAN

REF: W-8680-C

Attachment B
Process Flow Diagram

Attachmnet B: Process Flow – Alexander Orr, Jr. Water Treatment Plant – Water Treatment

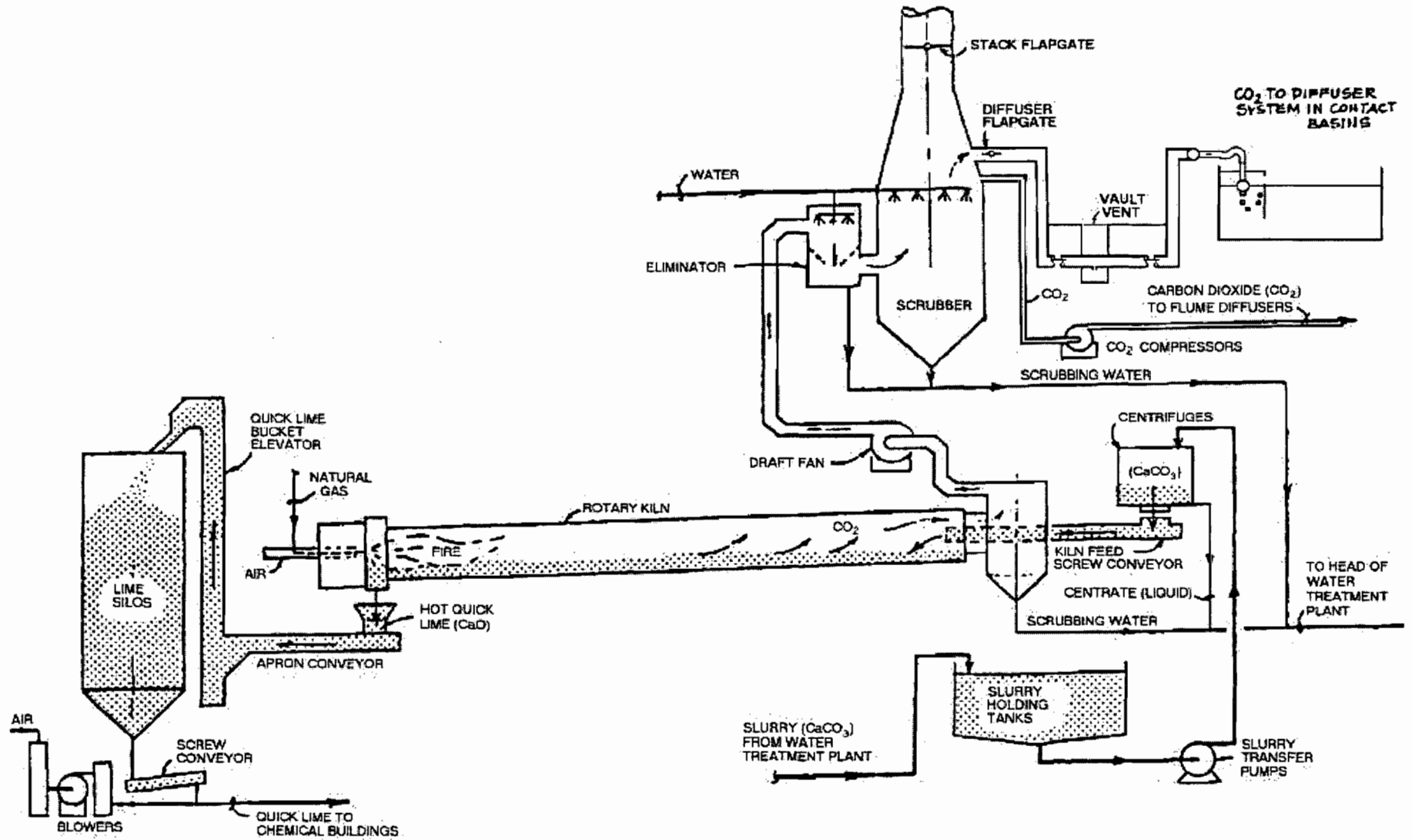


N.T.S.

50 Capacity of Pumps in mgd

Alexander Orr, Jr. Water Treatment Plant Simplified Process Diagram

Attachment B: Process Flow – Alexander Orr, Jr. Water Treatment Plant – Solids Recovery and Reuse, Rotary Kiln



Attachment C
Precautions to Prevent Emissions of Unconfined
Particulate Matter

Attachment C

Precautions To Prevent Emissions of Unconfined Particulate Matter Alexander Orr, Jr. Water Treatment Plant

The Alexander Orr, Jr. Water Treatment Plant will take the following reasonable precautions to control the emissions of unconfined particulate matter:

- Paving and maintenance of roads, parking areas, and yards.
- Application of water or chemicals to control emissions from such activities as demolition of buildings, grading roads, construction, and land clearing.
- Application of asphalt, water, oil, chemicals, or other dust suppressants to unpaved roads, yards, open stock piles, and similar sources.
- Removal of particulate matter from buildings or work area to prevent particulate from becoming airborne.
- Landscaping or planting of vegetation.
- Use of hoods, fans, filters, and similar equipment to contain and or vent particulate matter.
- Confining abrasive blasting, where possible.
- Enclosure or covering of conveyor systems

Attachment D
List of Emission Units and/or Activities that are
Considered Insignificant

The below listed emission units and/or activities are considered insignificant pursuant to Rule 62-213.430(6), F.A.C.

- 1 Fluoride Feeders, gravimetric belt type.
Note: While fluoride feeders are still installed they have not been used in the past two years and are to be removed once the replacing fluorosilicic acid feed system is online.
- 2 Lime Feeders, (6) gravimetric belt type, 2,083 lb/hr each.
- 3 Diesel Fuel Oil Storage Tanks, 360,000 gallons total capacity.
- 4 Diesel Fuel Oil Storage Tank (day tank at pump room), 1000 gallons.
- 5 LPG Storage Tank for Kiln Backup Engine (Auxiliary Motor), (500 gallons).
- 5 Aboveground Waste Oil Tank (300 gallons).
- 6 Lime Rejects Ball Mill.
Note: All ball mills have been removed. Rejects from the lime slakers are disposed of as waste.
- 7 Lime Solids Discharge Screw, Bucket Elevator and Screw Conveyor, 5 ton/hr.
- 8 Lime Storage Bins, (3) Chemical House No. 1, 1,050 tons.
- 9 Lime Storage Bins, (3) Chemical House No. 2, 1,050 tons.
- 10 Lime Transfer from truck loading chute from silos at lime plant.
- 11 Exhaust Units (Chemical House No. 1).
- 12 Exhaust Units (Chemical House No. 2).
- 13 Kiln Backup Engine (Auxiliary Motor).
- 14 Emergency Diesel Engine Driven Starting Air Compressor - Hatz 2M40LZ.
- 15 Emergency Diesel Engine Driven Starting Air Compressor - Lister H15TX20.
- 16 Two (2) 1,050 tons each lime silos.
Currently E.U. ID No. 008
Note: These units should be reclassified as "insignificant".



List of Insignificant Emission Units and/or Activities

Alexander Orr, Jr. WTP

Attachment
D

Revised 12/10/2004

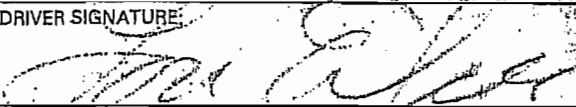
Attachment E
Fuel Analysis and Specification

BEST AVAILABLE COPY
Non-Negotiable Bill of Lading

MATERIAL SAFETY DATA SHEET AVAILABLE FROM THE TERMINAL FOR THESE PRODUCTS ON REQUEST
CUSTOMER NOTICE - THE PRODUCT TRANSFER DOCUMENTS FOR THIS TRANSACTION INCLUDE OTHER DOCUMENTS WHICH MAY CONTAIN ADDITIONAL AND/OR CORRECTING REFORMULATED GASOLINE INFORMATION. IF IN CONFLICT, THE INFORMATION IN THE OTHER DOCUMENTS WILL CONTROL.

SEE REVERSE SIDE FOR HAZARD WARNING INFORMATION & NOTES

Form 50605-A Rev. 11/97

DRIVER SIGNATURE: 	
TRUCK SEAL NUMBERS:	SHIPMENT RECEIVED BY:

ALL ITEMS SUBJECT TO CONDITIONS ON REVERSE SIDE HEREOF.

For Product Emergency
 Spill, Leak, Fire, Exposure or Accident, CALL
 CHEMTREC - Day or Night: 800-424-9300

COPY **6**

MARATHON ASHLAND PETROLEUM LLC, 539 S. MAIN STREET FINDLAY OHIO 45340 EPA #268
 *** CONVENTIONAL GASOLINES - THESE PRODUCTS DO NOT MEET THE REQUIREMENTS FOR REFORMULATED GASOLINES (RFG) AND MAY NOT BE USED IN ANY RFG COVERED AREA. *** SHIPPED FROM: 1601 S.E. 20TH STREET, FT. LAUDERDALE, FL 33316

DATE 02/14/01
 NUMBER 542224-226
 TIME IN 0940
 TIME OUT 0955

SOLD TO (CONSIGNEE)		SHIPPED FROM		LOC CODE
BP OIL COMPANY HANSFIELD OIL CO (108)		FT LAUDERDALE TERMINAL 1601 SE 20TH ST FT LAUDERDALE FLA		0000299446
FL, DEST.		DATE SHIPPED	SHIPPED VIA	
		02/14/01	BILL FREIGHT UNKNOWN 3947 PENN TANK LINES	
DESTINATION		CUSTOMER NUMBER		ITEM NUMBER
UNKNOWN FL		22041349500000		
DRIVER	TRAILER	COMPANY	CUSTOMER P.O. AND RELEASE NUMBER	TRANSMITTED CUSTOMER AND RELEASE NUMBER
LOUIS EIBER	4457	0305		

CARGO TANK COMPARTMENT PRODUCT DESCRIPTIONS	GROSS GAL.	NET GAL.	TEMP./API GR.	COMMENTS
NO2 LOW SULFUR, .05% MAX SULFUR, 40 CETANE MIN, DYED DIESEL FUEL, NONTAXABLE USE ONLY, PN. ENASLT FOR TAXABLE USE FUEL OIL, 3, NA1992, PG III 137	2200 ** 2200	2172 ** 2172	88.1/033.6	Meter 19 Preset 2200 Code 072 100.0%
NO2 LOW SULFUR, .05% MAX SULFUR, 40 CETANE MIN, DYED DIESEL FUEL, NONTAXABLE USE ONLY, PN. ENASLT FOR TAXABLE USE FUEL OIL, 3, NA1992, PG III 137	2800 ** 2800	2764 ** 2764	88.3/033.6	Meter 19 Preset 2800 Code 072 100.0%
NO2 LOW SULFUR, .05% MAX SULFUR, 40 CETANE MIN, DYED DIESEL FUEL, NONTAXABLE USE ONLY, PN. ENASLT FOR TAXABLE USE FUEL OIL, 3, NA1992, PG III 137	520 ** 520	513 ** 513	88.2/033.6	Meter 19 Preset 520 Code 072 100.0%
		5449		

CONV GASOLINE / 7.6 RVP GASOLINE / CLEAR L.S. #2 / DYED L.S. #2 /
 H.S. #2

(** - Batch Total)

YAES...



**City Gas Company
of Florida**

Miami Division
955 East 25th Street
Hialeah, FL 33013-3498
Tel: (305) 691-8710
Fax: (305) 691-7112
www.nui.com

NUI Corporation (NYSE: NUI)

MIAMI - DADE
WATER AND SEWER DEPARTMENT

RECEIVED
SEP 11 1998
PLANNING

MIAMI-DADE
WATER AND SEWER DEPT.
RECEIVED

JUL 23 1998
ENGINEERING
DIVISION
(PROJECT MANAGER)

July 22, 1998

Mr. Wilfredo M. Fernandez
Miami Dade Water & Sewer Department
P.O. Box 330316
Miami, Florida 33233-0316

Re: Heating Value of natural gas

Dear Wilfredo:

Attached please find a fuel analysis provided to City Gas by Florida Gas Transmission Company. In it you will note that the heating value of the natural gas delivered to City Gas is 1058 Btu/cf at standard pressure and temperature

Please, call me if you have any questions or need additional information.

Sincerely,

Adrian S. Morera
Key Account Manager
Enclosure

cc: J. PAPPAS
M. BLANCO-PAPE
V. FERNANDEZ-CUERO
T. CHU
J. MURIAS
F. SAGASTUME
PROJECT FILE (~~CO~~ ^{UNFER} 46495)
R. O'ROURKE

Companies and Affiliates:
City Gas Company of Florida
Elizabethtown Gas
Elkton Gas
North Carolina Gas

NUI Capital Corp.
NUI Energy
NUI Energy Brokers
NUI Environmental Group

TIC Enterprises, LLC
Utility Business Services
Valley Cities Gas
Waverly Gas

BEST AVAILABLE COPY

TOTAL P.03

Spot Analysis of Natural Gas for Delivery in Florida

(West Palm Beach Chromatograph)

DATE: November 17, 1997

TIME: 06:12

<u>Component Name</u>	<u>Mole %</u>
Hexane	0.094
Propane	0.865
Isobutane	0.215
n-Butane	0.175
Isopentane	0.064
n-Pentane	0.037
Nitrogen	0.387
Methane	93.317
CO2	1.029
Ethane	3.814
Totals	100.000

Dry Btu/cf @ 14.730 psia and 60°F = 1058.4

Real Relative Density = 0.6037

Total Sulfur	NA PPM
H ² S	NA PPM
H ² O	4.41 lb/MMcf

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(PROJECT MANAGER)

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JUL 23 1998
ENGINEERING
DIVISION
(PROJECT MANAGER)

Attachment F
Operation and Maintenance Plan

MAINTENANCE

TABLE OF CONTENTS

DESCRIPTION	SECTION/PARAGRAPH	PAGE
Servicing	1	
Overview	1.1	2-1-1
Maintenance Benefits	1.2	2-1-1
Best Performance	1.2.1	2-1-1
Benefits	1.2.2	2-1-1
Intended Use	1.2.3	2-1-2
Nature of Preventive Maintenance	1.3	2-1-2
Preventive	1.3.1	2-1-2
Awareness	1.3.2	2-1-2
Degree of Awareness	1.3.3	2-1-2
Promptly Corrected	1.3.4	2-1-2
Actions	1.4	2-1-2
Preventive	1.4.1	2-1-2
Adjusting	1.4.2	2-1-2
Servicing	1.4.3	2-1-3
Treating for Corrosion	1.4.4	2-1-3
Scheduled Maintenance	1.5	2-1-3
Maintenance Intervals	1.5.1	2-1-3
Guideline	1.5.2	2-1-4
Maintenance Schedule	1.5.3	2-1-4
Ancillary Equipment Maintenance	1.5.4	2-1-10
Information	1.5.5	2-1-10
Fuel System	1.6	2-1-10
Leak Check	1.6.1	2-1-10
Fuel Filters	1.6.2	2-1-10
Manual Priming Pump	1.6.3	2-1-11
Electric Priming Pump	1.6.4	2-1-11
Lubricating Oil System	1.7	2-1-11
Lubricating Oil Level	1.7.1	2-1-11
Adding Lubricating Oil	1.7.2	2-1-11
Draining Lubricating Oil	1.7.3	2-1-12
Lubricating Oil Filter	1.7.4	2-1-12

TABLE OF CONTENTS (Cont)

DESCRIPTION	SECTION/PARAGRAPH	PAGE
Lube Oil Filter Element Replacement	1.7.5	2-1-13
Bypass Valve Assembly	1.7.6	2-1-14
Cleaning	1.7.7	2-1-14
Location	1.7.8	2-1-14
Lube Oil Cooler	1.7.9	2-1-14
Cooling System	1.8	2-1-14
Coolant Level	1.8.1	2-1-14
Filling System	1.8.2	2-1-14
Flushing and Refilling Radiator	1.8.3	2-1-15
Coolant Analysis	1.8.4	2-1-15
Radiator	1.8.5	2-1-15
Heat Exchanger	1.8.6	2-1-15
Air Intake and Exhaust System	1.9	2-1-16
Turbocharger	1.9.1	2-1-16
Air Box Drains	1.9.2	2-1-17
Exhaust Manifold	1.9.3	2-1-17
Air Start System	1.10	2-1-18
General	1.10.1	2-1-18
Air Starter	1.10.2	2-1-18
Strainer	1.10.3	2-1-18
Generator	1.11	2-1-18
Engine Tune Up	1.12	2-1-18
Engine and Generator Mounts	1.13	2-1-19
Controls and Indicators	1.14	2-1-19
Corrosion Check	1.15	2-1-19
Troubleshooting	2	
Definition	2.1	2-2-1
Engine	2.2	2-2-1
Unit Troubleshooting	2.3	2-2-4
Introduction	2.3.1	2-2-4
Repairs and Adjustments	3	
Repairs	3.1	2-3-1
Engine	3.1.1	2-3-1
Generator	3.1.2	2-3-1
Systems	3.1.3	2-3-1
Adjustments	3.2	2-3-1
Engine	3.2.1	2-3-1
Generator	3.2.2	2-3-1
Systems	3.2.3	2-3-1

TABLE OF CONTENTS (Cont)

DESCRIPTION	SECTION/PARAGRAPH	PAGE
Lubrication	4	
Overview	4.1	2-4-1
Lubrication Benefits	4.2	2-4-1
Best Performance	4.2.1	2-4-1
Benefits	4.2.2	2-4-1
Intended Use	4.2.3	2-4-1
Nature of Preventive Lubrication	4.3	2-4-2
Lubrication Service	4.3.1	2-4-2
Lubrication Maintenance	4.3.2	2-4-2
Lubricating Oil	4.4	2-4-2
Check	4.4.1	2-4-2
Generator	4.5	2-4-3
Ancillary Equipment	4.6	2-4-3
Lubrication Schedule	4.7	2-4-3

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SERVICING

1.1 OVERVIEW

WARNING

Always use caution when working around rotating equipment. Serious injury to personnel or damage to equipment could occur.

WARNING

Always use caution when working around electrical equipment. Serious injury to personnel or damage to equipment could occur

WARNING

Clean or service only when the equipment is shut down, isolated, and tagged "Out of Service."

This section contains instructions for the care and recommended maintenance of the diesel engine generator set fabricated by Stewart & Stevenson Services.

1.2 MAINTENANCE BENEFITS

1.2.1 Best Performance Your generator set is ensured of its best performance and reliability when a scheduled preventive maintenance program is followed. A small cost and effort expended for a preventive maintenance program yields improved performance, efficiency, and reliability.

1.2.2 Benefits These benefits are realized by:

- a. Understanding the nature of preventive maintenance.
- b. Following the lubrication and preventive maintenance schedule that has been established.

1.2.3 Intended Use If a generator system is intended for emergency use at times of utility power failure, preventive maintenance is the key to standby service of the generator set. A program of regular preventive maintenance can assure the ready availability of the generator set in emergency situations. A complete log of all maintenance and repairs should be kept to help pinpoint future problem areas. Corrective action can then be taken to prevent breakdowns during operation of the generator sets.

Major mechanical or electrical repairs should be referenced in the EMD 645 Series Turbo Marine Engine Maintenance Manual and the Baylor Generator Instruction Manual in Chapter 6 of this manual.

1.3 NATURE OF PREVENTIVE MAINTENANCE

1.3.1 Preventive Maintenance should be preventive in nature, whereby potential failures are detected and corrected before they cause the equipment to break down.

1.3.2 Awareness The nature of preventive maintenance demands operator awareness of the generator set's operation. Awareness demands consciousness of abnormalities such as knocks or smoke. Awareness also demands knowing the generator set's equipment capabilities and perceiving the equipment's service needs. Being aware can also be described as being watchful, or being alert.

1.3.3 Degree of Awareness The degree to which awareness of the generator set's operation is necessary depends upon the extent of the generator set's automatic sensors, controls, and indicators.

1.3.4 Promptly Corrected Regardless of the method and manner of detection, the potential failure should be promptly corrected, in order to prevent a shutdown or a breakdown. The corrective actions taken or the service rendered constitute preventive maintenance.



If the operator has ANY QUESTIONS about the safe use or maintenance of the generator set, ASK THE SUPERVISOR - NEVER GUESS - ALWAYS CHECK.

1.4 ACTIONS

1.4.1 Preventive The nature of preventive maintenance calls for actions which will prevent major repair work. These actions can be performed at an operator level, and can usually be categorized into (1) adjusting, (2) servicing, and (3) treating for corrosion. All preventive actions should be referenced in the specific equipment manuals in Chapter 6.

1.4.2 Adjusting The action of correcting misalignments, testing for the proper set points (calibrating), and tightening loose components.

1.4.3 Servicing The action of maintaining the proper amounts (levels) of lubricating grease, oil, coolant, fuel oil, etc. Servicing also encompasses replacing or cleaning filter elements, as well as performing minor repair work. An example of minor mechanical repair work is replacing a gasket or seal, etc. An example of minor electrical repair work is replacing a light bulb or fuse, etc. Minor repair work can be accomplished by operator-level personnel and by use of this manual. While performing maintenance on equipment, refer to the specific equipment service manuals supplied in Chapter 6.

1.4.4 Treating for Corrosion This necessary, ongoing process consists of thorough cleaning, lubrication, and assurance of protective finish integrity. Generator sets located where high humidity or high temperatures are prevalent require extra awareness.

1.5 SCHEDULED MAINTENANCE

1.5.1 Maintenance Intervals Table 1.1 is intended as a guide for establishing a preventative maintenance schedule. The intervals, indicated on the table, represent time measured in elapsed hours of operation for a generator set being used for prime power. A generator set, which is standby power for emergency usage in the event of normal electrical power failure, accumulates little actual operating time. A time schedule should be established at the operator's discretion depending on the individual workloads and environmental constraints for their unit. Generally, the following schedule may be used for generator sets according to hours operated or elapsed time.

TABLE 1.1 Maintenance Intervals

Items Marked Under Interval of Hours of Operation	Perform Instead Every
8	week
50	month
100	2 months
150	3 months
200	4 months
350	6 months
500	10 months
700	12 months
1400	24 months
2100	36 months
2800	48 months

Perform preventive maintenance on items daily, weekly or when the hourmeter registers the recommended scheduled hours of operation.

1.5.2 Guideline Because operating requirements for this generator set will vary from standby to weekly operation, this maintenance program should be used as a guideline in conjunction with an ongoing oil analysis program.

1.5.3 Maintenance Schedule Table 1.2 summarizes recommended inspection, checks and maintenance procedures for the major pieces of equipment. The service and scheduled maintenance instructions that follow have been developed to ensure satisfactory engine operation and economical maintenance costs. Preventive maintenance is necessary to ensure reliable equipment operation with minimal down times.

The following information is furnished only as a guide for a preventative maintenance program, actual programs should be established by the operating personnel for the installation site.

NOTE

Refer to the EMD 645 Series Engine Maintenance Manual in Chapter 6 of this manual for detailed engine maintenance procedures.

Table 1.2 Maintenance Inspection/Check Schedule

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
General Conditions	Daily	Check for general appearance and integrity of unit. Inspect for leaks in the cooling, fuel, lube oil, exhaust and air start systems.
Lube Oil Level	Daily	Check oil level in pan and add oil if required. Refer to EMD <u>Marine Propulsion Unit Operating Manual</u> in Chapter 6 of this manual.
Engine Coolant	Daily	Check coolant level and add coolant at expansion tank if required. Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
Fuel Supply	Daily	Check fuel supply.
Air Start System	Daily	Drain Condensate from lines and tanks. Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
Governor	Daily	Check oil level and add oil if required. Refer to EMD <u>Marine Propulsion Operating Manual I</u> in Chapter 6 of this manual.
Engine Lubrication	50 hours initially and 100 hours thereafter	Take lube oil sample for analysis in a certified laboratory. Monitor for suitability of oil for continued use according to Specifications, Section 2 of this chapter. Refer to EMD <u>Maintenance Instructions</u> in Chapter 6 of this manual.

Table 2.2 Engine Maintenance Inspection/Check Schedule (Cont)

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
Generator Set	Every 50 hours	Inspect for corrosion on all exposed surfaces and treat if necessary. Refer to EMD <u>Maintenance Instructions</u> in Chapter 6 of this manual.
Lube Oil Circulating Pump	Every 50 hours	Check for proper operation. Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.
Immersion Heater	Every 50 hours	Check for proper operation. Refer to Watlow vendor data in Chapter 6 of this manual.
Intake Air Filter	Every 50 hours	Check restriction filter minder for proper differential pressure. Replace if necessary. Refer to Farr vendor data in Chapter 6 of this manual.
Generator	Every 50 hours	Clean housing, ventilation screens; inspect for loose or damaged windings, insulation and mounting components and check for any signs of moisture. Refer to Baylor <u>Generator Instruction Manual</u> in Chapter 6 of this manual.
Turbocharger Filter	Every 100 hours	Replace element. Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
Lube Oil Strainer	Every 100 hours	Clean strainer screen. Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
Generator Bearings	Every 100 hours	Inspect for excessive leakage of oil or grease and lubricate if necessary. Refer to Baylor <u>Generator Instruction Manual</u> in Chapter 6 of this manual.
Lube Oil Filter	Every 350 hours	Check lube oil pressure at filter input with engine at rated rpm and replace filter elements if tank pressure so indicates. Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
Fuel Filter (EMD)	Every 350 hours	Check fuel pressure with engine at rated rpm with gauge connected to filter input side and change filter elements if pressure is greater than 50 psi (345 kPa). Refer to EMD <u>Marine Propulsion Operating Manual</u> in Chapter 6 of this manual.
General Inspection	Every 350 hours	Check the following components of the engine assembly. Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Inspect air box • Inspect crankcase • Inspect crankshaft and connecting rods • Inspect pistons and piston rings • Inspect cylinder liners • Inspect cylinder head mechanism at operating temperature

Table 2.2 Engine Maintenance Inspection/Check Schedule (Cont)

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
Engine Nut & Bolt Tightness	Every 350 hours	<p>Check that the following nuts and bolts are tightened to the correct values as specified in EMD <u>Maintenance Instructions</u> in Chapter 6 of this manual:</p> <ul style="list-style-type: none"> • Cylinder head crab nuts • Exhaust manifold flange bolts • Cylinder liner water inlet line nuts and bolts • Head frame to crankcase bolts • Turbocharger to air duct bolts • Examine mounting bolts • All piping connection nuts and bolts
Lube Oil Circulating Pump and Motor	Every 700 hours	<p>Inspect and clean with dry air, remove and clean check valve and replace brushes (if DC motor). Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.</p>
Radiator	Every 700 hours	<p>Reverse flush radiator and inspect and clean radiator coil assembly if necessary. Refer to Air X Changer <u>Maintenance Instructions</u> in Chapter 6 of this manual.</p>
Cooling System	Every 700 hours	<p>Check operation and settings of engine water temperature controls. Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.</p>
Lube Oil Filters	Every 700 Hours	<p>Check and clean filter housing and strainers. Fill strainer box with oil before starting engine. Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.</p>
Lube Oil Coolers	Every 700 Hours	<p>Check temperature differential between lube oil and cooling water into engine and clean cooler if necessary. Refer to EMD <u>645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.</p>

Table 2.2 Engine Maintenance Inspection/Check Schedule (Cont)

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
Soak Back Pump and Motor	Every 700 hours	Check operation with engine shut down and soak back pump running; remove left rear hand hole covers and check oil flow through gear train. Observe camshaft bearings. If lube oil flows from camshaft bearings with turbo lube pump running and engine shut down, inspect turbo filter outlet check valve for proper operation.
Turbocharger and Soak Back Oil Filters	Every 700 hours	Check and clean housing and strainers. Refer to <u>EMD 645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.
Fuel Filters (EMD)	Every 1400 hours	Clean or replace suction strainer element. Refer to <u>EMD 645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.
Lube Oil Circulating Pump and motor	Every 1400 hours	Replace unit. Refer to <u>EMD 645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.
Cooling System	Every 2100 hours	Check inhibitor concentration and general condition of water coolant. Refer to <u>EMD Maintenance Instructions</u> in Chapter 6 of this manual.
Cooling System Thermostatic Valve	Every 2100 hours	Replace 'O' rings and thermostatic elements. Refer to <u>EMD 645 Series Turbo Marine Engine Maintenance Manual</u> in Chapter 6 of this manual.
Generator Bearings	Every 2100 hours	Replace the bearing grease with proper amounts and type. Refer to <u>Baylor Generator Instruction Manual</u> in Chapter 6 of this manual.

Table 2.2 Engine Maintenance Inspection/Check Schedule (Cont)

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
Expansion Tank Pressure Cap	Every 2800 hours	Replace unit.
Exhaust System	Every 3500 hours	Remove exhaust manifold to turbocharger adapter assembly and clean screen and trap box. Check for cracks and leaks. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Lubricating Oil	According to Lube Oil Analysis	Change engine-lubricating oil. Evaluation of engine oil condition should dictate the frequency of this item. Type of service, oil and filter element quality, and condition of the engine will influence the frequency of the oil change. Refer to <u>EMD Propulsion Operating Manual</u> in Chapter 6 of this manual. Refer to <u>EMD Maintenance Instruction 1760</u> in Chapter 6 of this manual. Clean oil suction screens, scavenging oil screens, oil pan, and filter housing when changing lubricating oil. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Engine Components	Every 4200 hours	Replace the following components. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Top deck covers (check latches) • Cylinder head grommets inlet and outlet seals • Lower liner seals
Engine Components	Every 8400 hours	Perform the following procedures. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Qualify injectors • Check injector timing and rack length • Check engine speed • Check overspeed trip • Remove and clean oil separator element • Check pressure drop • Inspect crankshaft damping device • Remove, clean, inspect and replace if necessary: <ul style="list-style-type: none"> - Soak back check valve - Soak back oil pressure relief valve in filter head - Soak back filter bypass valve - Turbo oil filter check valve
Exhaust System	Every 8400 hours	Inspect manifold sections for possible cracking of leg baffles or expansion joints and replace if necessary. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Lube Oil Filter	Every 8400 hours	Remove oil filter bypass valve, clean, inspect and replace if necessary. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.

Table 2.2 Engine Maintenance Inspection/Check Schedule (Cont)

Inspection Check Recommended	Inspection Frequency	Remarks/Reference
Starting Motors	Every 8400 hours	Disassemble, clean, inspect and lubricate. Refer to Ingersoll Rand manual in Chapter 6 of this manual.
Fuel Pump	Every 16000 hours	Replace coupling spider. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Soak Back Pump	Every 16000 hours	Replace coupling spider. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Engine Components	Every 16000 hours	Perform the following procedures. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Replace cylinder assemblies • Replace injectors • Inspect and qualify connecting rod bearings • Inspect and qualify piston cooling tubes • Check rocker arms, arm bushings, and cam followers • Check lash adjusters • Check exhaust valve timing
Engine Components	24000 hours	Perform the following procedures. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Install new thrust collars • Install new lower main bearings Replace water pump seals and worn parts
Turbocharger	24000 hours	Replace unit. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Cooling System	24000 hours	Replace flexible coupling seals. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Heat Exchanger	24000 hours	Inspect, clean, and test. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Fuel Pump	32000 hours	Replace unit. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Soak Back pump	32000 hours	Replace unit. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual.
Engine components	48000 hours	Perform the following procedures. Refer to <u>EMD 645 Series Engine Maintenance Manual</u> in Chapter 6 of this manual: <ul style="list-style-type: none"> • Replace oil pumps • Replace lower liner inserts • Inspect injector control linkage; replace links, seals and bearings if necessary.
Engine	96000 hours	Replace unit.

1.5.4 Ancillary Equipment Maintenance Ancillary equipment includes the systems that support the diesel engine and generator. Consult the vendor documentation in Chapter 6 for maintenance details and schedules on the pieces of equipment that support the generator set.

1.5.5 Information For details on the engine, refer to the EMD vendor manuals in Chapter 6 of this manual. For details on the generator, refer to the Baylor manual in Chapter 6 of this manual. Maintenance information for the auxiliary systems of this generator set can be found in Chapter 6 of this manual.

1.6 FUEL SYSTEM

1.6.1 Leak Check Make a visual check for evidence of fuel leaks at the fuel oil tank, lines and interconnections. A major cause of poor starting or power loss is the result of clogged filter element or a fuel oil system air leak. If your unit will not prime, fails to hold a prime, check that the lid and drain are properly tightened. Next, check all fitting connections and ensure none of the fuel oil lines are pinched or clogged with contaminants. If the remote fuel oil tank is equipped with an in-tank strainer assembly, check it for potential clogging.



Follow the manufacturer's recommendations to properly maintain equipment.

A major cause of poor starting or power loss is the result of clogged filter element or a fuel system air leak. If your unit will not prime, fails to hold a prime, or if air bubbles are present, check all fitting connections and ensure none of the fuel oil lines are pinched or clogged with contaminants. If the remote fuel oil tank is equipped with an in-tank strainer assembly, check it for potential clogging.



Follow the manufacturer's recommendations to properly maintain equipment.

1.6.2 Fuel Filters Each filter is a disposable type that is screwed directly to a common head. The filter is a pleated paper type around a metal perforated tube providing 1100 sq. in. filtering area. A tapered cock-type control valve in the head assembly directs the flow of fuel oil to either or both filters. One filter can be cut out of service to permit replacement without stopping the engine. The inlet and outlet connections are located in the head assembly.

The flow of fuel oil is directed and regulated by the position of the control valve. Centering the control valve lever or placing it in the "BOTH" position allows for use of both filter elements. When it is necessary to change filters, the flow of fuel oil can be directed through one filter while changing the other one. Move the control lever to the "L" or "R"; left or right position, depending on which filter is to be replaced. The position chosen, left or right, will determine which filter is replaced. The right position is for changing the left filter and the left position is for changing the right filter.

To change the elements, refer to the following procedure:

NOTE

Do not overtighten the filter body to the assembly as leaking may occur.

- a. To change a filter while the engine is running, move the filter selector lever to the letter representing the opposite filter.
- b. Unscrew and discard elements. Use strap wrench if necessary.
- c. Apply a new filter to the filter head and tighten until the neoprene gasket is sealed.
- d. With the engine running, move the selector lever to the position of the filter that was changed and check for leakage.

For complete details, refer to EMD 645/710 Operating Manual in Chapter 6 of this manual.

1.6.3 Manual Priming Pump The fuel oil priming pump is manually operated and located on the accessory rack. No scheduled maintenance is required. If the pump is not operating properly, it can be disassembled for inspection. Remove the crank, and then separate the shell from the lid and inspect for problems. For complete details, refer to EMD 645/710 Marine Propulsion Operating Manual in Chapter 6 of this manual.

1.6.4 Electric Priming Pump The electric fuel oil priming pump is also located on the engine rack. The electric fuel oil priming pump does not require routine maintenance under normal operating conditions. Proper maintenance of the fuel, storage, and delivery systems prevent problems in the manual and electric fuel oil priming pumps.

1.7 LUBRICATING OIL SYSTEM

1.8.1 Lubricating Oil Level Engine oil level should be checked with the engine hot and running at idle speed. A dipstick extends from the side of the oil pan into the oil pan sump. The dipstick should show a level between LOW and FULL. The oil level with the engine stopped should be above the FULL mark.

CAUTION

After draining and refilling the lube oil system, it is imperative that the strainer housing be filled with oil before starting the engine. Failure to do this may result in serious engine damage.

1.7.2 Adding Lubricating Oil Oil may be added with the engine running or stopped; however, the FULL level of oil on the dipstick is determined with the engine hot and running at idle speed. If the oil pan is overfilled with the engine stopped, oil will run out between the crankshaft and oil pan at the flywheel.

Lubricating oil may be poured into the strainer housing through the opening having the square cover.

CAUTION

If the round covers are removed from the strainer housing while the engine is running, hot oil under pressure will flow out of the opening and possibly cause personal injury.

For lube oil system capacities, refer to EMD 645 Series Engine Maintenance Manual in Chapter 6 of this manual.

1.7.3 Draining Lubricating Oil To drain the lubricating oil, it is first necessary to open both valves located under the square filler cover of the strainer housing. The front valve drains the oil from the lube oil filter into the engine sump and rear valve drains the oil from the strainer into the engine sump.

CAUTION

After draining and refilling the lube oil system it is imperative that the strainer housing be filled with oil before starting the engine. Failure to do this may result in serious engine damage.

1.7.4 Lubricating Oil Filter The lube oil filter is equipped with threaded holes that are piped internally to the inlet and outlet oil compartments. If the ½" NPT pipe plugs are removed and replaced with gauges, the oil filter inlet and outlet oil pressure can be monitored to determine the condition of the filter elements.

Periodic pressure readings will help prevent undue engine wear by indicating when filter element plugging and bypass are about to occur. Oil filter element replacement should be made as determined by scheduled pressure monitoring of the oil filter tank pressure. The replacement interval as determined by laboratory analysis of the lube oil can dictate earlier replacement of the elements.

NOTE

Readings must be taken with the lube oil temperature at least 150 °F (66 °C). Adequate water temperature will assure adequate oil temperature.

Readings should be taken with the engine at rated speed and load. The manufacturer's recommends that the filter elements be renewed if filter tank differential pressure reaches outlet/inlet pressures of 1.37 bar (20 psi). Tank pressure readings can be taken with engine speed at idle, but readings taken at rated speed are more reliable.

NOTE

If a marginal pressure reading is taken at idle speed, verify element condition at rated engine speed.

1.7.5 Lube Oil Filter Element Replacement The following is the procedure for changing the element of the lubricating oil filter (EMD).

- a. Operate the diesel engine until oil is warm and circulating freely, then stop the engine.
- b. Remove the square cap from the engine mounted lube oil strainer housing.

NOTE

Depending upon the temperature of the oil and the system at the time the drain valve is opened, adequate drainage of the lube oil filters can take from ½ hour for hot oil to several hours for a cold system.

NOTE

If the system is fully charged at the time the system is to be drained, the oil level will rise above the bottom of the oil pan inspection covers.

- c. Raise and latch the gate valve handle in the strainer housing to drain oil from the filter housing into the engine sump. It is not necessary to move the valve handle that drains the oil strainer housing.
- d. After enough time has elapsed to allow adequate drainage and easier handling of the filters, slightly loosen the nuts on the filter housing cover. Oil remaining at the bottom of the housing will leak into the drain trough.
- e. After oil has stopped draining from under the flat filter housing cover, loosen the retaining nuts and swing the hinge bolts clear of the cover. Swing the cover open. Remove and quickly dispose of the used filter elements.
- f. Using only clean towels, clean up the interior of the filter housing. Clean out the drain pan and surrounding area.
- g. Insert a set of new filter elements. Make certain that the elements are fully seated over the standpipes.
- h. When the filter elements are properly inserted, inspect the "O" ring in the circular groove in the housing cover. Replace if necessary.
- i. Close the cover. A guide hole in the filter cover must be aligned with the dowel on the filter housing body before the cover can be closed.

- j. Swing the hinge bolts into place and tighten the hold-down nuts to EMD specifications of 60 ft-lbs (81 Nm).

NOTE

Approved pleated paper elements have a red casing.

1.7.6 Bypass Valve Assembly The filter bypass valve assembly should be checked periodically or whenever improper oil circulation is suspected.

1.7.7 Cleaning Operation of the valve assembly cannot be effectively checked on the unit. It is recommended that qualified spare assemblies be available for exchange with the assembly in use. If a spare is not available, the valve assembly should be removed from the filter housing and cleaned of sludge and varnish by washing in solvent. The assembly should be carefully inspected after cleaning. If the poppet stem or valve body guide is worn, these pieces should be replaced.

1.7.8 Location The bypass valve is located between the inlet and outlet compartments. The current valve is mounted on the separator plate within the filtering compartment.

For complete details, refer to EMD Marine Propulsion Operating Manual in Chapter 6 of this manual.

1.7.9 Lube Oil Cooler Service the lube oil cooler at intervals specified in the Engine Maintenance Inspection/Check Schedule at the beginning of this section.

1.8 COOLING SYSTEM

The cooling system consists of three separate systems: a remote mounted expansion tank, a plate type lubricating oil heat exchanger, and a water cooling system including engine driven water pumps and Alfa Laval watermaker assembly with incorporated sterilizer for fresh water disinfection. These systems require differing types of maintenance for optimum performance.

The following procedures and principles are generalized for all radiator/heat exchanger equipment.

1.8.1 Coolant Level Check the coolant level weekly. The water level should not be allowed to go below the applicable "LOW" mark. Under the normal operating conditions, there should be no need to add coolant to the sealed cooling system except at extended intervals. However, this does not mean that the cooling system should not be checked on a weekly basis.

A clear tube low water indicator is mounted on the water expansion tank on the accessory rack.

1.8.2 Filling System The cooling system is filled through the filler opening at the top of the expansion tank. Add coolant as necessary. Do not overfill.



Allow system to cool down before opening filler cap. System under pressure could cause severe injury. Partially open the filler cap to relieve pressure prior to complete removal of the cap.

CAUTION

If the cooling system of a hot engine has been drained, do not fill until the engine cools. A sudden change in temperature may cause damage to the engine.

Make a visual check for cooling system leaks. Inspect all of the cooling system hoses at least once every 700 hours of operational service for signs of deterioration. Replace the hoses if necessary.

Refer to EMD 645 Series Engine Maintenance Manual and EMD 645/710 Operating Manual, found in Chapter 6 of this manual for servicing details.

1.8.3 Flushing and Refilling Radiator Clean the cooling system every 1000 hours of operational service. Use a good radiator cleaning solution designated as an inner coil cleaner/flushing agent and use in accordance with the instructions on the container. After the cleaning operation, flush the cooling system with soft water, adding a good grade of rust inhibitor or high boiling point type antifreeze. Refer to EMD 645 Series Turbo Marine Engine Maintenance Manual in Chapter 6 of this manual for complete details.

Refer to EMD Maintenance Instructions for details on the specifications of the cooling system and coolant selections.

With the use of a proper antifreeze or rust inhibitor, this interval may be lengthened to every six (6) months if no corrosion is evident before this. The length of the interval will depend upon an inspection for rust and other deposits on the internal walls of the cooling system. When a thorough cleaning of the cooling system is required, it should always be reverse flushed for maximum cleansing effect on the coolant galleries and lines.

1.8.4 Coolant Analysis Take a sample of the coolant at least every 2100 hours of operating time, and have a complete analysis run to determine needed additives

1.8.5 Radiator Inspect the exterior of the radiator core every 700 hours and, if necessary, clean it with a quality grease solvent that is designated for use as a coil cleaner. Direct the solvent through the fin assembly in the opposite direction of the normal airflow. Dry with compressed air in the same manner.

WARNING

Do not use fuel oil, kerosene or gasoline as a solvent.

It may be necessary to clean the radiator more frequently if the unit is being operated in an extremely dusty or caustic environment.

The inside of the tubes should be inspected periodically and cleaned as necessary. Removal of access plugs allows visual inspection and, if necessary, the use of mechanical tube cleaners. Tapered plugs that are removed for tube inspection or cleaning should be replaced in the same hole. Should tapered plugs develop leaks, additional tightening is normally all that is required. Thread dope may be used if tightening alone is not sufficient. If shoulder type plugs develop leaks, the gaskets should be replaced immediately. The repair of tube leaks depends on the location of the leak. If the leak occurs in the tube wall, it is usually most practical to use tapered tube sealing pins to plug both ends of the tube. When numerous tubes have become plugged and performance is affected, re-tubing will be necessary. If leaks develop in the tube-to-tube sheet joints, the tubes may either be plugged off or re-rolled. If re-rolling is attempted, care must be used in selection of the proper tube expander for the size and gauge of the tube being rolled.

CAUTION

If it is ever necessary to re-roll the tubes, care must be taken with this procedure. Do not over-roll as this will weaken the tube.

The unit's operating technician should be aware of operating conditions and note when the coolant temperature gauge reading begins to rise as the operating time for the unit progresses. The radiator coil should be cleaned well in advance of the coolant temperature safety warning initiation.

A daily inspection should be made of the liquid level glass at the coolant inlet of the radiator. Be sure the coolant is the proper level before operating the unit.

For complete details on the radiator and related assemblies, refer to the vendor data/manuals supplied with the equipment.

1.9 AIR INTAKE AND EXHAUST SYSTEMS

1.9.1 Turbocharger The turbocharger assembly is primarily used to increase engine horsepower and provide better fuel oil economy through utilization of the exhaust gases. The turbocharger is a single stage turbine with a connecting gears train that is driven by the engine gear train.

Inspect the mountings, intake, and exhaust ducting and connections for tightness and possible leaks. Check the oil inlet and outlet lines for leaks and corrosion causing restrictions to the oil flow. Check for unusual noises or vibrations and, if excessive, remove the turbocharger assembly and correct the cause (starting with the gaskets). For complete details on the turbocharger, refer to EMD 645 Series Engine Maintenance Manual in Chapter 6 of this manual.

WARNING

Turbocharger service should ONLY be performed by qualified personnel.

CAUTION

Follow the manufacturer's recommendations to properly maintain equipment.

It is not recommended or practical to attempt any reconditioning of the turbocharger in the field. It is recommended that it be returned to EMD for service. However, if this is not possible, refer to the EMD 645 Series Engine Maintenance Manual for details on the removal and installation procedures for the turbocharger.

1.9.2 Air Box Drains Accumulation of liquids from the engine air box is removed through drain holes in the base rails of the crankcase which are aligned with pipes located on each side of the oil pan at the front of the engine. Both pipes connect to the main drain flange mounted on the oil pan. The flange places pressures from each pipe in opposition in order to prevent excessive loss of air from the box.

The air box drains should be cleaned as follows:

- a. Disconnect external piping connected to the drain flange.
- b. Remove the drain flange from the oil pan and clean with brush and solvent.
- c. Remove air box hand-hole covers nearest the drain holes.
- d. Feed cleaning tool into the drain hole in the base rail, turning it and using a "rodding" motion to loosen carbon and sludge from inside the drain pipes.
- e. Once both drains have been completely cleared, flush piping with fuel oil or similar solvent to remove loose debris and residue.
- f. Mount drain flange to oil pan, reconnect external piping and reinstall air box hand-hole covers.

WARNING

Always use caution when working around electrical equipment. Serious injury to personnel or damage to equipment could occur

CAUTION

Follow the manufacturer's recommendations to properly maintain equipment.

1.9.3 Exhaust Manifold

The exhaust manifold is made up of chamber assemblies, expansion joints, and an adapter assembly. The expansion joints are used between chamber assemblies and between the adapter and screen assembly and the turbocharger, to compensate for expansion and contraction of the manifold due to temperature changes. The adapter assembly contains a stainless steel screen and trap to prevent entry of foreign objects/debris.

The screen/trap must be maintained according to the following procedure:

- a. Inspect the adapter and trap screen assembly between the rear expansion joint and the chamber assembly for the condition of the screen.
- b. Check exhaust manifold base flange bolts for proper tightness.

For a detailed description of the exhaust manifold assembly, refer to the EMD 645 Series Engine Maintenance Manual and EMD 645/710 Operating Manual in Chapter 6 of this manual.

1.10 AIR START SYSTEM

1.10.1 General The air start system components should be checked periodically for loose connections and/or corrosion. Repair or replace, if necessary.

1.10.2 Air Starter The air starting motors require no scheduled maintenance. The airline lubricator is the only component on the engine skid that requires scheduled maintenance. If equipped, the lubricator in the air line to the starting motors should be checked regularly for oil, refilled, and adjusted when necessary. Oil is added to the lubricator through a filler cone at the top of the bowl on the lubricator. Use of a clean, high quality grade of an SAE No. 10 oil is recommended for ambient temperatures between 60-120 °F (16-49 °C).

Adjustment procedure for the inline lubricator is as follows, (disregard if not equipped):

- a. Inspect the air start motor exhaust for excessive oil, as air is moving through system.
- b. Adjust needle valve on the lubricator assembly to permit only one or two drops of oil per second when the air is moving. The adjustment ratio is approximately two (2) drops of oil per turn of the needle valve.
- c. Re-inspect air exhaust.

1.10.3 Strainer The strainer in the air line should be checked and cleaned of any debris regularly. If strainer becomes clogged prematurely, check air tanks and connections for possible leaks.

For complete details on maintaining the engine mounted air start components, refer to EMD 645 Series Engine Maintenance Manual and EMD 645/710 Operating Manual in Chapter 6 of this manual. For details on the air start motor, refer to the manual in Chapter 6 of this manual.

1.11 GENERATOR

For complete servicing procedures, refer to the Baylor Generator Instruction Manual in Chapter 6 of this manual.

1.12 ENGINE TUNE-UP

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc., should only be required periodically to compensate for normal wear on the parts. For complete details on tune-up procedures, refer to EMD 645 Series Turbo Marine Engine Maintenance Manual, in Chapter 6 of this manual.

1.13 CONTROLS AND INDICATORS

There is no set schedule interval for inspecting and cleaning the control panels, gauges, and switches. With the DC potential disconnected, the control cabinet and panels should be blown out with air and/or wiped clean, inside and out. A light coat of a corrosion-preventive spray solution is recommended on unpainted/untreated surfaces. A non-oil base cleaner/lubricant spray is recommended, as an oil base spray will eventually fog the glass covers on the gauges/indicators, making them unreadable.

During the cleaning process, a visual inspection should be made of any loose components, terminal screws, and soldered connections. This inspection is especially beneficial for the skid-mounted local control panels and electrical enclosures that are constantly exposed to vibration from the engine. In addition, inspect the vibration absorbing neoprene panel and cabinet mounts for elasticity and resiliency. If hardened or cracked, replace immediately.

Refer to the applicable vendor manuals in Chapter 6 of this manual for complete details.

1.14 CORROSION CHECK

Treating for corrosion before it becomes a problem is a necessary, ongoing process. A weekly inspection for corrosion damage consists of thoroughly cleaning and preserving or lubricating all exposed metal surfaces. The generator set is sealed with several coats of industrial sealant paint but this protective shell can breakdown at vibration sensitive areas or places exposed to extreme heat for long periods of operation. Inspection for signs of rust should always be conducted and ongoing during the course of routine maintenance procedures.

When the unit is not in service, every precaution should be taken against corrosion. For further storage details, refer to Chapter 3, Section 3 of this manual.

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TROUBLESHOOTING

2.1 DEFINITION

WARNING

For your own protection, do not use substitute parts without the approval of Stewart & Stevenson Services.

CAUTION

If the operator has ANY QUESTIONS about the safe use or maintenance of the generator set, ASK THE SUPERVISOR - NEVER GUESS - ALWAYS CHECK.

Troubleshooting can be defined as the act of locating a trouble or defect in the equipment. Various troubleshooting techniques have been developed, but all pertinent data is used to locate a defect.

WARNING

Do not wear loose clothing, unbuttoned shirts, or neckties while working on moving equipment.

CAUTION

Follow the manufacturer's recommendations to maintain equipment properly.

2.2 ENGINE

The troubleshooting tables provided in this section (Tables 2-1 through 2-4) are intended to serve as a guide by which the technician can locate a malfunctioning component in an assembly or system. The engine manual, located in Chapter 6 of this manual, is devoted entirely to troubleshooting the engine and turbocharger. Chapter 1, Section 2 of this manual gives specifications and capacities of the engine systems that may be helpful in determining a problem.

TABLE 2.1 FUEL OIL SYSTEM

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Fuel oil not reaching engine	Malfunctioning check valve	Replace check valve.
	Faulty engine-driven fuel oil pump	Replace fuel oil pump, as outlined in Chapter 6 of this manual.
	Clogged filters and/or strainers	Clean strainers and/or replace filter elements.
Low fuel oil pressure at engine	Refer to "Fuel oil not reaching engine"	
Excessively high fuel oil pressure at engine	Faulty return line check valve	Replace check valve.
	Clogged return line	Clear obstructions from return line.
Fuel oil not reaching fuel oil tank during refill operation	Faulty solenoid valve	Replace fuel oil solenoid valve.
	Faulty fuel oil level switch	Replace fuel oil level switch.
	Faulty fuel oil transfer pump	Check pump motor switch starter for "ON" position.
	Clogged fuel oil strainer	Clean strainer.

TABLE 2.2 COOLING SYSTEM

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Excessively high temperatures in system	Faulty thermostatic valve	Replace thermostatic valve.
	Faulty jacket water cooler	Check fan belt for tightness. Check motor starter switch for "ON" position. Clean core and tubes if dirty.
	Faulty water pump	Repair or replace water pump, as outlined in Chapter 6 of this manual.
	Clogged lube oil cooler	Disassemble and clean lube oil cooler.

TABLE 2.3 LUBRICATION SYSTEM

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Low lube oil delivery pressure at engine lube oil manifold during engine operation.	Clogged oil strainer	Clean or replace strainer element. Replace filters.
	Faulty main lube oil pump	Repair or replace pump.
	Clogged oil line	Remove obstructions.
Low piston cooling oil pressure during engine operation.	Clogged oil strainer	Clean or replace strainer element. Replace filters.
	Faulty piston cooling pump	Repair or replace pump.
	Clogged oil line	Remove obstructions.
Low oil pressure to lube oil manifold and turbocharger during pre-lube operation.	Clogged "Y"-type strainer	Clean strainer element. Replace filters.
	Faulty circulating pump or soak-back pump	Repair faulty pump.
Low oil pressure to lube oil manifold during pre-lube operation.	Malfunction in solenoid valve	Repair or replace solenoid valve.
	Faulty ball valve or check valve	Replace valve. Replace filter.
Low oil pressure at turbocharger during pre-lube operation.	Clogged strainer	Clean strainer element.
	Faulty check valve	Replace faulty check valve.
	Faulty relief valve	Replace faulty relief valve. Replace turbocharger filter.
Excessively high pressure at lube oil manifold and turbocharger during pre-lube operation.	Faulty relief valve	Replace relief valve.

CAUTION

Use only specified fluid types. Do not mix fluids.

TABLE 2.4 AIR START SYSTEM

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Loss of input air.	Air supply not connected	Reconnect air supply through flexible connector at skid.
Low air pressure at pressure gauge.	Clogged input line	Remove obstruction.
Low air pressure at starter motor.	Clogged air filter	Clean or replace element.
	Faulty air relay valve	Repair or replace valve.
	Faulty ball valve	Repair or replace ball valve.
	Faulty lubricator	Repair or replace lubricator.
Air pressure normal but still won't start.	Worn Bendix mechanism	Replace Bendix mechanism.

2.3 UNIT TROUBLESHOOTING

2.3.1 Introduction This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the generator set and its components. Common malfunctions that may occur are listed in Table 2.5. Each malfunction stated is followed by a list of probable causes of the trouble. Corrective action recommended is described opposite each probable cause. This table does not list all malfunctions; refer to the manufacturer's literature in Chapter 6 for more specific and detailed troubleshooting information.

WARNING

Always use caution when working around electrical equipment. Serious injury to personnel or damage to equipment could occur.

Table 2.5 Unit Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1. Starting aid does not operate.	a. Defective switch	a. Test/replace switch.
	b. Defective solenoid.	b. Replace solenoid.
	c. Defective wiring.	c. Refer to wiring diagram.
2. Engine fails to crank.	a. Improper starting procedure.	a. Perform starting procedure according to Operation section.
	b. Defective starter switch.	b. Test/replace starter switch.
	c. Defective starting circuit or break in starting circuit wiring.	c. Refer to wiring diagram.
	d. Defective starter assembly.	d. Defective starter assembly.
3. Engine cranks but fails to start.	a. Improper starting procedure.	a. Perform starting procedure as outlined in Operation Section.
	b. Low or no fuel oil supply.	b. Service fuel oil tank.
	c. Water in fuel oil, contaminated or incorrect grade of fuel oil.	c. Service fuel oil filter/water separator. Drain tank of fuel oil and clean/service with clean, proper grade of fuel oil.
	d. Air in fuel oil lines.	d. Bleed fuel oil system. Tighten any loose fuel oil supply line connections.
	e. Obstruction in fuel oil supply line.	e. Clean fuel oil supply lines by flushing with clean fuel oil.
	f. Defective fuel oil pump.	f. Test/replace fuel oil pump.

Table 2.5 Unit Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
4. Engine starts correctly, but stops when START switch is released.	a. Defective STOP switch	a. Test/replace switch
	b. Defective or low oil pressure	b. Test/replace switch.
	c. Defective high engine temperature switch.	c. Test/replace switch.
	d. Defective wiring.	d. Notify direct support.
	e. Defective low fuel oil level switch.	e. Test/replace switch.
5. Engine stops suddenly.	a. Protective device tripped.	a. Check fault indicator for malfunction indication. Refer to the appropriate maintenance section.
	b. Fuel oil support exhausted.	b. Refill fuel oil tank.
	c. Air lock in fuel oil supply line.	c. Bleed fuel oil system. Tighten any loose fuel oil line connections.
	d. Obstruction in fuel oil line.	d. Service fuel oil system.
	e. Water in fuel oil.	e. Drain fuel oil tank. Service fuel oil system with clean fuel oil.
	f. Defective engine-protective device.	f. Test replace engine protective device.
6. Engine runs roughly or misfires.	a. Improper grade or contaminated fuel oil.	a. Check for fuel oil contamination. Drain fuel oil tank. Change fuel oil filters. Service with clean fuel oil of proper grade.
	b. Dirty air filter.	b. Service air filter.
	c. Obstruction in fuel oil line.	c. Clean or replace fuel oil supply line.
	d. Defective fuel oil injector(s).	d. Refer to Engine Service Manual.

Table 2.5 Unit Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
7. Engine does not develop full power.	a. Cylinder misfiring.	a. Refer to malfunction 6.
	b. Exhaust pipe or muffler restricted.	b. Clean or replace exhaust pipe, muffler, or turbocharger screen.
	c. Defective fuel oil injector(s).	c. Refer to Engine Service Manual..
8. Engine knocks.	a. Oil picked up by airstream.	a. Refer to Engine Service Manual.
	b. Low coolant temperature.	b. Refer to Engine Service Manual.
	c. Defective fuel oil injector(s).	c. Refer to Engine Service Manual.
	d. Improper grade of fuel oil.	d. Check for fuel oil contamination. Drain fuel oil tank. Change fuel oil filters. Service with clean fuel oil of proper grade.
9. Black or gray smoke in exhaust.	a. Dirty air filter.	a. Service air filter.
	b. Generator set overloaded.	b. Reduce load to rated level.
	c. Defective fuel oil injector(s).	c. Refer to Engine Service Manual.
	d. Improper grade of fuel oil.	d. Check for fuel oil contamination. Drain fuel oil tank. Change fuel oil filters. Service with clean fuel oil of proper grade.
10. Blue smoke in exhaust.	Faulty lube oil control.	Refer to Engine Service Manual.
11. White smoke in exhaust.	Misfiring cylinders.	Refer to Engine Service Manual.
12. Low oil pressure.	a. Low oil level.	a. Add oil to proper level on dipstick.
	b. Defective low oil pressure switch.	b. Test/replace switch.
	c. Clogged oil filter.	c. Service oil filter.

Table 2.5 Unit Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
12. Low oil pressure (Cont).	d. Improper oil viscosity.	d. Drain crankcase and refill with oil of proper viscosity.
	e. Internal engine fault.	Refer to Engine Service Manual.
13. Engine overheats.	a. Air inlet blocked.	a. Remove blockage.
	b. Cooling air fan defective.	b. Test/replace cooling air fan.
	c. Generator set overloaded.	c. Reduce load.
	d. Defective high engine temperature switch.	d. Test/replace switch.
	e. Loose or defective V-belt.	e. Adjust/replace V-belt.
	f. Coolant loss	f. Replenish coolant.
14. Frequency fluctuates.	a. Erratic engine operation.	a. Refer to Engine Service Manual
	b. Defective frequency meter.	b. Test/replace hertz meter.

REPAIRS AND ADJUSTMENTS

3.1 REPAIRS

WARNING

For your own protection, do not use substitute parts without the approval of Stewart & Stevenson Services.

WARNING

Do not wear loose clothing, unbuttoned shirts, or neckties while working on moving equipment.

3.1.1 Engine Repairs to the engine should be carried out in accordance with the procedures outlined in the EMD 645 Series Engine Maintenance Manual, and EMD 645/710 Operating Manual, included in Chapter 6 of this manual.

3.1.2 Generator Repairs to the generator should be made by qualified individuals using the Baylor Generator Service Manual located in Chapter 6 of this manual.

3.1.3 Systems Repairs to the various systems and controls furnished by Stewart & Stevenson should be done using this manual and various vendor information contained in Chapter 6. A detailed Parts List is contained in Chapter 4 of this manual, to help with procurement of replacement parts. All other ancillary equipment repairs should be referenced in the applicable vendor data in Chapter 6 of this manual and under separate cover.

3.2 ADJUSTMENTS

3.2.1 Engine Adjustments needed for the engine are contained in EMD 645 Series Engine Maintenance Manual, and EMD 645/710 Operating Manual, included in Chapter 6 of this manual.

3.2.2 Generator The generator should not need any adjustments, except for alignment checks on a 2-year basis. Refer to Baylor Generator Service Manual located in Chapter 6 of this manual for alignment instructions.

3.2.3 Systems Adjustments to the fuel, oil, and water systems need to be made only when some pressure or volume becomes out of tolerance. Refer to the specifications in Chapter 1, Section 2; the drawings in Chapter 5 and vendor data in Chapter 6 for procedures of adjustment of the particular item.

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LUBRICATION

4.1 OVERVIEW

WARNING

Always use caution when working around rotating equipment. Serious injury to personnel or damage to equipment could occur.

WARNING

Lubricate only when the equipment is shut down, isolated, and tagged "Out of Service."

This section contains instructions for the lubrication of the diesel engine generator set fabricated by Stewart & Stevenson Services. For convenience, lubrication details in this section pertain to major components supplied by others so that the service technicians have a single, abbreviated source for interval lubrication of the generator set as a unit. For complete details on a certain component, refer to the vendor data sets contained in Chapter 6 of this manual.

4.2 LUBRICATION BENEFITS

4.2.1 Best Performance Your generator set is ensured of its best performance and reliability when a scheduled preventive maintenance program is followed. A small cost and effort expended for a preventive maintenance program yields improved performance, efficiency, and reliability.

4.2.2 Benefits These benefits are realized by:

- a. Understanding the nature of lubrication as a part of preventive maintenance.
- b. Following the lubrication and preventive maintenance schedule that has been established.

4.2.3 Intended Use This generator system is intended for emergency use at times of utility power failure. Preventive maintenance that includes lubrication is the key to any standby service generator set. A program of regular lubrication can assure the ready availability of the generator sets in emergency situations. A complete log of all lubrication, as part of maintenance and repairs, should be kept to help pinpoint future problem areas.

4.3 NATURE OF PREVENTIVE LUBRICATION

CAUTION

If the operator has ANY QUESTIONS about the safe use of lubricants or lubrication of the generator set, ASK THE SUPERVISOR - NEVER GUESS - ALWAYS CHECK.

4.3.1 Lubrication Service The action of maintaining the proper amounts (levels) of lubricating grease, or oil. Lubrication service can be performed as part of a repair service to a specific component that requires lubrication as part of the installation procedure. While performing lubrication service on repaired/replaced equipment, refer to the specific equipment service manuals supplied in Chapter 6 of this manual. Lubrication service can also be a part of an interval maintenance program.

4.3.2 Lubrication Maintenance This necessary, ongoing process consists of thorough checking, assurance of protective lube coating, and the lubrication procedure. Generator sets located where high humidity or high temperatures are prevalent require extra awareness of the lubrication needs of the unit.

4.4 LUBRICATING OIL

4.4.1 Check Check the lubricating oil level with the engine stopped. If the engine has just been stopped, wait approximately twenty (20) minutes to allow the oil to drain back into the oil pan.

Add the proper grade oil, as required, to maintain the correct level on the dipstick. Refer Chapter 1, Section 2 of this manual and the EMD Maintenance Instructions in Chapter 6 of this manual for complete details on oil specifications.

Make a visual check for leaks around the filters and the external oil lines. Change the oil at the intervals shown in Chapter 2, Section 1, Table 2.2. The drain interval may be established on the recommendations of an independent oil analysis laboratory or the oil supplier until the most practical oil change period has been determined.

CAUTION

Avoid excessive lubrication and do not lubricate the governor while the engine is running.

4.5 GENERATOR

WARNING

Always use caution when working around electrical equipment. Serious injury to personnel or damage to equipment could occur

CAUTION

Follow the manufacturer's recommendations to properly maintain equipment.

For complete details on the lubrication of the Baylor generator, refer to the Baylor Generator Instruction Manual located in Chapter 6 of this manual. Refer to Chapter 1, Section 2 of this manual for specifications on the lubricant used.

4.6 ANCILLARY EQUIPMENT

For complete details on the lubrication of equipment and systems of the generator set, refer to the applicable vendor data in Chapter 6 of this manual.

4.7 LUBRICATION SCHEDULE

NOTE

The following Lubrication Schedule form has been included as an example and/or reproducible copy for use by attending service personnel. Additional components should be added by maintenance personnel on-site.

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G3608TA
TECHNICAL DATA

8/29/00 W- P 3/4
MB

CATERPILLAR

Caterpillar Inc.
Lafayette Engine Center
Lafayette, Indiana 47906

June 15, 2000

Gas Engine Emissions Letter

Project:	MDWASD Alexander WTP	Rating (note below):	2225	bhp @ 1000 rpm
Model:	G3608 LE	BSFC (Btu/bhp-hr):	6870	+/- 3.0%
Compression Ratio:	8.1	J/W Outlet Temp. (°F):	180	
A/C Inlet Temp. (°F):	130	Altitude (ft):	sea level	
Fuel LHV (Btu/ft³):	963	Ambient (°F):	110	
Fuel MN:	72.7			

	<u>NOx</u> (as NO2)	<u>CO</u>	<u>THC</u>	<u>NMHC</u>	<u>NMNEHC</u>
g/bhp-hr	0.70	2.60	8.00	1.06	0.51
tons/year	15.0	53.7	128.9	22.8	11.0

Exhaust Mass Flow (lb/hr, wet): 28,548
Exhaust Volume Flow (cfm, wet): 14,818
 @ 842°F stack temp, 14.6 psia

MIAMI-DADE
WATER AND SEWER DEPARTMENT
RECEIVED
SEP 12 2000
SD ENGINEERING DIVISION SD

Emission levels are based on engine operation at steady state conditions adjusted to the specified NOx level. The CO, THC, NMHC, and NMNEHC values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "not to exceed" values. Tons per year values are based on 8,760 hours of operation per year.

This information is valid for engine orders placed within six (6) months of the above date. Please contact the factory after six months if an extension is required.

Sincerely,

Jeffery A. Elijah
 Jeffery A. Elijah
 G3600 Applications
 Lafayette Engine Center



Caterpillar Inc.
Lafayette Engine Center
Lafayette, Indiana 47906

June 15, 2000

Gas Engine Emissions Letter

Project:	MDWASD Alexander WTP	Rating (note below):	2225	bhp @ 1000 rpm
Model:	G3608 LE	BSFC (Btu/bhp-hr):	6810	+/- 3.0%
Compression Ratio:	9.1	J/W Outlet Temp. (°F):	190	
A/C Inlet Temp. (°F):	130	Altitude (ft):	sea level	
Fuel LHV (Btu/lb):	963	Ambient (°F):	110	
Fuel-MN:	72.7			

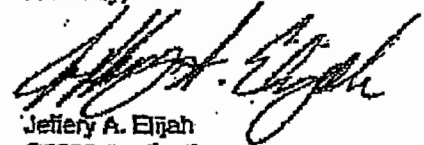
	<u>NOx</u> (as NO2)	<u>CO</u>	<u>THC</u>	<u>NMHC</u>	<u>NMNEHC</u>
g/bhp-hr	0.70	2.50	6.00	1.06	0.51
tons/year	15.0	53.7	128.9	22.8	11.0

Exhaust Mass Flow (lb/hr, wet): 26,548
 Exhaust Volume Flow (cfm, wet): 14,816
 @ 842°F stack temp, 14.5 psia

Emission levels are based on engine operation at steady state conditions adjusted to the specified NOx level. The CO, THC, NMHC, and NMNEHC values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "not to exceed" values. Tons per year values are based on 8,760 hours of operation per year.

This information is valid for engine orders placed within six (6) months of the above date. Please contact the factory after six months if an extension is required.

Sincerely,



Jeffery A. Eljah
G3600 Applications
Lafayette Engine Center

Operation		100%	75%	50%	25%
Speed	rpm	1000	1000	1000	1000
JW Outlet Temperature (°F)		190	190	190	190
A/C Inlet Temperature (°F)		130	130	130	130
Engine Power	bhp ¹	2225	1669	1113	556
NOx (as NO ₂)	g/bhp-hr ²	0.70	0.70	0.70	1.20
CO	g/bhp-hr ²	1.90	1.90	1.90	2.20
HC (Total)	g/bhp-hr ²	5.95	6.30	6.50	6.00
HC (Non-Methane)	g/bhp-hr ²	0.89	0.95	0.98	0.90
Exhaust Oxygen	% (dry)	12.3	11.7	10.7	10.2
BSFC	Btu/hp-hr	6810	7035	7550	9620
Compressor Out Pressure	In Hg abs	70.4	54.2	38.6	32.0
Compressor Out Temp (°F)		280	238	154	132
Intake Manifold Pressure	In Hg abs	69.7	53.8	38.3	23.9
Intake Manifold Temp (°F)		148	143	140	136
Air-Fuel Ratio	vol/vol	20.09	19.93	18.57	17.40
Timing	°BTDC	20.2	20.2	19	16.2
Fuel Energy	Btu/min ³	252538	195661	139990	89185
Exhaust (LHV)	Btu/min ⁴	97042	76771	56282	34002
Exhaust (to 350°F)	Btu/min ⁴	58201	46898	34427	22433
Aircooler	Btu/min ⁵	16141	8285	1113	63
Radiation - Engine only	Btu/min ⁶	11177	10468	9659	8740
Oil Cooler	Btu/min ⁷	10325	10025	9750	9450
Jacket Water	Btu/min ⁴	23467	19324	15993	13334
Air Flow	lb/hr	25760	19784	13195	7876
Air Flow (scfm @ 77°F, 13.9 psia)		6136	4715	3143	1876
Exhaust Flow	lb/hr	26537	20396	13626	8150
Exh Flow (cfm @ stack T, 14.5 psia)		14867	11610	8048	4978
Exhaust Stack Temp (°F)		847	868	918	965
Fuel Flow (scfh @ 60°F, 14.7 psia)		16743	12972	9281	5913

1) Continuous output and reference conditions according to ISO 3046/1 (77°F, 14.5 psia),
Natural gas LHV = 905 Btu/stt³.

(Engine power conversion: 1 bhp = 42.42 Btu/min)

2) Emissions data shown are not to exceed values.

3) Tolerance +/- 2.5%

4) Tolerance +/- 10%, jacket water heat rejection based on treated water as coolant

5) Tolerance +/- 5%, heat rejection based on treated water as coolant

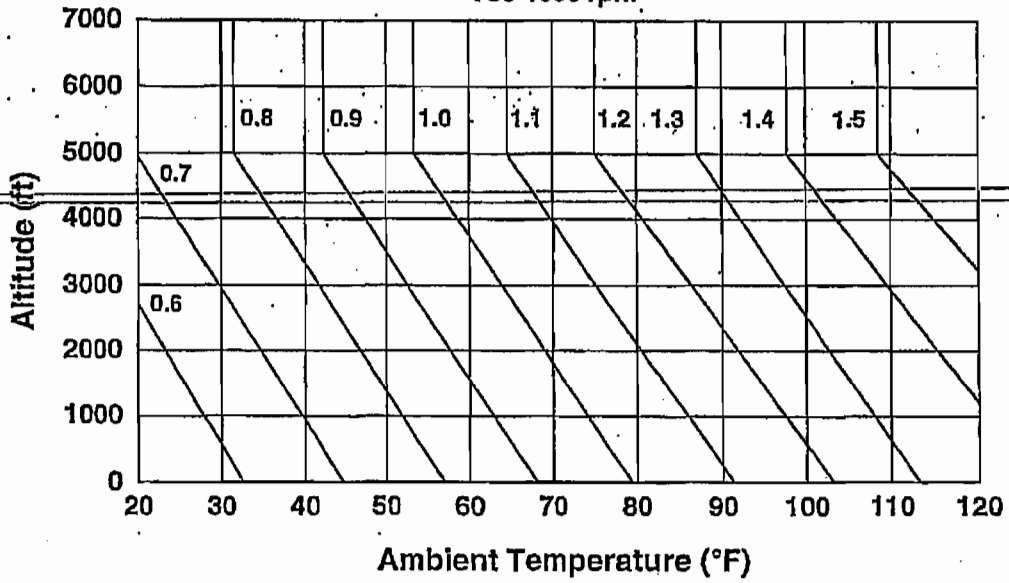
6) Tolerance +/- 25%

7) Tolerance +/- 20%, heat rejection based on treated water as coolant

Aftercooler Heat Rejection Factors

G3608 Industrial - 90°F SCAC

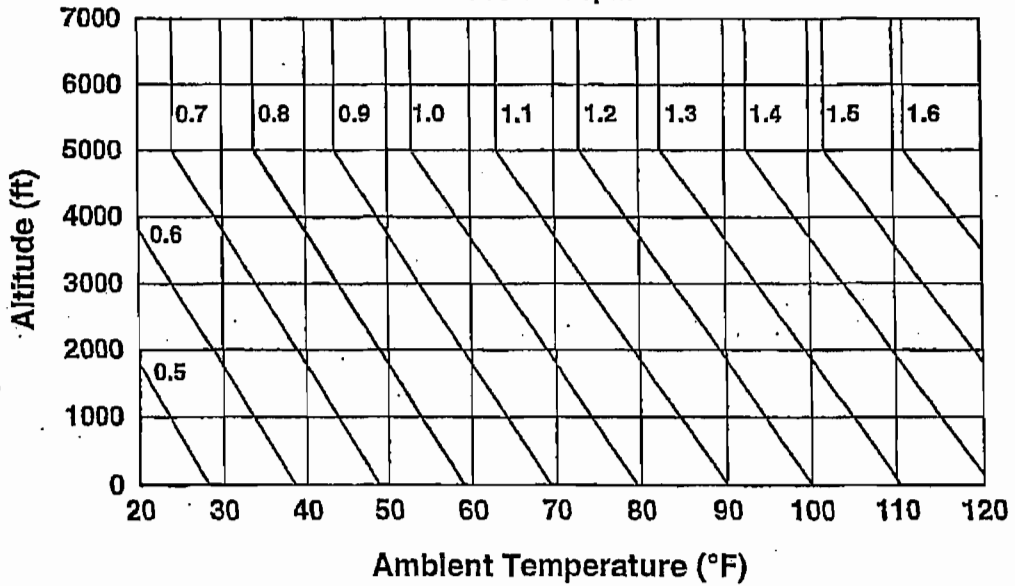
730-1000 rpm



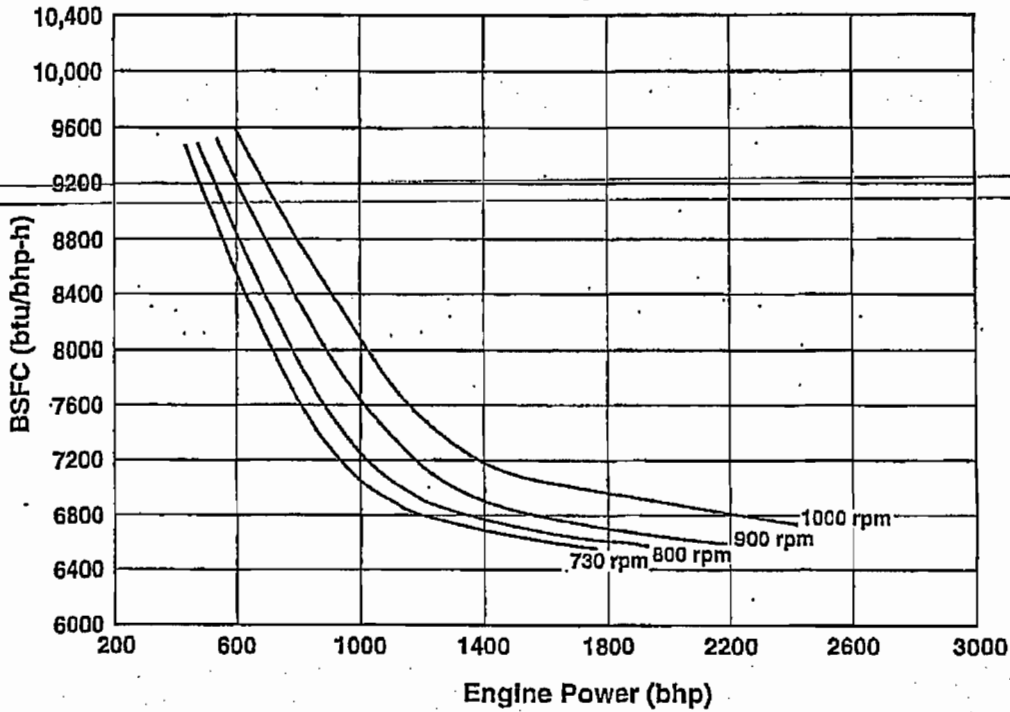
Aftercooler Heat Rejection Factors

G3608 Industrial - 130°F SCAC

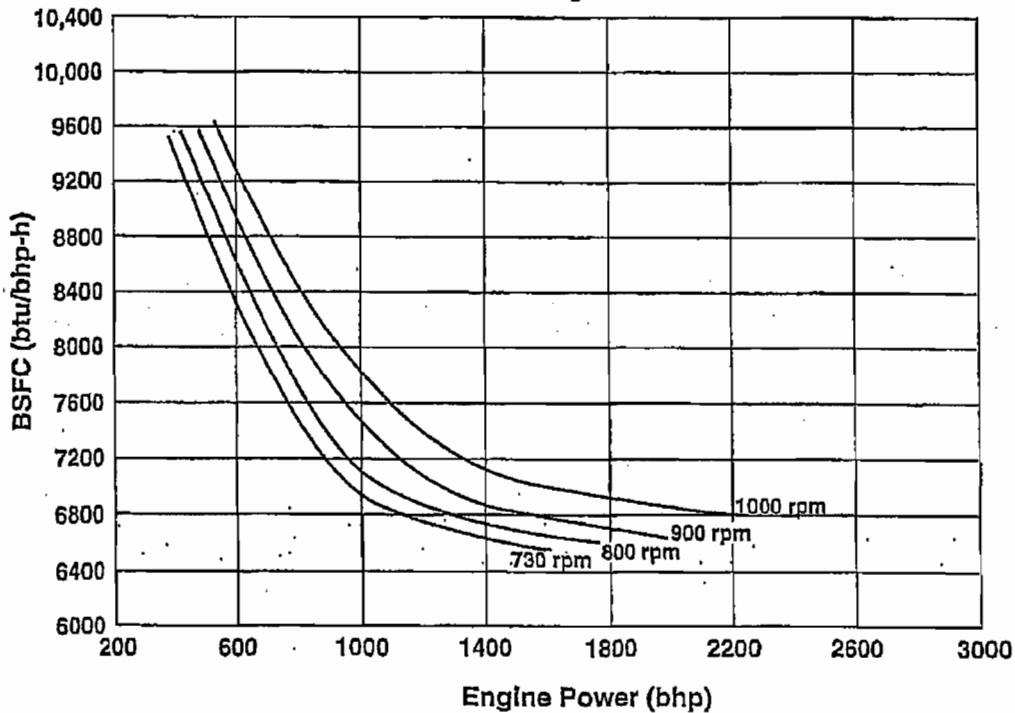
730-1000 rpm



G3608 BSFC Industrial Turbocharger 90°F SCAC



G3608 BSFC Industrial Turbocharger 130°F SCAC





Gas Engine Industrial Low Emission

G3608

1555-2350 HP

FEATURES

CATERPILLAR QUALITY THROUGHOUT

Gas engines incorporate many of the same proven components as their diesel counterparts - including the block, crankshaft, main bearings, camshaft and connecting rods. However, by operating at 40 to 50% lower cylinder pressure and bearing loads than diesels, they offer the extra benefit of prolonged life.

Caterpillar gas engines inherit more from their diesel counterparts than just strength. They are backed by the same support system recognized as one of the most sophisticated and dependable in the world.

APPLICATION FLEXIBILITY

Broad operating speed range and the ability to burn a wide spectrum of fuels.

LOW EMISSIONS

1 gram/hp hr NOx level at 1000 RPM.

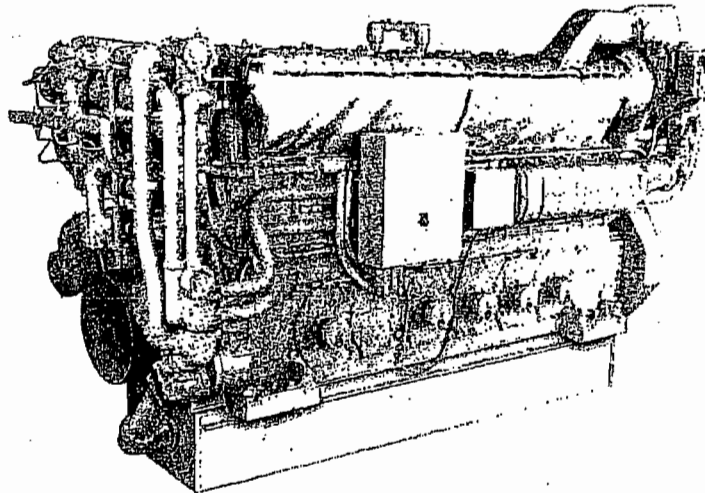
SUPERIOR TECHNOLOGY

Represent the latest technology in engine design. The engine is offered in a low emission, turbocharged and aftercooled configuration only. This configuration offers:

- High energy ignition systems for consistent firing
- Highly efficient enriched prechamber design for complete combustion
- Modern component design such as deep cup, oil gallery piston
- Electronic controls to optimize performance.

RESULT

Low emissions and BSFC under all operating conditions.



Arrangement may be shown with optional equipment

STANDARD PACKAGE ARRANGEMENT

GENERAL

- Flywheel and Ring Gear
- Crankcase Explosion Doors
- High Efficiency Turbos
- Aftercooler
- Engine Barring Device
- Torsional Vibration Damper
- Industrial Engine Supports
- Protective Guards

COOLING SYSTEM

- Jacket Water Pump
- Water Regulators, 189° F
- Separate Circuit Gear Driven Pump For Aftercooler/Oil Cooler Circuit

IGNITION SYSTEM

- Altronic III Ignition with Variable Timing

CONTROLS

- Electronic Supervisory System:

- Governing
- Air/Fuel Ratio Control
- Timing Optimization
- Instrument Panel to Monitor:

- Oil Pressure and Temperature
- Oil Pressure Differential Intake Manifold Pressure
- Intake Manifold Temperature

- Crankcase Pressure
- Water Temperatures
- Exhaust Temperatures
- Service Meter Hours
- Engine Speed

FUEL SYSTEM

- Fuel Filter
- Shipped Loose Gas Pressure Regulator

PROTECTION

- Misfire Sensing
- Detonation Sensing and Compensation
- Engineized to Run Shutdowns for: Engine Overspeed

- Oil Pressure
- Water Pressure
- Crankcase Pressure

LUBE OIL SYSTEM

- Gear Driven Lube Oil Pump
- Engine Mounted Lube Oil Filters
- Engine Mounted Lube Oil Cooler
- Prelube/Postlube System
- Sump Pump Connections

AIR INTAKE SYSTEM

- Shipped Loose Air Cleaners
- Installed Turbo Air Inlet Adapters

ATTACHMENTS

- Custom Industrial Base Expansion Tank

G3608 INDUSTRIAL GAS ENGINE GENERAL SPECIFICATIONS

Continuous Ratings (BHP)

	1000 rpm	900 rpm	800 rpm	700 rpm
LE TA-90	2350	2120	1880	1645
LE TA-130	2225	2000	1775	1555

Physical Factors

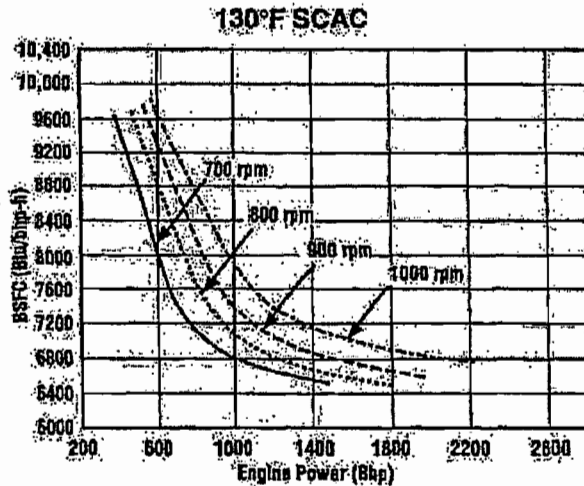
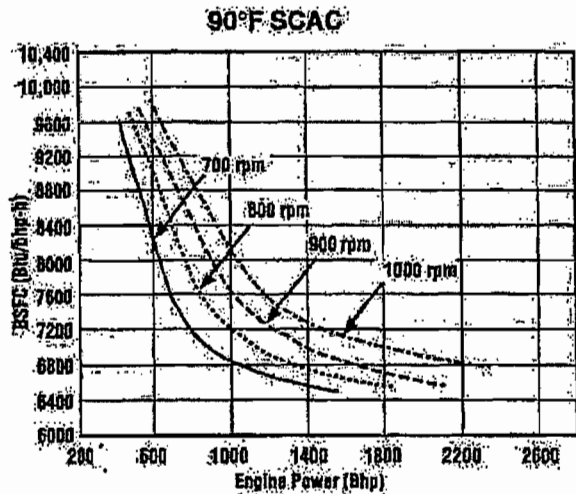
	Height	Width	Length	Weight
LE TA	129.2 in.	64.7 in.	213.5 in.	48,800 lbs.

General Specifications

CAT 3608 ENGINE

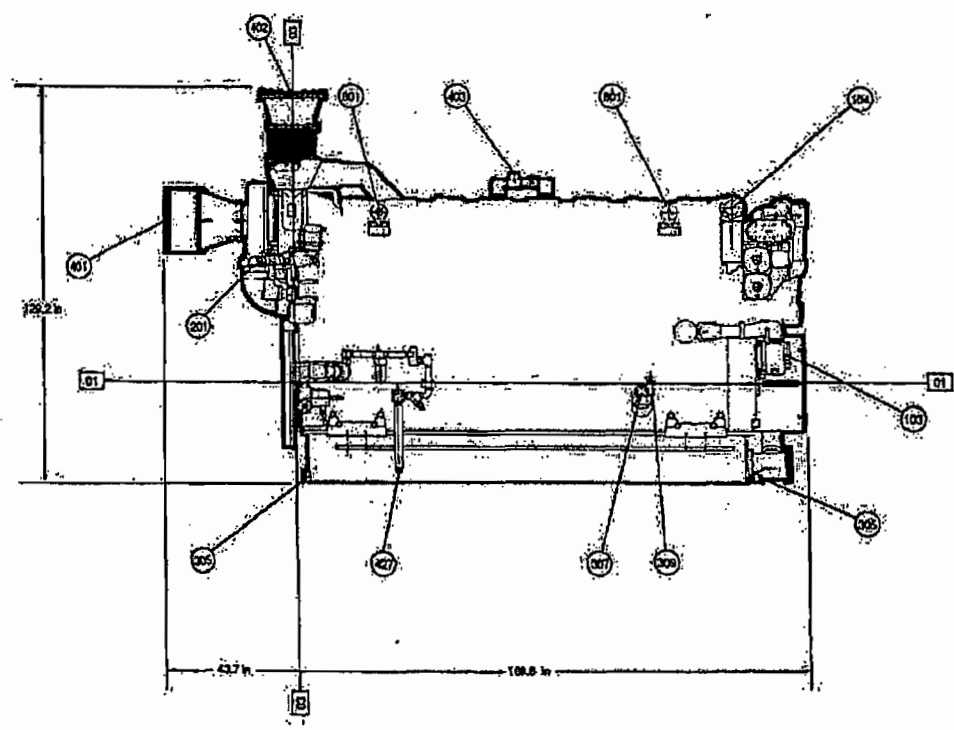
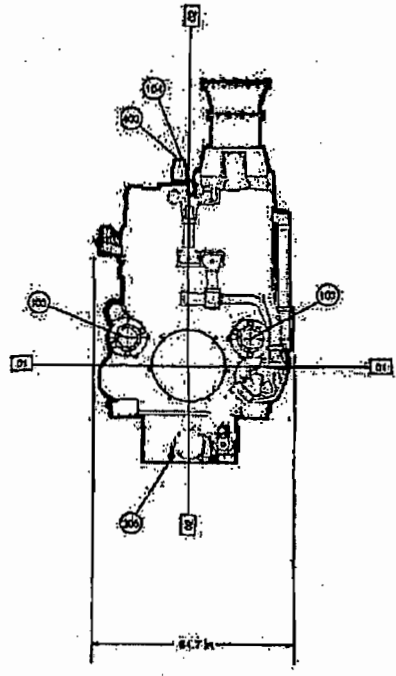
Type — Spark Ignited
 Displacement — 10,350 cu in
 Compression Ratio — 9.2:1
 Lube oil capacity — 341 gal
 Jacket water system — 140 gal

No. of Cylinders — 8
 Bore — 300 mm
 Stroke — 300 mm



G-808 INDUSTRIAL GAS ENGINE CONFIGURATION

- 01 CENTERLINE OF CRANKSHAFT
- 02 CENTERLINE OF ENGINE
- 03 REAR FACE OF CYL. BLOCK
- 103 WATER INLET
- 104 WATER OUTLET
- 201 FUEL INLET
- 305 OIL DRAIN
- 307 OIL FILLER
- 309 OIL LEVEL GAUGE
- 401 AIR INLET
- 402 EXHAUST
- 403 BREATHER OUTLET
- 427 AIR STARTING MOTOR INLET
- 801 LIFTING EYE



Note: General Configuration not to be used for installation.

CONDITIONS & DEFINITIONS

Ratings are based on SAE J1349 standard conditions of 100 kPa (29.61 in) Hg and 25°C (77°F); ISO 3046, DIN 6271;

BS 6514 standard conditions of 100 kPa (29.61 in) Hg, 27°C (81°F); and API 7B-11C standard conditions of 99 kPa (29.36 in) Hg, 29°C (85°F) also apply.

Ratings are based on dry natural gas having a low heat value of 35.22 MJ/m³ (905 Btu/ft³). Variations in altitude, temperature and gas composition from standard conditions may require a reduction in engine horsepower.

Turbocharged-aftercooled ratings apply to 1525 m (5,000 ft) and 25°C (77°F). For applications which exceed these limits contact your Caterpillar Dealer.

Materials and specifications are subject to change without notice. The International System of Units (SI) is used in this publication.

CATERPILLAR®

G3608TA

PRODUCT BROCHURE

G3608TA

PRODUCT DESCRIPTION

G3608TA

APPLICATION & INSTALLATION GUIDE



G3600 Family of Engines

**Product Description
and Specifications**

CATERPILLAR®

Engine Specifications

Engine Models	G3606	G3608	G3612	G3616
Configuration	6 Cylinder In-line	8 Cylinder In-line	12 Cylinder Vee	16 Cylinder Vee
Combustion System	*	*	*	*
Air Aspiration	TA	TA	TA	TA
Emissions (g/hp-hr)	NO _x	1.0	1.0	0.7
	CO	1.9	1.9	1.9
	THC	5.4	5.4	5.3
Mech Efficiency	38%	38%	38%	38%
Gas Pressure (psi)	45	45	45	45
Bore/Stroke	mm	300/300	300/300	300/300
	in.	11.81/11.81	11.81/11.81	11.81/11.81
Displacement	L	127.2	169.6	254.4
	cu in.	7764	10,352	15,528
Compression Ratio	9.2:1	9.2:1	9.2:1	9.2:1
Fuel Type				
Minimum Methane No.	50	50	50	50

* Spark Ignited, Lean Burn, Precombustion Chamber, Gas Admission

Engine Ratings

Generator Set – Ratings in ekW (generator output)

Engine Model	A/C Temp	50 Hz 1000 rpm	60 Hz 900 rpm
3606	90°F	1265	1135
	130°F	1195	1075
3608	90°F	1685	1515
	130°F	1590	1430
3612	90°F	2540	2285
	130°F	2400	2160
3616	90°F	3385	3050
	130°F	3195	2880

Assumes 96% generator on 3606 and 3608,
96.5% on the 3612 and 3616.

Industrial – Ratings in hp

Engine Model	Temp	1000 rpm	900 rpm	800 rpm	700 rpm
3606	90°F	1765	1590	1410	1160
	130°F	1665	1500	1335	1110
3608	90°F	2350	2120	1880	1510
	130°F	2220	2000	1780	1410
3612	90°F	3530	3175	2825	2360
	130°F	3335	3000	2665	2215
3616	90°F	4705	4235	3765	2490
	130°F	4445	4000	3555	2230

G3600 Product Description

The G3600 Family of Gas Engines incorporates advanced technology essential for high output, low emissions, and high thermal efficiency. Precise control of engine operating parameters allows the engine to operate at optimum performance on a wide range of fuels and ambient conditions.

Technological features include:

- Lean Burn Technology
- Precombustion Chamber
- Gas Admission Valves
- Advanced Electronic Controls
- Rugged Basic Structure

Primary applications for this engine are:

- Industrial
air compressors and direct drive chillers
- Electric Power Generation
load management and cogeneration
- Gas Compression
gas gathering and gas transmission

Many electric utilities are charging substantial demand charges and time of day rates which create a significant potential for gas engine sales. The high thermal efficiency of the 3600 Engines provides early payback and the low emissions allows easy permitting for most applications.

Direct drive air compressors and air conditioning chillers are two examples of ways to save costs by avoiding high electrical usage during peak periods. On-site power generation during peak periods is another way to drastically lower utility bills. Utilities themselves represent potential as they try to decentralize or add capacity. Cogeneration, either in base load or load management applications, provides another way

customers can enhance their savings. Future offerings of landfill and digester gas engine arrangements will expand this opportunity still further.

Fuel System

To ensure that each cylinder gets the correct amount of fuel at the proper air-fuel ratio, carburetors are not used. Instead, gas is admitted into the intake port, just ahead of the intake valve, see Figure 1. A unique gas admission valve, actuated by the camshaft, admits fuel into the intake port. A fuel manifold connects each cylinder and it is pressure in the manifold that meters the fuel into the intake port. By controlling the pressure in the manifold, the fuel into the engine is controlled, thereby controlling the power output of the engine. The control of the fuel pressure is the task of the electronically actuated fuel valve located on the right rear of the engine, see Figure 2. In order to admit fuel into the intake port at full load, the fuel pressure at the fuel inlet must be regulated to ± 0.25 psi within a range of 43 to 47 psi. Lower pressure will result in reduced power. Separate lines from the main fuel manifold provide additional gas to each precombustion chamber. An adjustable needle valve regulates the flow. These valves are adjusted to provide precise amounts of fuel to each prechamber so that consistent ignition and power are obtained from each cylinder.

Current design limits the fuel to dry processed natural gas with a minimum methane number of 50. Propane or untreated well head gas are not permitted. Low Btu engine arrangements are not available now but are being developed for landfills and sewage treatment plants. As new arrangements with expanded fuel capabilities are developed, they will be announced and made available. Low gas pressure fuel inlet systems are not available at the present time. Regulated gas pressures of 45 ± 2 psi, held to ± 0.25 are required at the engine inlet. Customer mounted remote gas filter groups are available for use before the fuel inlet connection. They are designed to filter 1 micron particle size with a maximum of 2 psi pressure

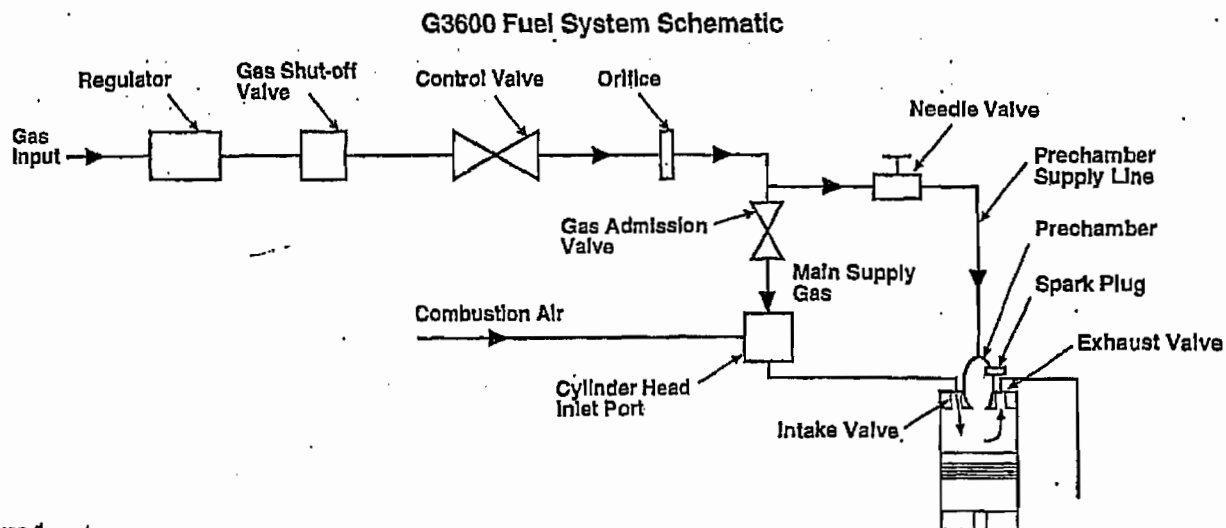


Figure 1

3600 Gas Valve

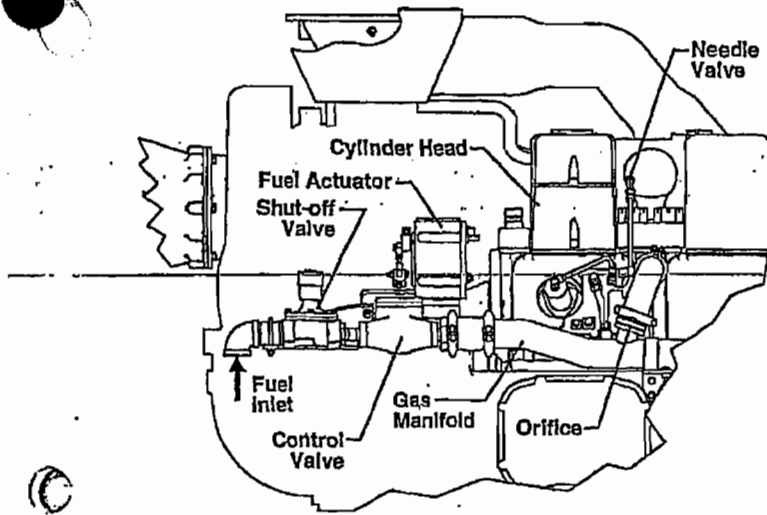


Figure 2

drop at rated flow and inlet pressures. See the *Drawings* section of this manual. Customer mounted gas pressure regulators are available to maintain gas pressure at the engine to 45 psi. They are available for gas pressures up to 150 psi.

Air System

Combustion air flows from the turbocharger, through the air inlet choke, through a water cooled plate/fin aftercooler, into the cylinder block air plenum, and then into the cylinder head inlet ports, see Figure 3. Fuel is introduced to the air in the cylinder head by the gas admission valve. Air flow is controlled by a combination of an air choke, (located downstream of the turbocharger

compressor outlet) and exhaust by-pass valve or wastegate. The wastegate, which by-passes exhaust gas around the turbocharger, determines the boost level, which in turn controls the intake manifold pressure, see Figure 4. The electronic control system determines the air pressure required to maintain the correct air/fuel ratio and controls the wastegate valve and/or choke butterfly valve accordingly. At loads above approximately 40%, the air choke is in the wide open position. Below this point, the inlet air choke restricts the air flow to maintain a sufficiently rich mixture for good combustion and stability, see Figure 5. Exhaust manifolds are dry with external thermal blanket shielding for reduced radiated heat and personnel safety. The low exhaust temperatures of lean burn engines allows the use of dry manifolds. They improve engine performance and response by retaining exhaust energy to drive the turbocharger, especially for constant torque, variable speed industrial applications. Both normal and heavy duty air cleaners are available to fit specific applications. Multiple high efficiency paper elements are used. They are shipped loose and are remote-mounted by the customer at the installation site using customer supplied piping. Under normal conditions a single enclosure is used for the inlines and two for the vees. Two enclosures required for vees under heavy duty applications. See the *Drawing* section of this Manual.

Ignition System

An 18mm J-gap spark plug is connected to the ignition transformer with an teflon extender and an aluminum electrical connection inside the teflon. The J-gap offers combustion advantages, particularly at low loads, and the teflon extender prevents electrical arcing to the

G3600 Air System Schematic

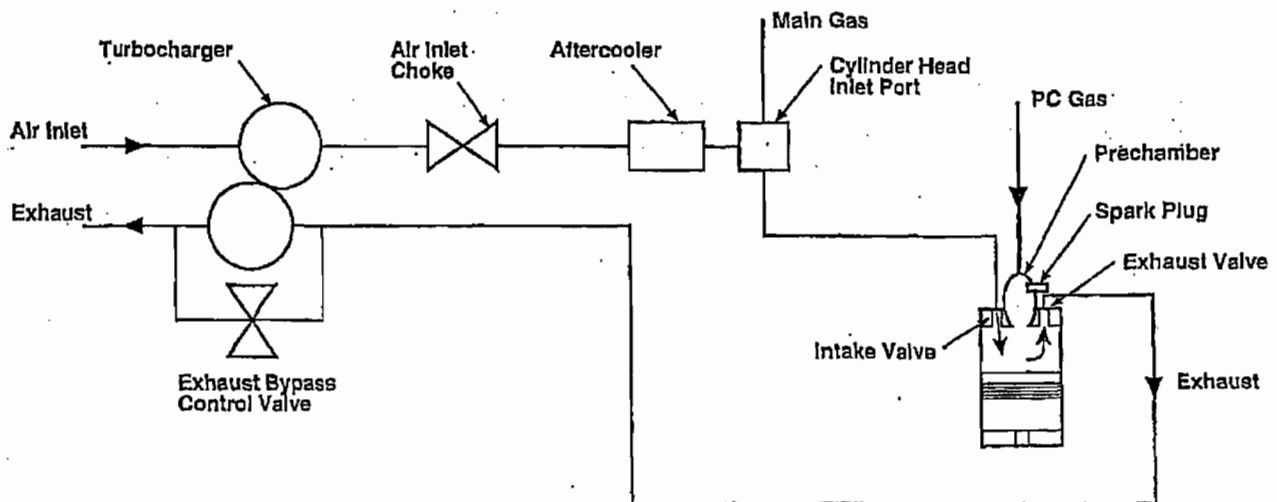


Figure 3

G3600 Exhaust Bypass

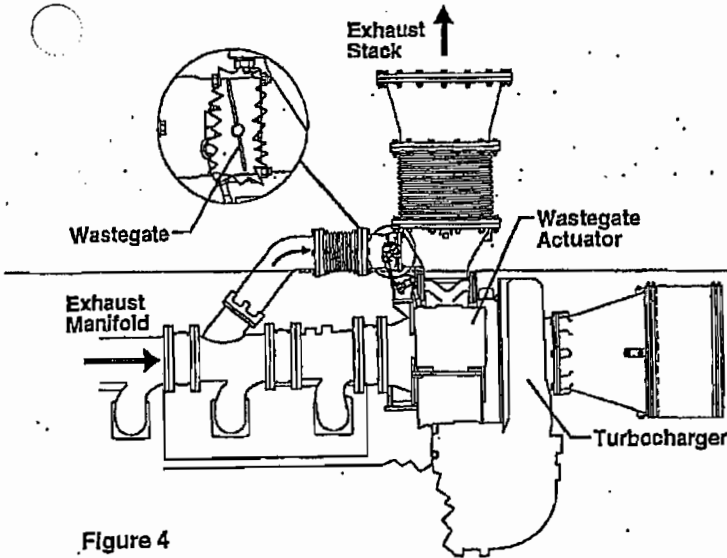


Figure 4

surrounding areas. Precious metal is used on both the center (iridium) and ground (platinum) electrodes. The metal is welded to copper cored electrodes. The copper core helps to transfer heat from the plug center.

The plug is mounted low in the prechamber to place the spark at beginning of the flame front as the enriched charge enters the main chamber. The low position allows for faster and more complete burn of the gas in the prechamber, which will provide for a positive ignition in the main chamber. This contributes to faster, more complete combustion which reduces fuel consumption. The ignition system is powered by a magneto which is driven by the camshaft at the rear of the engine.

G3600 Inlet Choke

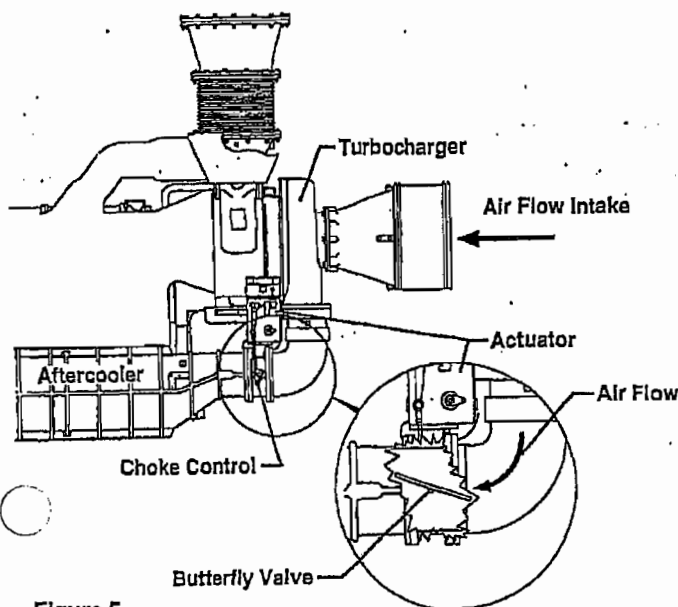


Figure 5

G3600 Engine Supervisory System

The Engine Supervisory System (ESS) is specifically designed for the Caterpillar G3600 Family of Engines. The Engine Supervisory System integrates several control sub systems installed on the engine. With the ability to communicate with the various subsystems, the ESS optimizes each controlled parameter to ensure maximum engine performance.

These subsystems include start/stop/prelube logic, engine monitoring and protection, along with governing, air/fuel ratio, and ignition control. The ESS panel is the control center for the system and houses the control modules of each sub system.

The System consists of:

- Engine Supervisory System Control Panel (ESS)
- Engine Mounted Junction Box
- Engine Mounted Sensors & Actuators
- Relays, Solenoids & Switches
- Harnesses

The System is subdivided into three interactive subsystems:

- The Start/Stop/Prelube Subsystem
 - Controls the action of the prelube pump, engine starters and gas shutoff valve.
- The Engine Monitoring and Protection Subsystem
 - Prevents engine starting or cause shutdown if vital parameters exceed acceptable limits.
 - Provides display of these parameters
 - Generates warnings when one or more parameters are outside acceptable limits.
- The Engine Control Subsystem
 - Provides Engine Governing
 - Air/Fuel Ratio Control
 - Ignition Timing Control

The Engine Supervisory System Control Panel

This panel, Figure 6, houses the control modules, switches, and potentiometers associated with the system.

- Engine Control Module (System Coordination, Governing, Air/Fuel Ratio Control)
- Timing Control Module (Ignition System Control)
- Status Control Module (Start/Stop Control)
- Computerized Monitoring System CMS (Display of System Parameters)
- Pyrometer Modules (Display of Exhaust Temperatures)
- Mode Control Switch
- Prelube Switch/Start Run ok Lamp
- Emergency Stop Switch
- Fuel Energy Adjustment Potentiometer
- Desired Speed Adjustment Potentiometer

Engine Supervisory System

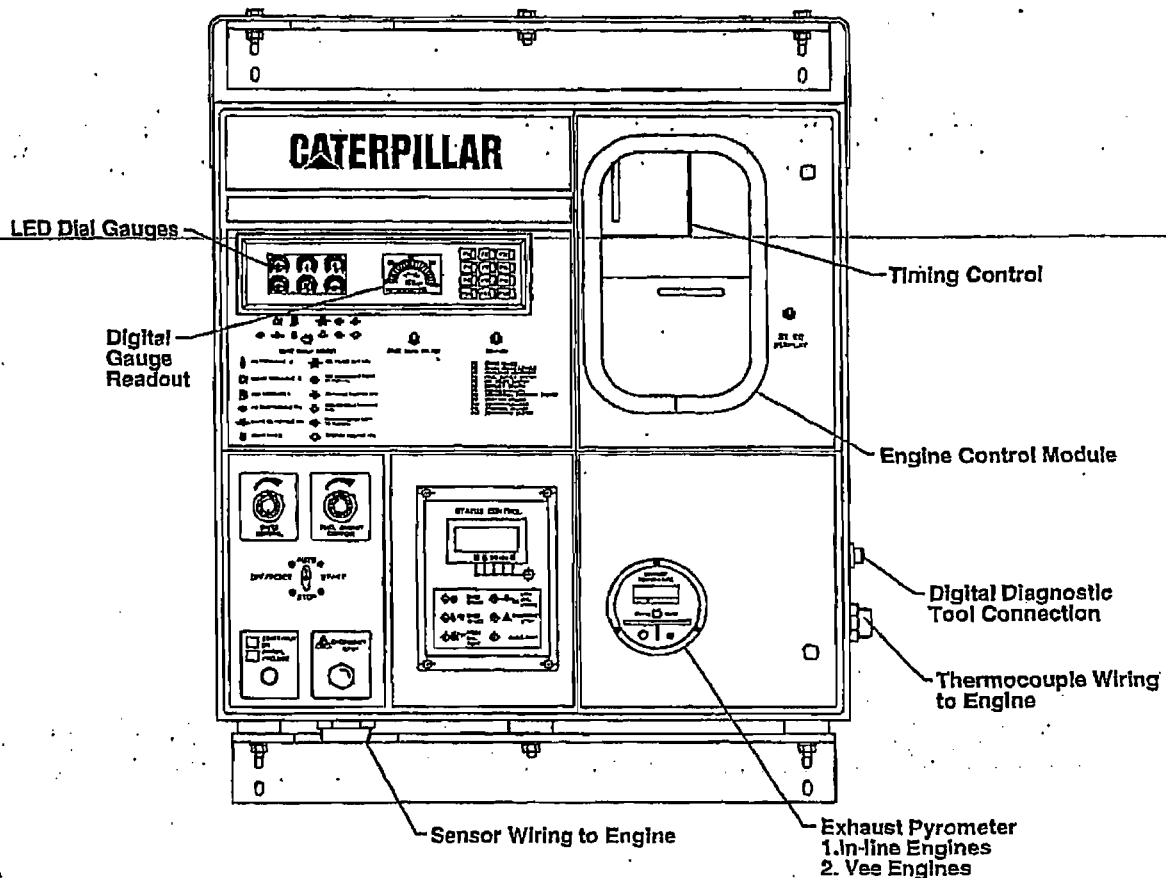


Figure 6

- Gauge Group Select Switch
- Gauge Data Select Switch
- Display Select Switch
- Dimmer Switch Diagnostics

Diagnostics

The Engine Supervisory System is self-diagnostic. Through lamps and fault codes, it directs the service technician to the system or component requiring maintenance.

Mounting

The Control Panel is a water proof enclosure intended to be remote mounted (up to 100 ft) from the engine. It is available with separate stand-alone legs or can be customer remote mounted.

Hazardous Environments

The Engine and Engine Supervisory System have been CSA certified for use in hazardous locations (Class 1 Division 2 Group D).

Personality Module

The Personality Module attaches to the Engine Control

Module and contains many of the application specific information for the system. The module contains application specific maps, protection set points, and customer defined settings. Once specified the personality module cannot be changed without removing and installing a new module. It is essential the application be clearly understood early in the order process to get the proper information in the personality module.

RS232 Computer Interface

RS232 output of system data will be available in 1994 for customer monitoring and information systems (requires a ship loose converter module).

Start/Stop/Prelube System

This Subsystem, Figure 7, consists of the following components:

- Engine Supervisory System Control Panel
 - Status Control Module
 - Engine Control Module
 - Mode Control Switch
 - Prelube Switch/Lamp
- Emergency Stop Switches
- Gas Shutoff Valve

Start/Stop/Prelube System

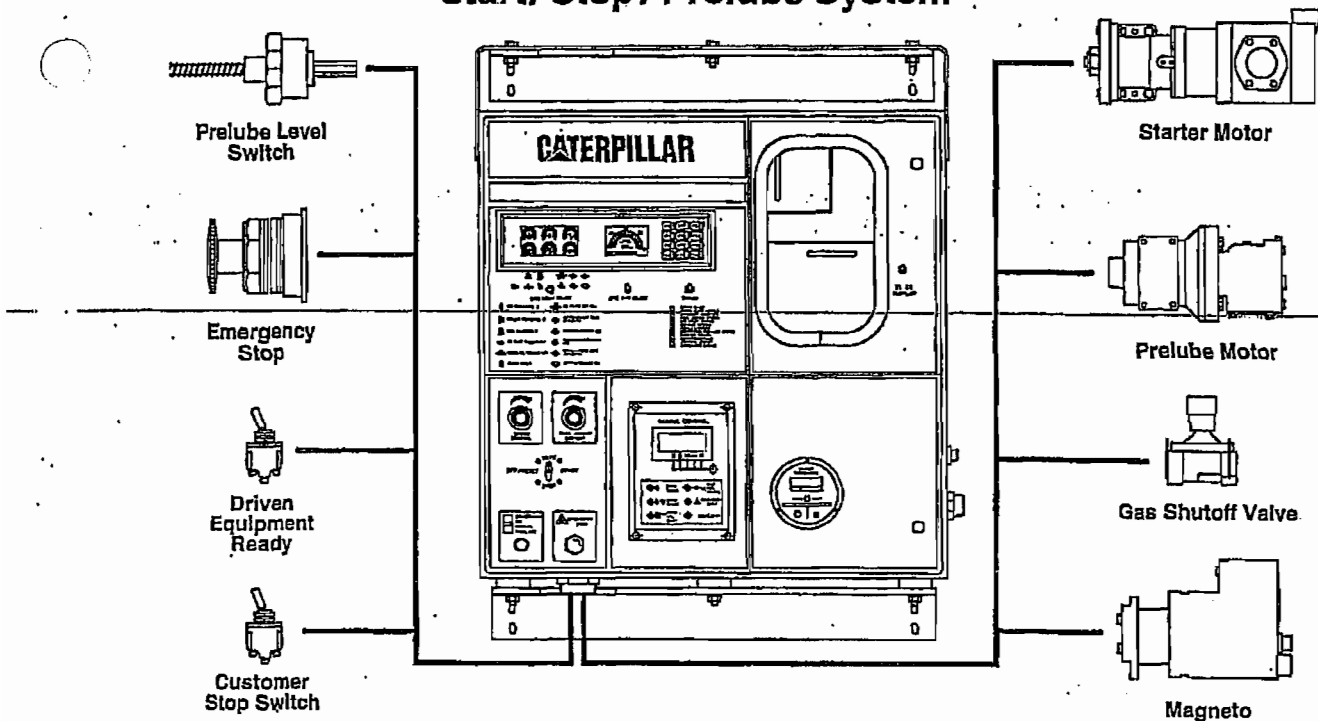


Figure 7

- Prelube pump system (Pump and Solenoids)
- Engine cranking system (Starters and Solenoids)

The Major Functions of this system are controlled by the Mode Control switch and Prelube push button. The Mode Control switch has 4 positions/operations:

Off/Reset

In Off/Reset the System Diagnostic Codes are reset. If the engine is running it will go through a sequenced shutdown; and once the post-lube cycle is complete the system power is turned off.

Stop

In Stop if the engine is running it will go through a sequenced shutdown and a post-lube cycle. All Control Modules will remain powered up.

Start

In Start the Engine Supervisory System will prelude the engine, crank, and run until the switch is moved from this position.

Auto

In Auto the system is configured for remote operation and becomes dependent on the remote Start Initiate Contact. If the contact is *Open* the system functions as if were the Stop position. If the contact is *Closed*, the system operates as if it were in the Start position.

The Prelube Switch located on lower left of the ESS Panel can be used to manually run the prelude pump. The pump

runs as long as the switch is depressed and until prelude conditions are achieved (indicated by the prelude complete contact closing).

There are Emergency Stop switches located on the ESS Panel and on the Engine Mounted Junction Box as well as an input the customer provided switches at other locations. Closing any one of the switches will immediately initiate an emergency shutdown of the engine. These switches are not intended for routine use and should only be used in an emergency.

The Engine Monitoring and Protection Subsystem

This Subsystem, Figure 8, consists of the following components:

- Engine Supervisory System Control Panel
 - Computerized Monitoring System (CMS)
 - Status Control Module
 - Engine Control Module
 - Timing Control Module
 - Pyrometer Modules
 - Gauge Group Select Switch
 - Gauge Data Select Switch
 - Display Select Switch
 - Dimmer Switch
- Engine Mounted Sensors
- Customer Inputs
- Customer Outputs

Monitoring and Protection System

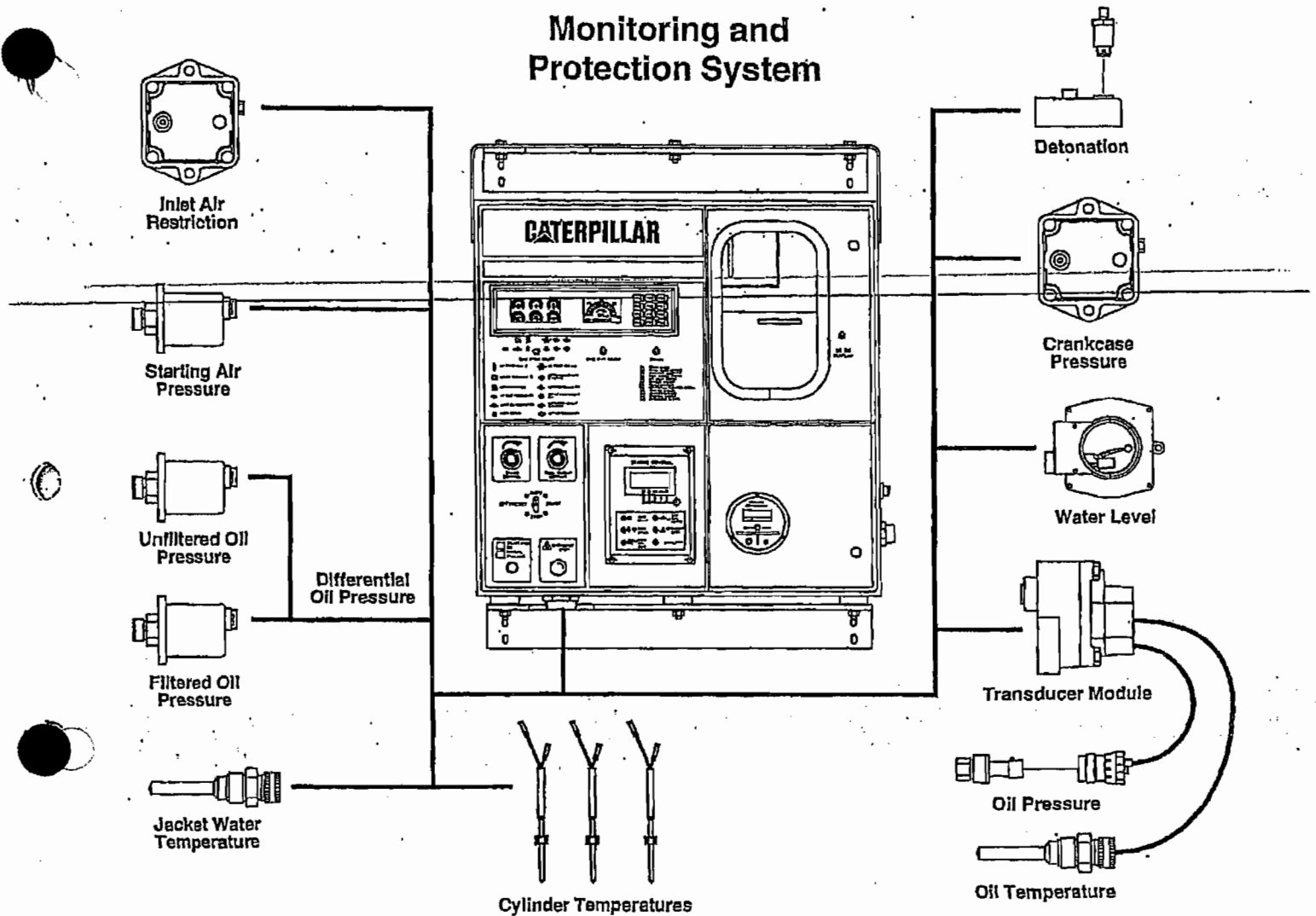


Figure 8

The system provides engine protection and monitors engine systems for vital parameters. It also provides warnings and/or inhibits engine starting or shuts down the engine when parameters are outside acceptable limits. Along with these features, it provides display/indication of engine operating parameters.

The following is a list of protection features listed by the module where the information is displayed.

Computerized Monitoring System (CMS)

The Display consists of 6 small gauges and 1 larger center gauge. The information displayed on the gauges is controlled by the gauge group select and the gauge data select switches. The gauge group select switch selects between two sets of parameters available for display on the 6 small gauges.

- Setting the switch to the left selects the first group of parameters:

1. Manifold Air Temperature

2. Jacket Water Temperature

3. Fuel Correction Factor

4. Manifold Air Pressure

5. Engine Oil Pressure/Prelube Status

6. Engine Load (%)

- Setting the switch to the right selects the second group of parameters:

7. Oil Filter Differential Pressure

8. Inlet Air Restriction (in-line engine or right bank of a vee)

9. Crankcase Pressure

10. Unused

11. Inlet Air Restriction (unused for an in-line or left back of a vee)

12. Starting Air Pressure

- The large gauge always indicates:

13. Engine Speed

The *gauge data switch* allows the data provided on each of the gauges to be viewed on the digital read-out below the large center gauge. The upper number in the gauge display indicates which parameter is being viewed (refer to above numbers in the lists of data). Each time the Gauge Data Switch is toggled the next gauge is selected (within the range of gauges currently selected by the Gauge Group Select).

If the Gauge Group Select is switched, the digital gauge will change to the gauge for the corresponding gauge position (i.e. if gauge 2 coolant temperature, was selected and the Gauge Group Select is moved the gauge data will switch to gauge 8, Inlet Air Restriction Right).

Fault Indicator Lights

The CMS has 12 lamps to indicate a fault condition has occurred. A fault is either a measured parameter outside a safe limit or a device that is malfunctioning. Each lamp indicates the system to look for to determine the exact problem.

- F1 - Check gauges
- F2 - Check fluid levels
- F3 - Auxiliary equipment
- F4 - Fuel Supply system
- F5 - Air Inlet system
- F6 - Exhaust system
- F7 - Module/wiring system
- F8 - Combustion Feedback system
- F9 - Ignition system
- F10 - Sensors/Devices
- F11 - Starting system
- F12 - Detonation system

The lamps direct the service technician to the subsystem or component with a problem. For exact information about the problem, the technician then reads the Fault Code on the module in question.

Status Control Module

The Display sequences automatically through these parameters in either English or metric units:

- Service Hours
- Engine Speed (Safety for Overspeed)
- Battery Voltage
- Engine Oil Pressure (Safety for Low Pressure)
- Engine Oil Temperature (Safety for High Temperature)

Displayed as lamps on the front of the module:

- **Overcrank** indicates the engine did not start after cranking or cycle cranking for the entire programmed time limit.

- **Overspeed** indicates the engine has been shutdown due to excessive speed.
- **High Oil Temperature** indicates the engine has been shutdown due to excessive oil temperature.
- **Low Oil Pressure** indicates the engine has been shutdown due to insufficient oil pressure.
- **Emergency Stop** indicates the engine has been shutdown due to one of the Emergency Stop Switches being depressed.

- **Auxiliary** indicates the engine has been shutdown due to a customer requested shutdown (customer stop input).

Engine Control Module

The primary function of the Engine Control Module is to govern the speed and to control the air/fuel ratio; however, it also has the role of system coordinator. Its personality module contains many of the protection set points and it controls much of the systems operation. The display on the Engine Control Module consists of 8 characters and 8 lights.

The lights indicate:

- **Status (Green)** – The data on the 8 Character Display is status information i.e. desired engine speed, fuel energy (Btu) setting.
- **Data Link 1 Active (Green)** – When lit, this light indicates that the Engine Control Module is properly communicating with the Timing Control Module.
- **Data Link 2 Active (Green)** – When lit, this light indicates that the Engine Control Module is properly communicating with the CMS Module.
- **Caution (Yellow)** – One or more potential problems exist. The 8 Character Display will be displaying a code that indicates the exact nature of the caution condition.
- **Sensor Fault (Red)** – A problem has been detected with one of the systems sensors. The 8 Character Display will be displaying a code that indicates the exact nature of the problem.
- **Actuator Fault (Red)** – A problem has been detected with one of the actuators. The 8 Character Display will be displaying a code that indicates the exact nature of the problem.
- **System Fault (Red)** – A problem has been detected with one of the control systems. The 8 Character Display will be displaying a code that indicates the exact nature of the problem.
- **Control Module Fault (Red)** – A problem has been detected with one of the control modules. The 8 Character Display will be displaying a code that indicates the exact nature of the problem.

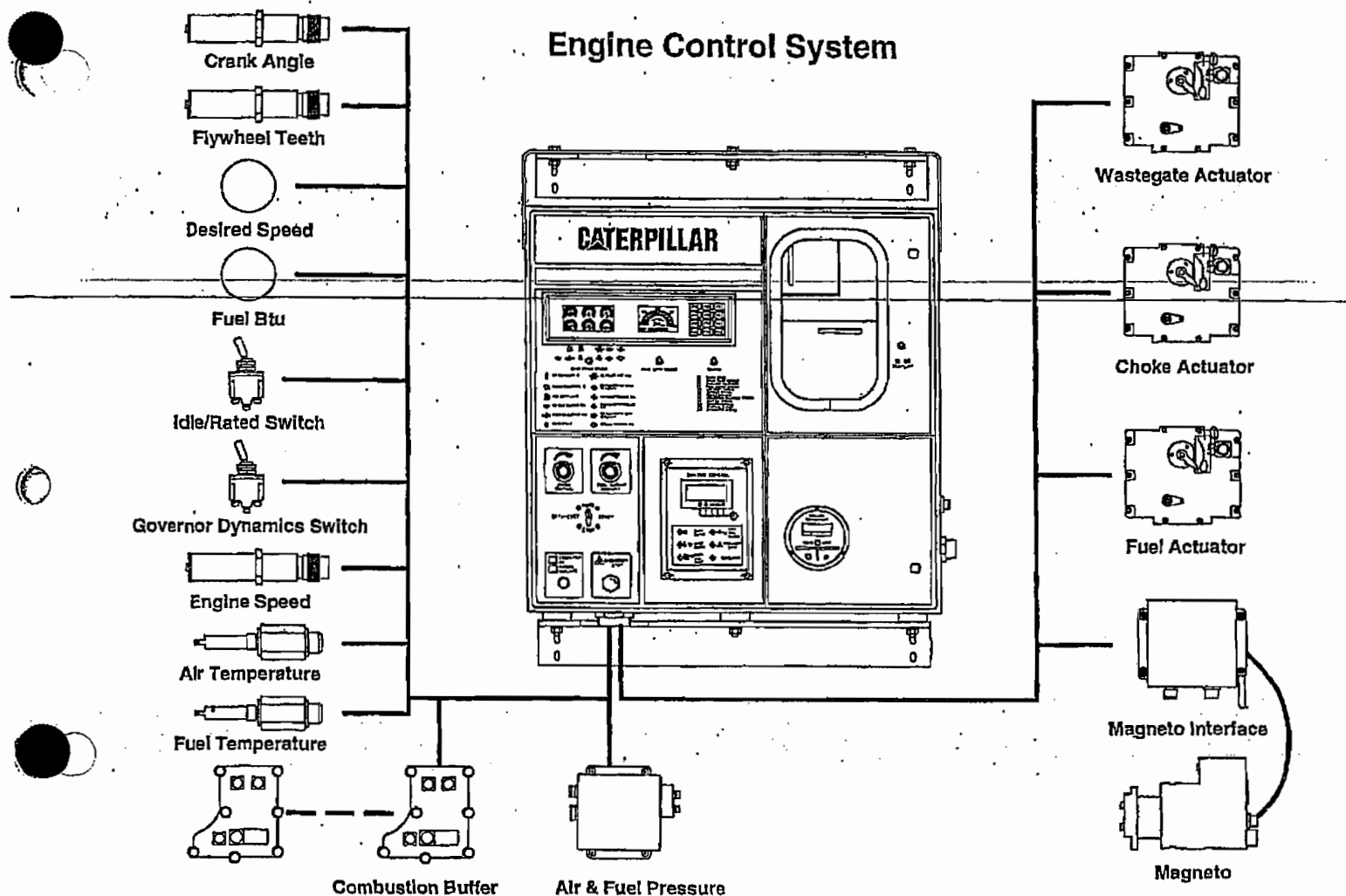


Figure 9

The Display Select Switch Allows the operator to step through the data on the Engine Control Display. Every time the switch is toggled the display steps through to the next item. Items displayed are either status or diagnostic codes (differentiated by one of the lights).

Timing Control Module

The primary function of the Timing Control Module is to maintain the ignition timing at the set point determined by the Engine Control Module. It does however measure the level of detonation or knock present in the engine. This data is used by the engine control to protect the engine from possible damage caused by detonation.

Pyrometer Modules

Each pyrometer module allows the read-out in 9 separate temperatures (in °C). The module powers up displaying the reading of channel 0 (exhaust stack temperature). To read the temperature values on the other eight channels, press the *Push to Advance* button on the front of the gauge. One of these modules is used for in-line engines two for vee engines.

The pyrometer continuously compares channel 0 (stack temperature) to a set point. If the temperature ever exceeds that set point, a contact closes instructing the system to shutdown.

Customer Inputs

- Driven Equipment Ready Contact allows the customer to stop and/or inhibit Start of the engine due to a problem with the driven equipment
- Customer Stop Contact allows the customer to request the engine to shut down for any reason needed by his equipment.

Customer Outputs

- Horn Driver annunciates that a problem has been detected in the system that may cause the engine to shutdown if it is not corrected.
- Prelube Complete annunciates that the engine is prelubed and ready to start.

- Engine Failure annunciates that the engine has shutdown with a fault. The fault needs to be reset in order to restart.
- Crank Terminate annunciates that the engine has started and is running.
- Run Relay annunciates that the fuel is turned on to the engine.
- Mode Switch Position provides the position of the mode-control switch (to be read by remote equipment).

Engine Control Subsystem

The Subsystem, Figure 9, consists of the following components:

- Engine Supervisory System Control Panel
 - Engine Control Module Timing Control Module
 - Desired Speed Potentiometer
 - Fuel Energy Content Potentiometer
- Engine Mounted Sensors
- Engine Mounted Actuators Engine Speed Governing

The Engine Control Module performs the governing function. The governor is more like a diesel engine governor than a typical gas engine governor. The G3600 Engine is governed by modulating the fuel valve controlling fuel flow independent of air flow. The air flow is controlled by the air/fuel ratio controller in response to the measured fuel flow.

Desired Speed

Desired speed is controlled by an idle/rated switch (Open selects idle speed of 550 rpm; Closed selects the speed set by the desired speed input). The desired speed input is typically the potentiometer on the front face of the ESS panel, but may be controlled by an external module.

Droop

The Customer can select any where from 0% to 10% speed droop.

Loadshare Module

A generator set loadshare module compatible with the ESS is available as a ship loose item.

Switchable Governor Response

In order to provide optimum engine response with a generator set that operates in parallel with a utility or with other generator sets it is necessary to have two governor settings. The G3600 control system offers a dual dynamics governor. The *Governor Dynamics Switch* selects from either *Stand-alone* or *Paralleled* governor settings.

Tunable Governor Response

To provide optimum package response with a variety of driven equipment, the G3600 Control System offers tunable governor dynamics.

Fuel Limiting

The fuel system on the G3600 Engine does not have any carburetor or equivalent, as a result the governor is required to insure that the air/fuel mixture does not exceed the rich flammability limit (Rich Misfire). By coordinating with the Air/Fuel Ratio Control section, the governor is able to read the actual air/fuel ratio and use that information to keep the engine from getting too rich.

The governor also provides power limiting on the G3600 Engine. By reading the fuel flow and comparing against maximum allowed flow (function of engine speed) the governor protects the engine against overpower situations.

Air/Fuel Ratio Control

The G3600 Engine does not have a carburetor; instead the air flow and fuel flow are independently controlled. The governor has complete control of the fuel flow. This leaves the air flow as the only parameter for adjusting the air/fuel ratio.

Desired Air Flow

The Air/Fuel Ratio Controller calculates the actual fuel flow and uses a desired air/fuel ratio combined with a fuel energy content (set on the *Energy Content* Potentiometer on the front panel of the ESS) to determine the required air flow. The desired air/fuel ratio for a given speed and load is stored in an application specific map in the Engine Control Personality Module. This map is created to achieve maximum engine performance (efficiency and emissions).

Actual Air Flow

The Engine Control reads inlet manifold air pressure and temperature combined with engine speed to estimate the actual air flow into the engine.

Air Flow Control

Once the control has calculated a desired air flow and an actual air flow, it modulates the wastegate and choke valves to make the actual match the desired.

Fuel Correction System

Combustion Measurement

Once the engine is running and the measured load exceeds a set level (typically 25%), the combustion measurement system compensates for any changes in the ambient conditions or fuel quality. The Engine Control reads the time required for the flame to propagate from the spark plug to the combustion sensor for each cylinder and creates an engine average *burn* time.

Desired Combustion Burn Rate

The Engine Control Personality Module contains application specific maps that define for any given engine speed and load the burn time that achieves maximum engine efficiency and burn proper emissions.

G3600 Family of Engines

Technical Data

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G3600 Engine Performance Data

The Performance section provides data for each engine. It is divided into sections depending on the engine model selected. The data for each engine model includes a rating curve, part load performance, BSFC curves, altitude deration factors and aftercooler heat rejection factors. Use the table of contents to help find the information for a specific engine. For example, the data for a G3606 Engine is organized as follows:

Part Load Data

Gen Sets

60Hz.

50 Hz

Industrial

1000 rpm

900 rpm

Aftercooler Heat Rejection Factors

BSFC Curves

Altitude Deration

Rating Curves

Rating Definitions

Ratings are based on SAE J1349 standard conditions of 29.61 in. Hg (100 kPa) and 77°F (25°C); ISO 3046/1, BS 5514/1 and DIN 6271/1 standard conditions of 61 in. Hg (100 kPa) 81°F (27°C); and API 7B-11C standard conditions of 29.38 in. Hg (99 kPa), 85°F (29°C) also apply.

Ratings are based on dry natural gas with a lower heating value of 905 Btu/ft³. Variations in altitude, temperature and gas composition from standard conditions may require a reduction in engine horsepower.

Methane number is a scale to measure ignition and burning characteristics of various fuels. Representative values are shown below.

Methane100

Ethane44

Propane34

n-Butane10

Hydrogen0

Most dry pipeline natural gas has a methane number of 67 or above. Field gas can go much lower. The engine must be operated on a gas with a methane number of 50 or above. The gas being used should have a complete analysis and the methane number determined. Consult the dealer or factory for assistance.

Part Load Data

Tabular part load data is divided into five general areas: engine configuration (including application), emissions, air system and combustion factors, heat rejection, and air/fuel and exhaust flows.

Engine Configuration

The first block of information defines the engine configuration for which the data applies. It covers aspiration, speed, jacket water temperature, aftercooler temperature, engine power, and generator output (if applicable). This data, along with the title, must be consistent with the engine being applied.

Emissions

The information in this block covers NO_x, CO, HC (total), HC (non-methane), and Exhaust Oxygen. Emissions shown are *Not to Exceed* values.

Air System and Combustion Factors

This section provides fuel consumption, turbocharger compressor pressure and temperature, intake manifold pressure and temperature, air-fuel ratio and timing.

Heat Rejection

Formula: Total heat input = work output + total exhaust heat + radiation + jacket water + oil cooler + aftercooler.

- **Total heat input** is figured by multiplying the BSFC (Btu/bhp-h) times the horsepower output to get Btu/hr. To obtain, Btu/min, divide by 60. Fuel volume consumed is obtained by dividing the total heat by the heat content of the fuel (905 Btu/ft³).
- **Work output** is the total horsepower developed. It is expressed in Btu/min where 1 hp = 42.4 Btu/min.
- **Total exhaust heat** is the total heat available in the exhaust when it is cooled from the stack temperature down to standard conditions of 77°F. When expressed in Higher Heating Value (HHV), it includes the latent heat of vaporization. At standard conditions, 970 Btu are released as each pound of steam is condensed to water. The figures shown are in terms of low heat value and, therefore, do not include the heat of vaporization.
- **Radiation** is the amount of heat loss from the surface of the engine into the engine room or surrounding ambient.
- **Jacket water heat** is the total amount of heat picked up by the engine cooling system. It is the only source of heat on the jacket water cooling circuit, and has its own water pumps mounted on the lower right front of the engine.
- **Oil cooler heat** is the total heat rejected by the lube oil system. This cooling circuit is common with the aftercooler circuit and are the water pumps mounted on the lower left front of the engine.
- **Aftercooler heat rejection** is given for standard conditions of 77°F and 500 ft altitude. This heat rejection is increased for higher ambients and higher altitudes. We are trying to maintain a constant outlet temperature so as inlet temperature to the aftercooler goes up, so does the heat that must be removed. As

the air pressure decreases, the turbo imparts more energy to the incoming air to get up to the required boost pressure. Be sure to use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Failure to properly account for these factors could cause the engine to detonate and cause engine shutdown or failure.

- Recoverable exhaust heat is not a separate component of the heat balance equation but is the customary number used in heat recovery calculations.

It represents the heat available when cooling the exhaust from the stack temperature down to 350°F. This figure, plus the jacket water heat rejection, is used in determining steam production.

If an exhaust temperature other than 350°F is desired, the recoverable heat can be calculated by the following formula:

$$Q = CpM (T_1 - T_2)$$

Q = Heat Rejection in Btu/min

Cp = Specific Heat of Exhaust Gas:

0.258 Btu/lb/°F — Low Emission Engines

0.278 Btu/lb/°F — Standard Engines

$$M = \text{Exhaust Mass Flow} = \frac{Ev \text{ (CFM)} \times 41.13}{(T_1 + 460^\circ)} \text{ lb/min}$$

T₁ = Exhaust From Engine °F

T₂ = Exhaust Out of Heat Recovery Silencer °F

Ev = Exhaust Flow by Volume (CFM)

In every calculation using engine data, there is a tolerance band or a deviation from norm. When using the heat balance, the following tolerance should be used.

Work Output.....	± 3%
Heat Input	± 2.5%
Exhaust Total.....	± 10%
Exhaust Recoverable	± 10%
Jacket Water	± 10%
Oil Cooler	± 20%
Aftercooler	± 5%
Radiation.....	± 25%

Heat rejection numbers are based on treated water as the coolant.

Air, Fuel, and Exhaust Flows

This data provides mass and volume flow information of the air, fuel and exhaust. It should be used when sizing ventilation systems, fuel piping, and exhaust equipment. The inlet air flow is based on conditions of 77°F and 13.9 psi air pressure. The exhaust flow is based on stack temperature and 13.9 psi gas pressure. Fuel flow is referenced to fuel at 60°F and 14.7 psi.

Aftercooler Heat Rejection Factors

Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft altitude. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions at the installation site. Multiply the factor by the standard aftercooler heat rejection.

Altitude Deration Factors

This information is used to show altitude deration required for various ambient temperatures and altitudes. Use to determine actual engine power at the installation site.

Rating Curves

The curves of rated engine brake horsepower vs engine rpm illustrates the capability of the engine at both 90°F and 130°F aftercooler water temperatures.

CATERPILLAR®

**G3600
Engine
Basics**

Engine Design Specifications

G3606

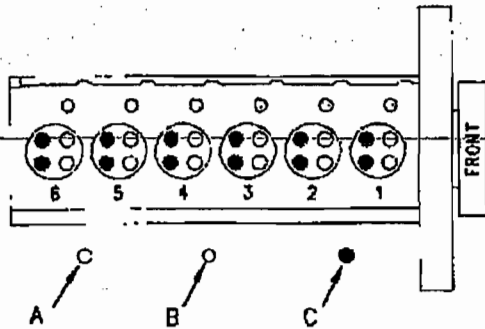


Illustration 1
G3606 Engine Design
(A) Inlet. (B) Gas admission. (C) Exhaust.

Number and arrangement of cylindersIn-line 6

Valves per cylinder

Inlet valves2
Exhaust valves2
Gas inlet valve1

Displacement127.2 L (7762 cu in.)

Bore300 mm (11.8 in.)

Stroke300 mm (11.8 in.)

Compression ratio9.2:1

CombustionSpark Ignited

Firing order

Standard rotation CCW1-5-3-6-2-4

Valve lash

Inlet0.50 mm (.020 in.)
Exhaust1.27 mm (.050 in.)
Gas admission0.64 mm (.025 in.)

When the crankshaft is viewed from the flywheel end the crankshaft rotates in the following directionCounterclockwise

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right side of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

G3608

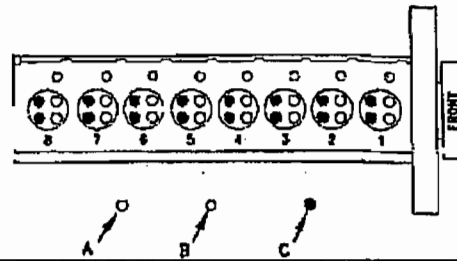


Illustration 2
G3608 Engine Design
(A) Inlet. (B) Gas admission. (C) Exhaust.

Number and arrangement of cylindersIn-line 8

Valves per cylinder

Inlet valves2
Exhaust valves2
Gas admission valve1

Displacement170 L (10,352 cu in.)

Bore300 mm (11.8 in.)

Stroke300 mm (11.8 in.)

Compression ratio9.2:1

CombustionSpark Ignited

Firing order

Standard rotation CCW1-6-2-5-8-3-7-4

Valve lash

Inlet0.50 mm (.020 in.)
Exhaust1.27 mm (.050 in.)
Gas admission0.64 mm (.025 in.)

When the crankshaft is viewed from the flywheel end the crankshaft rotates in the following directionCounterclockwise

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right side of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

G3612

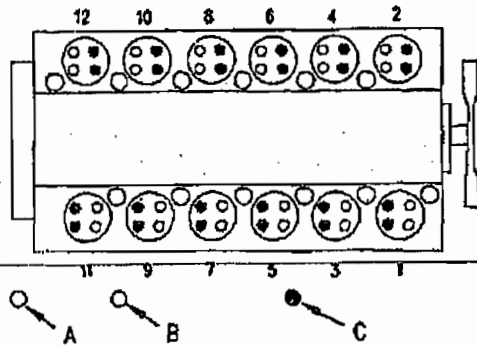


Illustration 3
G3612 Engine Design
(A) Inlet. (B) Gas admission. (C) Exhaust.

G3616

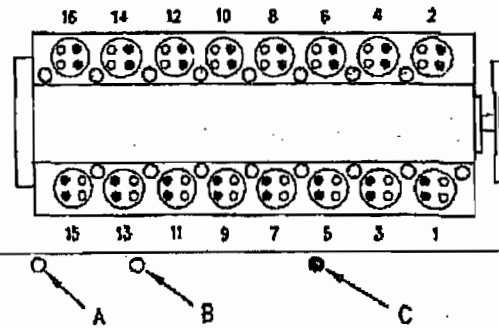


Illustration 4
G3616 Engine Design
(A) Inlet. (B) Gas admission. (C) Exhaust.

Number and arrangement of cylindersVee 12

Valves per cylinder

Inlet valves2
Exhaust valves2
Gas admission valve1

Displacement254.5 L (15,525 cu in.)

Bore300 mm (11.8 in.)

Stroke300 mm (11.8 in.)

Compression ratio9.2:1

Compression ratio10.5:1

CombustionSpark Ignited

Firing order

Standard rotation

CCW1-12-9-4-5-8-11-2-3-10-7-6

Valve lash

Inlet0.50 mm (.020 in.)
Exhaust1.27 mm (.050 in.)
Gas admission0.64 mm (.025 in.)

When the crankshaft is viewed from the flywheel end the crankshaft rotates in the following direction.Counterclockwise

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right side of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

Number and arrangement of cylindersVee 16

Valves per cylinder

Inlet valves2
Exhaust valves2
Gas admission valve1

Displacement339.3 L (20,700 cu in.)

Bore300 mm (11.8 in.)

Stroke300 mm (11.8 in.)

Compression ratio9.2:1

Compression ratio10.5:1

CombustionSpark Ignited

Firing order

Standard rotation CCW

.....1-2-5-6-3-4-9-10-15-16-11-12-13-14-7-8

Valve lash

Inlet	0.50 mm (.020 inch)
Exhaust	1.27 mm (.050 inch)
Gas admission	0.64 mm (.025 inch)

When the crankshaft is viewed from the flywheel end the crankshaft rotates in the following direction Counterclockwise

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right side of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

Engine Supervisory System

The Engine Supervisory System (ESS) is specifically designed for the Caterpillar G3600 Engines. The ESS integrates several control systems that are installed on the engine. With the ability to communicate with the various systems, the ESS optimizes each controlled parameter in order to ensure maximum engine performance.

The ESS communicates with the following systems:

- Start/Stop/Prelube Logic
- Engine Monitoring And Protection
- Governing
- Air/Fuel Ratio
- Ignition Control

The control panel for the ESS is the center of control for the systems. The control panel for the ESS contains the control modules of each system.

The Engine Supervisory System consists of the following components:

- Control Panel For The Engine Supervisory System (ESS)
- Engine Mounted Junction Box
- Engine Mounted Sensors And Actuators
- Relays, Solenoids And Switches
- Harness

The Engine Supervisory System (ESS) is divided into the following three interactive systems:

Start/Stop/Prelube System – This system controls the starting of the engine, the stopping of the engine, and the prelube pump.

Engine Monitoring And Protection System – This system provides a display of parameters of engine operation. The system generates warnings when one or more parameters are outside acceptable limits. The system can stop the engine if the engine operation reaches a setpoint that is programmed for shutdown. The system can prevent the engine from starting if certain parameters are outside of acceptable limits.

Engine Control System – This system governs the engine. This system controls the air/fuel ratio, the ignition timing, and the limiting of power.

Note: Some of the components within the ESS perform more than one function. For example, the Engine Control Module (ECM) is involved with starting the engine, stopping the engine, monitoring the engine, and controlling the engine.

Engine Mounted Sensors

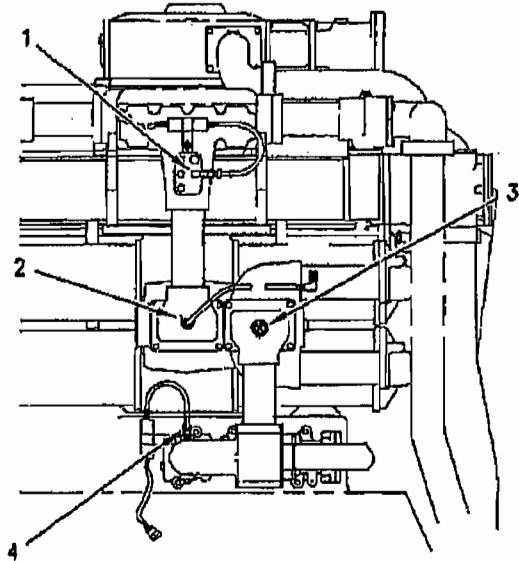


Illustration 5
 Engine Mounted Sensors Front View
 (1) CMS unfiltered engine oil pressure sensor. (2) SCM engine oil temperature sensor. (3) SCM filtered engine oil pressure sensor. (4) CMS filtered engine oil pressure sensor.

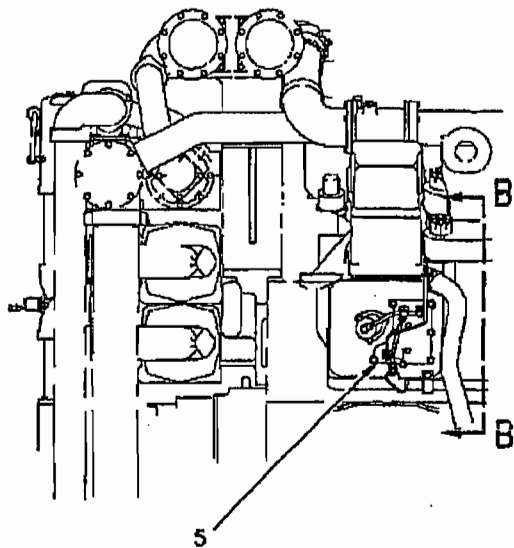


Illustration 6
 Engine Mounted Sensors Left Side View
 (6) Combustion buffer.

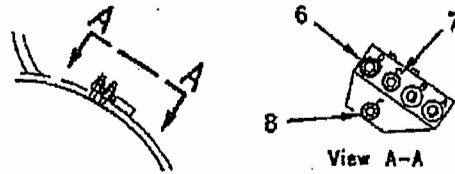


Illustration 7
 Engine Mounted Sensors Rear View
 (6) Timing control speed sensor. (7) Engine control speed sensor. (8) Timing control crank angle sensor.

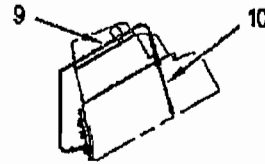


Illustration 8
 Engine Mounted Sensors View B-B
 (9) Combustion feedback cable. (10) Combustion feedback extension and probe.

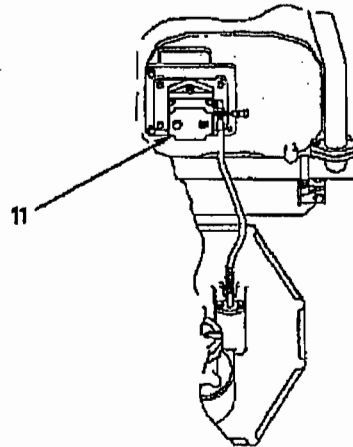


Illustration 9
 Engine Mounted Sensors Right Side View
 (11) Crankcase pressure sensor.

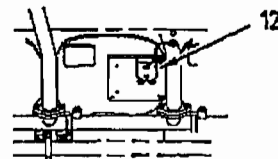


Illustration 10
 Detonation Sensors
 (12) Detonation sensors.

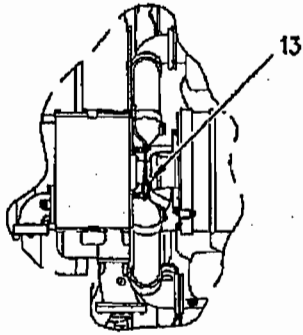


Illustration 11
 Engine Mounted Sensors Top View
 (13) Jacket water temperature sensor.

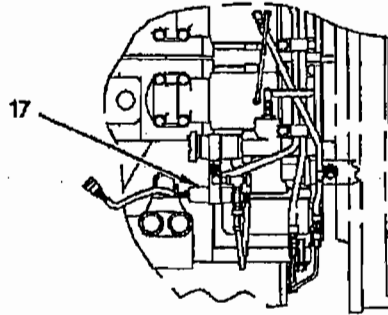


Illustration 14
 Engine Mounted Sensors Left Side View
 (17) Starting air pressure sensor.

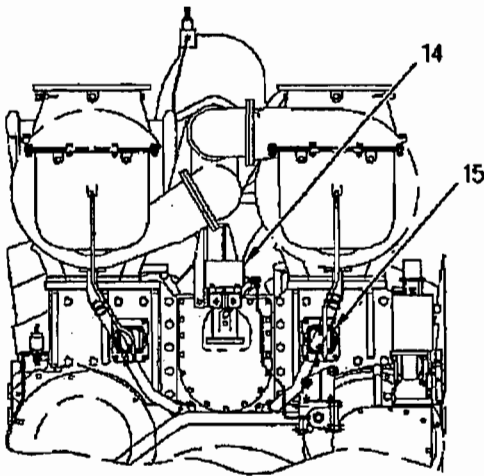


Illustration 12
 Engine Mounted Sensors Rear View
 (14) Fuel and air Pressure module. (15) Inlet air restriction.

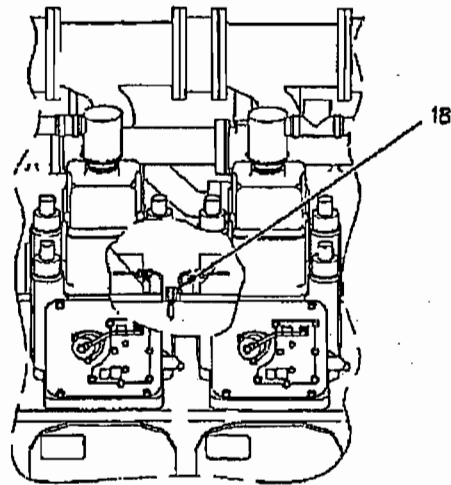


Illustration 15
 Engine Mounted Sensors Right Side View
 (18) Inlet air temperature sensor.

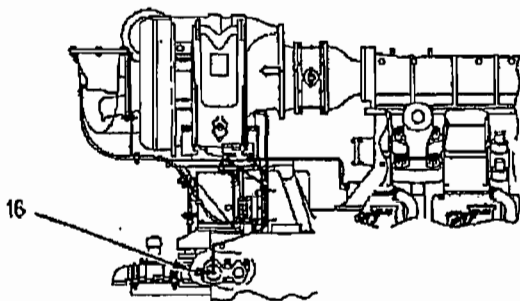


Illustration 13
 Engine Mounted Sensors Right Side View
 (16) Fuel temperature sensor.

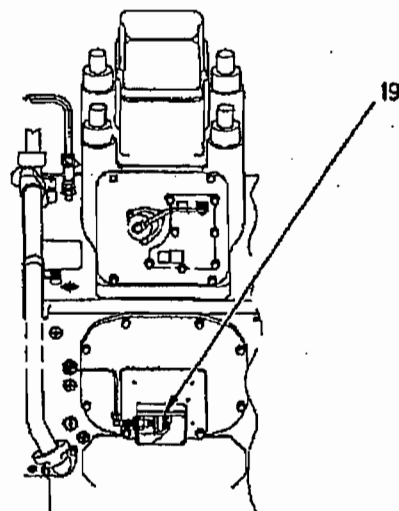


Illustration 16
 Engine Mounted Sensors Right Side View
 (19) Prelube pressure switch.

Control Panel For The Engine Supervisory System (ESS)

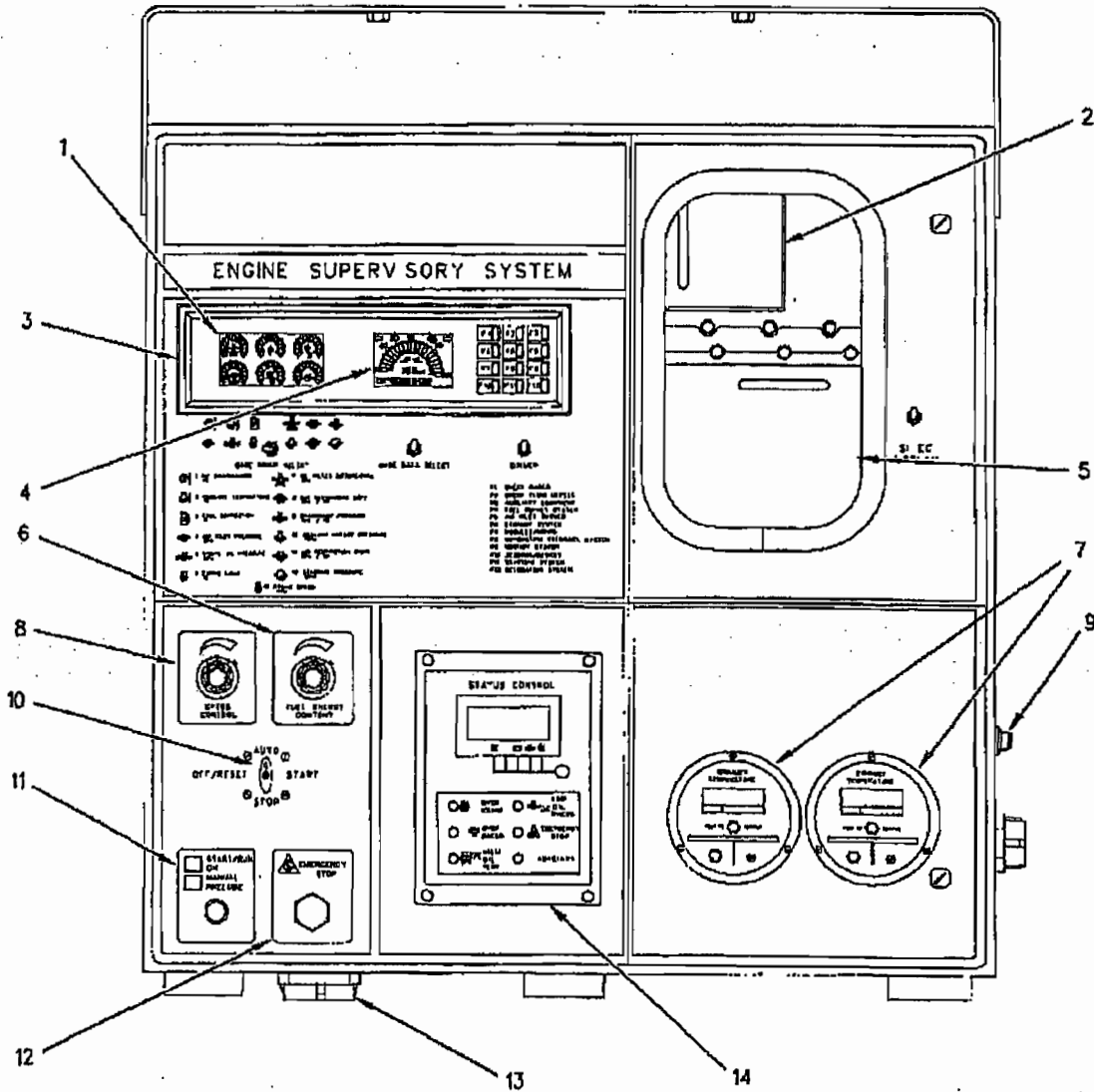


Illustration 17

(1) LED Dial gauges. (2) Timing Control Module (TCM). (3) CMS Gauge panel. (4) Digital gauge readout. (5) Engine Control Module (ECM). (6) Fuel energy adjustment dial. (7) Exhaust pyrometer. (8) Engine speed adjustment dial. (9) Digital Diagnostic Tool (DDT) connection. (10) Mode control switch. (11) Prelube switch. (12) Emergency stop push button. (13) Sensor wiring to the engine. (14) Status Control Module (SCM).

This panel contains the control modules, the switches, and the potentiometers that are associated with the system.

- Engine Control Module (ECM) (System Coordination, Governing, Air/Fuel Ratio Control)
- Timing Control Module (TCM) (Ignition System Control)
- Status Control Module (SCM) (Start/Stop Control)
- Computerized Monitoring System (CMS) (Gauge Panel Display of System Parameters)
- Pyrometer Module (Display of Exhaust Temperatures)
- Mode Control Switch (MCS)
- Pre-lube Switch/Start Run Okay Lamp
- Emergency Stop Switch
- Fuel Energy Adjustment Potentiometer
- Desired Speed Adjustment Potentiometer
- Gauge Group Select Switch
- Gauge Data Select Switch
- Display Select Switch
- Dimmer Switch Diagnostics

Diagnostics

The Engine Supervisory System is self-diagnostic. Through lights and fault codes, the ESS directs the service technician to the system or the component that requires maintenance.

Mounting

The control panel for the ESS is a waterproof enclosure. The control panel is intended to be mounted at a remote location. The control panel can be mounted up to 30.5 m (100 ft) from the engine.

Hazardous Environments

The engine and the Engine Supervisory System have been Canadian Standards Association (CSA) certified for use in hazardous locations Class 1, Division 2, Group D.

Customer Interface Connections

Refer to Installation And Initial Start-up Procedures, SEHS9549, for information regarding customer input and output connection points.

RS232 Computer Interface

RS232 output of system data is available for customer monitoring and information systems. This output requires a ship loose converter module.

Start/Stop/Prelube System

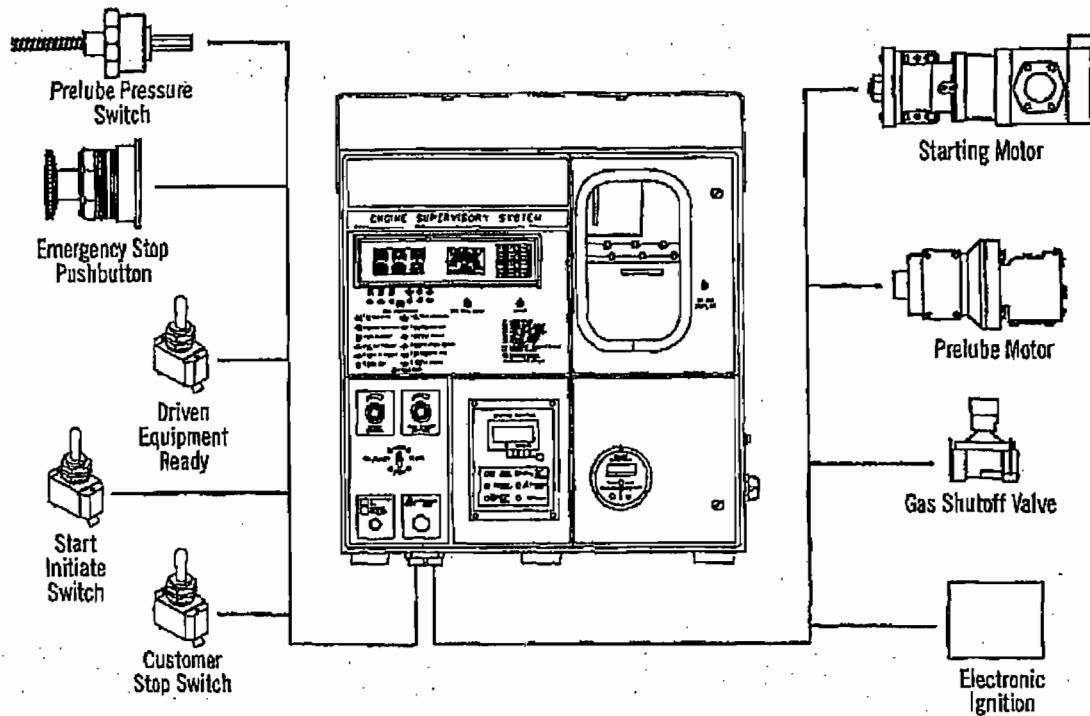


Illustration 18

The system consists of the following components:

1. The Control Panel For The Engine Supervisory System (ESS). The control panel consists of the following components:

- Mode Control Switch (MCS)
- Status Control Module (SCM)
- Engine Control Module (ECM)
- Prelube Switch/Lamp
- Speed Control Dial
- Fuel Energy Content Dial
- Emergency Stop Push Button

2. Gas Shutoff Valve (GSOV)
3. Ignition System
4. Fuel Actuator
5. Prelube Pump System (Pump And Solenoid)
6. Engine Cranking System (Starting Motors And Solenoids)

The controls for the Start/Stop/Prelube and the Status Control Module perform the automatic start/ stop functions. The Status Control Module monitors certain engine functions that are required for operation. The Status Control Module monitors and provides an automatic shutdown of the engine under normal operating conditions.

The Speed Control Potentiometer will allow the operator the ability to select the engine speed that is needed for a particular application. Low idle speed is 550 rpm. Rated speed can be as high as 1000 rpm.

The Fuel Energy Content Potentiometer is used in order to adjust the setting for the Lower Heat Value of the fuel. The Fuel Energy Content Potentiometer setting should be adjusted in order to display a Btu value on the ECM that is equal to the Lower Heating Value of the fuel supply in terms of Btu/ft³. The Lower Heating Value Btu is based on the data from a fuel analysis that is input into the Caterpillar Methane Number Program, 5.0, LEKQ6378-01.

The major functions of this system are controlled by the following components:

- Mode Control Switch (MCS)
- Prelube Push Button

The MCS has the following four positions and operations:

- AUTO
- START
- STOP
- OFF/RESET

AUTO – When the mode control switch is in the AUTO position, the system is configured for remote operation. When the remote start/stop initiate contact closes, the prelube system will operate and the engine will start. When the remote start/stop initiate contact opens, the engine will shut off. If the cool down cycle is programmed, the engine will operate for the cool down period before the engine stops. The cool down cycle can be programmed for a 0 to 30 minute period. A cool down period is not recommended for G3600 engines.

START – When the mode control switch is turned to the START position, the prelube system will operate. When the prelube pressure is sufficient, the engine will start. The engine will operate until the ESS receives a shut down signal.

STOP – When the mode control switch is turned to the STOP position, the engine will shut off. After the engine stops, a postlube cycle will operate. The power to the control panel is maintained when the mode control switch is in the STOP position. The "STOP" mode can be used to troubleshoot some problems without starting the engine.

OFF/RESET – When the mode control switch is turned to the OFF/RESET position, the engine is immediately shut off and the diagnostic lights of the status control module are reset. Power is removed from the control panel and the actuators after the engine completes the postlube cycle.

MANUAL PRELUBE button enables the operator to prelube the engine. All G3600 Family Engines should be lubricated before the crankshaft is rotated. This includes crankshaft rotation in order to service the engine. Rotating the crankshaft before prelube may cause damage to the crankshaft bearings if the surfaces of the bearings are dry.

All G3600 Family Engines require lubrication prior to start-up. The ESS will not permit the engine to start until sufficient prelube pressure has been achieved. The actuators will be powered up after the engine has been prelubed.

Note: The ECM is programmed to provide engine lubrication after the engine is shut off. The typical duration of the postlube is 60 seconds.

The **EMERGENCY STOP** push button immediately de-energizes the Gas Shutoff Valve and grounds the CIS in order to stop the engine (no cool down). The engine may not be restarted until the Status Control Module has been reset by turning the MCS to the OFF/RESET position. More than one **EMERGENCY STOP** push button may be used, depending on the engine installation.

NOTICE

The EMERGENCY STOP push button is not to be used for normal engine shutdown. To avoid possible engine damage, use the Mode Control Switch (or Start Initiate Contact for remote operation) for normal engine shutdown.

These engines require a prelube cycle prior to start-up. The engine will not start until the Status Control Module tells the Engine Supervisory System that the minimum requirement for oil lubrication has been reached.

The Engine Control Module is programmed to provide a period of engine lubrication (postlube) after shutdown. The time that is required for postlube is typically 60 seconds.

Sequence Of Operation

The Mode Control Switch (MCS) of the remote control panel has four positions: AUTO, START, STOP, OFF/RESET. If the MCS is in the AUTO position and a signal to run is received from a remote initiate contact (IC), or when the MCS is placed in the START position, the engine will prelube, crank, terminate cranking and run. The engine may cycle crank if the feature for cycle crank is utilized. The engine will run until the signal to run is removed by either turning the Mode Control Switch (MCS) to STOP, OFF/RESET, or opening the remote initiate contact with the MCS in the AUTO position. Once the MCS is moved to the STOP position, or if in the AUTO position and the remote initiate contact opens, the engine will run for a short period of time in the cool down mode, if the cool down feature was utilized, if the cool down feature was not utilized the engine will shut down immediately. The engine will then start the postlube cycle. The engine is then capable of immediate restart.

Sequence Of Operation (Normal Start/ Stop)

When the MCS is placed in the START position or the AUTO position and the remote initiate contact is closed:

1. A signal is sent to the prelube relay.
2. The prelube pump will run.
3. The prelube switch will close to indicate that 6.9 kPa (1 psi) of oil pressure is at the switch.
4. After a preprogrammed period of time (typically 30 seconds), the ECM will send a signal in order to energize the prelube pump switch relay. The green prelube light will turn on. CMS Gauge No. 5 will stop flashing. A start signal is sent to the SCM.

Upon receipt of a signal to start, the SCM will check in order to ensure that the following conditions are met:

1. An emergency stop signal is not present.
2. All faults have been reset.
3. All sensors are connected and operating properly.
4. No abnormal mode control switch signals are present.
5. The engine is not already running.
6. The SCM microprocessor is functioning properly.
7. The SCM is not in the programming mode.

The SCM will not allow the start sequence to begin. The SCM will display the proper diagnostic code when applicable, if an above fault condition exists. However, once the SCM is satisfied that conditions are normal, the SCM will energize the Starting Motor Relay (SMR) and the Run Relay (RR). The SCM will also signal for fuel to be turned on by energizing the Fuel Control Relay (FCR) and the Run Relay (RR). The fuel actuator will begin to open at 50 rpm. The Ignition Shutoff Relay will be energized in order to begin the ignition system functioning.

If the feature for cycle crank is enabled, the SCM will automatically crank/rest/crank the engine for adjustable time periods. If the engine fails to start within the selected total crank time, the SCM will execute an overcrank fault. If a fault condition occurs while the engine is cranking, the SCM will terminate and lock out cranking. The SCM will display the applicable diagnostic code, or the SCM will light the appropriate LED.

After the engine starts and has achieved the crank termination speed (typically 250 rpm), the SCM will de-energize the starting motor by de-energizing the SMR. The SCM will energize the Crank Termination Relay (CTR). Once the correct low idle oil pressure is achieved, the SCM will signal for the ECM to accelerate the engine to rated speed.

The engine will run if the operating conditions remain normal and a signal to run is being received by the SCM. The SCM will sequentially display each of the following for a two second period: the engine oil pressure, the oil temperature, the rpm, the service hours, and the system DC volts. This is done via the digital display prior to or while the engine is operating. As well as monitor for any fault or abnormal conditions that may occur.

Upon loss of the run signal, the engine will continue to run for an adjustable cool down period if the cool down feature is utilized. However, if the cool down feature is not used or if the SCM receives an off/reset signal, the SCM will immediately de-energize the Run Relay. The fuel circuitry will be de-energized. If the signal to run returns before the engine stops, the SCM will immediately go back to the running state. This means, the fuel will be turned back on, but the starting motor will not energize. However, if a restart does not occur and the rpm continues to drop, then the SCM will initiate cranking upon reaching zero rpm. Assuming that the run signal does not return and the engine speed continues to diminish until zero rpm is reached, then the Crank Termination Relay (CTR) will be de-energized and the SCM will be ready for an instant restart. The Fuel Control Relay will be ready for an instant restart. The Fuel Control Relay (FCR) of the SCM will de-energize in two seconds after zero rpm.

Sequence Of Operation (Fault Conditions)

If a fault condition occurs prior to starting the engine, the SCM will:

1. De-energize and lock out the starting motor circuit.
2. Ensure that fuel is shut off.
3. De-energize the Run Relay Circuit.
4. Energize the fault shutdown circuitry (Engine Failure Relay).

If a fault condition occurs while the engine is running, then the SCM will respond in the following manner:

1. Fuel control circuitry will be de-energized for energized to run engines.
2. Ignition Shutoff Relay will be de-energized, for an overspeed, emergency stop, or diagnostic codes 01, 04, 06 or if all six LEDs are on. The relay will also de-energize if the engine has not shut down within five seconds after the FCR commanded it to do so. This would be the result of a fault condition. The relay circuitry shall be re-energized for 10 to 15 seconds after the engine reaches zero rpm. The relay shuts off the ignition system.
3. The Starting Motor Relay (SMR) circuitry shall be locked in the de-energized state.
4. The Run Relay (RR) circuitry shall be de-energized.
5. The Fault Shutdown Circuitry shall be energized, including the Engine Failure Relay (ENFR).

If a fault occurs before or after the engine starts, then the appropriate fault indicating LED shall flash at two Hertz or a diagnostic code shall be displayed to indicate the nature of the problem. The indicators shall remain on. The SCM shall remain in the fault mode until it receives a reset signal.

Engine Monitoring And Protection System

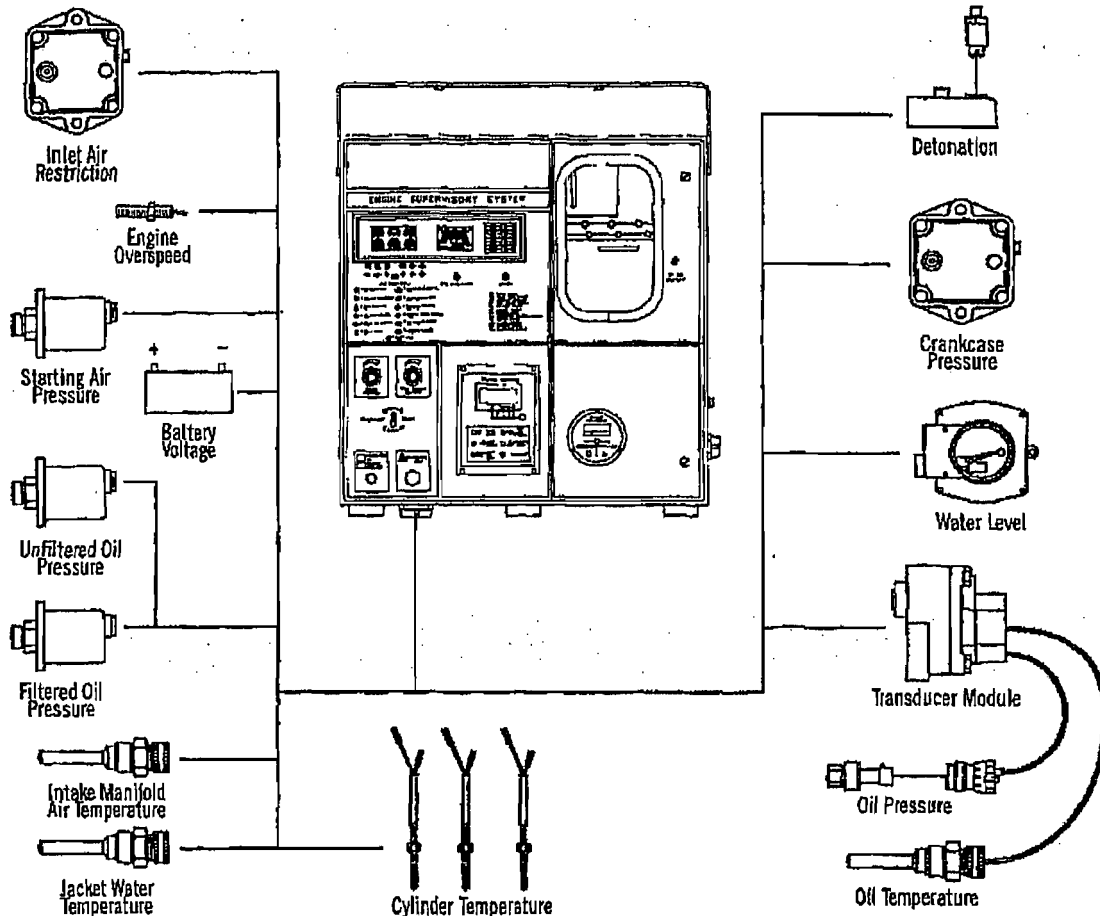


Illustration 19

The system provides engine protection and monitors engine systems for vital parameters. The system provides warnings and/or inhibits the engine from starting. The system shuts down the engine when the parameters are outside acceptable limits. Along with these features, the system provides display/ indication of the engine operating parameters.

Engine Shutdown And Start Inhibiting Functions

The engine shutdown features provide engine protection by shutting down the engine when certain operating parameters are beyond acceptable limits. The engine shutdown features provide engine protection when the driven equipment sense a shutdown signal to the control panel for the ESS.

The start inhibiting features provide protection to the engine and the driven equipment by preventing the engine from cranking when the engine parameters are not

within acceptable limits or the driven equipment has indicated that the driven equipment is not ready to start.

Engine shutdown and start inhibiting problems will be indicated by the CMS panel display, the Engine Control Module (ECM) or the Status Control Module (SCM). The CMS panel display will provide a diagnostic indication when the lights are ON. The ECM will display a FLASHING diagnostic code to indicate that engine shutdown due to a specific problem that was encountered. The ECM will display a SOLID diagnostic code in order to indicate that a warning condition has occurred due to a specific problem that was encountered. For additional information on troubleshooting the displayed information, refer to Troubleshooting, SENR6510, for G3600 Engines.

Computerized Monitoring System (CMS)

The display consists of six small gauges (left side) and one larger gauge (center). The information that is displayed on the gauges is controlled by the GAUGE GROUP SELECT switch and the GAUGE DATA SELECT switch. The GAUGE GROUP SELECT switch selects between two sets of parameters that are available for display on the six small gauges.

The GAUGE GROUP SELECT switch allows the data that is provided on each of the gauges to be viewed on the digital readout. The digital readout is located below the large center gauge. The upper number in the gauge display will indicate which parameter is being viewed. Each time that the GAUGE DATA SELECT switch is toggled, the next gauge is selected. This is within the range of gauges currently selected by the GAUGE GROUP SELECT switch.

If the GAUGE GROUP SELECT switch is switched, then the digital gauge will change to the gauge for the corresponding gauge position. If gauge 2 coolant temperature was selected and the GAUGE GROUP SELECT switch is moved the gauge data will switch to gauge 8, AIR RESTRICTION LEFT.

CMS Gauge Display

The film on the control panel for the ESS is either in English Units or Metric Units. Depending on the application, the readouts will be in either English Units or Metric Units. By setting the "GAUGE GROUP SELECT" switch to the left, the following engine functions are displayed on the gauge and the digital readout.

Gauge 1 AIR TEMPERATURE – The temperature of the air inlet manifold is displayed in °C or °F. The temperature is displayed within one degree.

Gauge 2 COOLANT TEMPERATURE – Temperature is displayed in °C or °F. The temperature is displayed within one degree.

Gauge 3 FUEL CORRECTION – The display shows a percent value. This is a ratio of the difference between the adjusted setting of the fuel energy content Btu potentiometer and the Btu energy content of the fuel that the engine is burning.

Note: When the red limit bars on this gauge are turned off, the air/fuel ratio is not being automatically controlled and the fuel correction factor is fixed at 100%. When the red bars are present, the air/fuel ratio control is based on the in cylinder measured combustion burn time.

Gauge 4 AIR INLET PRESSURE – Air inlet manifold pressure (absolute) is displayed in kPa or psi/10.

Gauge 5 ENGINE OIL PRESSURE – Pressure is displayed (gauge) in kPa or psi.

Note: Prelube oil pressure is indicated by a bar around the display for the oil pressure gauge. A solid bar indicates that the prelube pressure is OKAY. A flashing bar indicates that the prelube pressure is NOT OKAY.

Gauge 6 ENGINE LOAD – Load is displayed as a percentage of the full rated power output of the engine. The calculation of the percentage is based on the following factors: flow of fuel, engine rpm, and fuel energy content.

By setting the "GAUGE GROUP SELECT" switch to the right, the following engine functions are displayed on the gauge and the digital readout.

Gauge 7 OIL FILTER DIFFERENTIAL – The amount of pressure drop between the inlet and the outlet of the oil filter housing is displayed in kPa or psi.

Gauge 8 AIR RESTRICTION LEFT – The amount of pressure drop between the inlet (unfiltered) and outlet (filtered) sides of the air cleaner, displayed in kPa/10 or inches of H₂O/10.

Gauge 9 CRANKCASE PRESSURE – This gauge indicates the pressure that is inside the crankcase. This is displayed in kPa/10 or inches of H₂O/10

Gauge 10 COOLANT OUTLET PRESSURE – This gauge is not used.

Gauge 11 AIR RESTRICTION RIGHT – This gauge is not used with the G3600 engines.

Gauge 12 STARTING PRESSURE – This gauge indicates the air pressure that is available for starting the engine. This is displayed in kPa or psi.

The large gauge (center) always indicates the engine speed.

Gauge 13 ENGINE SPEED – This gauge displays engine speed in rpm (within 10 rpm).

CMS Fault Indicator Lights

The CMS has 12 lights that indicate a fault condition has occurred. A fault is either a measured parameter outside a safe limit or a malfunctioning device. Each light indicates the system to look for in determining the exact problem.

F1 CHECK GAUGES – One or more gauges indicate that a parameter is outside of the normal operating range. Check gauges.

F2 CHECK FLUID LEVELS – One or more fluid levels are below an acceptable limit. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F3 AUXILIARY EQUIPMENT – One or more problems exist in the interface for the driven equipment. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F4 FUEL SUPPLY SYSTEM – One or more problems exist in the system that controls the fuel. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F5 AIR INLET SYSTEM – One or more problems exist in the system that controls the inlet air. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F6 EXHAUST SYSTEM – One or more problems exist in the exhaust system. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F7 MODULES/WIRING – One or more problems exist with specific control modules and/or the wiring. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F8 COMBUSTION FEEDBACK SYSTEM – One or more problems exist in the controls for the feedback from the combustion system. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F9 IGNITION SYSTEM – One or more problems exist in the ignition system. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F10 SENSORS/DEVICES – One or more problems exist on specific control devices. This includes sensors, actuators, etc. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F11 STARTING SYSTEM – One or more problems exist in the engine starting system. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

F12 DETONATION SYSTEM -- One or more problems exist in the system that detects detonation. Observe the diagnostic code(s). Refer to Troubleshooting, SENR6510 for G3600 Engines.

Status Control Module (SCM)

The bottom of the control panel for the ESS contains the Status Control Module (SCM). This displays fault conditions and key engine parameters. The Status Control Module (SCM) accepts information from the operator, magnetic speed pickup (MPU), pressure/temperature module and the Engine Supervisory System (ESS). This information is used to determine the "on/off" state of the engine's fuel and ignition system.

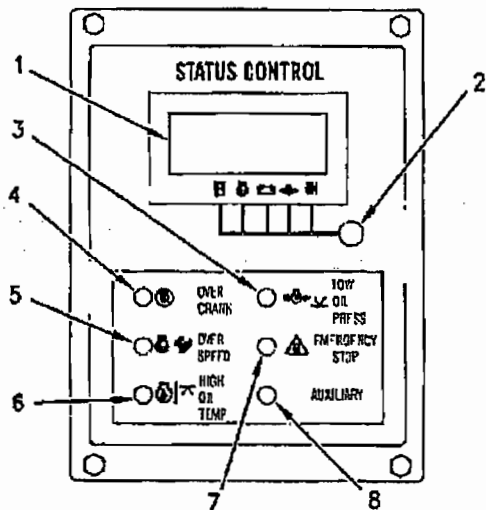


Illustration 20
Status Control Module (SCM)
(1) Liquid Crystal Display (LCD). (2) Switch (display hold switch). (3) Low Oil Pressure Light Emitting Diode (LED). (4) Overcrank LED. (5) Overspeed LED. (6) High Oil Temperature LED. (7) Emergency stop LED. (8) Auxiliary LED (shutdown).

The SCM receives a signal that instructs the SCM to start the engine. The SCM activates the fuel system and the starting motor. When the engine rpm reaches the crank termination speed, the starting motor is disengaged. When the SCM receives a signal to stop the engine, the fuel system is shut off.

The SCM has the following features:

Cycle Crank -- The SCM can be programmed to crank-rest-crank for adjustable time periods.

Speed Control -- When the engine oil pressure increases past the low oil pressure set point, the SCM will inform the ECM that the ECM should increase the engine speed from idle to rated.

Cooldown -- After the SCM receives a signal to perform a normal shut down, the SCM will wait for a preprogrammed amount of time before shutting the engine off via the gas shutoff valve.

Automatic Operation -- While in the automatic mode, the SCM can be started by a remote initiate signal. This signal is when the initiate contact (IC) closes. Upon the loss of the signal, the SCM will perform a normal shut down.

Power Down -- The ESS system is designed to remove power when in the *off/reset* mode once the postlube cycle is complete. The SCM will not allow the engine to power down until the *Crank Termination Relay* and the *Fuel Control Relay* are both off. Both relays turn off two seconds after zero rpm.

Fuel Solenoid Type -- The SCM can be programmed to work with either an Energize To Run (ETR) fuel system or an Energize To Shutdown (ETS) fuel system. In G3600 applications this must be an ETR system.

LED Display -- Six LEDs are located on front of the SCM to annunciate overcrank shutdown, overspeed shutdown, low oil pressure shutdown, high-oil temperature shutdown, emergency stop and auxiliary shutdown.

Emergency Stop -- LED (7) will flash if the *Emergency Stop* button is used to stop the engine.

Pressure/Temperature Module

Malfunction -- If the signal from the engine mounted oil pressure/temperature transducer module is lost or unreadable, the engine will be shut down via the fuel control. A diagnostic

code will be displayed. The SCM can be programmed to ignore the malfunction of the transducer module.

Speed Pickup Malfunction – If the SCM loses the magnetic pickup signal, the engine will be shut down via the ignition system and the fuel control. A diagnostic code will be displayed.

Overcrank Protection – If the engine fails to start within a programmed amount of time, the SCM will cause the starting sequence to cease. LED (4) will flash. The mode control switch must be turned to the *Off/Reset* position before another attempt to start the engine can be made.

Liquid Crystal Display (1) – Service hours, engine speed, system battery voltage, engine oil pressure and engine oil temperature are sequentially displayed in either English or Metric Units. Pressing switch (2) on the front of the SCM will cause the display to lock (stop) on one of the engine parameters. Pressing the switch again will resume the display to normal sequencing. When a fault signal is detected, the display is also used to indicate diagnostic codes. This is to aid in troubleshooting. Refer to Systems Operation, Testing And Adjusting, Status Control Module (SCM), SENR6515, *Troubleshooting Section, Diagnosed Problems*.

Note: All diagnostic lights should turn on briefly when the panel is powered up. This is a light test.

Overspeed Protection – If the engine speed exceeds the set point for the overspeed, then the engine will be shut down via the ignition control and the fuel control. LED (5) will flash. The set point for the overspeed is lowered to 75 percent of the original value while the *Overspeed Verify* switch is depressed. This will allow the overspeed circuit to be tested while the engine is operating at rated speed.

Low Oil Pressure Protection – If the engine oil pressure drops below the low oil pressure set point, it will be shut down by means of the fuel control. LED (3) will flash. There are two set points for the low oil pressure. One set point is for when the engine

speed is below the oil step speed. The another set point is for when the engine speed is above the oil step speed.

High Oil Temperature Protection – If the engine oil temperature exceeds the set point, the fuel will be shut off. LED (6) will flash. Refer to the Testing And Adjusting section of *G3612 and G3616 Engines Systems Operation and Testing & Adjusting Manual*, SENR5528, for status control module service procedure for information about testing and programming of the SCM.

Note: If a fault occurs and the control for the fuel does not shut down the engine, the ignition is shut off five seconds after the fault has occurred.

Engine Control Module (ECM)

The ECM monitors the fuel energy content for the air/fuel ratio control and for limiting the power. The ECM also has the function of system coordinator. The personality module of the ECM contains many of the protection set points. The personality module controls much of the systems operation. The display on the ECM consists of eight characters and eight lights.

The lights indicate:

STATUS (Green) – When this light is on, this light is for status information. Status information is the desired engine speed, fuel energy (Btu) setting, etc.

COMMUNICATION LINK 1 ACTIVE (Green) – When this light is on, this light will indicate that the ECM is properly communicating with the Timing Control Module (TCM).

COMMUNICATION LINK 2 ACTIVE (Green) – When this light is on, this light will indicate that the ECM is properly communicating with the Computerized Monitoring System (CMS Gauges), the Digital Diagnostic Tool (DDT) ports, and the optional Customer Communication Module (CCM).

CAUTION MODE (Yellow) – One or more problems exist. The code that indicates the exact nature of the condition will be displayed.

SENSOR FAULT (Red) – A problem with one of the sensors has been detected. One or more problems exist. The code that indicates the exact nature of the condition will be displayed.

ACTUATOR FAULT (Red) – A problem with one of the actuators has been detected. The code that indicates the exact nature of the problem will be displayed.

SYSTEM FAULT (Red) – A problem with one of the control systems has been detected. The code that indicates the exact nature of the problem will be displayed.

CONTROL MODULE FAULT (Red) – A problem with one of the control modules has been detected. The code that indicates the exact nature of the problem will be displayed.

The DISPLAY SELECT switch that is located on the right hand side of the ESS control panel door will allow the operator to step through the data on the Engine Control Module display. Every time the switch is toggled, the display steps through to the next item. Items displayed are either status codes or diagnostic codes. These codes are differentiated by one of the lights.

ECM Timing Control Module (TCM)

The Timing Control Module (TCM) maintains the ignition timing that is determined by the ECM. The TCM also protects the engine from unacceptable levels of detonation.

The TCM provides the ECM with information about detonation. The ECM sends a signal to the TCM for the engine timing that is desired. The signal can be retarded up to six crankshaft degrees if detonation is sensed. The engine will be shut down if high levels of detonation persist.

ECM Pyrometer Module

The pyrometer module allows the read out in nine separate temperatures in °C. The module powers up and displays the reading on channel zero (exhaust stack temperature). In order to read the temperature values on the other eight channels, press the *Push To Advance* button on the front of the gauge.

The pyrometer continuously compares channel zero (exhaust stack temperature) to a set point. If the exhaust stack temperature ever exceeds the set point, a contact closes. The ECM shuts down the engine.

Engine Control System

FUEL AND COMBUSTION SYSTEM

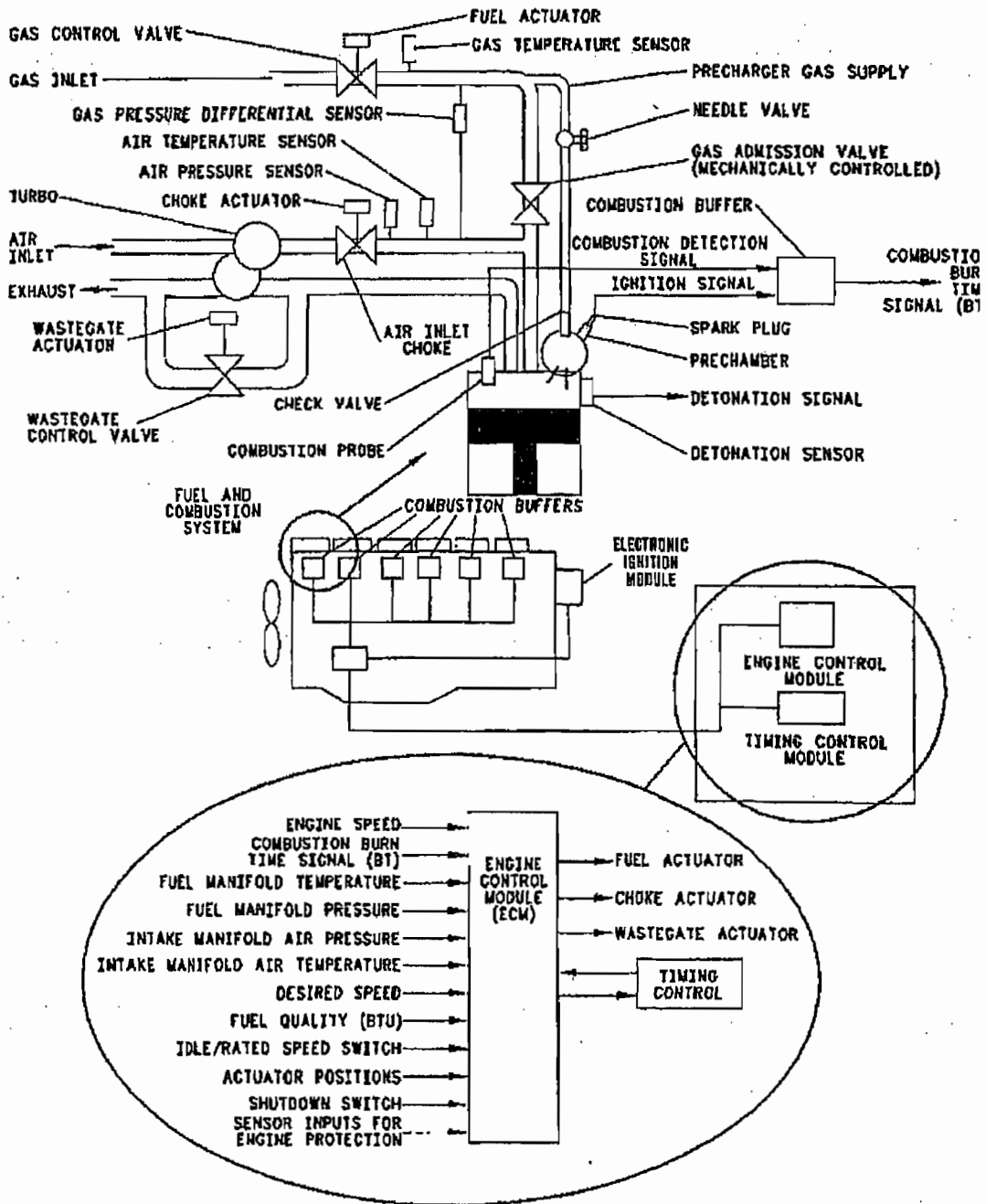


Illustration 21

The Engine Control System consists of the following components:

1. Engine Supervisory System (ESS) Control Panel
 - Engine Control Module (ECM)
 - Timing Control Module (TCM)
 - Desired Speed Potentiometer
 - Fuel Energy Content Potentiometer
2. Engine Mounted Sensors
3. Engine Mounted Actuators
 - Fuel
 - Wastegate
 - Choke

Governor

The Electronic Control Module (ECM) performs the governing function. The governor resembles a diesel engine governor more than a typical gas engine governor. The G3600 Engine is governed by modulating the fuel valve that controls the fuel flow independent of the air flow. The command signal that is sent from the ECM to the fuel actuator is based on the difference between the actual engine speed (as measured by the ECM magnetic pickup) and the desired engine speed.

Speed Droop

A setting from 0 to 10 percent speed droop can be selected by using the *Customer Selectable Parameter Screen, Number 31*, on the Digital Diagnostic Tool.

Switchable Governor Response

In order to provide a optimum engine response, with a generator set that operates in parallel with a utility or that operates with other generator sets, there must be two governor settings. The G3600 control system offers a dual dynamics governor. The *Governor Dynamics Switch* will select from either *Stand Alone* or *Paralleled* governor settings. Refer to *Installation And Initial Start-up Procedures, SEHS9549*, for information regarding switching from *OFF-GRID* to *ON-GRID* governor dynamics.

Desired Speed Control

Desired speed is controlled by an idle/rated switch. Open selects the idle speed of 550 rpm, closed selects the speed set by the desired speed potentiometer. The desired speed input is typically the potentiometer on the front face of the ESS panel. The desired speed may be controlled by an external input to the ECM. Refer to *Installation And Initial Start-up Procedures, SEHS9549*, for information regarding customer input.

Fuel Limiting

The governor provides the limiting of power on the G3600 Engine. The governor calculates the fuel flow. The governor compares the fuel flow against the maximum allowed flow. The governor protects the engine against over power situations.

Transient Fuel Limiting

In order to prevent the engine from operating at an air/fuel ratio that is excessively rich, the command signal that is sent to the fuel actuator may be limited. This will limit the amount of fuel flow into the engine during engine starting, engine acceleration or variable load operating conditions.

Personality Module

The Engine Control System contains a Personality Module. The Personality Module provides the engine application control maps. The Personality Module attaches to the ECM and the Personality Module communicates with the ECM. The Personality Module receives input from the engine control system sensors. The Personality Module monitors and controls the engine according to the parameters that are within the Personality Module. The Personality Module contains application specific engine control maps, protection set points and customer defined settings.

Air/Fuel Ratio Control

The G3600 Engine does not have a carburetor. The air flow and the fuel flow are independently controlled. The governor has complete control of the fuel flow. This leaves the air flow as the only parameter for adjusting the air/fuel ratio. The air flow is controlled by the exhaust wastegate system in order to maintain the desired air/fuel ratio or the desired combustion burn time (BT).

Fuel Flow

The ECM will calculate the fuel flow by using the following inputs:

- measured fuel manifold pressure
- measured fuel manifold temperature
- measured air inlet manifold pressure
- measured air inlet manifold temperature
- engine speed
- Btu setting

Air Flow

The ECM calculates the air flow based on the measured inlet manifold air pressure, the measured inlet manifold temperature, and the engine speed.

Desired Air/Fuel Ratio

The desired air/fuel ratio varies depending on engine speed and load. These values are stored in application specific maps in the Personality Module. These maps were created to achieve optimum engine performance (efficiency and emissions) as the engine speed and load varies.

Combustion Burn Time (BT)

Combustion Burn Time is the time measured for combustion flame propagation from the ignition spark in the precombustion chamber to the combustion sensing probe. The probe is mounted in the main combustion chamber.

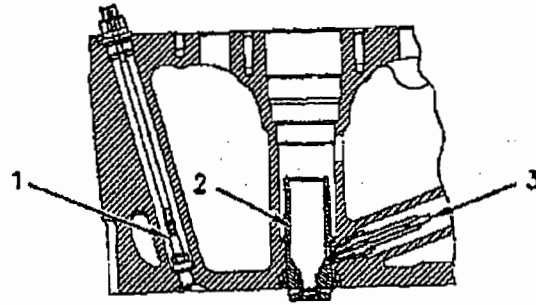


Illustration 22
Cylinder Ignition and Sensor
(1) Combustion sensor. (2) Precombustion chamber.
(3) Gas Ignition spark plug.

In-cylinder combustion sensing for each cylinder, allows the engine to respond rapidly to changes in ambient conditions, fuel quality or speed and load changes. This results in a more precise control of the engine emissions and the fuel consumption. The combustion sensor is a nonconventional 14 mm (.55 in.) spark plug. The spark plug operates in conjunction with an electronic combustion buffer. This measures the actual time between the spark and the passage of the flame across the sensor. This information is averaged and compared with a desired map setting in the personality module. Corrections for variations in fuel quality, temperatures, etc. are made automatically as well as more quickly and accurately than manual adjustments.

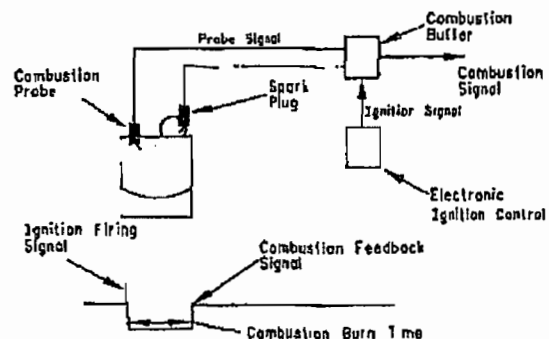


Illustration 23
Basic Combustion Probe System Diagram

The measured combustion burn time signals are sent to the ECM on two separate circuits. One circuit is dedicated to the Cylinder No. 1.

Another circuit sends the signals for the remaining cylinders to the ECM. The signals are received by the ECM in the firing order sequence.

Air Flow Control

Once the ECM has determined a desired air flow, the ECM modulates the exhaust bypass valve by changing the position of the wastegate actuator.

When the engine is operating in a normal operation mode, at an engine load that is typically greater than 50 percent, the air/fuel ratio is automatically controlled based on the average Combustion Burn Time (BT).

The position command signal that is sent from the ECM to the wastegate actuator is based on the difference between the average BT that is measured from the cylinders and the desired BT that is programmed into the personality module. Maintaining the desired BT ensures optimum engine performance and stable engine operation even when the quality of the fuel changes or when ambient conditions change.

When the engine is operating in precombustion chamber calibration mode or at an engine load that is typically less than 50 percent, the position command signal that is sent from the ECM to the wastegate actuator is the difference between the measured air/fuel ratio and the desired air/fuel ratio. The measured air/fuel ratio is a calculated value that is based on sensor inputs from the engine to the ECM. The inputs to the ECM that are required to calculate the air/fuel ratio are fuel manifold pressure, fuel manifold temperature, inlet manifold air pressure, inlet manifold air temperature, engine speed and fuel quality (Fuel Energy Content potentiometer setting). At start-up, the fuel energy content (Btu) is adjusted in order to agree with the fuel analysis by using the Fuel Energy Content potentiometer on the ESS control panel. When the engine is operating at greater than 50 percent load, the engine control overrides the manual fuel setting and provides fuel quality information. This is based upon the actual combustion burn time measurements that are taken during the combustion process. The manual setting of

the Btu potentiometer will provide a starting point for the Air/Fuel Ratio Control system until the BT information is available from the combustion sensors.

Fuel Correction Factor

The fuel correction system will use the desired burn time along with the measured burn time in order to compute a fuel correction factor.

The percent fuel correction factor represents the difference in the actual energy content (Btu/ft³) and the setting of the *Fuel Energy Content* potentiometer. The potentiometer is located on the front control panel of the ESS.

For example: the engine air/fuel ratio had been properly adjusted using a Btu dial setting of 900 Btu. After the engine has been running for a period of time, the quality of the fuel that is supplied to the engine will change from 900 to 990 Btu/ft³. The result would be that the combustion flame would be faster. The ECM would slow down the combustion time by changing the air/fuel ratio to a leaner setting. The ECM would display a calculated fuel correction factor of 110 percent (990/900 times 100).

Fuel System

To ensure precise regulation of fuel flow on G3600 engines, carburetors are not used. Fuel flow is controlled electronically in order to maintain precise control of fuel delivery to the engine. The fuel system contains the following components: a gas shutoff valve, a fuel control valve, a electronic actuator, a fuel manifold, a gas admission valve, a needle valve, a check valve, a check valve, and a precombustion chamber.

Gas is delivered to the engine through a customer supplied regulator (2). Fuel pressure must be 310 ± 14 kPa (45 ± 2 psi) and the fuel pressure must be regulated to 1.7 kPa (.25 psi). Lower fuel pressure may result in reduced power. The regulator is connected to a gas shutoff valve (3), which is controlled by the Engine Control Module (ECM).

Control valve (4), which is controlled by the electronic actuator (10) regulates the gas pressure in the fuel manifold (5). The electronic actuator controls the fuel manifold pressure. This control is based on a signal that was received from the engine control module. The engine control module determines the signal. The signal is based on the difference

between the actual engine rpm and the desired engine rpm. Engine speed is controlled by the fuel manifold pressure. The fuel manifold (5) supplies gas to all cylinders.

Each cylinder has an orificed fuel line that is connected to the fuel manifold. The fuel line delivers gas to the gas admission valve (11) and from the gas admission valve on to the main combustion chamber. A separate fuel line (8) and adjustable needle valve (7) provide a new supply of gas to the precombustion chamber (12).

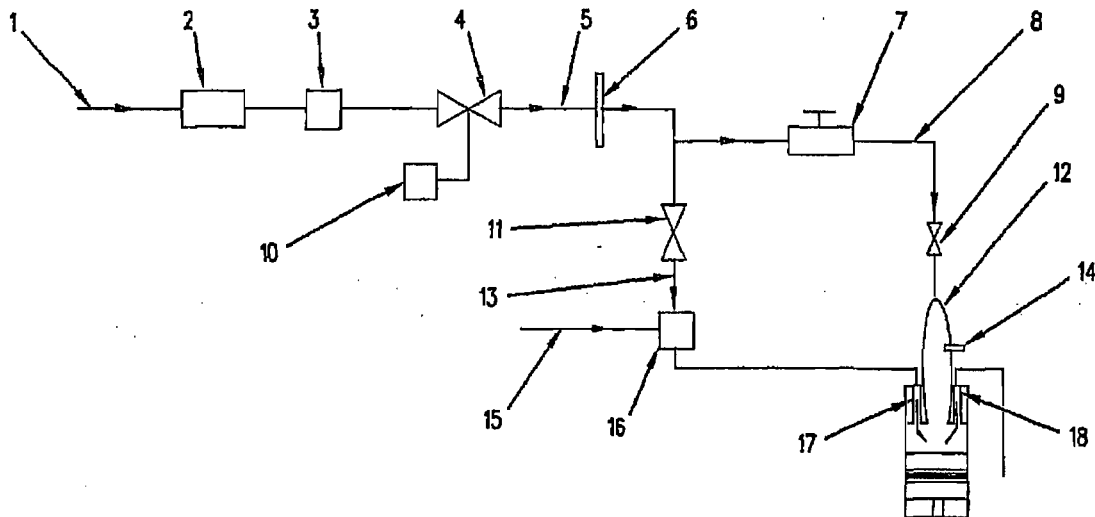


Illustration 24

Fuel System Schematic Diagram

(1) Gas input. (2) Customer supplied regulator. (3) Gas shutoff valve. (4) Control valve. (5) Fuel manifold. (6) Orifice. (7) Needle valve. (8) Precombustion chamber supply line. (9) Precombustion chamber check valve. (10) Electronic actuator. (11) Gas admission valve. (12) Precombustion chamber. (13) Main gas supply. (14) Spark plug. (15) Combustion air. (16) Cylinder head inlet port. (17) Inlet valve. (18) Exhaust valve.

Main Combustion Chamber

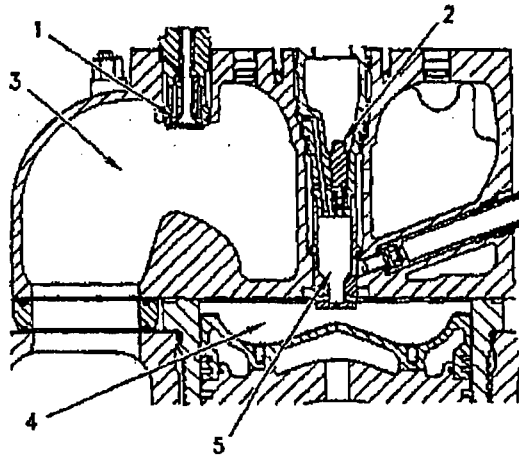


Illustration 25
(1) Gas admission valve. (2) Check valve. (3) Inlet air.
(4) Main combustion chamber. (5) Precombustion chamber.

The gas admission valve (1) is mounted in the inlet port and is actuated by the camshaft. As the gas admission valve is opened, gas is admitted into the inlet port. The gas mixes with the combustion air in the inlet port. The gas and combustion air mix and flow into the cylinder.

Combustion air flow into the cylinder head is regulated (depending on the engine load) by the exhaust bypass valve (wastegate) and inlet air choke. As air flows into the cylinder head inlet valve chamber, the cam operated gas admission valve (1) admits gas to the air flow as the inlet valve opens. At the same time, an additional, separate, new gas supply is added to the precombustion chamber (5) through a ball type check valve (2).

Precombustion Chamber

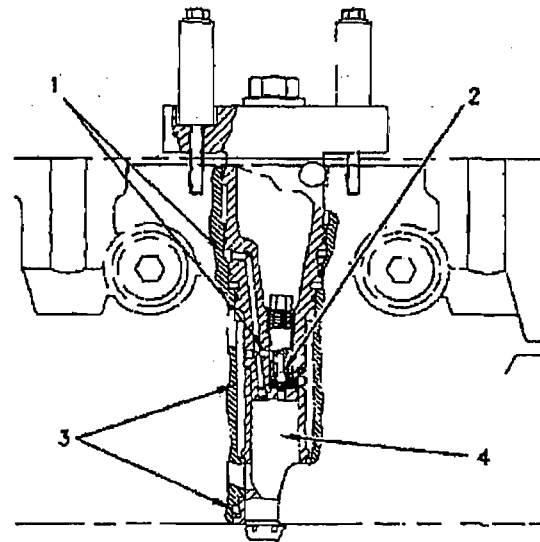


Illustration 26
PC Check Valve and Fuel Supply Path
(1) Fuel inlet passage. (2) Check valve. (3) Passageways for the jacket water coolant. (4) Precombustion chamber.

The new gas supply for the precombustion chamber (4) comes from the manifold. The new gas goes through a separate line and an adjustable needle valve. The new gas flows through the fuel inlet passage (1) into a ball type check valve (2). The check valve is located at the top of the precombustion chamber (4). The main charge of the air/fuel mixture flows through the inlet valves and into the cylinder. The check valve opens. The check valve adds new gas supply to the precombustion chamber. The gas in the precombustion chamber is ignited by the spark plug. The ignited gas in the precombustion chamber ignites the gas mixture in the cylinder in order to ensure consistent combustion and complete combustion.

Adjustment of the needle valve settings is a calibration procedure that is done by using the Digital Diagnostic Tool (DDT). The needle valve settings are adjusted in order to provide the desired combustion burn time. This depends on the engine speed and the engine load.

The need for low emissions and consistent combustion requires the use of an enriched precombustion chamber. To further enhance the overall effectiveness of this system, the side mounted spark plug is installed low in the precombustion chamber. With this design, the initiation of the flame front in the precombustion chamber is near the outlet to the main combustion chamber. This ensures that the rich fuel mixture is more completely burned prior to entering the main chamber than the fuel mixture would be burned if the ignition source was at the top of the precombustion chamber. Mixing of the fuel in the precombustion chamber with the lean combustion air from the main chamber during cylinder compression, yields an optimum air/fuel mixture for initiation of combustion.

The ignition transformer causes an increase of the primary voltage. The increased voltage is needed to send a spark (secondary electrical impulse) across the electrodes of the spark plugs. For good operation, the connections (terminals) must be clean and tight. The negative transformer terminals for each transformer are connected together and the terminals are connected to ground.

Timing Control System

The Caterpillar Detonation Sensitive Timing Control (DSTC) system provides detonation protection for the engine and electronic adjustment of ignition timing with a variable timing.

Ignition System

The components of the gas engine ignition group and the fully shielded ignition system wiring are used with the magneto in order to provide spark ignition.

Ignition Transformer

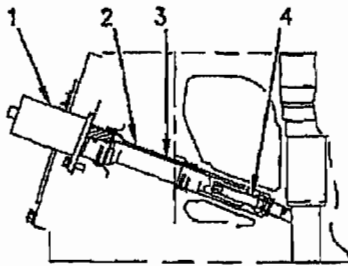


Illustration 27
Components of the Gas Engine Ignition Group
(1) High energy ignition transformer. (2) Tube.
(3) Extension with a spring loaded rod. (4) Spark plug.

Timing Control System

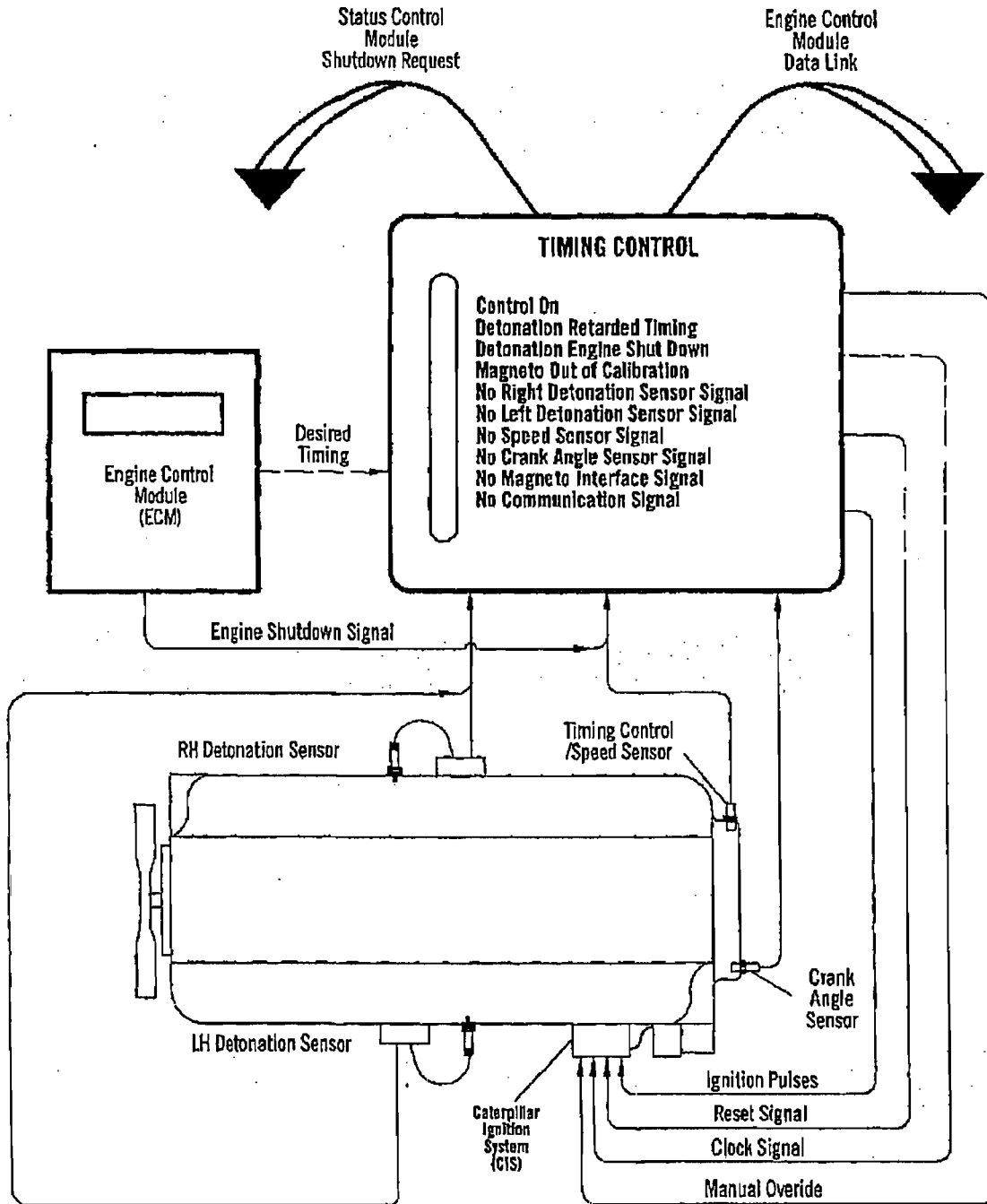


Illustration 28

Timing Control Module (TCM)

The TCM determines the ignition timing. The TCM communicates the ignition timing with the Caterpillar Ignition System (CIS). The TCM provides the system diagnostics.

Engine timing, controlled by the TCM, is based upon the desired timing signal received from the ECM. The desired timing signal from the ECM varies depending on engine speed, engine load and engine detonation.

The ignition timing is controlled by three signals that are sent from the TCM to the CIS. The CIS sends a signal that indicates that the plug is firing to the TCM. The TCM uses this signal to calculate actual engine timing.

Timing Control Sensors

The TCM uses two sensor signals for the ignition timing control. The TCM uses the detonation sensors for detonation protection. The Crank Angle Sensor (CAS) and the Speed Sensor (TCMPU) provide top center (TC) and rotational position needed to control timing. The detonation sensors provide an electrical signal of the engine's mechanical vibrations that are used in order to calculate the detonation levels.

Crank Angle Sensor (CAS)

This passive magnetic speed sensor indicates the crankshaft angle to the TCM. The crank angle sensor provides the TC signal used to control timing and calculate actual timing. The signal is generated when the TC hole (for the No. 1 piston) in the flywheel face passes the sensor.

Speed Sensor (TCMPU)

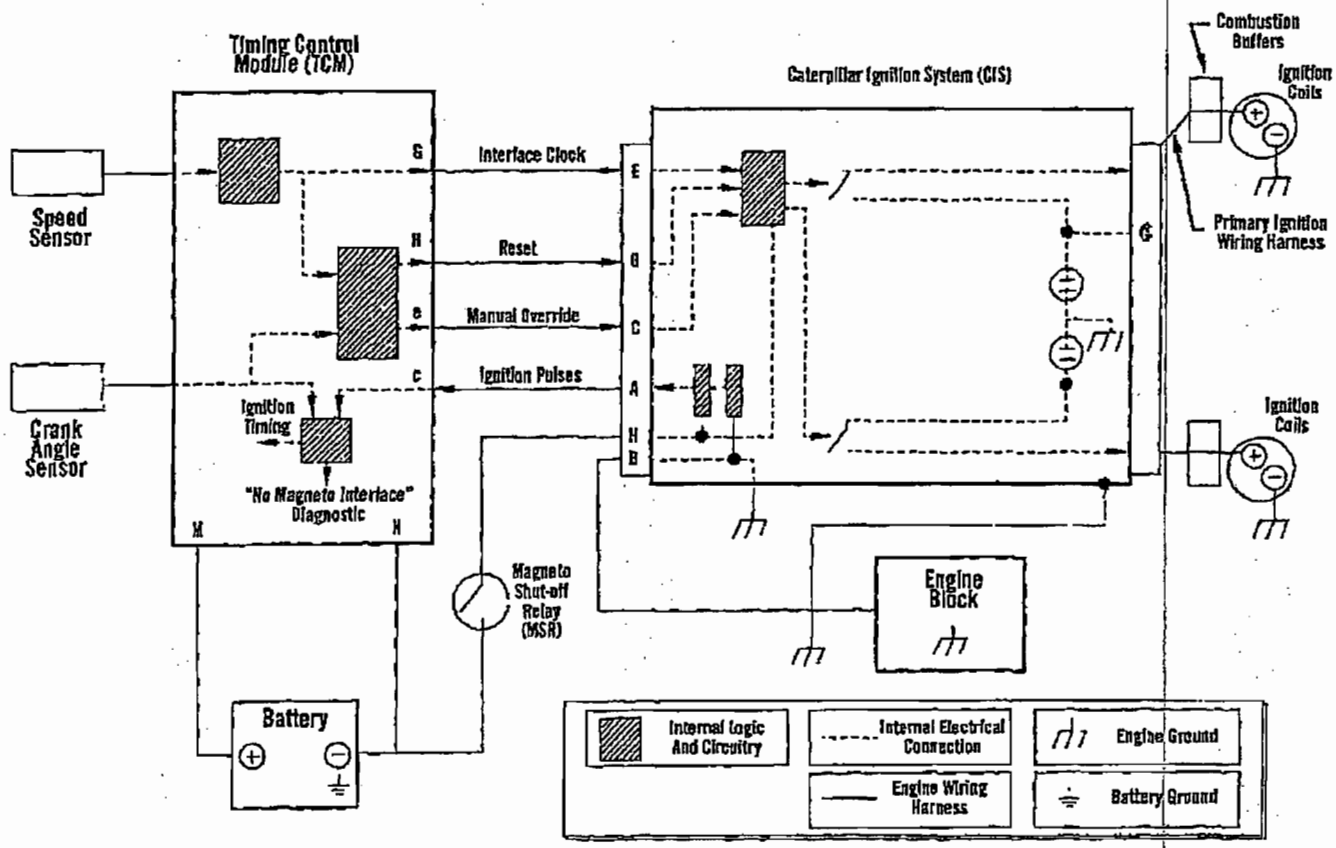
This passive magnetic speed sensor indicates engine speed to the TCM. The speed sensor produces a signal whenever a ring gear tooth on the flywheel passes the sensor. The signal is used to calculate engine speed, to monitor the crankshaft angle between TC pulses and to clock the MIB electronics.

Detonation Sensors

The detonation sensor is a powered device that outputs a filtered electrical signal and a amplified electrical signal of the engine's mechanical vibrations. When increased levels of vibration are occurring, the ECM calculates the engine detonation. If necessary, the ECM will adjust the ignition timing in order to control detonation. This is done by sending a desired timing signal that is retarded as much as six crank degrees to the TCM. When the level of vibration has returned to normal, the ECM will adjust the desired timing signal in order to gradually allow the ignition timing to return to operation. This adjustment is based on the desired timing map that is part of the personality module.

G3600 Ignition Timing System

Illustration 29



The Timing Control provides three signals to the Caterpillar Ignition System (CIS) in order to communicate the desired ignition timing. These signals are the Ignition Interface Clock, the Reset Pulse signal, and the Manual Override signal. The CIS returns the Ignition Pulses to the Timing Control. The Timing Control calculates the Actual Engine Timing. The Timing Control performs some ignition diagnostics from this signal.

Ignition Interface Clock

The Ignition Interface Clock signal is a square wave version of the speed sensor signal. This signal provides a timing clock for the CIS.

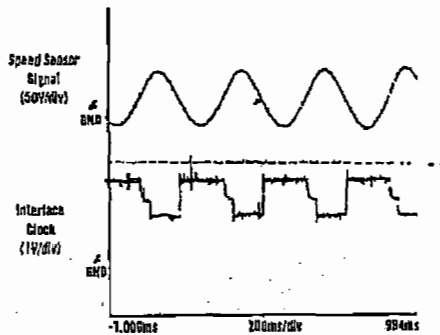


Illustration 30
Relationship Between Speed Sensor and Clock Signals

Sent from Timing Control (pin-G) to CIS (pin-E, 10 pin Connector).

The waveform is a square wave version of the speed sensor signal, with peak voltage of 2.5 V and minimum voltage of 1 V. The positive-going edge of the clock signal should align with the negative-going zero-crossing of the speed sensor signal.

Reset Pulse

The Reset Pulse signal indicates to the CIS the ignition timing desired by the Timing Control. The pulse is sent once from TC to TC.

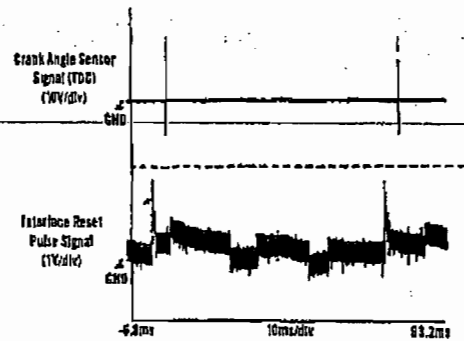


Illustration 31
Interface Reset Pulse Signal Relative to Crank Angle TC Signal

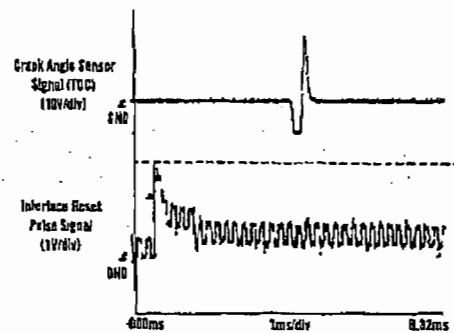


Illustration 32
Close Up of Interface Reset Pulse Signal Relative to Crank Angle TC Signal

Sent from Timing Control (pin-H) to CIS (pin-G, 10 pin Connector).

The Interface Reset Pulse signal is normally below 1 V. The Reset Pulse goes high to about 2.5 V. This signal should go high once from Top Center (TC) to TC.

Manual Override ("Mag Cal" Mode As Seen In DDT)

The Manual Override signal tells the CIS to control fully advanced ignition timing.

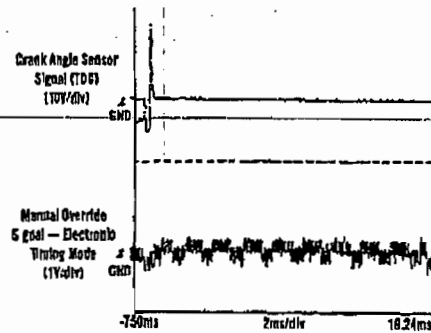


Illustration 33
Manual Override Signal, Timing Control In Electronic Timing Mode

Sent from Timing Control (pin-E) to CIS (pin-C, 10 pin Connector).

The manual override signal should remain below 1 V when the system is in Electronic Timing Control mode. A 5 V signal on this line will tell the CIS to run the ignition at fully advanced timing.

Ignition Pulses

The Ignition Pulse signal is the odd number bank's capacitor charge. The signals waveform indicates the discharge of the CIS and firing of cylinders. One pulse is shown for each number cylinder. This signal is used by the TCM to calculate ignition timing and some ignition diagnostics.

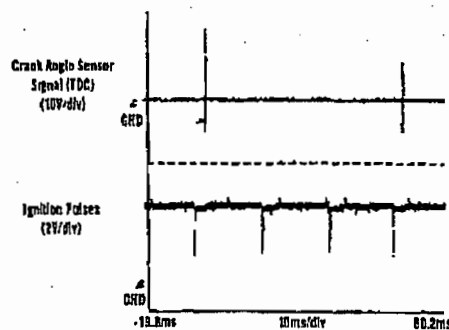


Illustration 34
Ignition Pulses Relative to Crank Angle TC Signal (Six Cylinder Engine)

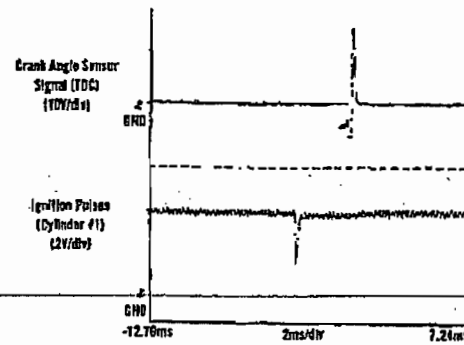


Illustration 35
Close Up of Ignition Pulses Relative to Crank Angle TC Signal (Six Cylinder Engine)

Sent from CIS (pin-A, 10 pin Connector) to Timing Control (pin-C).

From TC to TC, this waveform should show one pulse for each number cylinder. The pulse is normally at 5 V and goes below 2 V when the MIB detects the ignition firing.

Interaction Of The Interface Signals

The manual override signal is held below one volt, the CIS is placed in *Mag Cal* Mode. The TCM generates the Clock signal by squaring the Speed Sensor (TCMPU) signal. This clock signal is used by the CIS electronics in order to keep track of the rotational position. When the the Reset pulse is received from the TCM, the CIS counts nine Clock signal edges. The CIS will then signal to fire Cylinder Number One. The CIS continues to monitor the Clock. The CIS signals to fire the remaining cylinders through the rotation. When the CIS discharges to fire the cylinder, an ignition pulse is generated. The Ignition Pulse signal is a reduced voltage signal of the odd number bank's capacitor voltage. Ignition Timing is calculated by comparing the timing offset between TC from the Crank Angle Sensor and the Ignition Pulse for Cylinder Number One.

When the Manual Override signal goes above one volt, the CIS operates in Manual (Standard) Mode. The CIS will no longer control ignition firing. The CIS will generate an ignition pulse at the most advanced ignition timing. The Ignition Timing is calculated in the same manner as in Electronic Timing Mode.

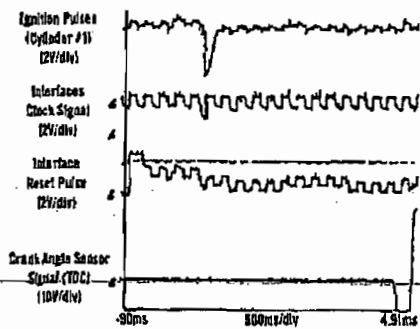


Illustration 36
Interaction of Reset, Clock, Ignition Pulse and TC Signal

When the CIS receives the Reset Pulse, the CIS generates a ignition pulse after 9 Clock Signal edges (both rising and falling edges). The CIS generates the Ignition Pulse for Cylinder Number One. This should occur before the TC signal of the engine.

Ignition Pulse Firings

From TC to TC, this waveform should show one pulse for each cylinder. The pulses should go from 190 V to ground when the cylinder is signaled to fire.

Engine Start-up

At engine start-up, the Timing Control performs some system checks not done once the engine is running. The Manual Override signal places the CIS in Manual Mode until the engine speed is above 500 rpm. Once the engine speed increases between 300 and 500 rpm, the Timing Control will compare the timing of Cylinder No. 1 firing to the *Mag Cal* Timing stored in internal memory. If the two timing values do not match, the Timing Control will display the "Magneto Out Of Calibration" fault.



G3600 Ignition System

General Information

- System Operation
- Digital Diagnostic Tool (DDT) Service Tool
- Engine Timing Reference
- Engine Rotation
- Hazardous Location (CSA)
- Power for Auxiliary Panels
- Electrical Schematics

Components-Engine Mounted

- Spark Plugs
- Spark Plug Extenders
- Ignition Transformers
- Magneto
- Magneto Interface Box
- Crank Angle Sensor
- Speed Sensor
- Detonation Sensor

Components-Remote Mounted

- Timing Control Module

Ignition Timing System
System Operation
Timing Control Module (TCM) Control Signals
Ignition Timing Control Logic

Customer Connections

Reference Material

Ignition System

General Information

System Operation

Caterpillar Gas Engines use a low tension ignition system. The low tension ignition system provides dependable firing with low maintenance. An ignition transformer is mounted near the spark plug for each cylinder. The ignition transformer converts the low level primary voltage to the high level secondary voltage required to arc across the J-gap spark plug. An extension piece connects the spark plug to the ignition transformer secondary.

The low level primary voltage (approximately 200 volts) is generated by a magneto. The magneto is mounted at the rear of the engine and driven by the camshaft. The variable timing magneto contains a permanent magnet alternator and solid-state electronic switches to control ignition firing.

The Timing Control System provides electronic control of the engine timing. This system controls the variable timing magneto to provide optimum engine timing during steady-state and transient operating conditions. Timing accuracy is controlled to within ± 0.7 degrees of crank angle. This system also provides detonation sensitive timing. The Timing Control System will retard engine timing when a level of detonation is reached that might damage the engine.

A normal engine shutdown is accomplished by shutting off the fuel supply. The ignition system continues to operate until the engine is below 50 rpm. This allows the engine to consume the fuel that is trapped between the shutoff valve and the cylinder. The ignition system is disabled for engine overspeed and emergency stop shutdowns.

Digital Diagnostic Tool (DDT)

Service Tool

A DDT service tool can be used to read the actual and desired engine timing. The DDT is also used to set the ignition system into the magneto calibration "MAG CAL" mode. The "MAG CAL" mode allows the magneto to be

manually adjusted to the magneto calibration setting of 28 ± 1 degree. The DDT does not display a desired timing in the "MAG CAL" mode but does display the actual engine timing.

Engine Timing Reference

Many procedures on the engine require a timing reference. The G3600 Gas Engines are considered "in time" when the number 1 cylinder is at top-dead-center position on the compression stroke, the crankshaft timing pin is engaged in the bracket attached to the crankshaft and the camshaft timing pin is engaged in the hole in the camshaft assembly.

Engine Rotation

SAE standard engine rotation is counterclockwise as seen from the flywheel end of the engine.

Note: The front end of the engine is opposite the flywheel end. Left side and right side are as seen from the flywheel end of the engine. The number 1 cylinder on the G3606 and G3608 engines is the front cylinder. The number 1 cylinder on the G3612 and G3616 engines is the front right cylinder.

Hazardous Location (CSA)

Factory certification by the Canadian Standards Association (CSA) is available. With an attachment design, the G3600 Gas Engine is approved for use in Class 1, Division 2, Group D hazardous locations. CSA approval is required for engines operating in hazardous locations in Canada. CSA certification is recognized by many authorities outside of Canada as well.

Power for Auxiliary Panels

The G3600 Engine Supervisory System control panel requires 24 VDC for operation. The power source for this system can also be used to power auxiliary panels. The magneto should not be used to power auxiliary panels. All magneto power is required to provide optimum engine operation and maximum spark plug life.

Electrical Schematics

Electrical schematics are shipped with the engine and should be kept with the service manual. All ignition system components, wiring, and terminal connections are shown in the schematic.

Components—Engine Mounted

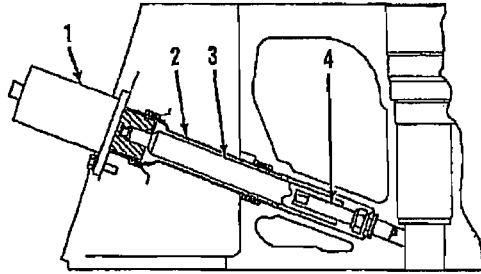


Figure 1: Ignition Group Components
(1) High energy ignition transformer. (2) Tube.
(3) Extender with spring loaded aluminum rod.
(4) Spark plug.

Spark Plugs

An 18 mm J-gap type spark plug (4) is mounted in each cylinder head with the firing end extending into and positioned low in the prechamber insert (see Figure 1). The spark plugs include precious metal electrodes for durability and resistance to electrical erosion. Other features developed for this application include copper-cored electrodes for better heat transfer, and a ceramic resistor for electrical noise suppression.

Failure to use recommended plugs, or failure to properly maintain the spark plugs will affect the engines fuel consumption, emissions, and steady-state stability.

Spark Plug Extenders

The spark plug extenders (3) provide the high voltage electrical connection from the ignition transformer secondary to the spark plug terminal. The one piece extender consists of a brass center electrode and spring-loaded tip within a Teflon insulator.

Ignition Transformers

An ignition transformer (1) is mounted on each cylinder head side cover. The ignition transformer converts the low level primary voltage (approximately 200 Volts) from the magneto to the high level secondary voltage (3,000-30,000 Volts) required to arc across the spark plug J-gap.

There is a separate pin on the magneto output connector for each ignition transformer. The ignition transformers are connected to the magneto output connector by wiring that is installed in a metal conduit assembly. Each ignition transformer primary coil positive terminal is connected to a solid-state electronic switch in the magneto. The wires from the primary coil negative terminals are connected together and attached to the engine block near the magneto.

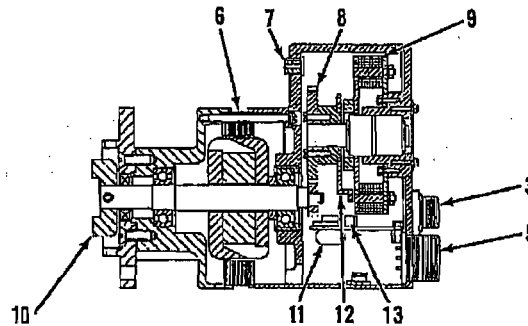


Figure 2. Cross Section Of Solid State Magneto
(3) Magneto interface box input connector.
(5) Magneto output connector. (6) Magneto alternator.
(7) Vent. (8) Speed reduction gears. (9) Pick-up coil.
(10) Drive tang. (11) Energy storage capacitor. (12) Rotating timer arm. (13) SCR solid state switch.

Magneto

The variable timing magneto (Figures 2 and 3) contains a permanent magnet alternator and solid-state electronic switches to control ignition firing. The magneto is mounted at the rear of the engine on the camshaft cover.

A drive gear from the camshaft turns the magneto drive tang (10). The drive tang turns the permanent magnet alternator (6), speed reduction gears (8), and the rotating timer arm (12). As the alternator is turned, it provides power to charge the storage capacitor (11). The G3612 and G3616 magnetos contain two storage capacitors, one stores the charge to fire the right bank (odd

numbered) cylinders and the other fires the left bank (even numbered) cylinders. There are separate stationary pick-up coils (9) and solid-state switches (13) for each cylinder.

Two conditions must be met before the storage capacitor will discharge across an ignition transformer primary. The switch in the Magneto Interface Box (MIB) and a solid-state switch in the magneto must be closed. The voltage from the storage capacitor is sent to the MIB and then back to the solid-state switches in the magneto through the magneto interface box connector (3). The switch in the MIB is controlled by signals from the Timing Control System. While the rotating timer arm is over a pick-up coil, the solid-state switch in the magneto paired with that pick-up coil is closed.

Note: The maximum ambient air temperature for magneto operation is 85°C (185°F).

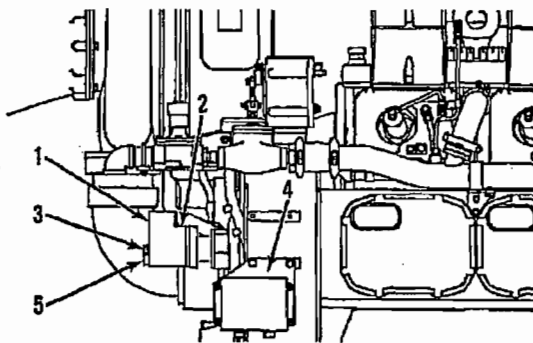


Figure 3: Solid State Magneto
(1) Electronic firing section of magneto. (2) Alternator section of magneto. (3) Magneto interface box input connector. (4) Magneto interface box. (5) Magneto output connector.

Magneto Interface Box

The Magneto Interface Box (MIB) is mounted near the magneto at the rear of the engine. The MIB is an interface between the Timing Control System and the magneto. The Timing Control Module sends signals to the MIB that control when the spark plugs fire. The MIB returns a signal to the Timing Control Module when the spark plugs fire.

Crank Angle Sensor

The crank angle sensor is mounted in a bracket above the flywheel. This passive magnetic pick-up indicates crankshaft angle to the Timing Control Module. A pulse is generated when the Top-Dead-Center (TDC) hole in the flywheel passes beneath the sensor. The TDC pulse is required to calculate actual engine timing.

Speed Sensor

The speed sensor is mounted in a bracket above the ring gear. This passive magnetic pick-up generates a pulse whenever a ring gear tooth on the flywheel passes beneath the sensor. There are 255 teeth on the ring gear. The pulses are used to calculate engine speed, monitor crankshaft angle between the crank angle sensor pulses, and provide a clock signal for the magneto interface box.

Detonation Sensor

The detonation sensor consists of an accelerometer body with a short steel jacketed wiring connection to an electronic buffer unit. The accelerometer body is threaded into the cylinder block and the buffer unit is mounted on a plate nearby. The detonation sensor outputs a filtered and amplified electrical signal that represents the engine's mechanical vibration. This signal is processed by the Timing Control System and used to provide detonation protection.

Components-Remote Mounted Timing Control Module

The Timing Control Module (TCM) is located inside the ESS control panel and is visible through the window on the front of the panel. The TCM receives information from the Crank Angle Sensor, Speed Sensor, Detonation Sensors, and the Engine Control Module. This information is used to control engine timing.

The TCM controls the engine timing based upon the set point determined by the Engine Control Module (ECM). This is accomplished by receiving the desired timing set point from the ECM over a dedicated data link and generating the proper control signals for the magneto interface box. The TCM returns its status (caution and fault codes) along with the

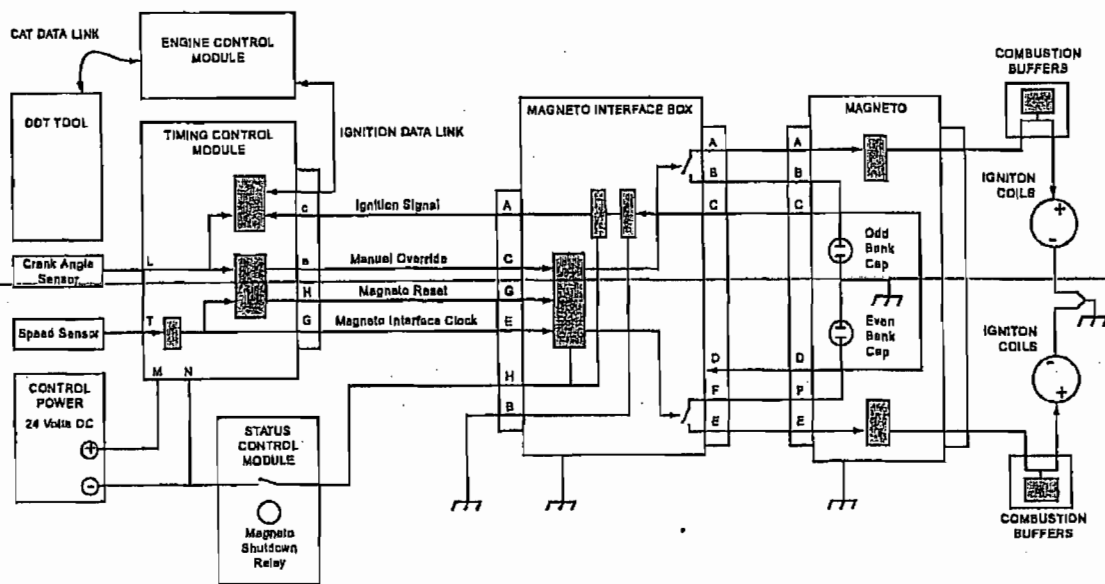


Figure 4: G3600 Ignition Timing System.

actual timing and the detonation level to the ECM for processing.

Ignition Timing System

System Operation

The Engine Supervisory System (ESS) integrates several control subsystems installed on the engine. With the ability to communicate with the various subsystems, the ESS optimizes each controlled parameter to ensure maximum engine performance. The subsystems include start/stop/prelube logic, engine monitoring and protection, and engine control which includes the Ignition Timing System (Figure 4). The ESS panel is the control center for the Engine Supervisory System and houses the control modules of each subsystem. The Timing Control Module (TCM) (Figure 5) maintains the ignition timing at the set point determined by the Engine Control Module (ECM). This is accomplished by receiving the desired timing set point from the ECM across a dedicated data link and generating the proper control signals for the magneto interface box.

Timing Control Module (TCM)

Control Signals

When the manual override signal is held below 1 volt and engine speed is greater than 500 rpm, the ignition system operates in the electronic timing mode. The Timing Control Module (TCM) generates the magneto interface clock signal which the Magneto Interface Box (MIB) uses to keep track of the engine's rotational position. The magneto interface clock signal is a square wave version of the speed sensor signal. The TCM sends a magneto reset pulse once per crankshaft revolution. When the MIB receives the magneto reset pulse, it counts 9 magneto interface clock signal edges and then closes the switch in the MIB which fires a cylinder. The MIB continues to monitor the magneto interface clock signal and fires the remaining cylinders in the rotation. When the magnetos odd bank capacitor discharges to fire a cylinder an ignition pulse is generated. The ignition signal is a reduced voltage version of the ignition pulse.

The TCM calculates the engine timing by comparing the timing offset between the ignition signal for cylinder 1 and the Top-Dead-Center (TDC) pulse from the crank angle sensor.

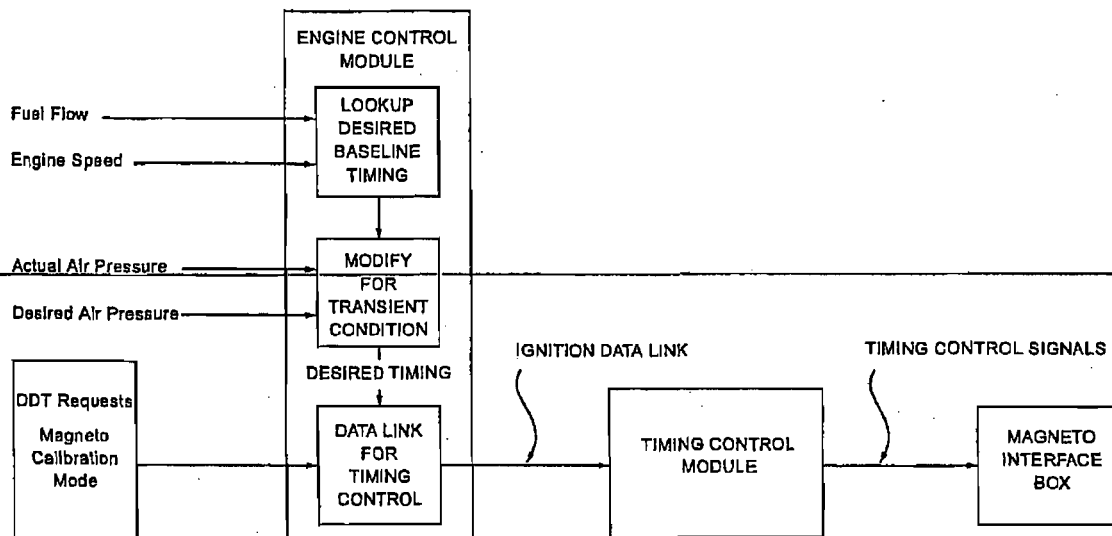


Figure 5: G3600 Ignition Timing Control Logic

When the manual override signal is above 1 volt, the ignition system operates in the magneto calibration "MAG CAL" mode. A DDT service tool is used to request the "MAG CAL" mode. In the "MAG CAL" mode, electronic timing is disabled. The solid-state switches in the MIB are always closed and ignition timing is fully advanced to 28 ± 1 degree. In "MAG CAL" mode, a spark plug will fire as soon as the timing arm in the magneto enters the pick-up coil field associated with that plug. The ignition timing is calculated in the same manner as it is in the electronic timing mode.

At engine start-up the Ignition System operates in the "MAG CAL" mode until the engine is above 500 rpm. The TCM checks for the ignition pulse firing signal from cylinder 1 between 120 and 300 rpm. The TCM will display the "No Magneto Interface Signal" fault if this ignition pulse is not detected for 0.3 seconds. Between 300 and 500 rpm the TCM compares the current timing of cylinder 1 with the "MAG CAL" timing stored in internal memory. The "Magneto Out of Calibration" fault will be displayed if the two values do not match.

Ignition Timing Control Logic

The primary function of the Engine Control Module (ECM) is to govern the engine speed and control the air/fuel ratio. It also has the role of systems coordinator. The software to operate the ECM is stored in a personality module that is mounted on the front of the ECM. The personality module contains many of the protection set points and stores the maps that are used for engine control. The map to control the ignition timing is stored in the personality module.

A DDT service tool connected to the Cat Data Link can be used to read the actual and the desired engine timing. The information on the Cat Data Link is sent from the ECM. The DDT is also used to place the ignition system in the magneto calibration "MAG CAL" mode. The ECM receives the request from the DDT and flags the Timing Control Module (TCM) to operate in the "MAG CAL" mode. In "MAG CAL" mode, the solid-state switches in the MIB are always closed and the ignition timing is fully advanced to 28 ± 1 degree.

If the DDT is not requesting "MAG CAL" mode, the ECM flags the TCM to operate in electronic timing mode. In electronic timing mode the ECM sends the desired timing set

point to the TCM over a dedicated data link. The desired timing set point is selected from the ignition timing map based on fuel flow and engine speed. The set point value is modified during transient conditions based on the actual and desired inlet manifold air pressure.

The ECM also uses the detonation level from the TCM to retard the engine timing if excessive levels of detonation are measured. The retarded timing essentially reduces the peak cylinder pressure.

Customer Connections

The only customer connections required to complete the ignition system are control power for the ESS panel and interconnect wiring between the ESS panel and the engine mounted junction box.

Two interconnect harnesses are available from Caterpillar to complete the wiring from the ESS panel to the junction box. One harness contains all wiring required for the start/stop/prelube systems, monitoring and protection system, and control systems which includes the ignition wiring. The other harness connects the engine thermocouples to the pyrometer(s) in the ESS panel. The harnesses are available in lengths of 20, 50, and 100 feet.

Reference Material

Special Instruction - *Installation and Initial Start-Up*. SEHS9708 for G3608 and G3606. SEHS9549-01 for G3616 and G3612.

This publication provides the information required to install the interconnect wiring between the ESS panel and the engine mounted junction box and completes the initial engine start-up.

Electrical Schematics - Wiring schematics are shipped with the engine and should be kept with the service manual. All ignition system components, wiring, and terminal connections are shown in the schematic.

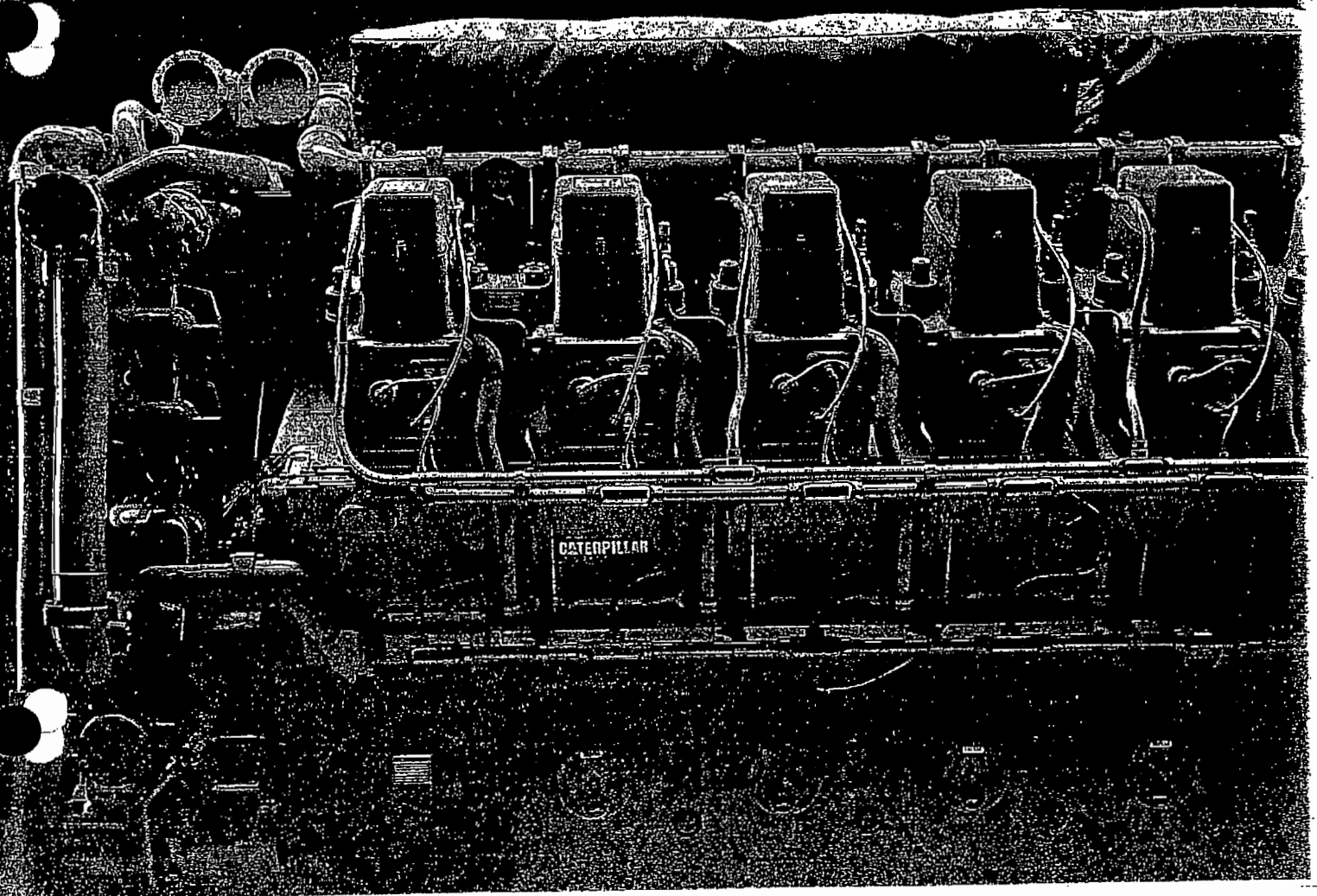
Service Manual - *Systems Operation Testing and Adjusting*. SENR4258-03 for G3608 and G3606. SENR5528-03 for G3616 and G3612.

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G3600

Family Of Gas Engines

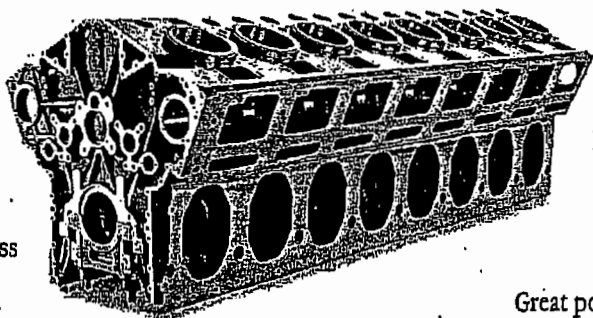
**Lower Speeds,
Higher Horsepower,
Lower Emissions.**



Cat® G3600 Family of Natural Gas Engines are the biggest, most powerful, most sophisticated gas engines ever built by Caterpillar. Ten years in development, the goal was to create a new engine that would run longer, and be more reliable than anything else on the market.

The Ultimate Po

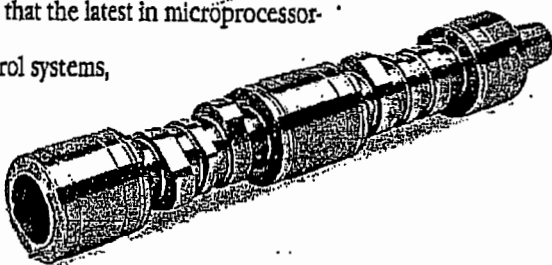
What resulted was an engine able to do more work in more applications. An engine that thinks for itself, allowing more unsupervised uptime with a minimum of 45,000 hours between major overhauls. An engine that burns less fuel, uses less oil, yet can meet or exceed almost any emissions standard anywhere in the world.



A Powerhouse of Technologies.

The G3600s get their strength from a foundation that is pure diesel, and therefore pure Caterpillar. Built for pressures that far exceed gas combustion, the block, crankshaft, rods, bearings, pistons, and other major components, are all the products of the latest innovations in over 60 years of diesel engine technology and design.

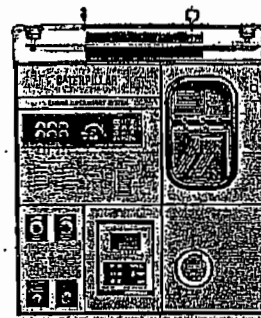
Add to that the latest in microprocessor-driven control systems, computer



controlled ignition and combustion, and electronic sensing and monitoring devices, and you begin to get the picture. The G3600s clearly deliver all and more of what Caterpillar has always been known for—reliable, heavy-duty power.

G3600 Electronics.

Great power requires great control. And the brains behind all the brawn is the Cat Engine Supervisory System. The ESS control system greatly enhances engine power and flexibility by constantly monitoring operations and making adjustments to optimize performance.



Through ESS, key parameters like timing, detonation margin, and air/fuel ratios are precisely controlled, adding power, fuel efficiency, and reducing emissions.

In addition, it's through the ESS that the G3600s get their ability to self-diagnose and self-adjust before problems occur, thereby assuring great performance and reliability.

● G3600 Mechanicals.

Engineered into every component of the G3600s is the Caterpillar drive for durability.

Durability that translates directly into lower owning



Caterpillar. Powering The Way Worldwide.

From offshore oil rigs, to natural gas fields, from wide open spaces, to the confines of an urban city. Whether it's powering a generator, a compressor

or a pump. No matter what the available gaseous fuel. Wherever the need is for efficient, reliable, durable power,

and in a big way, there's a G3600 configuration to answer the call.

And because reliable power also means reliable support,

count on the 1,200 strong worldwide Cat dealer facilities

network to deliver all the customer and product

support you need to keep your power up and costs down. From application matching, to maintenance,

to financing, your local Cat dealer has all the engine power and manpower required to ensure that everything Caterpillar put into the G3600s is everything you get out.



ver Tool.

and operating costs. Some of the major mechanical innovations that make these gas engines the ultrareliable powerhouses they are include: one-piece cylinder block casting; press-forged crankshaft; steel-

backed
aluminum



bearings with a lead-tin overlay; forged, heat treated, shot peened connecting rods; high-alloy, cast iron cylinder liners; and steel crowned, forged aluminum, deep cup pistons.

