City of West Allis
7525 West Greenfield Avenue | West Allis, WI 53214

Fire Administration Backup Generator Basis of Design Report

May 2017

Prepared by:

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Donohue Project No.: 13021

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APPENDICES

EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report identifies options for the replacement of the existing backup generator located at the Fire Administration Building; potential design problems and suggested resolutions; confirms design and construction schedules; and, includes an opinion of probable construction cost. This report includes a Design Technical Memorandum – Electrical, Structural and Mechanical (Appendix A) as well as project specific vendor information (Appendix B), a Construction Cost Opinion (Appendix C), a Construction Phasing Plan (Appendix D), and Project Schedule (Appendix E). The next phase of the design, the Plans and Specifications, will proceed per the recommendations of this Report.

The City's primary objective for this project is to replace the existing diesel generator with a natural gas generator.

1.2 ELECTRICAL DESIGN

The Design Technical Memorandum – Electrical, Structural and Mechanical establishes design criteria for a new natural gas generator. The memorandum also presents alternate locations evaluated for the generator to be installed.

The following is a summary of recommendations:

- Install a new generator sized to operate critical loads in the Fire Administration Building and Fire House #1
- Install new natural gas meter and regulator to accommodate increased demand from the addition of the generator
- Install the generator in the same location as the existing due to the structural uncertainty and limited work space on the roof
- Install new intake louver and ventilation duct
- Install new exhaust piping

1.3 DESIGN CONCEPT DRAWINGS

The drawings provided in Appendix B graphically depict major features of the design basis for the generator.

1.4 CONSTRUCTION COST OPINION

Our opinion of probable construction cost for this Basis of Design is $94k for a generator sized to power the emergency panels in the Fire Administration Building and Fire House #1. The construction cost opinion includes a cost breakdown for the project.

1.5 CONSTRUCTION PHASING PLAN

The Bidding Documents will not dictate specific means and methods for the Work; however, they will define construction sequences and constraints that are necessary to maintain operation during construction. The most significant constraint for the project is to keep the Fire Administration Building

and Fire House #1 operational during the generator replacement. The Construction Phasing Plan presents a sequence of major construction tasks to meet these constraints. The Construction Phasing Plan will be developed in greater detail during subsequent phases of the design to identify more detailed constraints that may be required and to establish the Contract Times to be specified in the Bidding Documents.

1.6 PROJECT SCHEDULE

There is no agency-required compliance schedule for the project. Therefore, the design schedule shown below has been developed to comply with the City's goal to construct the project in the next year.

ACTIVITY	COMPLETION
Submit DRAFT Basis of Design	05/08/2017
Complete Master Plan / Basis of Design	05/22/2017
Design	
Pre-final Plans*	07/03/2017
Bidding Documents	07/17/2017
Bid and Award	
Advertisement	August 2017
Bid Closing/Opening	September 2017
Award of Contract	October 2017
Construction	
Notice to Proceed	October 2017
Substantial Completion	May 2018
Final Completion	June 2018

*Pre-Final plans will be provided within four (4) weeks of detailed design Notice To Proceed (NTP). Dates assume NTP of June 5, 2017.

The Bid and Award dates and significant Construction completion dates will be refined as the design progresses. The construction completion dates are based on the Possible Construction Schedule prepared for critical construction tasks.

Appendix A

Design Technical Memorandum – Electrical, Structural and Mechanical

Electrical Design
Technical Memorandum

Fire Administration and Fire House #1
Backup Generator
City of West Allis

Date: May 8, 2017

To: Michael Lewis, Director of Public Works / City Engineer

Copy: Peter Daniels, Principal Design Engineer

From: Mike Stohl, P.E., Project Manager

Purpose

The purpose of this Technical Memorandum is to document the established electrical design basis for the project. The following electrical and structural design basis have been developed for the project:

- Generator Design
- Electrical Design Guidelines
- Structural Evaluation
- Ventilation Requirements

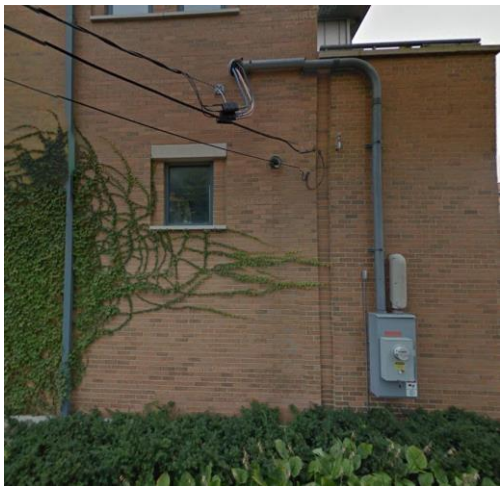
Generator Design

Facility Description

Electrical service for the Fire Administration Building come through a WE Energies (W.E.) owned pole mounted transformer located near the Northeast corner of the building. The transformer steps down the voltage to 208/120V 3 phase 4 wire and connects to metering equipment located on the Northeast side of the building. From the utility meter the conductors enter a 400A, 208/120V, 3 phase, 4 wire Main Distribution Panel (MDP).

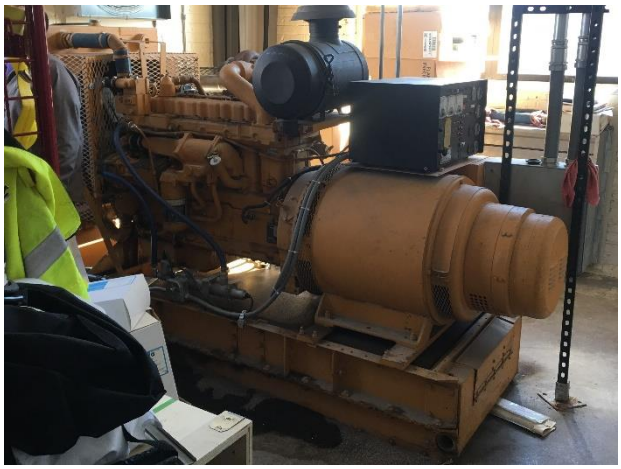
Service Entrance and Utility Meter
Fire Administration Building

Electrical service for Fire House #1 come through a WE Energies (W.E.) owned pole mounted transformer located near the Northwest corner of the building. The transformer steps down the voltage to 208/120V 3 phase 4 wire and connects to metering equipment located on the Northwest side of the building. From the utility meter the conductors enter a 400A, 208/120V, 3 phase, 4 wire Main Distribution Panel (MDP).



Service Entrance and Utility Meter
Fire House #1

The Fire Administration Building has an existing 100 kilowatt (kW) diesel generator located in the garage that provides power to emergency panels located in the Fire Administration Building and Fire House #1. Each building has an Automatic Transfer Switch (ATS) with power and control wiring to start the generator in the event of a power outage. The Fire Administration Building and Fire House #1 have a 150A and 225A ATS respectively.



Existing Generator Located in Garage

Generator Design

1. Generator sized equivalent to existing diesel generator will be replaced with a natural gas generator with the same kilowatt rating of 100kW. Natural gas service to the facility will be modified to increase the supply pressure from 7-inches water column to 2-psig and the meter change to allow for the additional gas flow. Supplier has indicated there will be no charge for this meter change.

2. Generator Location: A structural analysis was performed on the existing roof above the garage to determine if relocating the generator to the roof is a feasible option. The roof was constructed in 1929 and consists of steel beams supporting a concrete slab. Results of the analysis indicate the existing roof beams would be overstressed with the addition of the new generator. Further locating the generator on the roof will allow limited work space around the enclosure and likely limit the ability to fully open the enclosure doors to 90 degrees. Therefore, Donohue does not recommend relocating the generator to the roof above the garage.

3. Generator Airflow Considerations: Existing space has inadequate ventilation to reject both the radiator heat and the radiated heat from the engine. It is recommended that the new generator be installed with its radiator ducted to the building exterior through the existing wall louver. A new intake air louver should also be provided to allow the required radiator airflow into the space which will require increasing the size of the existing opening.

4. Generator Exhaust: The existing exhaust piping has significant rust as well as the brackets securing it. It is recommended to replace the exhaust piping and brackets.

Conclusions

It is recommended to replace the existing generator with a new generator with the same kilowatt rating to power the emergency panels for the Fire Administration Building and Fire House #1. Structural review has eliminated the feasibility of installing the generator on the roof due to insufficient support strength of the supporting structure. To avoid adding additional capital costs as well as allow for straight forward construction sequencing and minimize downtime, it is recommended to install the new generator in the same location as the existing with ducted radiator discharge, a new intake air louver and new exhaust piping.

Electrical Design

General Design

1. Applicable Codes

    a. National Electrical Code (NEC)
    b. NFPA 110: Standard for Emergency and Standby Power Systems
    c. Wisconsin Administrative Code, Department of Safety and Professional Services (SPS), Chapter 316 – Electrical

2. Backup Generator

    a. Sized equivalent to the existing generator that supplies power to the emergency panels at the Fire Administration Building and Fire House #1.
    b. Natural gas generator complete with control and auxiliary equipment as well as an integrated electrical panel with dual 200A and 250A breaker for the Fire Administration Building and Fire House #1.
    c. Skid mounted located indoor at east end of the garage.
    d. Manufactured by Cummins Power Generation, MTU Onsite Energy, Caterpillar, or Kohler Power Systems.

3. Conduit

    a. Interior Conduit:
        1. Exposed Dry Locations - Galvanized rigid steel conduit:
        2. Flexible Conduit – Liquidtight flexible metal conduit.
    b. Minimum Size: ¾ inch
    c. Threaded, no set screw or indentor type fittings

4. Conductors (600V and less)

    a. Branch Circuits – Single conductor THHN/THWN (90^{o}C) copper conductors.
    b. Feeders and Conduit Duct Banks – Single conductor XHHW-2 copper conductors.
    c. Minimum size #12 AWG.

Appendix B

Vendor Information

Specification sheet

Spark-ignited generator set

45–100 kW standby
EPA emissions

Description

Cummins Power Generation generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary standby applications.

Features

Gas engine - Rugged 4-cycle Cummins QSJ5.9G spark-ignited engine delivers reliable power. The electronic air/fuel ratio control provides optimum engine performance and fast response to load changes.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads and fault clearing short-circuit capability.

Control system - The PowerCommand® 1.1 electronic control is standard equipment and provides total generator set system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance. The PowerCommand® 2.3 control is also optional and is UL 508 Listed and provides AmpSentry® protection.

Cooling system - Standard cooling package provides reliable running at up to 50 ℃ (122 ℉) ambient temperature.

Enclosures - The aesthetically appealing enclosure incorporates special designs that deliver one of the quietest generators of its kind. Aluminum material plus durable powder coat paint provides the best anti-corrosion performance. The generator set enclosure has been evaluated to withstand 180 MPH wind loads in accordance with ASCE7-10. The design has hinged doors to provide easy access for service and maintenance.

NFPA - The generator set accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

Warranty and service - Backed by a comprehensive warranty and worldwide distributor and dealer network.

	Natural Gas		Propane		
	Standby (60 Hz)		Standby (60 Hz)		Data sheets
Model	kW	kVA	kW	kVA	60 Hz
C45 N6	45	56	45	56	NAD-6093-EN
C50 N6	50	63	50	63	NAD-6094-EN
C60 N6	60	75	60	75	NAD-6095-EN
C70 N6	70	88	70	88	NAD-6096-EN
C80 N6	80	100	80	100	NAD-6097-EN
C100 N6	100	125	100	125	NAD-6098-EN

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Generator set specifications

Governor regulation class	ISO 8528 Part 1 Class G3
Voltage regulation, no load to full load	± 1.0%
Random voltage variation	± 1.0%
Frequency regulation	Isochronous
Random frequency variation	± 0.25% @ 60 Hz
Radio frequency emissions compliance	Meets requirements of most industrial and commercial applications

Engine specifications

Design	Naturally aspirated or turbo charged (varies by generator set model)
Bore	102.1 mm (4.02 in)
Stroke	119.9 mm (4.72 in)
Displacement	5.9 liters (359 in^3)
Cylinder block	Cast iron, in-line 6 cylinder
Battery capacity	850 amps at ambient temperature of 0 °F to 32 °F (-18 °C to 0 °C)
Battery charging alternator	52 amps
Starting voltage	12 volt, negative ground
Lube oil filter type(s)	Spin-on with relief valve
Standard cooling system	50 °C (122 °F) ambient cooling system
Rated speed	1800 rpm

Alternator specifications

Design	Brushless, 4 pole, drip proof, revolving field
Stator	2/3 pitch
Rotor	Direct coupled, flexible disc
Insulation system	Class H per NEMA MG1-1.65
Standard temperature rise	120 ºC (248 °F) standby
Exciter type	Torque match (shunt) with PMG as option
Alternator cooling	Direct drive centrifugal blower
AC waveform total harmonic distortion	< 5% no load to full linear load, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50 per NEMA MG1-22.43
Telephone harmonic factor (THF)	<3%

Available voltages

1-phase	3-phase				
• 120/240	• 120/208	• 120/240	• 277/480	• 347/600	• 127/220

Generator set options

Fuel system
- ☑ Single fuel - natural gas or propane vapor, field selectable
- ☐ Dual fuel – natural gas and propane vapor auto changeover
- ☐ Low fuel gas pressure warning

Engine
- ☐ Engine air cleaner
- ☐ Shut down – low oil pressure
- ☐ Extension – oil drain
- ☐ Engine oil heater

Alternator
- ☐ 120 °C temperature rise alternator
- ☑ 105 °C temperature rise alternator
- ☐ PMG
- ☑ Alternator heater, 120V
- ☐ Reconnectable full 1 phase output alternator

Control
- ☑ AC output analog meters
- ☑ Stop switch – emergency
- ☐ Auxiliary output relays (2)
- ☐ Auxiliary configurable signal inputs (8) and relay outputs (8)

Electrical
- ☑ One, two or three circuit breaker configurations
- ☑ 80% rated circuit breakers
- ☐ 100% rated LSI circuit breakers
- ☑ Battery charger

Enclosure
- ☐ Aluminum enclosure Sound Level 1 or Level 2, sandstone or green color
- ☐ Aluminum weather protective enclosure with muffler installed, green color

Cooling system
- ☑ Shutdown – low coolant level
- ☑ Warning – low coolant level
- ☐ Extension – coolant drain
- ☑ Coolant heater options:
  - ● <4 °C (40 °F) – cold weather
  - ○ <-17 °C (0 °F) – extreme cold

Exhaust system
- ☑ Exhaust connector NPT
- ☐ Exhaust muffler mounted

Generator set application
- ☑ Base barrier – elevated genset
- ☑ Battery rack, standard battery
- ☐ Battery rack, larger battery
- ☑ Radiator outlet duct adapter

Warranty
- ☑ Base warranty – 2 year/400 hours, standby
- ☐ 3 year standby warranty options
- ☐ 5 year standby warranty options

Generator set accessories

- ☑ Coolant heaters – 1000W / 1500W
- ☑ Battery rack, standard/larger battery
- ☐ Battery heater kit
- ☐ Engine oil heater
- ☐ Remote control displays
- ☐ Auxiliary output relays (2)
- ☐ Auxiliary configurable signal inputs (8) and relay outputs (8)
- ☑ Annunciator – RS485
- ☐ Remote monitoring device – PowerCommand 500/550
- ☑ Battery charger – stand-alone, 12V
- ☑ Circuit breakers
- ☐ Enclosure Sound Level 1 to Sound Level 2 upgrade kit
- ☑ Base barrier – elevated generator set
- ☑ Mufflers – industrial, residential or critical
- ☐ Alternator PMG
- ☑ Alternator heater

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Control system PowerCommand 1.1

PowerCommand control is an integrated generator set control system providing voltage regulation, engine protection, operator interface and isochronous governing (optional). Major features include:

- Battery monitoring and testing features and smart starting control system.
- Standard PCCNet interface to devices such as remote annunciator for NFPA 110 applications.
- Control boards potted for environmental protection.
- Control suitable for operation in ambient temperatures from -40 ºC to +70 ºC (-40 ºF to +158 ºF) and altitudes to 5000 meters (13,000 feet).
- Prototype tested; UL, CSA, and CE compliant.
- InPower™ PC-based service tool available for detailed diagnostics.

Operator/display panel

- Manual off switch
- Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup, controls and adjustments (English or international symbols)
- LED lamps indicating generator set running, not in auto, common warning, common shutdown, manual run mode and remote start
- Suitable for operation in ambient temperatures from -40 °C to +70 °C
- Bargraph display (optional)

AC protection

- Over current warning and shutdown
- Over and under voltage shutdown
- Over and under frequency shutdown
- Over excitation (loss of sensing) fault
- Field overload

Engine protection

- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Low coolant temperature warning
- High, low and weak battery voltage warning
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Redundant start disconnect
- Cranking lockout
- Sensor failure indication
- Low fuel level warning or shutdown

Alternator data

- Line-to-line and Line-to-neutral AC volts
- 3-phase AC current
- Frequency
- Total kVa

Engine data

- DC voltage
- Lube oil pressure
- Coolant temperature
- Engine speed

Other data

- Generator set model data
- Start attempts, starts, running hours
- Fault history
- RS485 Modbus® interface
- Data logging and fault simulation (requires InPower service tool)

Digital governing (optional)

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital voltage regulation

- Integrated digital electronic voltage regulator
- 2-phase line-to-line sensing
- Configurable torque matching

Control functions

- Time delay start and cooldown
- Cycle cranking
- PCCNet interface
- (2) Configurable inputs
- (2) Configurable outputs
- Remote emergency stop
- Automatic transfer switch (ATS) control
- Generator set exercise, field adjustable

Options

- ☐ Auxiliary output relays (2)
- ☐ Remote annunciator with (3) configurable inputs and (4) configurable outputs
- ☐ PMG alternator excitation
- ☐ PowerCommand 500/550 for remote monitoring and alarm notification (accessory)
- ☐ Auxiliary, configurable signal inputs (8) and configurable relay outputs (8)
- ☐ Digital governing
- ☐ AC output analog meters (bargraph)
  - Color-coded graphical display of:
    - 3-phase AC voltage
    - 3-phase current
    - Frequency
    - kVa
- ☐ Remote operator panel
- ☐ PowerCommand® 2.3 control with AmpSentry® protection

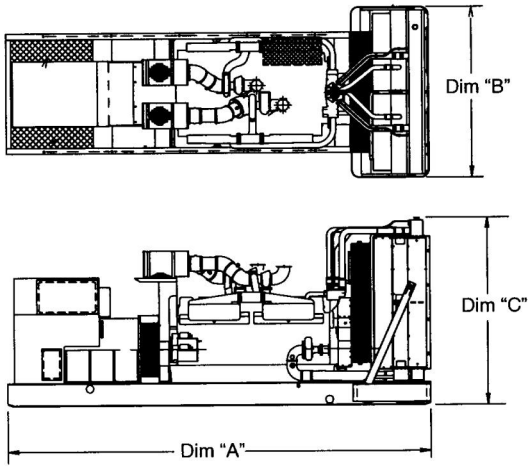
Ratings definitions

Emergency standby power (ESP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Limited-time running power (LTP):
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime power (PRP):
Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Base load (continuous) power (COP):
Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.



This outline drawing is for reference only. See respective model data sheet for specific model outline drawing number.

Do not use for installation design

Model	Dim "A" mm (in.)	Dim "B" mm (in.)	Dim "C" mm (in.)	Set Weight*wet kg (lbs.)
		Open Set		
C45 N6	2489 (98)	1016 (40)	1473 (58)	989 (2180)
C50 N6	2489 (98)	1016 (40)	1473 (58)	989 (2180)
C60 N6	2489 (98)	1016 (40)	1473 (58)	1103 (2431)
C70 N6	2489 (98)	1016 (40)	1473 (58)	1111 (2449)
C80 N6	2489 (98)	1016 (40)	1473 (58)	1173 (2587)
C100 N6	2489 (98)	1016 (40)	1473 (58)	1233 (2719)
		Weather Protective Enclosure		
C45 N6	2489 (98)	1016 (40)	1473 (58)	1070 (2359)
C50 N6	2489 (98)	1016 (40)	1473 (58)	1070 (2359)
C60 N6	2489 (98)	1016 (40)	1473 (58)	1184 (2610)
C70 N6	2489 (98)	1016 (40)	1473 (58)	1192 (2628)
C80 N6	2489 (98)	1016 (40)	1473 (58)	1255 (2766)
C100 N6	2489 (98)	1016 (40)	1473 (58)	1315 (2898)
		Sound Attenuated Enclosure Level 1		
C45 N6	3023 (119)	1016 (40)	1473 (58)	1114 (2455)
C50 N6	3023 (119)	1016 (40)	1473 (58)	1114 (2455)
C60 N6	3023 (119)	1016 (40)	1473 (58)	1227 (2706)
C70 N6	3023 (119)	1016 (40)	1473 (58)	1236 (2724)
C80 N6	3023 (119)	1016 (40)	1473 (58)	1298 (2862)
C100 N6	3023 (119)	1016 (40)	1473 (58)	1358 (2994)
		Sound Attenuated Enclosure Level 2		
C45 N6	3454 (136)	1016 (40)	1473 (58)	1127 (2485)
C50 N6	3454 (136)	1016 (40)	1473 (58)	1127 (2485)
C60 N6	3454 (136)	1016 (40)	1473 (58)	1241 (2736)
C70 N6	3454 (136)	1016 (40)	1473 (58)	1249 (2754)
C80 N6	3454 (136)	1016 (40)	1473 (58)	1312 (2892)
C100 N6	3454 (136)	1016 (40)	1473 (58)	1372 (3024)

* Weights above are average. Actual weight varies with product configuration.

Codes and standards

Codes or standards compliance may not be available with all model configurations – consult factory for availability.

	The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins Power Generation products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.		This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.
			The generator set is available Listed to UL 2200, Stationary Engine Generator Assemblies.
International Building Code	The generator set is certified to International Building Code (IBC) 2012.		All low voltage models are CSA certified to product class 4215-01.
		U.S. EPA	Engine certified to U.S. EPA SI Stationary Emission Regulation 40 CFR, Part 60.

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

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NAS-6092b-EN (8/16)

Power Generation

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Generator Set Data Sheet

Power Generation

Model: C100 N6
Frequency: 60 Hz
Fuel type: Natural gas/propane
kW rating: 100 natural gas standby
100 propane standby
Emissions level: EPA Emissions

Fuel consumption

	Natural gas Standby kW (kVA)				Propane Standby kW (kVA)			
Ratings	100 (125)				100 (125)			
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**
scfh	549.6	805.4	1050.8	1317.7	207.5	311.8	411.2	518.7
m^3/hr	15.6	22.8	29.8	37.3	5.9	8.8	11.7	14.7

Engine

	Natural gas Standby rating	Propane Standby rating
Engine model	QSJ5.9G-G3	
Configuration	Cast Iron, In line, 6 cylinder	
Aspiration	Turbocharged and aftercooled	
Gross engine power output, kWm (bhp)	122 (163.9)	
BMEP , kPa (psi)	1381.0 (200.3)	
Bore, mm (in)	102.1 (4.02)	
Stroke, mm (in)	119.9 (4.72)	
Rated speed, rpm	1800	
Piston speed, m/s (ft/min)	7.2 (1416)	
Compression ratio	8.5:1	
Lube oil capacity, L (qt)	14.2 (15)	
Overspeed limit, rpm	2250	

Fuel supply pressure

Minimum operating pressure, kPa (in H_2O)	1.5 (6)
Maximum operating pressure, kPa (in H_2O)	3.5 (14)

Air

Combustion air, m^3/min (scfm)	8.4 (297.8)	8.5 (298.5)
Maximum normal duty air cleaner restriction, kPa (in H_2O)	0.4 (1.5)	0.4 (1.5)
Maximum heavy duty air cleaner restriction, kPa (in H_2O)	3.7 (15)	3.7 (15)

Exhaust

Exhaust flow at set rated load, m^3/min (cfm)	27.3 (965)	25.7 (908.7)
Exhaust temperature at set rated load, °C (°F)	635.2 (1175.4)	645.7 (1194.3)
Maximum back pressure, kPa (inH_2O)	8.5 (34.1)	8.5 (34.1)

Standard set-mounted radiator cooling	Natural gas Standby rating	Propane Standby rating
Ambient design, °C (°F)	50 (122)	50 (122)
Fan load, kWm (HP)	9.0 (12)	9.0 (12)
Coolant capacity (with radiator), L (US gal)	16 (4.2)	16 (4.2)
Cooling system air flow, m^3/min (scfm)	218.0 (7700)	218.0 (7700)
Total heat rejection, MJ/min (Btu/min)	8.9 (8428)	8.9 (8428)
Maximum cooling air flow static restriction, kPa (inH_2O)	0.12 (0.5)	0.12 (0.5)

Weights	Natural gas	Propane
Unit dry weight kg (lb)	1276 (2812)	1276 (2812)
Unit wet weight kg (lb)	1315 (2898)	1315 (2898)

Note: Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating factors

Natural gas

Standby	Engine power available up to 488 m (1600 ft) at ambient temperatures up to 25°C (77°F). Above these elevations derate at 4% per 305m (1000ft) and 2% per 10°C above 25°C (77°F).

Propane

Standby	Engine power available up to 488 m (1600 ft) at ambient temperatures up to 25°C (77°F). Above these elevations derate at 4% per 305m (1000ft) and 2% per 10°C above 25°C (77°F).

Ratings definitions

Emergency standby power (ESP)	Limited-time running power (LTP)	Prime power (PRP)	Base load (continuous) power (COP)
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.

Alternator data

Standard alternators		Natural gas/ propane single phase table	Natural gas/propane three phase table					Full single phase output, reconnectable
Maximum temperature rise above 40 °C ambient		**120 °C**	**120 °C**	**120 °C**	**120 °C**	**120 °C**	**120 °C**	**120 °C**
Feature code		BB90-2	B986-2	B946-2	B943-2	B952-2	BB86-2	BB88-2
Alternator data sheet number		ADS-207	ADS-207	ADS-207	ADS-207	ADS-207	ADS-207	ADS-209
Voltage ranges		120/240	120/240	120/208	277/480	347/600	127/220	120 - 480
Voltage feature code		R104-2	R106-2	R098-2	R002-2	R114-2	R020-2	Varies by voltage
Surge kW		98.7	102.7	102.7	103.9	103.9	103.2	Varies by voltage
Motor starting kVA (at 90% sustained voltage)	Shunt	360	360	360	360	360	360	516
	PMG	423	423	423	423	423	423	607
Full load current amps at standby rating		417	301	347	150	120	328	Varies by voltage

Optional alternators for improved starting capability		Natural gas/ propane single phase table	Natural gas/propane three phase table					Full single phase output, reconnectable
Maximum temperature rise above 40 °C ambient		**105 °C**	**105 °C**	**105 °C**	**105 °C**	**105 °C**	**105 °C**	
Feature code		BB91-2	BB94-2	BB93-2	BB95-2	BB92-2	BB85-2	
Alternator data sheet number		ADS-208	ADS-208	ADS-208	ADS-207	ADS-207	ADS-207	
Voltage ranges		120/240	120/240	120/208	277/480	347/600	127/220	
Voltage feature code		R104-2	R106-2	R098-2	R002-2	R114-2	R020-2	Not available
Surge kW		100.1	104.5	104.5	103.9	103.9	103.2	
Motor starting kVA (at 90% sustained voltage)	Shunt	422	422	422	360	360	360	
	PMG	497	497	497	423	423	423	
Full load current amps at standby rating		417	301	347	150	120	328	

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

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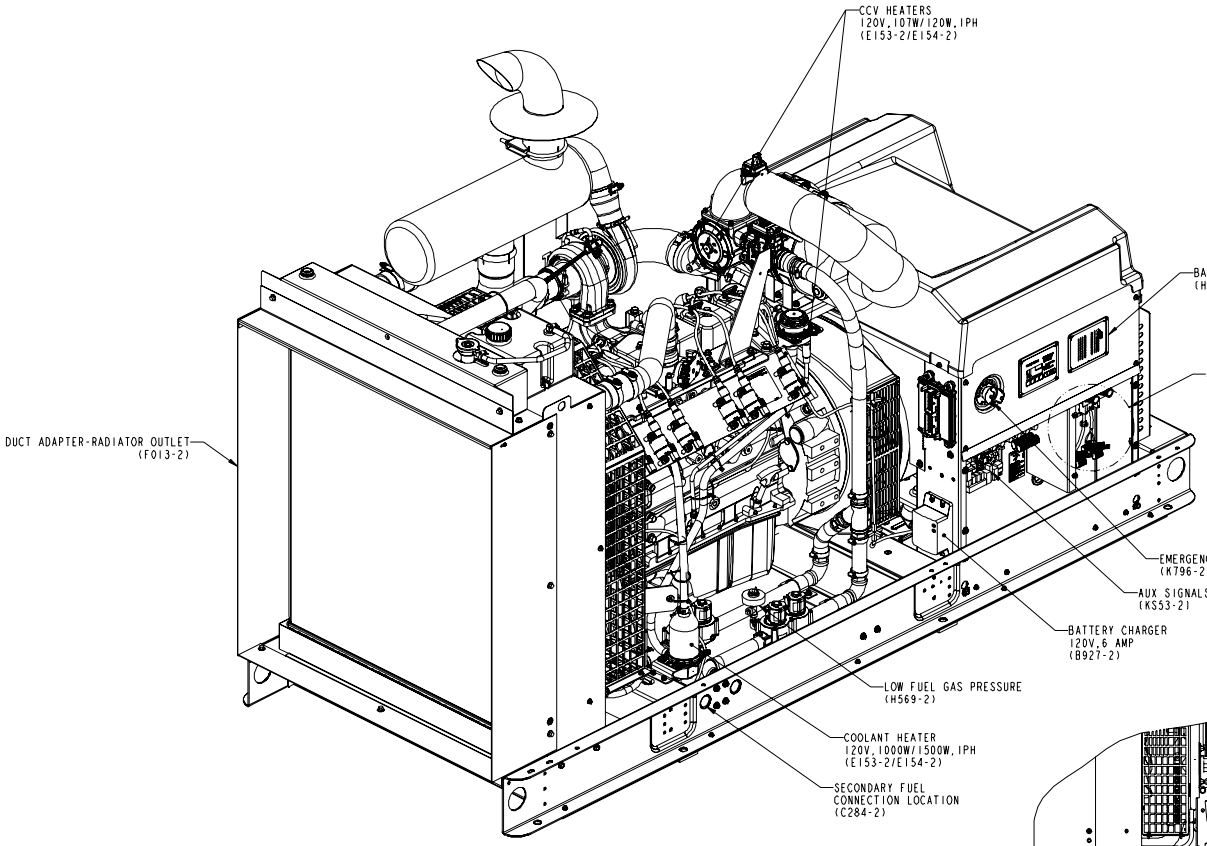
NAD-6098a-EN (08/15)

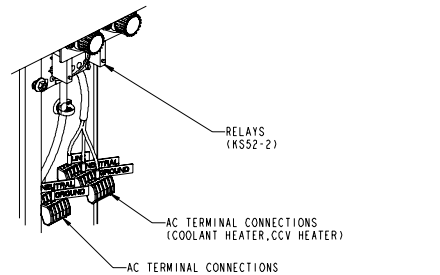
Power Generation

power.cummins.com

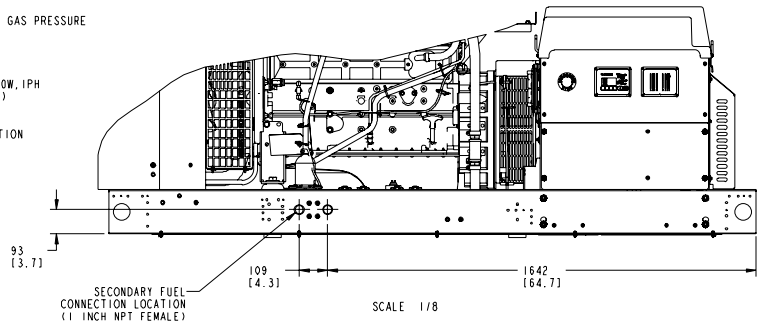
PTC® Creo® Parametric

REL NO	LTR	NO	REVISION	BM	CKD	APVD	DATE
ECO-152008	A	1	PRODUCTION RELEASE	RAH	ELN	E_NORDSTROM	23APR15





DETAIL A
SCALE 1/2



SCALE 1/8

**C45 N6, C50 N6,
C60 N6, C70 N6,
C90 N6, C100 N6**

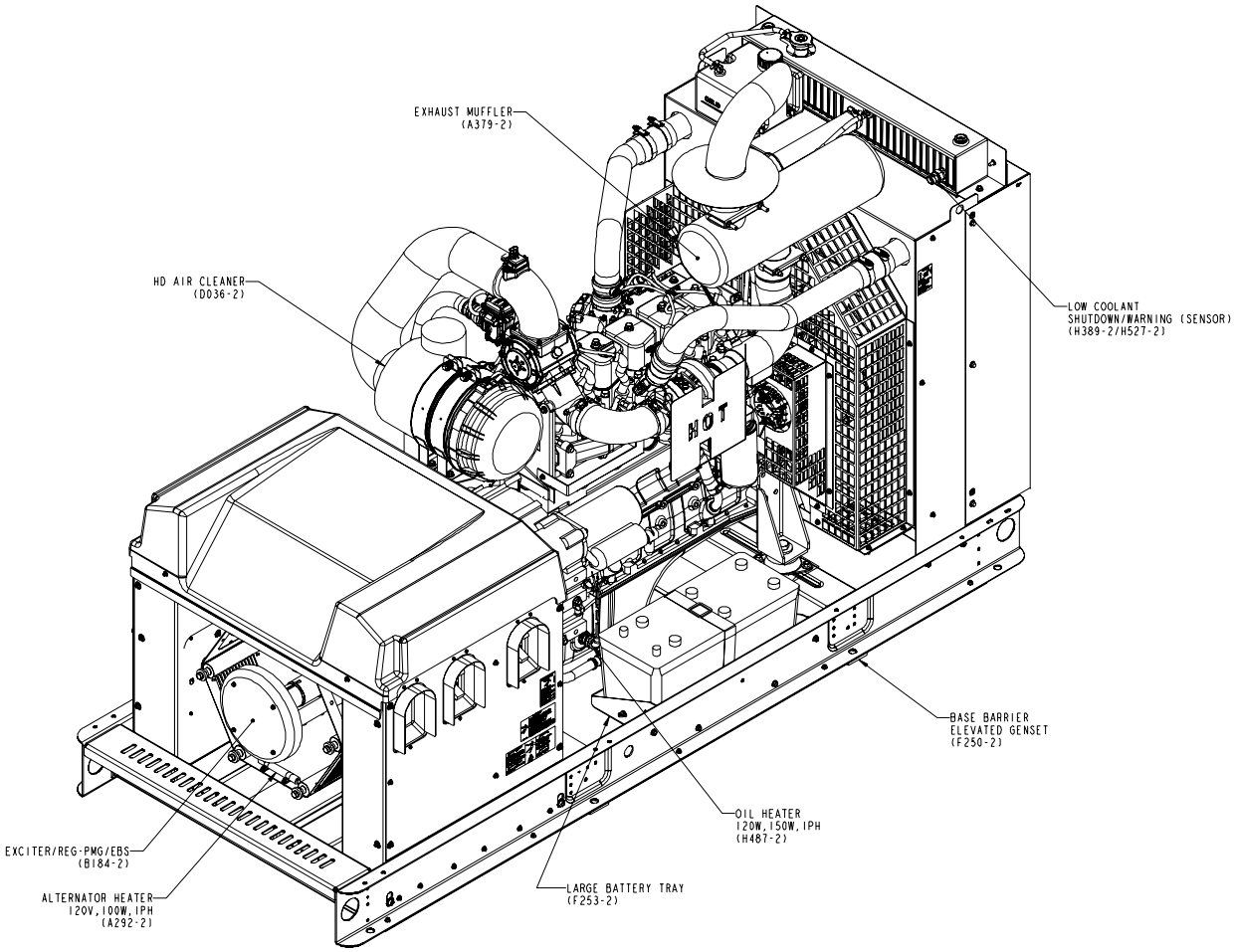
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS			BOM NONE	DRN R_HALVERSON	CUMMINS POWER GENERATION
DIM	RULE		DO NOT SCALE PRINT	CHD E_NORDSTROM	
X ±1		5.00- 6.99 +0.15/-0.08		APVD E_NORDSTROM	OUTLINE,GENSET
.X ±0.8		7.00- 9.99 +0.20/-0.10		DATE 23APR15	OPTIONS
.XX± 0.38		10.00-17.49 +0.25/-0.13			
ANG TOL: ± 1.0°	SCALE: 3/16	17.50-24.99 +0.30/-0.13	CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP	FIRST USED ON ARROW	SITE CODE PGF

SIZE D | A051E744 | SHEET 1 of 2 | REV A

Drawing Name: A051E745 Revision: A
Part Name: A051E744 Revision: A
Sheet 1 of 3

PTC® Creo® Parametric

REL NO	LTR	NO	REVISION	BBR	CKD	APVD	DATE
ECO-152008	A	1	PRODUCTION RELEASE	RAH	ELN	E_NORDSTROM	23APR15



C45 N6, C50 N6,
C60 N6, C70 N6,
C90 N6, C100 N6

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		RULE	
X	±1	3.00- 4.99	+0.15/-0.08
.X	±0.6	5.00- 9.99	+0.20/-0.10
.XX	±0.38	10.00-17.49	+0.25/-0.13
		17.50-24.99	+0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/16

BOM TO NONE
DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DRN R_HALVERSON
CHD E_NORDSTROM
APVD E_NORDSTROM
DATE 23APR15

DIM INTERPRETATION PER ASME Y14.5M-1994
TOLERANCING PER ASME Y14.5M-1994

FIRST USED ON ARROW

SITE CODE PGF

CUMMINS POWER GENERATION

OUTLINE,GENSET OPTIONS

SIZE D | A051E744 | SHEET 2 of 2 | REV A

Drawing Name: A051E745 Revision: A
Part Name: A051E744 Revision: A
Sheet 2 of 3

Appendix C

Construction Cost Opinion

City of West Allis

Fire Administration Backup Generator Replacement

INITIAL COST ESTIMATE

General Description
Replacement of backup generator at the Fire Administration Building; generator sized equivalent to existing.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Electrical				
100 kW Generator	Each	1	33,600	33,600
Conduit	Lump Sum	1	1,000	1,000
Wire	Lump Sum	1	3,200	3,500
Removals	Lump Sum	1	3,600	3,600
Mechanical				
Natural Gas Piping	Lump Sum	1	3,750	3,750
Ductwork and Louvers	Lump Sum	1	11,000	11,000
Exhaust Piping	Lump Sum	1	1,200	1,200
Subtotal				57,650
Contingency			30%	17,295
Subtotal				74,945
Contractor Overhead & Profit			25%	18,736
Total Construction Cost				**93,681**

Appendix D

Construction Phasing Plan

Construction Phasing Plan Memorandum

Fire Administration and Fire House #1
Backup Generator Replacement
City of West Allis

Date: May 8, 2017

To: Michael Lewis, Director of Public Works / City Engineer

Copy: Peter Daniels, Principal Design Engineer

From: Mike Stohl, P.E., Project Manager

The Bidding Documents will not dictate specific means and methods for the Work; however, they will define construction sequences and constraints that are necessary to maintain power to the Fire Administration Building and Fire House #1 during construction. It will be necessary to remove the existing generator and install the new generator and associated equipment efficiently to limit the amount of time that Administration Building and Fire House #1 are without emergency backup power.

This Construction Phasing Plan presents a sequence of major construction tasks to meet these constraints. Generally, only major tasks considered to be on the critical path to establish the specified Contract Times are identified. These will be developed in greater detail during subsequent phases of the design to identify more detailed constraints that may be required and to establish the Contract Times to be specified in the Bidding Documents.

Replacement Phasing for Existing Generator

1. Removal of existing generator.
2. Removal of existing fan and louver.
3. Site preparation and installation of fan, duct and louver.
4. Installation of conduit, conductors and control wires from each transfer switch to the generator.
5. Installation and testing of new generator.
6. Test transfer switches and generator as a whole system.

Appendix E

Possible Construction Schedule

City of West Allis
Fire Administration Building and Fire House #1 Backup Generator
Design Completion and Possible Construction Schedule

ID	TASKS	Start	Finish
1	Meet with City to discuss report		
2	City review of Report	05/09	05/19
3	Complete Basis of Design	05/22	
4	Prepare Bidding Documents	05/23	07/03
5	Meet with City to discuss pre-final documents	07/03	
6	Internal document QC and incorporation	07/05	07/07
7	Meet with City to review bidding documents	07/10	
8	Incorporate City Comments	07/11	07/14
9	Submit bidding documents to City	07/17	
10	Bid Advertisement	08/07	
11	Bid Opening	09/04	09/25
12	Notice of Award	10/02	
13	Notice to Proceed	10/16	
14	Shop Drawing Prep (by Contractor)	10/17	11/13
15	Shop Drawing Reviews	11/14	12/12
16	Equipment Production (Based on 6 week LT)	12/13	03/12
17	Equipment Install	03/13	05/31
18	Project Close-out	06/15	

Timeline: 2017 – 2018 (h, April, May, June, July, August, ptemb, October, ovemb, ecemb, January, ebruar, March, April, May, June, J; each month divided B | M | E)

May 8, 2017

Donohue & Associates, Inc. Project #13021