CITY AT THE CENTER
WEST ALLIS

Wisconsin Award for Municipal Excellence

ENGINEERING DEPARTMENT

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MEMORANDUM

TO: Gary Barczak, Chair, Board of Public Works
Vincent Vitale, First District
Cathleen M. Probst, Second District
Thomas G. Lajsic, Fourth District
Rosalie Reinke, Fifth District

FROM: Peter C. Daniels P.E., Principal Engineer

DATE: August 2, 2016

RE: Communication from Principal Engineer regarding Generator Master Plan for City Buildings

The attached report was prepared by the City's consultant, Donohue & Associates Inc., and identifies options for the replacement of backup generators and automatic transfer switches at the various City facilities listed below and includes an opinion of probable construction cost. The City's primary objectives for this study were to optimize generator sizing and provide reliable long-term backup power. It is recommended that new diesel generators be installed at all of the following facilities over time. The following is a priority list based on the age of the existing generators:

1. **Fire Station 1 / Administration Building** – Install a new generator indoors to replace the existing generator manufactured in 1969. Generator will be connected to emergency loads in each of the facilities. Replacement is recommended in the short term - **2017**. Cost = **$102,500**.

2. **Fire Station 3** – Install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing generator manufactured in 1974. New generator will be connected to the entire facility through the existing automated transfer switch as well as a new automatic transfer switch and a panel board for emergency loads. Replacement is recommended in the short term - **2018**. Cost = **$132,500**.

CITY AT THE CENTER
WEST ALLIS

3. **Fire Station 2** – Install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing generator manufactured in 1979. New generator will be connected to emergency loads in each of the facilities. Cost = **$135,500**. Replacement is recommended in the short term - **2019**.

4. **Police Station** – Install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing diesel generator (which is oversized and requires replacement to prevent wet stacking which is a condition in which not all fuel is burned and is instead passed on into the engine exhaust) and to replace the existing natural gas generator manufactured in 1995 (which is showing signs of corrosion and is approaching the end of its expected useful life). New generator will be connected to a new auxiliary panel feeding the switchboard and two automatic transfer switches. The existing diesel generator, existing 480 volt power breaker and dry type transformer should be salvaged and sold. Cost = **$380,500**. Replacement is recommended in the next **5-10 years**.

5. **Health Department** – Enter into a preventative maintenance agreement with a local distributor to include annual load bank testing of the existing generator manufactured in 2001. The existing generator is oversized and is susceptible to wet stacking. Generator to remain as is and be replaced with a new generator with sub base fuel tank and weatherproof enclosure in the next **5-10 years**. Cost = **$117,500**.

DRAFT

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

Generator Master Plan
Basis of Design Report

June 2016

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 backup generators and automatic transfer switches at the various City facilities listed below; potential design problems and suggested resolutions; and, includes an opinion of probable construction cost. This report includes a Design Technical Memorandum – Electrical, summary of electric usage provided by WE Energies (Appendix B), project specific vendor information (Appendix C), a Construction Cost Opinion (Appendix D), 7and generator sizing information (Appendix E). The purpose of this report is to summarize findings from the study and to provide the City with a tool to plan for future generator upgrades.

The City's primary objectives for this study are to optimize generator sizing and provide reliable long-term backup power at:

- City Hall (7525 West Greenfield Avenue)
- Health Department (7120 West National Avenue)
- Police Station (11301 West Lincoln Avenue)
- Fire Station 1 / Administration Building (7300 West National Avenue)
- Fire Station 2 (2040 South 67th Place)
- Fire Station 3 (10830 West Lapham Street)

1.2 ELECTRICAL DESIGN

The Design Technical Memorandum – Electrical (Appendix A) establishes design criteria for replacement generators and automatic transfer switches. The memorandum presents alternates for the generator sizing, re-use of electrical distribution equipment including automatic transfer switches and the introduction of automatic transfer switches where required.

The following is a summary of recommendations:

- Develop a preventative maintenance plan including annual load bank testing for the existing generator at the Health Department; replace the existing diesel generator with an appropriately sized to operate the entire Health Department in 5-10 years based on equipment performance
- Install a new diesel generator appropriately sized to operate the entire Police Station replacing the existing natural gas and diesel generators; sell the diesel generator to a whole sale group
- Install a new diesel generator at Fire Station 1 / Administration Building sized to operate the emergency loads replacing the existing diesel generator
- Install a new diesel generator at Fire Station 2 sized to operate the emergency loads replacing the existing diesel generator
- Install a new diesel generator at Fire Station 3 sized to operate the entire facility replacing the existing diesel generator

1.3 CONSTRUCTION COST OPINION

Our opinion of probable construction cost for this study is as follows for the various facilities (breakdowns are included in Appendix D):

- City Hall – completed under separate project
- Health Department - $117,500
- Police Station - $380,500
- Fire Station 1 / Administration Building - $102,500
- Fire Station 2 - $135,500
- Fire Station 3 - $132,500

Sum of all projects is $868,500.

Appendix A

Design Technical Memorandum – Electrical

Electrical Design
Technical Memorandum

Generator Master Plan
City of West Allis

Date: June 7, 2016

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 study. The following electrical design basis has been developed for the study:

Health Department
- Generator and Transfer Switch Design

Police Station
- Generator and Transfer Switch Design

Fire Station 1 / Administration Building
- Generator and Transfer Switch Design

Fire Station 2
- Generator and Transfer Switch Design

Fire Station 3
- Generator and Transfer Switch Design

Electrical Design Guidelines

Generator and Transfer Switch Design

City Hall

Facility Description

Electrical service enters City Hall site through a We Energies (W.E.) owned transformer vault on the southwest corner of the building. The vault was not accessible at the time of the building inspection; it is assumed that the utility metering equipment is located within the transformer vault. The transformer steps down the voltage to 120/208, 3 phase, 4 wire and is connected to a City owned Westinghouse Switchboard located in the basement through enclosed bus duct.

City Hall has an existing 15 kilowatt (kW) natural gas generator on the upper level that powers essential lighting loads. The generator is connected to a Zenith automatic transfer switch (ATS) located in the basement adjacent to the main switchboard. The normal source of the Zenith ATS is a feeder switch located in the main switchboard; the Zenith ATS load terminal is connected to a panelboard labeled "Emergency Panel E".

Generator and Transfer Switch Designs

The City Hall backup power supply is being upgraded through a standalone construction project. It is anticipated that the new Cummins 250 kW generator will be operational by September 2016. This project will add generator for the entire facility as well as the emergency loads by installed a new service entrance rated transfer and emergency panel transfer switch; the existing natural gas generator will be removed.

Health Department

Facility Description

Electrical service enters the Health Department through a We Energies (W.E.) owned transformer bank on a pole north of the facility. The transformer steps down the voltage to 120/208, 3 phase, 4 wire and is connected to a City owned Westinghouse disconnect switch located in the grade level electrical room. The utility metering equipment is located adjacent to the disconnect switch within the electrical room.

The Health Department has an existing 250 kW diesel generator (manufactured in 2001 by Caterpillar) located outdoor in the east parking lot shown in the photo below. The existing Caterpillar generator was installed in 2014 replacing a 1974 generator (purchased and installed by City in 1990) that had a cracked engine block. The damaged generator was sold at an auction. The generator is connected to a G.E. Zenith automatic transfer switch (ATS) located in the electrical room. The ATS is configured to provide backup power to the entire facility.

Generator and Transfer Switch Designs

The Health Department is considered a non-life safety facility meaning the existing ATS arrangement does not require modifications. The generator is oversized since the nameplate rating 870 amps for output and the transfer switch connected to it is rated 600 amps. Further, the Health Department has had a peak usage of 38.2 kW (15% of generator nameplate) in the past 24 months. Manufacturers recommend that the generators be loaded to at least 30% of the nameplate rating to avoid wet stacking (condition in which not all fuel is burned and is passed on into the engine exhaust side).

It is recommended that the City enter into an agreement with a local distributor to enter into an agreement for preventative maintenance including annual load bank testing (estimated $3,500/annually). This will help to assure the generator runs with adequate load on a regular basis.

Alternatively, the generator can be replaced with a unit that is properly sized to avoid potential damage from wet stacking. This is not suggested at this time since the generator has not reached its useful life.

Relocating the generator to a separate facility was investigated; the feasibility depends on the interpretation of the Code of Federal Regulations:

Title 40: Protection of Environment, Chapter I – Environmental Protection Agency, Subchapter C – Air Programs, Part 60 – Standards of Performance for New Stationary Sources, Subpart IIII – Standard for Performance for Stationary Compression Ignition Internal Combustion Engines, 60.4208 What is the Deadline for Importing or Installing Stationary CE ICE produced in previous model years?

(a) After December 31, 2008, owners and operators may not install stationary CI ICE (excluding fire pumps) that do meet the applicable requirements for 2007 model year engines.

(i) *"The requirements of this section do not apply to owners or operators of stationary CI ICE that have been modified, reconstructed, and do not apply to engines that were removed from one location and reinstalled at a new location."*

Title 40: Protection of Environment, Chapter I – Environmental Protection Agency, Subchapter C – Air Programs, Part 60 – National Emission Standards for Hazardous Air Pollutants for Source Categories (Continued), Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines, 63.6590 What Parts of My Plant Does This Cover?

(a) Affected Source (1) Existing stationary RICE (iii) *"For stationary RICE located at an area source of HAP emissions, a stationary RICE is existing if you commenced construction or reconstruction of the stationary RICE before June 12, 2006.*

Police Station

Facility Description

Electrical service enters the Police Station through a We Energies (W.E.) owned padmount transformer located on the east side of the facility. The transformer steps down the voltage to 120/208, 3 phase, 4 wire and is connected to a City owned G.E. switchboard. The utility metering equipment is located on the exterior face of the building adjacent to the electrical room.

The Police Station has an existing 1,825 kW diesel generator (manufactured April 2001 by Caterpillar) located on a trailer on the east side of the facility shown in the photo below (left). The generator is connected to a City owned G.E. power circuit breaker (1200 amp trip) located on the exterior of the building adjacent to the electrical room. The power circuit breaker is connected to a G.E. 500 KVA dry type transformer located in the building. The transformer steps down the voltage from 480 to 120/208 and connected to the switchboard in Section 5. The switchboard has a main breaker connected to the upstream utility transformer and a main breaker connected to the generator (through the power breaker and dry type transformer); these main breakers are kirk key interlocked configured such that only one can be closed at a given time.

The Police Station also has an existing 80 kW natural gas generator (manufactured in 1995 by Kohler) located on the southeast portion of the facility shown in the photo above (right). The generator is connected to two devices within the electrical room: a double throw safety switch and a general duty safety switch. The double throw safety switch accepts the Kohler generator conductors on the top terminals, accepts conductors from an exterior mounted generator connection cabinet (disconnect) on the bottom terminals and feeds a 400 amp ATS (emergency terminals) from the load terminals. The 400 amp ATS receives normal power from the G.E. switchboard via a 350 amp breaker and the load terminals feed Panel EM/MDP. The general duty safety switch feeds the emergency terminals of a 104

amp ATS; the normal power is received from the G.E. switchboard via a 100 amp breaker and the load terminals feed Panel EM/LS. The emergency equipment arrangement is shown in the photo below.

Panel EM/MDP powers ACU #1, ACU #2, Panel 1 in the East Garage, Panel G/X, Panel 1X/A, Panel 1X/B, and Motor #4 EBC. Panel EM/LS powers the fire alarm panel, emergency garage lighting and shore power for the Caterpillar generator.

The current configuration is such that when power is lost the Kohler generator automatically starts and re-powers the loads connected to Panel EM/MDP and Panel EM/LS through the ATS's switching to the emergency positions. Staff manually open the utility main breaker in the switchboard, manually closed the generator main in the switchboard, and manually starts the Caterpillar generator. The Caterpillar generator is up to rated voltage and frequency it re-powers the switchboard resulting in the ATS's to switch to the normal positions and stopping the Kohler generator.

Generator and Transfer Switch Designs

The Police Station is considered a life safety facility meaning it needs to comply with NFPA 110 Level 1 and have a dedicated transfer switch(es) for emergency loads. The facility is equipped with two ATS's that power the emergency loads meeting the intent of the standard.

The Caterpillar is oversized and requires replacement in order to prevent wet stacking. The Kohler generator is showing signs of corrosion and is approaching the end of its expected useful life. The maximum load that the facility has consumed in the past 24 months is 222 kW; the total connected capacity of the existing generators is 1955 kW.

Replacing the Caterpillar and Kohler generators with an appropriately sized diesel unit is recommended. The generator can be supplied with an auxiliary panel with three output breakers for connection to the two existing ATS's and Section 5 of the switchboard. The generator voltage can be 120/208 which will allow the power breaker and dry type transformer to be removed; given the age of this equipment there should be re-sale value. The new generator would be supplied with a sub-base fuel tank sized for 24 hours of continuous operation at rated generator nameplate power with a weatherproof enclosure.

The current configuration can be modified so that one large generator automatically starts and takes on the loads connected to the ATS's (no change to ATS operation) but the ATS's maintain the emergency position once the switchboard is manually switched to generator power. To achieve this configuration auxiliary contacts will need to be added to the breaker in Section 5 of the switchboard; contacts would be connected to the ATS's and the ATS's would be programmed to remain in the emergency position if the breaker in Section 5 is closed (the ATS's will see voltage available on the normal and emergency terminals but stay in the emergency position knowing the normal terminals are energized through the generator preventing the switches from changing state until utility power returns).

Attempting to automate the switching of the switchboard will be difficult requiring substantial modifications to the switchboard. The operational benefit does not outweigh the capital costs; it is recommended to maintain manual switching of the switchboard.

Fire Station 1 / Administration Building

Facility Description

Electrical service enters the Fire Station 1 / Administration Building site through separate We Energies (W.E.) owned transformer banks on a pole north of the facilities (one transformer per building). The transformers steps down the voltage to 120/208, 3 phase, 4 wire; the Administration Building transformer is connected to a City owned Siemens distribution panel (MDP) located in the grade level garage area of the Admin Building and the Fire Station transformer is connected to a Cutler Hammer panelboard (Panel A) in the mezzanine level of the Fire Station. The utility metering equipment for the respective buldings is located on the exterior.

The Administration Building has an existing 100 kW diesel generator (manufactured in 1969 by Kato) located indoor in the garage area as shown in the photo below (left). The generator is connected to two disconnect switches located on the wall immediately south of the generator: a 200 amp Siemens switch that feeds Panel 1E in the Administration Building and a 200 amp Cutler Hammer switch that feeds the emergency terminals to the ATS in Fire Station 1. The disconnect switches are shown in the photo below (right).

The Administration Building was renovated in 2002 and is equipped with a 150 amp Kohler ATS that feeds Panel 1E – both located in the Mechanical Room. Fire Station 1 was renovated in 2003 is equipped with a 200 amp Kohler ATS that feeds Panel 1E.

Generator and Transfer Switch Designs

The Administration Building and Fire Station 1 are configured with dedicated ATS's for the emergency loads to meet the standard for NFPA 110 Level 1 life-safety facilities. The generator is appropriately sized (nameplate output is 346 amps) for the emergency loads in the two facilities. It is recommended to replace the generator in kind due to its age and lack of spare parts available. The new generator would be supplied with a sub-base fuel tank sized for 24 hours of continuous operation at rated generator nameplate power and would be an open design suitable for an indoor installation.

Fire Station 2

Facility Description

Electrical service enters the Fire Station 2 site through a We Energies (W.E.) owned padmount transformer on the south of the facility. The transformer steps down the voltage to 120/208, 3 phase, 4 wire and is connected to a City owned Square-D distribution panel (MDP) located in the below grade level. The utility metering equipment is located exterior near the padmount transformer.

Fire Station 2 has an existing 65 kW diesel generator (manufactured in 1979 by Detroit Diesel) located in a walk-in equipment enclosure on the east side of the facility as shown in the photo below (left). The generator is equipped with two circuit breakers (50 amp and 200 amp) and is connected to two ATS's located on the wall adjacent to Panel MDP in the basement as shown in the photo below (right). The lower ATS is rated 70 amps and is for optional standby (OS) equipment connecting to Panel B/OS; the upper ATS is rated 225 amps and is for life safety (LS) connecting to panel LS.

The electrical equipment within the building was renovated in 2006; the facility is configured with dedicated ATS's to meet the standard for NFPA 110 Level 1 life-safety facilities.

Generator and Transfer Switch Designs

Fire Station 2 is configured with dedicated ATS's for the emergency loads to meet the standard for NFPA 110 Level 1 life-safety facilities. The generator is appropriately sized (nameplate output is 226 amps) for the emergency loads in the facility. It is recommended to replace the generator in kind due to its age and lack of spare parts available. The new generator would be supplied with a sub-base fuel tank sized for 24 hours of continuous operation at rated generator nameplate power with a weatherproof enclosure.

Fire Station 3

Facility Description

Electrical service enters the Fire Station 3 site through a We Energies (W.E.) owned pole mounted transformer on the east of the facility. The transformer steps down the voltage to 120/240, 1 phase, 3 wire and is connected to a City owned Siemens distribution panel (MDP) located in the Turn-Out Gear Lockers Room. The utility metering equipment is located exterior near the northeast corner of the facility.

Fire Station 3 has an existing 40 kW diesel generator (manufactured in 1974 by Detroit Diesel) located on the east side of the facility as shown in the photo below (left). The generator is connected to the MDP which feeds an ASCO ATS as shown in the photo below (right). The ATS is rated 260 amps and is for optional standby (OS) equipment connecting to Panel A.

The electrical equipment within the building was renovated in 2003; the facility is configured with an overall facility ATS.

Generator and Transfer Switch Designs

Fire Station 3 shall be modified to be equipped with a dedicated ATS and panelboard for emergency loads to comply with NFPA 110 Level 1 life-safety facilities matching the City's other fire stations. The generator is appropriately sized (nameplate output is 167 amps) for the emergency loads in the facility. It is recommended to replace the generator in kind due to its age and lack of spare parts available. The new generator would be supplied with a sub-base fuel tank sized for 24 hours of continuous operation at rated generator nameplate power with a weatherproof enclosure.

Conclusions

It is recommended to install a new diesel generators at all of the facilities over time. The following is a priority list based on age of the existing generators:

Fire Station 1 / Administration Building – install a new generator indoor to replace the existing generator in kind. Generator will be connected to emergency loads in each of the facilities. Replacement is recommended in the short term.

Fire Station 3 – install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing generator in kind. New generator will be connected to the entire facility through the existing ATS as well as a new ATS and panelboard for emergency loads. Replacement is recommended in the short term.

Fire Station 2 – install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing generator in kind. New generator will be connected to emergency loads in each of the facilities. Replacement is recommended in the short term.

Police Station – install a new generator with sub base fuel tank and weatherproof enclosure to replace the existing diesel and natural gas generators. New generator will be connected to a new auxiliary panel feeding the switchboard and two ATS's. Diesel generator, existing 480 volt power breaker and dry type transformer should be salvaged and sold. Replacement is recommended in the next 5-10 years.

Health Department – enter in a preventative maintenance agreement with a local distributor to include annual load bank testing. Generator to remain as is and be replaced with a new generator with sub base fuel tank and weatherproof enclosure in the next 5-10 years.

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
    d. Wisconsin Administrative Code, Department of Agriculture, Trade and Consumer Protection (ATCP), Chapter 93 – Flammable, Combustible and Hazardous Liquids

2. Backup Generator

    a. Sized to power facilities as noted in Generator Design section.
    b. Engine-driven diesel generator complete with control and auxiliary equipment.
    c. Outdoor in weatherproof enclosure adjacent to facilities.
    d. Sub-base fuel tank, dual wall contained, sized for 24 hours continuous operation.
    e. Manufactured by Cummins Power Generation, MTU Onsite Energy, Caterpillar, or Kohler Power Systems.

3. Automatic Transfer Switch

    a. Added where required to comply with NFPA 110 Level 1 Facilities.
    b. Controls capable of automatic startup, continuous operation, and shutdown.
    c. Manufactured by Cummins Power Generation, MTU Onsite Energy, Caterpillar, or Kohler Power Systems.

4. Lighting Panelboards – 120/208V

    a. The 120/208V panelboards will power the emergency loads in the various facilities that require a NFPA 110 Level 1 transfer switch.
    b. 42-circuit panelboards.
    c. Manufactured by Eaton (Cutler Hammer), Schneider (Square-D), ABB, Siemens or General Electric.

5. Conduit

    a. Exterior Conduit:

        1. Underground - Concrete encased with reinforcing and Schedule 40 PVC conduit. Underground bends, elbows, and stub-ups will be PVC coated galvanized rigid steel conduit.

b. Interior Conduit:

1. Exposed Dry Locations - Galvanized rigid steel conduit:
2. Exposed Corrosive and Wet Locations – PVC coated galvanized rigid steel conduit.
3. Flexible Conduit – Liquidtight flexible metal conduit.

c. Minimum Size: ¾ inch
d. Threaded, no set screw or indentor type fittings

6. Conductors (600V and less)

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

7. Lighting (as required during preliminary design for generator enclosure)

a. Interior Lighting (within generator enclosure)

1. Light emitting diode (LED) fixtures.
2. Adequate lighting for a bright well-lit environment.

b. Exterior Lighting (located on generator enclosure)

1. Equipment enclosure mounted LED wall pack fixtures at the enclosure entrances.

Appendix B

WE Energies Usage

Stohl, Mike

From: Barczak.Robert <Robert.Barczak@we-energies.com>
Sent: Monday, February 15, 2016 3:26 PM
To: Stohl, Mike
Cc: Peter Daniels
Subject: RE: RFP 1311 backup generator

Mike I see you scheduled a meeting for Wednesday March 9th at 9am at the site.

We can re-visit our design then to answer any questions you have at that time.

In regards to your question about on-peak demands and actual maximum demands for 5 other West Allis City buildings, the information I have for this buildings is as follows:

	Highest On-peak Demand	Highest Customer Demand
▪ Health Department, 7120 W National Avenue	38.2kW	38.2kW
▪ Police Station, 11301 W Lincoln Avenue	210kW	222kW
▪ Fire Station 1, 7300 W National Avenue	33.2kW	33.2kW
▪ Fire Station 2, 2040 S 67th Place	55.8kW	64.8kW
▪ Fire Station 3, 10830 W Lapham Street	25.6kW	25.6kW

Please note this information is looking back over the past 24 months.

The highest on-peak demand is the highest demand these services had during the on-peak period that runs from 9am to 9pm, Monday to Friday.

The Highest Customer Demand is the highest demand we saw on these services when looking over a 24 month period regardless if this demand was set during on-peak or off-peak hours.

I trust this helps Mike.

Appendix C

Vendor Information


Power Generation

Appendix D

Construction Cost Opinion

City of West Allis

Health Department Backup Generator - Entire Building

INITIAL COST ESTIMATE

General Description
Replacement of existing generator with new 75 kW diesel generator connected to existing transfer switch.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural	Lump Sum	1	2,500	2,500
Sitework	Lump Sum	1	2,000	2,000
Instrumentation & Controls	Lump Sum	1	2,500	2,500
Electrical				
75 kW Generator	Each	1	36,000	36,000
Conduit	Lump Sum	1	4,500	4,500
Wire	Lump Sum	1	13,000	13,000
Removals	Lump Sum	1	4,800	4,800
Subtotal				62,800
Contingency			30%	18,840
Subtotal				81,640
Contractor Overhead & Profit			25%	20,410
Total Construction Cost				**102,050**
Engineering			15%	15,308
Total Capital Cost				**117,358**

City of West Allis

Police Station Backup Generator - Entire Building

INITIAL COST ESTIMATE

General Description
Replacement of existing generators with new 350 kW diesel generator connected to existing transfer switches.
Costs assume new generator will be located where the diesel generator is currently located.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural	Lump Sum	1	3,500	3,500
Sitework	Lump Sum	1	3,000	3,000
Instrumentation & Controls	Lump Sum	1	5,000	5,000
Electrical				
350 kW Generator	Each	1	90,000	90,000
Conduit	Lump Sum	1	33,000	33,000
Wire	Lump Sum	1	63,000	63,000
Removals	Lump Sum	1	9,600	9,600
Subtotal				203,600
Contingency			30%	61,080
Subtotal				264,680
Contractor Overhead & Profit			25%	66,170
Total Construction Cost				**330,850**
Engineering			15%	49,628
Total Capital Cost				**380,478**

City of West Allis

Fire Staton 1 and Administration Building Backup Generator - Emergency Loads

INITIAL COST ESTIMATE

General Description

Replacement of existing generator with new 75 kW diesel generator connected to existing transfer switches.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural	Lump Sum	1	2,500	2,500
Mechanical	Lump Sum	1	5,000	5,000
Instrumentation & Controls	Lump Sum	1	2,500	2,500
Electrical				
75 kW Generator	Each	1	36,000	36,000
Conduit	Lump Sum	1	2,500	2,500
Wire	Lump Sum	1	4,000	4,000
Removals	Lump Sum	1	4,800	4,800
Subtotal				54,800
Contingency			30%	16,440
Subtotal				71,240
Contractor Overhead & Profit			25%	17,810
Total Construction Cost				**89,050**
Engineering			15%	13,358
Total Capital Cost				**102,408**

City of West Allis

Fire Staton 2 Backup Generator - Emergency Loads

INITIAL COST ESTIMATE

General Description

Replacement of existing generator with new 100 kW diesel generator connected to existing transfer switches.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural	Lump Sum	1	2,500	2,500
Sitework	Lump Sum	1	3,000	3,000
Instrumentation & Controls	Lump Sum	1	2,500	2,500
Electrical				
100 kW Generator	Each	1	42,000	42,000
Conduit	Lump Sum	1	7,500	7,500
Wire	Lump Sum	1	12,500	12,500
Removals	Lump Sum	1	4,800	4,800
Subtotal				72,300
Contingency			30%	21,690
Subtotal				93,990
Contractor Overhead & Profit			25%	23,498
Total Construction Cost				**117,488**
Engineering			15%	17,623
Total Capital Cost				**135,111**

City of West Allis

Fire Staton 3 Backup Generator - Entire Facility & Emergency Loads

INITIAL COST ESTIMATE

General Description

Replacement of existing generator with new 60 kW diesel generator connected to existing transfer switch and new transfer switch. Costs include adding an emergency transfer switch and panelboard.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural	Lump Sum	1	2,500	2,500
Sitework	Lump Sum	1	3,000	3,000
Instrumentation & Controls	Lump Sum	1	2,500	2,500
Electrical				
60 kW Generator	Each	1	34,200	34,200
Conduit	Lump Sum	1	3,000	3,000
Wire	Lump Sum	1	4,000	4,000
Removals	Lump Sum	1	4,800	4,800
100 amp transfer switch	Lump Sum	1	4,800	4,800
100 amp panelboard	Lump Sum	1	5,500	5,500
Emergency circuit relocation	Lump Sum	1	9,000	9,000
Subtotal				70,800
Contingency			30%	21,240
Subtotal				92,040
Contractor Overhead & Profit			25%	23,010
Total Construction Cost				**115,050**
Engineering			15%	17,258
Total Capital Cost				**132,308**

Appendix E

Generator Sizing

Generator Sizing
Technical Memorandum

Generator Master Plan
City of West Allis

Date: June 7, 2016

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 design basis for the sizing of the replacement generators. The following practices were used for the study:

Health Department

- Peak load has been 38.2 kW; existing transfer switch is 600 amp rated (equivalent to 173 kW). Recommendation is 75 kW. As-built drawings are not available so peak load doubled to result in recommendation.

Police Station

- Peak load has been 222 kW; existing transfer switches are fed from breakers rated 350 amp and 100 amp (breakers can by loaded to 80% per National Electrical Code). Equivalent power is 104 kW using 80% of breaker ratings for emergency load. Recommendation is 350 kW. As-built drawings are not available so emergency load was removed from peak load and that sum was doubled to result in recommendation.

Fire Station 1 / Administration Building

- Peak load has been 33.2 kW for the entire facility; existing transfer switches connected to emergency load only are rated 200 amp and 150 amp (equivalent to 101 kW). Recommendation is 75 kW. As-built drawings do not indicate connected nor demand loads so peak load doubled to result in recommendation.

Fire Station 2

- Peak load has been 64.8 kW for the entire facility; existing transfer switches connected to emergency load only are fed from breakers rated 200 amp and 50 amp (breakers can by loaded to 80% per National Electrical Code). Equivalent power is 58 kW using 80% of breaker ratings for emergency load. Recommendation is 100 kW. As-built drawings are not available so connected emergency load was doubled to result in recommendation.

Fire Station 3

- Peak load has been 25.6 kW for the entire facility; existing transfer switch is fed from 200 amp rated breaker (breakers can by loaded to 80% per National Electrical Code). Equivalent power is 31 kW using 80% of breaker ratings for building load. Recommendation is 60 kW. As-built drawings are not available so connected building load was doubled to result in recommendation.