
# Vienna Town Hall
# Emergency Generator Study

## Department of Public Works

Vienna, VA

2019.07.26

Work Order No. 18521-020

Final Report Submission

# Table of Contents

**I. EXECUTIVE SUMMARY** ..... 2
**II. EXISTING CONDITIONS** ..... 3
**Building** ..... 3
**Electrical** ..... 3
**Plumbing** ..... 3
**III. ANALYSIS** ..... 5
**Electrical** ..... 5
**Plumbing** ..... 6
**Generator Information** ..... 7
**IV. RECOMMENDATIONS AND CONCLUSIONS** ..... 10

# Appendices

Appendix A – Drawings
Appendix B – Product Data Sheets
Appendix C – Cost Estimates
Appendix D – Utility Bills

# I. EXECUTIVE SUMMARY

The Vienna Town Hall emergency generator is located in the parking lot behind the building, and adjacent to the dumpster pad. The generator was previously used for the Town of Vienna Police Department and was repurposed for the Town Hall after an upgrade project for the police station. The existing emergency generator supports life safety and some mission critical loads within the building. The existing generator is a Generac 45KW/75 kVA, model SG045. The generator is natural gas powered. The Town of Vienna is planning to replace the existing generator with a new generator to serve the entire building. The purpose of this study is to size the new generator, provide layout and costing information on the generator, and identify necessary upgrades required to allow for Town of Vienna personnel to develop a cost estimate to secure funding for the upgrade. The analysis will include both diesel and natural gas powered generators.

# II. EXISTING CONDITIONS

## Building

The building is located at 127 Center Street S, Vienna, Virginia 22180, and was constructed in the 1960's. The building is two stories above ground with a basement, and occupies approximately 20,813 square feet. The building was renovated most recently in 2012. The building is Use Group B – Business, with a small area of Use Group A-3 – Council Chambers & Conference Rooms. The building houses the office of the Mayor, Human Resources, Finance, Information Technology, Parks & Recreation, Planning & Zoning, Public Information, Public Works, Town Attorney, Town Clerk, Town Council, and Town Manager.

The parking lot currently provides 49 spaces, of which one is occupied by the existing Emergency Generator located adjacent to the dumpster enclosure.

## Electrical

**Existing Electrical Service**

The facility is served by a Dominion Virginia Power Co. 300 kVA pad mounted transformer. The existing service is to a CT cabinet in the electrical room in the basement. There are three taps coming off of the CT Cabinet. One is for the Elevator Control Panel, the second is for Panel MDP, a 600A 208Y/120V Distribution Power Panel, and the third is for a power panel in the server room to provide power to the existing server racks.

In 2012, a 45 kW/ 75 kVA, 208Y/120V, 0.60 PF, natural gas generator in a weatherproof enclosure from the Police Station was installed in the parking lot. The generator was connected to Panel GSB-1 via ATS in the main electrical room. Normal power is provided from MDP.

MDP serves multiple power panels in the building for local power on each floor.

Building lighting is currently 2x4 fluorescent fixtures.

## Plumbing

The building is provided with Natural Gas by Washington Gas & Light Company. The buildings gas meter is located on the south-west side of the building, on the left side of the building entrance. The gas meter serves the existing natural gas generator located in the parking lot adjacent to the dumpsters, and building heating boilers and domestic hot water heater located in the basement.

The gas meter is WGLCO #Z51062, as manufactured by Dresser Roots Meter, Model 3M175, Rotary Gas meter, Serial #1412715, 3,000 CFH maximum. The gas service to the site is supplied at 2 PSIG, and is regulated after the meter to provide ½ PSIG to the connected appliances.

The gas meter is currently serving three pieces of equipment: the gas boiler, gas hot water heater, and the Emergency Generator. The generator is supplied by a 1" gas line, equipped with a B42R Itron Pressure regulator, with a 3/16 Orifice, designed for a maximum of 11" WC. The Generator is rated for 817,000 btuh of input. A 3" gas line enters the building with a main gas shut-off valve located in the Mechanical Room. The boiler is supplied by a 2" gas line and is designed to operate between 3.5-14.0" w.c.. The boiler is a Weil McLain Model 580, Series 1, equipped with a Power Flame Burner with a rated input of 641,000 btuh. The domestic hot water heater is manufactured by A.O. Smith, Model BTR199-118, and is rated at 199,000 btuh input, and is designed to operate between 3.5-14.0" w.c.

The building is supplied by a Itron Model B34R pressure regulator, Serial #1159084, with an outlet pressure of 7" wc, and is equipped with a Green spring. The orifice is 3/4x7/8, and the regulator was manufactured 1/15.

The connected capacity of all natural gas fired equipment is currently at 1,657 MBH.

# III. ANALYSIS

## Electrical

WRA has evaluated the existing electrical service. We have reviewed the provided existing drawings as well as the provided utility bills for the past two years. The maximum connected load for the building was found to be approximately 200 kVA. This is 160 kW utilizing an assumed power factor of .8. Review of the existing Utility Bills have shown the maximum demand usage of the building is 100 kW over the past twelve months, see the table below. The utility bills are also provided in Appendix D.

**MAXIMUM ELECTRICAL DEMAND DATA FROM EXISTING UTILTIY BILLS**

| Bill Month | April 2018 | May 2018 | June 2018 | July 2018 | August 2018 | Sept. 2018 | Oct. 2018 | Nov. 2018 | Dec. 2018 | Jan. 2019 | Feb. 2019 | March 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum Demand Data (kW) | 63.2 | 76.0 | 88.8 | 90.4 | 85.6 | 100 | 78.4 | 71.2 | 67.2 | 63.2 | 68.8 | 66.4 |

During our walk through of the building, we were made aware that the data racks in the building have issues when the building is on the generator power. The generator does not provide stable power across all phases and the racks lose power. WRA was also informed that approximately 4 new racks will be installed sometime this year as the existing Vienna Police Station undergoes renovation. Additionally, Town personnel are in the process of replacing the existing fluorescent lighting in the building with LED lighting. This process may aid in offsetting the load of the additional server racks that will be installed.

WRA recommends installing, at a minimum, a new 125 kW generator. The size is based upon the existing maximum demand load of 100 kW plus a spare capacity of 25% for future growth, as recommended by the National Electrical Code (NEC). Specific generator options are given below. Existing infrastructure would require updates to accommodate connecting the new generator, as well as to meet requirements specified by the Fairfax County Design Guidelines. Fairfax County Electrical Design guidelines require installing a permanent connection box for a roll-up generator with all new generator projects. In addition, modifications to the system are required to meet the NEC. Equipment required for Life Safety is required to be separated from other equipment in the building.

The following description of new equipment would be installed to meet the NEC and Fairfax County Design Guidelines. Panel GSB-1 would become the building's life safety panel. A new ATS (ATS-2) and power panel (MC-1) should be installed adjacent to the GSB-1 panel. This new panel would be designated as a Mission Critical Panel. All Mission Critical circuits on GSB-1 should be transitioned from GSB-1 to the MC-1. A new 600A ATS (ATS-3) should be installed adjacent to panel MDP. MDP would be designated as the new stand by panel. Identification of all the modifications that would be required, including specific circuits requiring transfer to alternate panels, would be documented during the project design phase. New, 600A feeders from the new generator, 2 sets of (4) 350 kcmil copper conductors in (2) 3" sch 40 PVC conduits, will be extended to the side of the building into an electrical trough. This will require demolition of the existing pavement and existing generator feeder along with the new conduit installation and new

pavement work. Tapped off the trough, two 200A and one 600A enclosed circuit breakers or disconnect switches will be installed. These points of disconnection would be connected to the ATS's described above as emergency power feeders. Additional modifications in the electrical room will be required to provide normal power service to the ATS's. See Appendix A for a potential Site Layout Plan.

For construction sequencing, the electrical infrastructure described above could be installed and tested, including the roll-up generator connection box. A temporary generator could then be connected to power the building in case of emergencies and power outages while the existing generator is demolished. A new concrete pad should be poured and installed in the same location so that the existing pad and the new generator could be installed and tested.

WRA has analyzed both Natural Gas and Diesel Generator options for this study. Two manufacturers, Kohler and Generac, were consulted. Both recommended a 150 kW, natural gas generator as their primary recommendation for a generator of this size. A 150 kW is the standard size natural gas generator offered for this range of generator. For diesel generators, Generac recommenced a 130 kW model and Kohler recommended a 150 kW model. The Generator Information section below provides more details about the generators.

## Plumbing

### Natural Gas Generator

The Kohler Natural Gas Generator Model 150REZGC requires a 1-1/2" NPT gas piping connection, and 7-11" W.C. of gas Pressure. The fuel consumption rate is 2,129 CFH for the generator at 100% capacity.

| | |
|---|---|
| Generator | 2,129 |
| Boiler | 641 |
| Hot Water Heater | 199 |
| **Total** | **2,969 CFH** |

Although the existing natural gas meter is rated for 3,000 CFH, WRA would recommend increasing the meter to a 5M Rotary meter rated at 5,000 CFH to allow for full flow to connected equipment. Meter sizing will be coordinated and confirmed with Washington Gas during the Design Phase. The gas piping serving the generator from the meter will also need to be upgraded in size, and a new pressure regulator will need to be installed at the generator.

### Diesel Generator

If a new diesel-powered generator is selected, it will be equipped with a belly tank designed to allow for a minimum run time of 8-hours. Re-fill of the fuel tank would be provided by Town personnel in the event that the generator needs to run longer than an 8-hour period. The 150 KW generator consumes 11.7 GPH at 100% load. Based on standard tank sizes available, the 298-gallon belly tank would allow for 24 hours of operation at full load.

## Generator Information

### Emissions

Natural Gas generators burn cleaner than diesel, and emissions are not an issue. The Diesel generator analyzed in this report is certified as Tier 3.

### Noise

The Town of Vienna does not currently have a noise ordinance that would add restrictions to the generator. However, it has been requested that the generator be supplied with accessories that would limit the noise to the maximum extent possible. Operating noise level varies based on generator manufacturer and the level of noise reduction from an enclosure also varies based on the manufacturer. Enclosure that are typically offered are rated as Level 1 and Level 2 sound enclosures. A Level 1 sound enclosure will reduce the generator noise level to an average of 80 dBA at 23 feet from the enclosure. A Level 2 sound enclosure will reduce the generator noise level to an average of 75 dBA at 23 feet from the enclosure. The sound level produced by the Kohler Natural Gas Engine in a Level 2 enclosure was found to be 73 dBA during testing. The sound level produced by the Kohler Diesel Engine in a Level 2 enclosure was found to be 75 dBA during testing. The sound level produced by the Generac Diesel Engine in a Level 2 enclosure was found to be 78.6 dBA during testing. The generator selected will require a weather proof, Level 2, sound attenuated enclosure and critical grade muffler silencer to limit the noise emitted while in use. Please see Appendix B for cutsheets of the Level 2 sound attenuation enclosure which will aid in restricting the noise pollution of the generator.

### Load Bank

The Town of Vienna has requested a reactive load bank be included with the installation of the generator. Load banks are available in Resistive and Reactive types. Resistive load banks are the most common type, and mimic the operational load that a power source will see in actual use. They convert electrical energy (current) into heat using power resistors and dissipate the heat using air or water. Examples of resistive loads include incandescent lightbulbs and devices with heating elements, such as space heaters and hot plates. Reactive load banks are used to simulate systems affected by electric motors or other electromagnetic devices on a power network. In general, equipment that requires reactive power compensation are motor-driven devices, transformers and capacitors.

Although resistive load banks cost less, reactive load banks can simulate real world conditions on the generator and are the preferred choice for many WRA Clients. ASCO provided our team with a quote for a free-standing reactive load bank. The quoted budget price for the reactive load bank and controller is $76,087.74. There would be additional cost for an extra house-keeping pad as well as wiring and conduit to connect the unit to the generator. The ASCO reactive load bank is 60 W x 91 L x 81 H. Due to the heat generated by the load bank while in operation, the device requires working space around the unit.

ASCO also provided a quote for a free-standing resistive load bank. The size of the free standing resistive load bank is 39” W x 67” L x 43” H. The free-standing load bank would cost $9,547, however there would be additional cost for an extra house-keeping pad as well as wiring and conduit to connect the unit to the generator.

As a third alternative, Kohler can provide a radiator mounted resistive load bank. This would be mounted to the top of the generator enclosure and not require additional footprint. A picture of the radiator mounted resisted load bank is shown below. The radiator mounted unit would come prewired from the manufacturer and costs $19,000.


FIGURE 1 - RADIATOR MOUNTED RESISTIVE LOAD BANK

Physical Dimensions

The existing generator is in the parking lot, adjacent to a brick enclosure surrounding the building dumpster. The 75 kVA generator is 33” wide by 86” long. It is located on a concrete generator pad that is 50” wide by 99” long. The concrete pad is approximately 55” from the brick wall enclosing the dumpster. Bollards are used to protect the exposed sides of the generator from vehicular traffic.

The new natural gas Generator is 45.4” wide by 66.8” long (Generac or Kohler). It is recommended that the generator pad extend 12” in each direction. The pad size would then be 69.4” by 90.8”. This would fit in a standard parking space, which is approximately 108” wide by 216” long.

The new Diesel Generator is 40” wide by 145” long. It is recommended that the generator pad extend 12” in each direction. The pad size would then be 64” by 169”. Again, this would fit in a standard parking space, which is approximately 108” wide by 216” long.

Due to the generator being installed inside an enclosure, there will be required clear space on both sides of the generator to allow the enclosure doors to open. The bollards protecting the side of the existing generator may have be removed and relocated. The required clear space and reinstallation of the bollards may encroach on the existing adjacent parking spot, resulting in the possible loss of one parking spot for the facility. This would be finalized during the design process.

Sketches of both the natural gas and diesel engines have been provided in Appendix A that show the layout of the engine with regards to the allocated space for the existing generator. The first option, sketches A and D for each generator type, show the radiator mounted load bank. The diesel generator would require some extra clearance space on one end. The generator could be installed so this needed space overlaps into the clear green space behind the generator. The second option, sketches B and E, show the space required for the free standing resistive load bank and the new generator. With the natural gas option, the generator and load bank will still fit in the existing space. For the diesel generator, the concrete pad for the load bank is right on the edge of the first parking spot and the required clearance for the load bank encroaches into that spot. The third option, sketches C and F, show the space required for the free standing reactive load bank and the new generator. With the natural gas option, the generator and load bank will still fit in the existing space. The generator would need to be installed so the working space overlaps with grass area. For the diesel generator, the required footprint for the engine and the load bank would require the use of an additional parking spot.

Cost

The cost of the Kohler Natural Gas generator was given from the representative to be $52,000. The cost of the Generac Natural Gas generator was given from the representative to be $77,220. The cost of the Kohler Diesel generator was given from the representative to be $46,000. The cost of the Generac Diesel generator was given from the representative to be $41,423.00. These costs represent the Generator installation and testing only, and do not include the cost for the design of the project, the other electrical upgrades required to support the generator, new concrete pad, or demolition of existing.

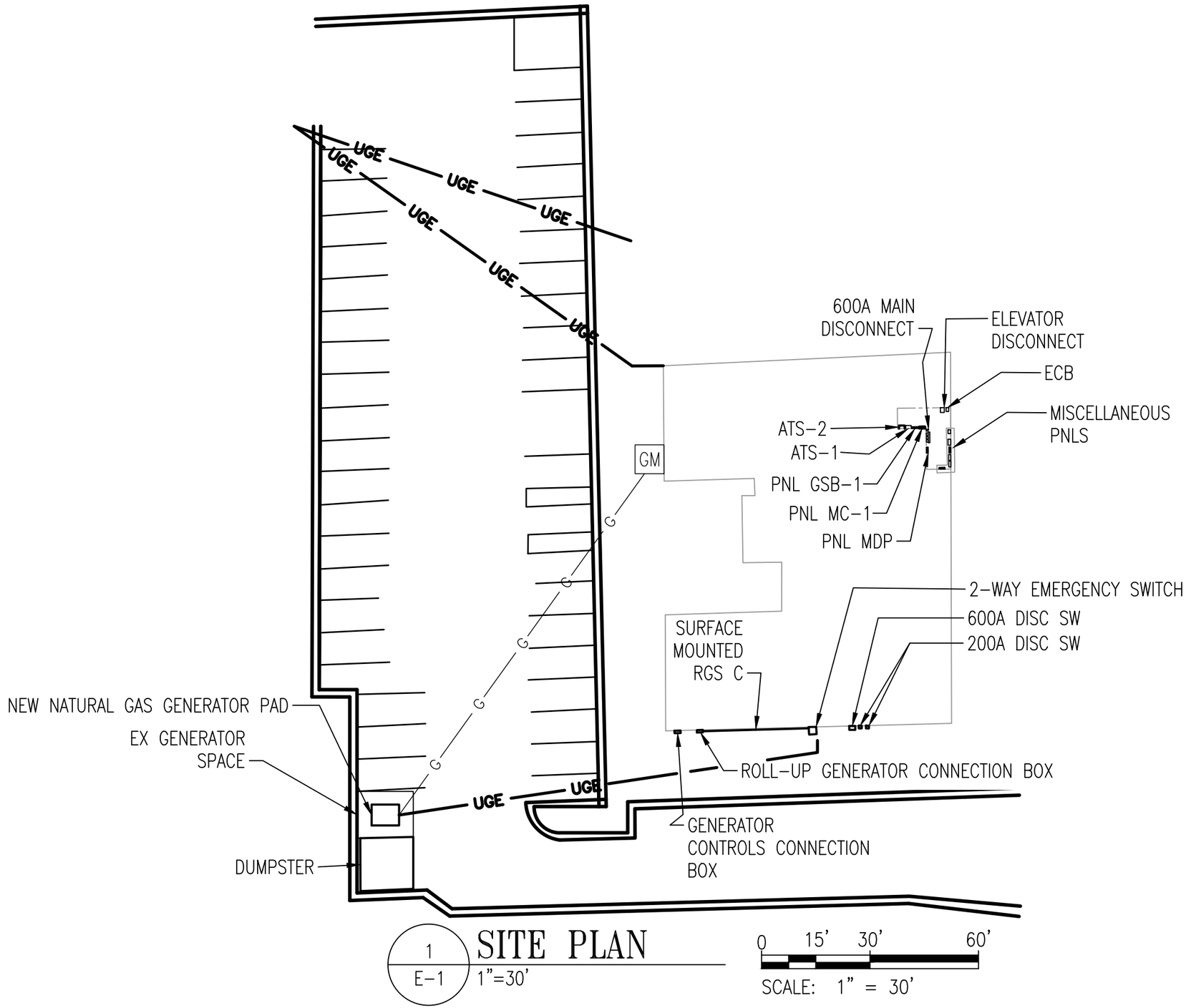
For a rough order of magnitude cost for the entire project, please see WRA Cost estimate provided in Appendix C for both Natural Gas and Diesel Generator installations and the ASCO reactive load bank. Generator cost data was provided by Kohler and Generac. The costs for the load banks were given by both ASCO and Kohler, as described above in the load bank section. The price for the reactive load bank was included in our cost estimate. The cost for demolition, concrete pad, ATS's, enclosed circuit breakers, wiring and other miscellaneous equipment is from 2019 RS Means CostWorks. Pricing for moving circuits from one panel to another was not developed as a part of this effort.

# IV. RECOMMENDATIONS AND CONCLUSIONS

WRA recommends a natural gas generator set. This recommendation is partially because the existing generator is a natural gas engine but also because the natural gas generator has the ability to operator at a lower rating. When Diesel engines operate below 80% of their rated capacity, the issue of wet stacking becomes a concern. Wet stacking is when the generator does not burn all of the fuel before it is exhausted. The fuel then builds residue in the exhaust system. This requires extra maintenance or additional equipment to simulate load on the generator so it runs in the optimal range. A Natural Gas generator is capable of operating at lower ranges, which will accommodate the difference in peak energy demand of the building between winter and summer months. WRA recommends Kohler's 150 kW model 150REZGC for the basis of design based on the cost difference, physical dimensions, operation range, and fuel consumption rate ($ft^3$/hr). Refer to Appendix B for more details. The 130 kW, model SD130, offered by Generac would be the primary diesel option based on cost. Utilizing phased construction and a temporary roll up generator, the new generator would be installed in the same location as the existing generator. A new connection box for a roll up generator would be installed on the exterior of the building. Two new ATS devices and one new power panel would be installed in the electrical room. The concrete pad of the existing generator would be demolished, and a new pad would be installed. A Level 2 sound attenuation enclosure and critical grade muffler should be installed with the generator to limit noise pollution to the surrounding neighborhood.

The cost of the Natural Gas generator with reactive load bank is estimated at $499,437.00. The existing parking space is large enough to house the generator and reactive load bank while maintaining service clearances.

# Appendix A – Drawings




1 / E–1 SITE PLAN

1"=30'

0 15' 30' 60'

SCALE: 1" = 30'

| REVISIONS | | |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

CLIENT INFORMATION

TOWN OF VIENNA
TOWNHALL
VIENNAL, VA

GENERATOR STUDY

KEY PLAN

GRAPHIC SCALES

SIGNATURE

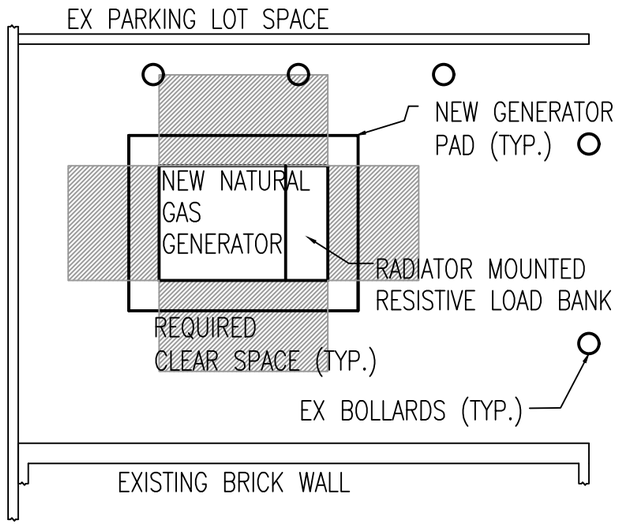

**Whitman, Requardt & Associates, LLP**
801 South Caroline Street, Baltimore, Maryland 21231


# SITE PLAN

DRAWING NO.

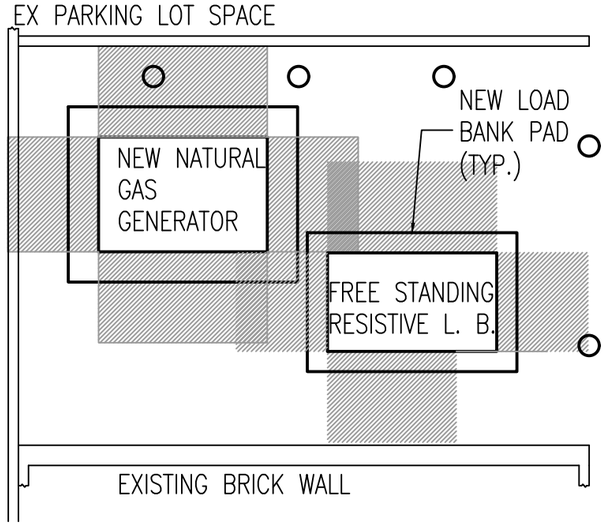
**E–1**

| | | |
|---|---|---|
| SCALE: | | |
| DATE: 07/26/2019 | SHEET OF 2 | |
| DES: | DRAWN: | CHECK: |



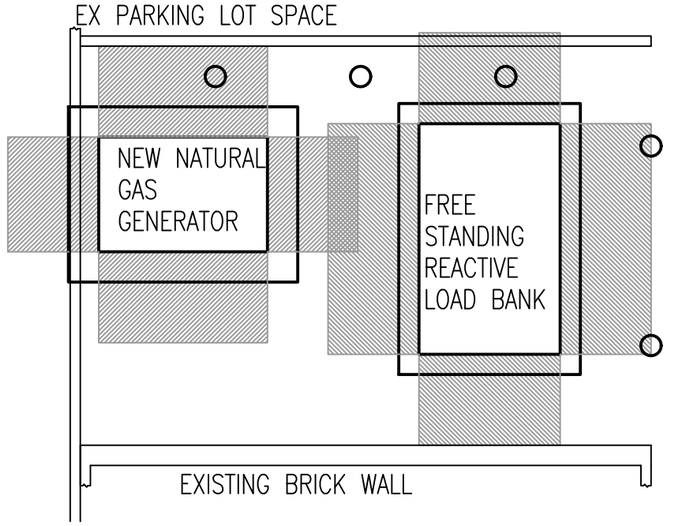

# NEW NG GENERATOR RESISTIVE LOAD BANK

A / E-2 1"=60'



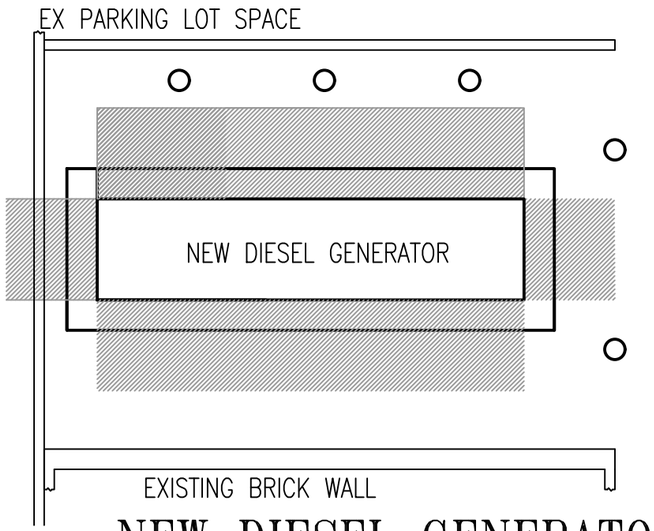

# NEW NG GENERATOR RESISTIVE LOAD BANK

B / E-2 1"=60'



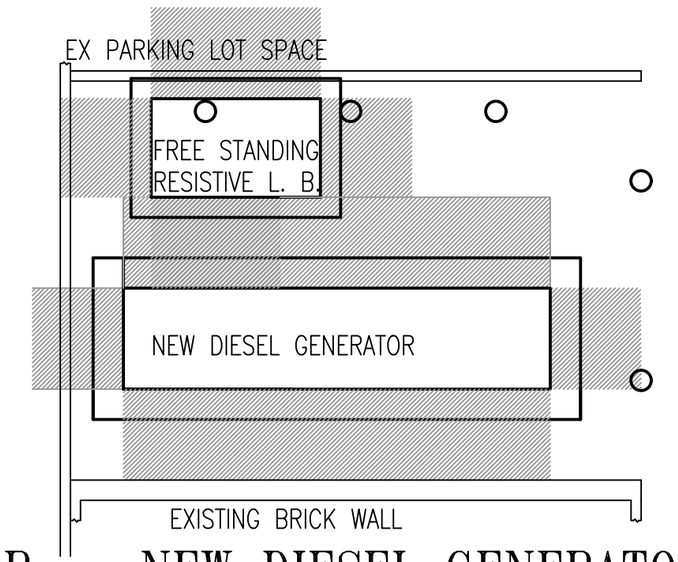

# NEW NG GENERATOR REACTIVE LOAD BANK

C / E-2 1"=60'



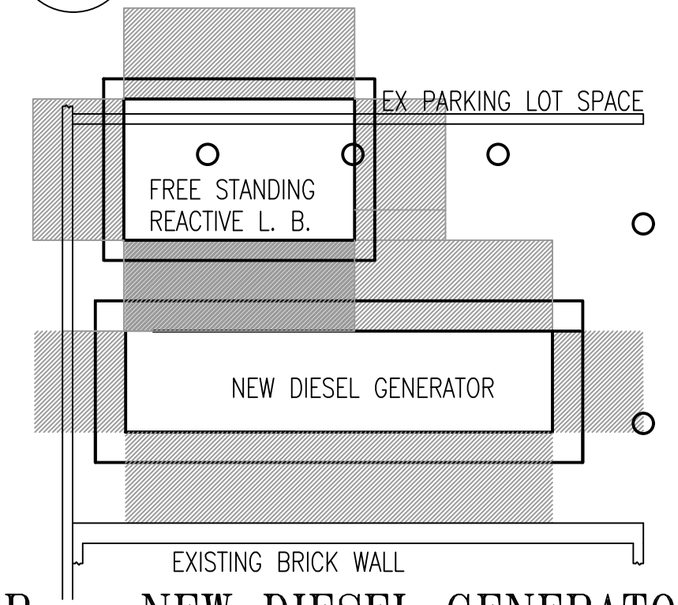

# NEW DIESEL GENERATOR RESISTIVE LOAD BANK

D / E-2 1"=60'




# NEW DIESEL GENERATOR RESISTIVE LOAD BANK

E / E-2 1"=60'




# NEW DIESEL GENERATOR REACTIVE LOAD BANK

F / E-2 1"=60'

0 30' 60' 120'

SCALE: 1" = 60'

REVISIONS

| | | |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

CLIENT INFORMATION

TOWN OF VIENNA
TOWNHALL
VIENNAL, VA

GENERATOR STUDY

KEY PLAN

GRAPHIC SCALES

SIGNATURE

Whitman, Requardt & Associates, LLP
801 South Caroline Street, Baltimore, Maryland 21231

LAYOUT OPTIONS

DRAWING NO.

E-2

| | | |
|---|---|---|
| SCALE: | | |
| DATE: 07/26/2019 | SHEET OF 2 | |
| DES: | DRAWN: | CHECK: |