2 - Town of Huntington

Notice

Project: Town of Huntington Community Microgrid Feasibility Assessment

Agreement Number: 66396

Contractor: Town of Huntington

NY Prize Final Report

TOWN OF **HUNTINGTON**
LONG ISLAND, NEW YORK

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Executive Summary

The Town of Huntington, New York was awarded a contract by the New York State Energy Research and Development Authority (NYSERDA) to conduct a feasibility study of community microgrid in a statewide effort to help communities:

- Reduce costs
- Promote clean energy
- Build reliability and resiliency into the grid

The attached report presents the Stage 1 findings and recommendations from a technological, operational, legal, and business standpoint. The Town of Huntington led the feasibility assessment in collaboration with TRC Energy Services, a division of TRC Environmental Corp (TRC). The report establishes that the proposed community microgrid design is feasible and will reduce operating costs for the critical and non-critical facilities involved in the microgrid as well as increase resiliency in the event of a grid shut down.

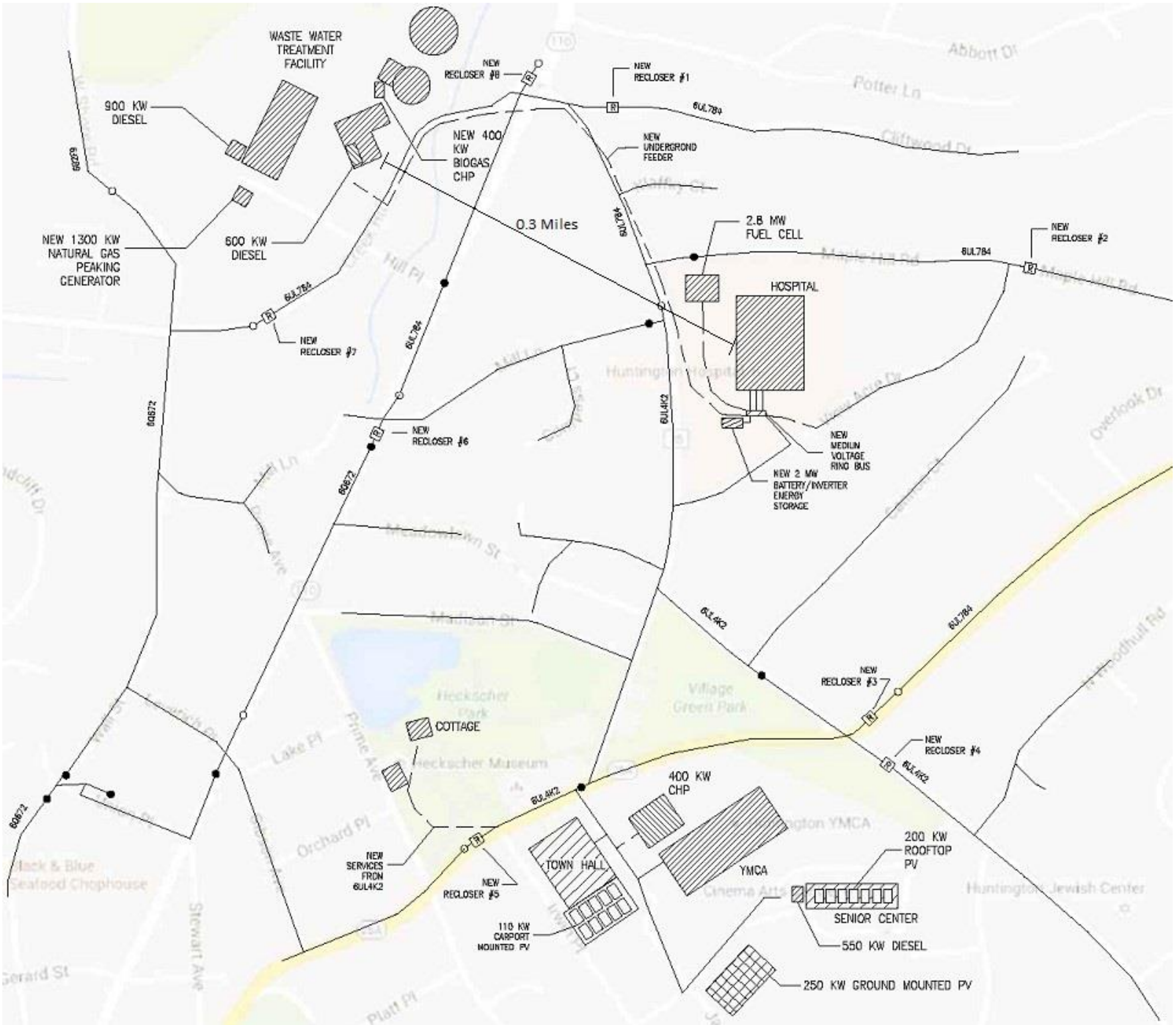
The Town of Huntington is located in the New York metropolitan area on the North Shore of Long Island in Suffolk County. The Town employs approximately 700 people and has services for residents including, transportation, emergency management, and senior care. The town's facilities that will be involved in the microgrid are:

- Huntington Town Hall
- Flanagan Senior Center
- Huntington YMCA
- Heckscher Park Museum & Cottage
- Huntington Waste Water Treatment Plant
- Huntington Hospital

The distributed energy resources (DER) will supply 100% of the energy demands of the microgrid in an emergency island situation under all conditions. All of the DER are new with the exception of a 900 kW Diesel Generator. The two reciprocating generators will not operate in grid parallel mode and will only serve as peaking support during emergency island situations. The battery storage component will provide the primary peaking power as well as providing frequency regulation and Volt/VAR support.

Location	Description	Capacity	Fuel
Huntington Hospital	Fuel Cell	2.8 MW	Natural Gas
Huntington Hospital	Battery Storage	2.0 MWh	N/A
Town Hall	Reciprocating CHP	400 kW	Natural Gas
Town Hall/YMCA/Senior Center	Solar PV	560 kW	Sunlight
Town Hall/YMCA/Senior Center	Flywheel	100 kW	N/A
Wastewater Treatment Plant	Reciprocating CHP	400 kW	Biogas/Natural Gas
Wastewater Treatment Plant	Reciprocating Generator	1.3 MW	Natural Gas
Wastewater Treatment Plant (existing)	Reciprocating Generator	900 kW	Diesel

Table of Distributed Energy Resources



Layout Plan of Facilities and Distributed Energy Resources

The DER are expected to be owned by a third party owner/operator with power purchase agreements signed with the town facilities to provide them microgrid services and discounted rates on power. The distribution infrastructure will remain under the ownership of PSEG-LI and the microgrid participants will continue to be customers of PSEG-LI since during normal operation mode the microgrid does not produce more power than the microgrid users consume. As a utility distribution microgrid, this project does not face some of the franchise problems that will be encountered by private ownership. It does, however, require utility buy-in and cooperation. Furthermore, current PSEG-LI tariffs do not permit net metering of CHP and Fuel Cell resources – permitting net metering of all microgrid assets would allow waste heat to be optimized in locations where it is needed as well as significantly increase the financial outlook of community microgrids.

The estimated cost of the microgrid is expected to be $22,879,692, inclusive of investment tax credits. The microgrid is financially feasible under all scenarios discussed in section 3.5 of this report with Stage III funding. The financial feasibility of the project was most sensitive to the negotiated price of excess power produced by the fuel cell during off peak periods as well as the price of natural gas. If the excess generation produced by the fuel cell can be negotiated over $0.08/kWh the project will have a positive NPV without Stage III funding, however may require it to attract investor attention. The business case for this microgrid is primarily driven by the high efficiency provided by the combined heat and power aspects (reciprocating engine CHP and Fuel Cell) of the proposed design.

The Huntington Community Microgrid Project would provide the town's residents with resilient power and access to emergency services, community centers, and a fully functioning Hospital serving a population of 300,000 during emergency situations. The near zero emissions of the fuel cell combined with the solar portion of this project will provide environmental benefits to the community.

Summary of Microgrid Capabilities

The feasibility Study of the Town of Huntington Community Microgrid project will be assessed for providing all minimum and desired capabilities. The proposed microgrid will include the following distributed energy resources: solar PV, energy storage, combined heat and power systems (CHP), and Fuel Cells. The systems will be sized considering the following variables: ability to support system loads in island mode, cost, environmental permitting, green-house gas reduction, and energy efficiency opportunities. The system will be designed to connect to and disconnect from the grid for island mode. The microgrid will provide power to the select facilities in the Town of Huntington, NY while providing clean reliable and cost effective energy during normal (grid paralleled) operation as well as improving system resiliency during emergencies. Advanced technologies and innovative business models will be explored and assessed for inclusion.

The Town of Huntington Community Microgrid Team consists of the following organizations and customers that will be impacted by microgrid implementation and are willing to participate in the feasibility study.

Table 1: Microgrid Stakeholders

Public Interest Group / Stakeholder	Name of Organization	Role
Local Electric Distribution Company	PSEG-LI	-Coordination and approval to leverage existing infrastructure as they are the owner of the utility distribution system that the microgrid will utilize
Local Fuel Distribution Company	National Grid	-Owner of natural gas distribution systems -Coordination and approval to ensure sufficient connections and supply is available to support new energy generating assets
Local Government	Town of Huntington	-Prime Proposer -Owner of critical facilities that will be a part of the microgrid -Will benefit from increased energy resiliency and reduced operational costs
Energy Consumers	Huntington YMCA	-Potential owner of microgrid generation assets -Manages Huntington YMCA which will benefit from increased resiliency and decreased operation costs.
	Huntington Hospital	-Potential owner of microgrid generation and energy storage assets -Manages Huntington Hospital which will benefit from increase resiliency and decreased operational costs
	Town of Huntington	- Potential owner of microgrid and energy storage generation assets - Manages Town Hall, Wastewater Treatment Plant, and Flanagan Senior Center
	Residential	- Residential customers along the feeder lines will also be considered for inclusion in the microgrid and will be able to participate as part of the microgrid.
Engineering Support	TRC	-Sub-Contractor to provide engineering support during proposed development and feasibility study

Task 1: Development of Microgrid Capabilities

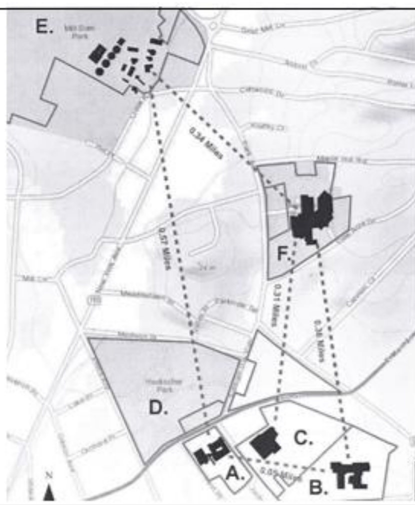
The Town of Huntington Community Microgrid meets all of the minimum and preferred capabilities as defined the NYSERDA New York Prize Program.

1.1: Minimum Required Capabilities Subtask

The capabilities described in this section were designated as minimum required capabilities by NYSERDA NY Prize. The approach being assessed will include all minimum required capabilities as described below.

1.1.1: Required Capability: *Serves at least one but preferably more, physically separated critical facilities located on one or more properties*.

Project Approach: The sites included in the proposed community microgrid include Huntington Town Hall, Huntington Hospital, Huntington Waste Water Treatment Plant, Huntington YMCA, Flanagan Senior Center, and Heckscher Park Museum and Cottage. These sites are considered critical and would benefit from increased energy reliability. All sites are located within 0.7 miles, in an area known as Huntington Village. This area is a busy downtown district and common community gathering place which has suffered from energy reliability issues in the past. Following Hurricane Sandy, this area was without power for ten days. Additionally, the lack of redundancy for Huntington Hospital when running on emergency back-up generation means their ability to perform critical medical procedures is severely limited when the electric grid is down.



Site A
Huntington Town Hall
100 Main Street
Huntington, NY 11743

Site B
Flanagan Senior Center
423 Park Avenue
Huntington, NY 11743

Site C
Huntington YMCA
60 Main Street
Huntington, NY 11743

Site D
Heckscher Park
164 Main Street
Huntington, NY 11743

Site E
Huntington Wastewater
Treatment Facility
65 Creek Road
Huntington, NY 11743

Site F
Huntington Hospital
270 Park Avenue
Huntington, NY 11743

Figure 1: Microgrid Facilities

After meeting with PSEG-LI it was determined that residential loads, mainly single family homes, would be picked up along the three main feeders serving the critical facilities identified above. Figure 2 shows the surrounding residential areas that will be included along with the critical facilities.

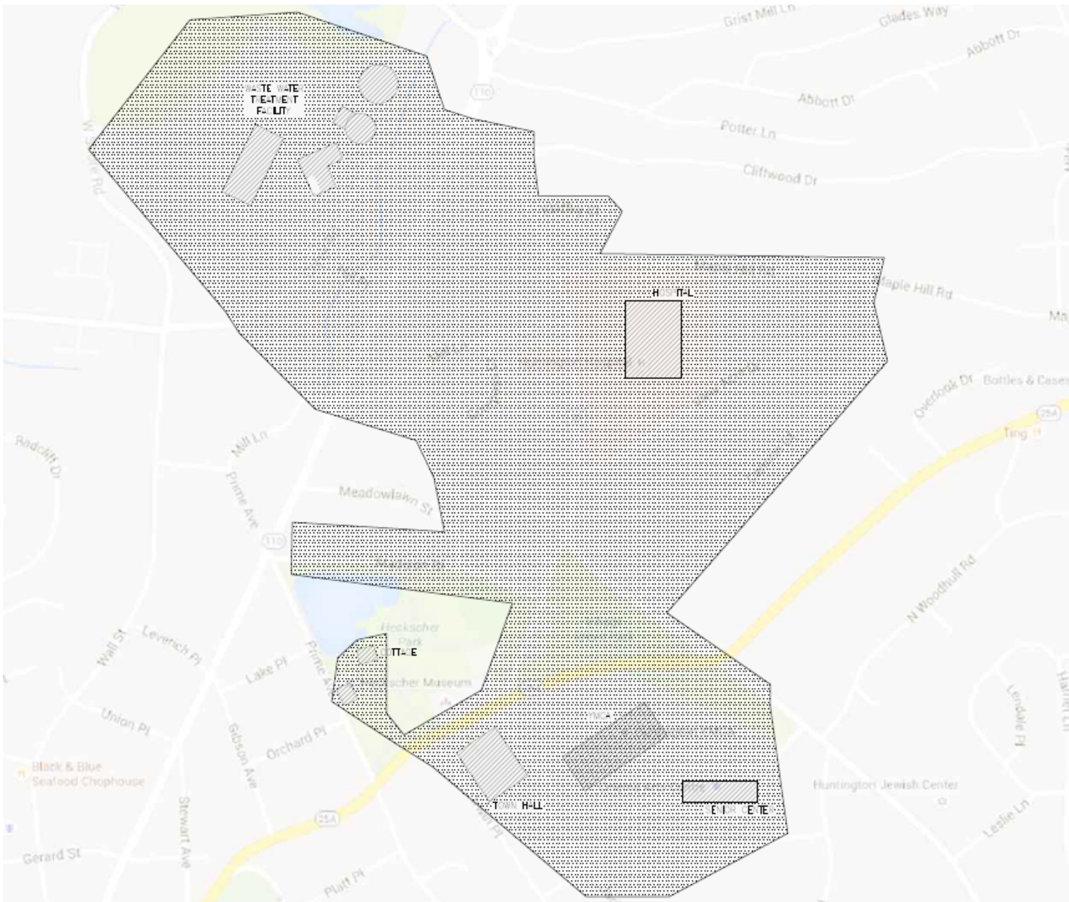


Figure 2: Microgrid Footprint

1.1.2: Required Capability: *The primary generation source capacity cannot be totally diesel fueled generators.*

Project Approach: The existing diesel generators at the Flanagan Senior Center and at the Huntington WWTF will be retained for use as peaking generators that will only be utilized during emergencies. The Wastewater Treatment Plant has one existing 900 kW Diesel Generator and one existing 600 kW Diesel Generator. The Flanagan Senior Center has an existing 550 kW Diesel Generator. The Hospital is installing two new 900 kW diesel generators in addition to their existing 900 kW generator, these three will not be included in the microgrid and will remain as a back-up source of power as required by Life Safety Codes. In addition, a small scale CHP and solar PV will be evaluated at these sites. All new fuel-based generation will be fueled by natural gas. The use of green technologies such as fuel cells and solar PV will be evaluated at larger CHP sites such as the YMCA and Huntington Hospital. We are proposing 2.8MW of fuel cell generation at the hospital being used in a combined heat and power capacity with 2000kVA of battery storage. We are also proposing a 400 kW Biogas CHP at the WWTF with the waste heat being used to maintain the digester temperature as well as a 400 kW natural gas CHP site at the

Town Hall and YMCA with the lower temperature jacket water used to heat domestic hot water at the YMCA and the higher temperature exhaust for the heating at Town Hall.

1.1.3: Required Capability: *A combination of generation resources must provide on-site power in both grid-connected and islanded mode.*

Project Approach: Energy generation resources are described in section 1.1.2. The CHP and renewable resources combined with storage will provide the majority of the power requirements of the critical facilities connected to the microgrid during grid paralleled operation. Natural Gas fueled peaking generators will provide additional power when called upon during periods of high power demand on PSEG-LI's system. All generating resources will be used during emergencies, dispatched according to the microgrid load in an islanded condition. There will be sufficient generating capacity to meet the peak demand of all critical facilities, with a 20% allowance for spinning reserve.

1.1.4: Required Capability: *Must be able to form an intentional island.*

Project Approach: Upon request from PSEG-LI to intentionally island, any additional generating assets needed to support the current operating load of the microgrid will be brought on-line. A command will then be issued to open all points of interconnection with the main utility grid, resulting in sectionalizing of the distribution infrastructure, thus separating the microgrid from the utility grid. All critical facilities will continue to receive power as normal, with the power produced by the generating resources distributed via the now sectionalized microgrid system. Simultaneously with the disconnection from the main utility grid, all generator voltage regulators will switch from power factor to voltage control mode to maintain system voltage; the base load generation will switch to droop control; peaking generators will switch to isochronous governor control to maintain system frequency.

1.1.5: Required Capability: *Must be able to automatically separate from grid on loss of utility source and restore to grid after normal power is restored.*

Project Approach: Upon sensing a loss of the utility source, the grid tie sectionalizing switches will immediately open. If the currently operating generation resources for the microgrid are not sufficient to support the microgrid load at the moment of transfer, a pre-planned partial load reduction will be initiated by a high speed load management system to allow the remainder of the microgrid to continue operating while additional generation is brought on line. The fuel cell based CHP systems will go into hot standby mode until the microgrid voltage and frequency is stabilized. Once stabilization is reached, the fuel cell systems will ramp up to the base load setpoint established by the microgrid controller, at a rate of 400 kW/minute. As the additional generating capacity is on-line the previously shed loads will be restored. As described in 1.1.4, simultaneously with separation from the utility grid, all generator voltage regulators will switch from power factor to voltage control mode; the base load generation will switch to droop control; the peaking generators will switch to isochronous governor control. Once the normal utility voltage and frequency is restored, the system will wait for five minutes per IEEE 1547 standard, and then initiate automatic re-synchronization with the utility grid. The microgrid frequency and voltage will be automatically adjusted to match the utility, and a close command will be issued to the grid tie sectionalizing switches. At that point, generator voltage control will switch to power factor mode, and all governor controls will be set to droop. Generator dispatch will revert to the economic dispatch control system. Unneeded generation assets will be shut down.

1.1.6: Required Capability: *The system must comply with manufacturer's requirements for scheduled maintenance intervals for all generation; plan on intermittent renewable resources that will be utilized toward overall generation capacity only if paired with proper generation and/or energy storage that will allow 24 hours per day and 7 days per week utilization of the power produced by these resources.*

Project Approach: Fuel Cells and packaged CHP systems to be designed for 99.9% availability and will provide power 24 hours per day and 7 days per week. Downtime for individual units will be scheduled so as to have no impact on operational capability. The peaking generators will be capable of continuous operation for the durations needed during outages and will have adequate downtime even in island mode to allow for routine service and maintenance.

1.1.7: Required Capability: *Generation must be able to follow the load while maintaining the voltage and frequency when running parallel connected to grid. It also needs to follow system load and maintain system voltage within ANSI c84-1 standards when islanded.*

Project Approach: When in Grid Paralleled operation, the microgrid voltage and frequency are controlled by the utility grid. Microgrid generation will provide MW and MVARS to the system based on the generator set points determined by Economic Dispatch. When operating in Island Mode, generator voltage regulators will maintain the system voltage, with the MVAR contribution of each generator proportional to the generator load. System frequency will be maintained by isochronous operation of the peaking generators.

1.1.8: Required Capability: *Include a means for two-way communication and control between the community microgrid owner/operator and the local distribution utility through automated, seamless integration. Include processes to secure control/communication systems from cyber-intrusions/disruptions and protect the privacy of sensitive data.*

Project Approach: The entire microgrid communications and control system will be NERC CIP compliant using a dedicated communications network, and password authentication. A secure communications gateway with firewall will be constructed to allow PSEG-LI to monitor operation of the microgrid and allow it to have operational control of the microgrid distribution and other functions as established by the operating agreement.

1.1.9: Required Capability: *Provide power to critical facilities and a diverse group of customers connected directly to the microgrid—diversity should apply to customer type (e.g. residential, small commercial, industrial, institutional, etc.) and overall demand and load profile.*

Project Approach: The system to be assessed will include a mix of town-owned facilities, a not-for-profit hospital, the local YMCA and adjoining residential and commercial buildings. The project will support critical facilities and safe havens which will support the population of the Town of Huntington, approximately 200,000. The senior center provides services for about 300 senior citizens as well as hosting pre-school and day care services. The YMCA was used as a community warming center during Hurricane Sandy and has approximately 10,000 members. The hospital's 24 hour emergency room has more than 50,000 visits annually and more than 3,000 inpatient surgeries and 8,000 outpatient surgeries are performed annually. The Huntington Wastewater Treatment Plant is the oldest and largest treatment Plant in Suffolk County and is vulnerable to storm surge. The total coincident load is shown in Table 1, as the facilities do not have upgraded meters, interval data was not available.

	Peak	Min	Avg
January	3,076	1,864	2,052
February	3,042	1,935	2,195
March	3,017	1,894	2,111
April	3,307	2,028	2,208
May	3,891	2,409	2,544
June	4,220	2,793	2,971
July	4,762	3,189	3,256
August	4,479	3,054	3,226
September	4,580	2,928	3,100
October	4,173	2,535	2,668
November	3,681	2,124	2,287
December	3,188	1,957	2,099

Figure 3: Coincident Loads - All Facilities

1.1.10: Required Capability: *Must include an uninterruptible fuel supply or minimum of one week of fuel supply on-site.*

Project Approach: Natural gas will be the primary fuel source, as it is uninterruptable, reducing system dependence on the electrical transmission system. Some additional peaking capacity in the form of existing diesel generators will be available on an emergency basis. The potential run time for the existing diesels will be evaluated and additional on-site fuel supply will be considered.

1.1.11: Required Capability: *Demonstrate that critical facilities and generation are resilient to the forces of nature that are typical to and pose the highest risk to the location/facilities in the community grid. Describe how the microgrid can remain resilient to disruption caused by such phenomenon and for what duration of time.*

Project Approach: A basic risk assessment will be conducted to identify and prioritize risks. The CHP, solar PV, energy storage and CHP installations will be outside of the flood plain, in addition to the relocation of existing generation at the WWTP to above the flood plain. The CHP and energy storage equipment will be housed in structures compliant with the NY building code and will withstand all weather and seismic events anticipated for the Huntington NY area. The portions of the PSEG-LI distribution system that will be sectionalized to become the microgrid distribution system will be storm hardened and/or relocated underground to reduce vulnerability. Additionally, in the event of the loss of parts of existing feeder 6UL4K2, the Town Hall, Senior Center, and YMCA Area can function independently as a smaller microgrid, albeit with reduced functionality.

Figure 4: Partial Layout Plan

Long Island specifically has been deeply impacted by volatile weather. Hurricane Sandy had a significant impact leaving the majority of the Town of Huntington residents without power for 10 days. As the temperature dropped substantially directly following the hurricane many residents were forced to take shelter at the hospital and YMCA. While the YMCA does not have its own backup generation, they were able to borrow a diesel generator to provide services as a warming center to the community.

1.1.12: Required Capability: *Provide black-start capability.*

Project Approach: In the event of a complete outage, the peaking generation will be capable of self-contained black start using storage batteries. Once power is available from these units, the remaining generation can be started.

1.2: Preferable Microgrid Capabilities Subtask

The capabilities described in this section were designated as preferred microgrid capabilities by NYSERDA NY Prize. The approach being assessed will include both of the two primary preferred capabilities as described below.

1.2.1: Preferable Capability: *Integrate and demonstrate operation of advanced, innovative technologies in electric system design and operations, including, but not limited to, technologies that enable customer interaction with the grid such as, Microgrid Logic Controllers, Smart Grid Technologies, Smart Meters, Distribution Automation, Energy Storage.*

Project Approach: The Microgrid Load management system will incorporate real time metering and preplanned prioritizing of loads to permit the system to react to contingencies during islanded operation while maintaining system voltage and frequency and spinning reserve. Facilities participating in the microgrid will be able to view sub-hourly energy usage that will give them the tools to control energy use based on time of day and season. Energy storage will be utilized for efficient dispatch of renewable energy. The capabilities of the distributed generation resources allow the project to participate in ancillary market opportunities. The microgrid controller will smoothly integrate efficient generation dispatch while maintaining reliable power under both grid paralleled and islanded operation.

1.2.1.1: Preferable Capability: *Include an active network control system that optimizes demand, supply and other network operation functions within the microgrid.*

Project Approach: A fully integrated control system will be incorporated into a high speed, cyber secure communications system to monitor and control all aspects of microgrid operation, power generation and load management. All critical functions will be performed on redundant computer servers for maximum reliability.

1.2.1.2: Preferable Capability: *Include energy efficiency and other demand response options to minimize new microgrid generation requirements.*

Project Approach: The Town of Huntington and the other stakeholders have an existing commitment to energy efficiency, the Hospital has been partially upgraded to LED's as well as the Town Hall. The Waste Water Treatment Plant has installed VFD's on some of their pumps and currently participates in PSEG-LI demand response program. The continuation of such programs will be encouraged for each stakeholder. The planned use of proven energy efficient design such as combined heat and power systems, renewable resources, energy storage and load management systems will increase energy efficiency and reduce peak loads at facilities. In addition, energy reduction measures will be implemented at the facilities with a focus on reducing demand and limiting the required generation of the microgrid.

1.2.1.3: Preferable Capability: *Address installation, operations and maintenance and communications for the electric system to which interconnection is planned (e.g., underground networks, overhead loops, radial overhead systems);*

Project Approach: The microgrid distribution system will incorporate flexibility and redundancy so as to allow planned and unplanned maintenance without affecting power delivery to end users. Consideration will be given in the design for creating loop feeds that increase reliability. A robust and hardened communications system will be able to function independent of any other communications carrier or media.

1.2.1.4: Preferable Capability: *Coordinate with the Reforming the Energy Vision (REV) work to provide a platform for the delivery of innovative services to the end use customers;*

Project Approach: The project team will continue to follow the progress of the REV work in order to provide innovative services that are aligned with REV.

1.2.1.5: Preferable Capability: *Take account of a comprehensive cost/benefit analysis that includes, but is not limited to, the community, utility and developer's perspective.*

Project Approach: The requirements of task 3 and task 4 of the statement of work have been met. Additionally, a financial model of the microgrid was created and will be shared with potential project owners and developers.

1.2.1.6: Preferable Capability: *Leverage private capital to the maximum extent possible as measured by total private investment in the project and the ratio of public to private dollars invested in the project.*

Project Approach: Ownership and cost recovery mechanisms are discussed in section 3 - commercial feasibility assessment. Private sector capital providers have shown interest in assuming ownership of the project and signing power purchase agreements with the microgrid participants.

1.2.1.7: Preferable Capability: *Involve clean power supply sources that minimize environmental impacts, including local renewable resources, as measured by total percentage of community load covered by carbon-free energy generation.*

Project Approach: Large scale PV will be assessed with the goal to optimize the amount of carbon-free energy generation. Replacing conventional steam boilers with highly efficient CHP systems will provide low cost thermal energy to the facilities while greatly reducing emissions. CHP also achieves reductions in utility power generation emissions by eliminating transmission losses and reducing demand on utility peaking facilities. The planned use of Fuel Cell technology as a major source of both thermal and electrical energy provides clean, efficient and nearly emission free energy for the microgrid facilities.

1.2.1.8: Preferable Capability: *Demonstrate tangible community benefits, including but not limited to, (e.g. jobs created, number of customers served, number of buildings affected, scale of energy efficiency retrofits, etc.)*

Project Approach: The project will provide lower cost electrical energy for the facilities that are connected to the microgrid, as well as greatly reduced emissions that improve air quality. The ability to maintain critical town and community facilities during emergencies is a benefit to public safety and improves the quality of life for area residents.

1.2.2: Preferable Capability: *Incorporate innovation that strengthens the surrounding power grid and increases the amount of actionable information available to customers—providing a platform for customers to be able to interact with the grid in ways that maximize its value.*

Project Approach: The project will offer local power supply resiliency and provide reliability improvements to the existing PSEG-LI distribution system through sectionalizing and islanding capability, as well as potential undergrounding and loop feed configuration. The implementation of advanced metering will enable microgrid customers to better manage their energy use and costs by virtue of having precise time of day information on their energy use. The implementation distributed generation will reduce the PSEG-LI system peak demand, avoiding the need for additional transmission and distribution infrastructure.

Task 2: Develop Preliminary Technical Design Costs and Configuration

2.1: Proposed Microgrid Infrastructure and Operations

2.1.1: Infrastructure

The microgrid will incorporate portions of PSEG-LI existing overhead 13.8 kV primary distribution system.

New switching equipment and protective relays will be installed to monitor and control the separation of this microgrid system from the remainder of PSEG-LI system when necessary due to island the microgrid.

The Distributed Energy Resources (DER) which will support the microgrid consists of the following assets at multiple locations within the microgrid:

Huntington Hospital

- 2.8 MW fuel cell operating as a CHP system
- 2.0 MW/ 2.0 MWh energy storage battery/inverter system with 1.0 MW load bank (used to provide load when necessary for fuel cell during transition to/from island mode)

Town Hall/ YMCA/ Senior Center

- 400 kW natural gas fueled CHP system
- 560 kW PV
- 100 kW flywheel energy storage (for smoothing PV output.)

Wastewater Treatment Plant (WWTP)

- 1300 kW Natural Gas fueled generator (for island mode peaking and demand reduction only)
- 900 kW diesel generator (existing) for emergency capacity in island mode
- 400 kW Natural Gas/Biogas CHP System

Total capacity of DER in island mode is 6.9 MW, not including PV or the existing 900 kW diesel generator.

With the diesel generator, the maximum capacity is 7.7 MW

All of the DER will interconnect with PSEG-LI's 13.8 kV primary distribution at the three locations described above.

A new underground feeder will be installed to connect the peaking generators at the Waste Water Treatment Plant to the base load generation and energy storage system at the hospital. This will provide increased system resiliency and prevent a separation of these systems caused by damage to the aboveground distribution infrastructure. The Town Hall/YMCA/Senior Center portion of the microgrid is capable of self-sustaining operation in the event of damage to the overhead distribution between the hospital and the town hall area.

CHP-Thermal Output

The 2.8 MW fuel cell at the Hospital will contribute approximately 2,680 lb/hr of 125 psig steam to the hospital's heating system.

The 400 kW biogas fueled generator at the Waste Water Treatment Plant will provide approximately 1,364,000 Btu/hr when operating on a 25%/75% mix of digester gas/natural gas. This thermal energy will be utilized for process heating of the digester and for space heating of the Waste Water Treatment Plant facilities.

The 400 kW CHP equipped generator at the Town Hall/YMCA/Senior center will produce approximately 1,157 lb/hr of 50 psig steam for heating of the Town Hall and YMCA, as well as 61,434 Btu/hr of low temperature heat to be used for heating of swimming pool water at the YMCA.

Task 2.1.2: Operation

Normal Operation – Grid Paralleled Operation

During normal operation, all of the isolation switches on the primary distribution system will remain closed. The distribution will operate within the PSEG-LI system as it presently does.

Normal Operation – DER utilization

During normal, grid paralleled operation; the 2.8 MW fuel cell at the hospital will operate as base load generation.

The 400 kW CHP generator at the Town Hall/YMCA/Senior Center will be dispatched based on thermal demand.

The 400 kW biogas fueled CHP at the Wastewater Treatment Plant will operate continuously to provide process heating for the digester.

The 1,300 kW and 900 kW peaking generators at the Wastewater Treatment Plant will not run during normal grid paralleled operation.

The 2 MW energy storage battery/inverter system will provide demand peak reduction for the microgrid, discharging energy during periods of peak demand, and charging during off peak periods.

During normal operation, the Energy Storage system may also provide ancillary services to the grid by Frequency regulation and or Volt/VAR support.

Emergency Operation – Loss of utility source

If an unplanned loss of all utility power occurs due to transmission failure or other major event, all of the microgrid isolation reclosers will immediately open to electrically isolate the microgrid from the remainder of the PSEG-LI system.

Emergency operation – DER operation

The microgrid load management system will shed a predetermined quantity of load at the building level to limit the demand to a maximum of 80% of the available DER that was on-line at the time of the outage. The energy storage system will maintain the voltage and frequency of the microgrid as additional generation is brought on-line. The energy storage system combined with the 1000kW load bank will balance the output of the fuel cell to avoid tripping off line during the transition from grid paralleled to islanded microgrid operation. Once islanded, the fuel cell will continue to operate in grid following mode. The microgrid frequency and voltage will be maintained by the 1,300 kW peaking generator and the 900 kW diesel generator if the latter unit is on-line.

On a loss of the utility, any generators that are off line will immediately be commanded to start and synchronize with the bus. Once on-line, the fuel cell and two CHP generators will assume the microgrid base load, 1,300 kW peaking generator and the energy storage system will provide peaking capacity and maintain system voltage and frequency.

The energy storage battery will be maintained at 70-80% capacity while operating in island mode to allow sufficient margin for absorbing excess power, reducing the ramping requirements on the two generators in the event of sudden load rejection.

The base load generator capacity will be adjusted during island operation to leave sufficient headroom for peaking generation via the energy storage inverters.

The combined capacity of all DER can meet 100% the demands of the microgrid in an island mode under all conditions. In the event of a failure or one or more of the DER assets, the microgrid can continue to operate at reduced maximum capacity.

Task 2.2: Load Characterization

The critical facility loads were obtained from the Town of Huntington for town owned facilities, from Huntington Hospital and from The Huntington YMCA. The only documentation available was monthly Kilowatt hours and monthly peak electrical demand. No hourly or sub-hourly incremental demand information was available due to the lack of advanced metering in this service area. We confirmed the metering limitations with PSEG-LI. Monthly natural gas consumption records were also provided for the town facilities, the YMCA and the hospital.

The monthly electrical and heating load profiles for the critical facilities were evaluated both to determine an overall coincident monthly demand profile, and to evaluate the types of DER to be used and where the best locations were within the defined area of the microgrid.

Monthly Electric Load Profiles

The monthly load profiles were developed using the monthly billing demand for each facility as peak monthly demand. The average demands are based on the monthly kWh over the number of hours in the billing period.

	kW		
	Peak	Min	Avg
January	446	196	247
February	449	212	303
March	478	208	291
April	483	218	259
May	692	258	267
June	701	276	313
July	784	310	354
August	769	297	339
September	707	284	322
October	648	259	267
November	507	209	253
December	460	202	244

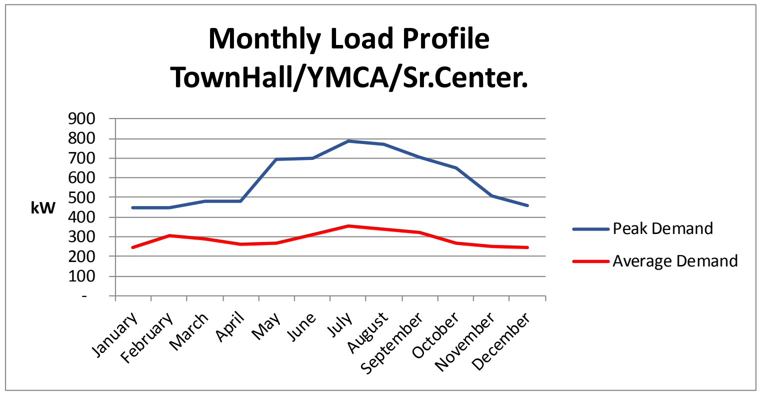


Figure 5: Town Hall/YMCA/Senior Center Load Profile

	kW	
	Peak	Avg
January	2,099	1,462
February	2,047	1,506
March	1,975	1,461
April	2,287	1,602
May	2,674	1,943
June	3,015	2,317
July	3,463	2,674
August	3,169	2,542
September	3,370	2,445
October	2,993	2,065
November	2,620	1,708
December	2,190	1,541

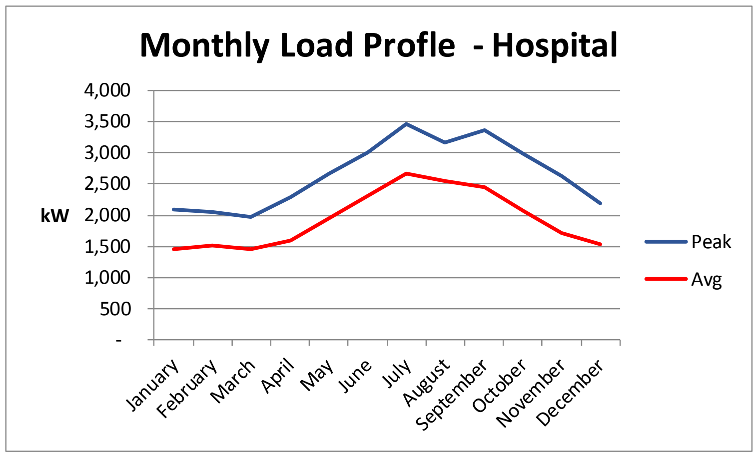


Figure 6: Huntington Hospital Load Profile

	kW		
	Peak	Min	Avg
January	487	195	329
February	479	192	334
March	497	199	332
April	474	189	323
May	459	184	305
June	434	174	311
July	441	176	317
August	467	187	305
September	446	178	306
October	475	190	307
November	500	200	317
December	494	198	300

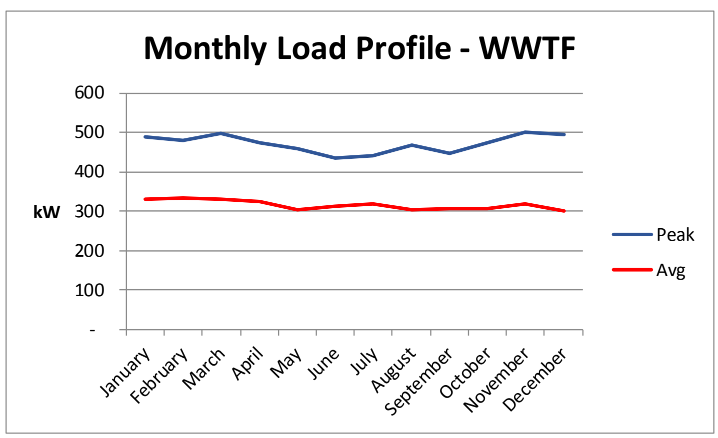


Figure 7: Waste Water Treatment Plant Load Profile

Coincident Load

The summation of the monthly peak demand and average demand for all facilities is shown below. This is the basis used for determining the microgrid operating demand in island mode. Additionally, there will be some load, primarily residential and some small commercial that will be included in the microgrid when islanded. The amount of that load is not presently known but is expected to be minimal. The DER was sized with allowances for maintaining a 20% spinning reserve margin at all times when islanded. Also, due to the lack of hourly or more detailed demand data, these estimates are most likely higher than the actual incremental value that would actually occur in islanded operation.

	Peak	Min	Avg
January	3,076	1,864	2,052
February	3,042	1,935	2,195
March	3,017	1,894	2,111
April	3,307	2,028	2,208
May	3,891	2,409	2,544
June	4,220	2,793	2,971
July	4,762	3,189	3,376
August	4,479	3,054	3,226
September	4,580	2,928	3,100
October	4,173	2,535	2,668
November	3,681	2,124	2,287
December	3,188	1,957	2,099

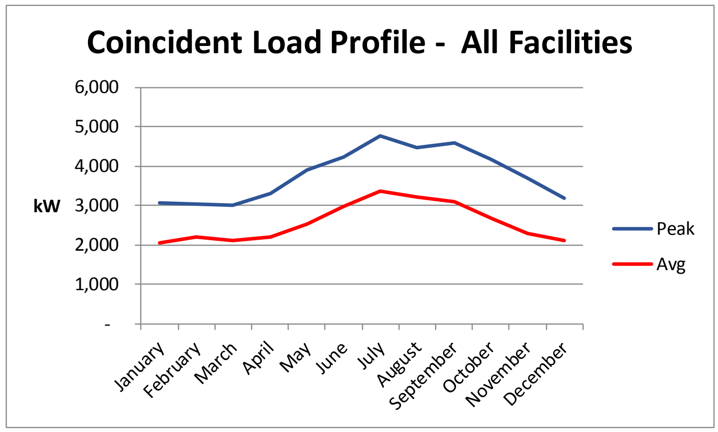


Figure 8: Coincident Load Profile

Thermal Demand

The thermal energy needs of each of the facilities were analyzed for opportunities to utilize CHP for increased fuel to energy conversion efficiency.

The hospital has the largest electrical demand as well as the largest heating energy use. It was therefore determined that a low-emission fuel cell which can also provide thermal energy in the form of 125 psig steam would be a good choice for base load generation at the hospital.

The following chart and graph shows the annual heating energy use of the hospital and the anticipated heat that will be provided by the fuel cell.

Huntington Hospital 2014 Steam production

	MBTU/hr	Lb/hr steam	lb. steam/ month	Lb. steam from Fuel Cell	
January	8,969.40	7,518	5,593,658	1,993,920	
February	11,321.59	9,490	7,060,575	1,800,960	
March	18,152.03	15,215	11,320,291	1,993,920	
April	11,062.81	9,273	6,899,189	1,929,600	
May	7,766.63	6,510	4,843,563	1,993,920	
June	4,713.90	3,951	2,939,765	1,929,600	note 1
July	5,472.49	4,587	3,412,851	1,993,920	note 1
August	4,618.64	3,871	2,880,360	1,993,920	note 2
September	4,766.72	3,996	2,972,705	1,929,600	"
October	6,593.02	5,526	4,111,658	1,993,920	"
November	8,989.85	7,535	5,606,409	1,929,600	"
December	8,540.10	7,159	5,325,930	1,993,920	

notes
1 estimated
2 2013 data

Figure 9: Huntington Hospital Steam Usage

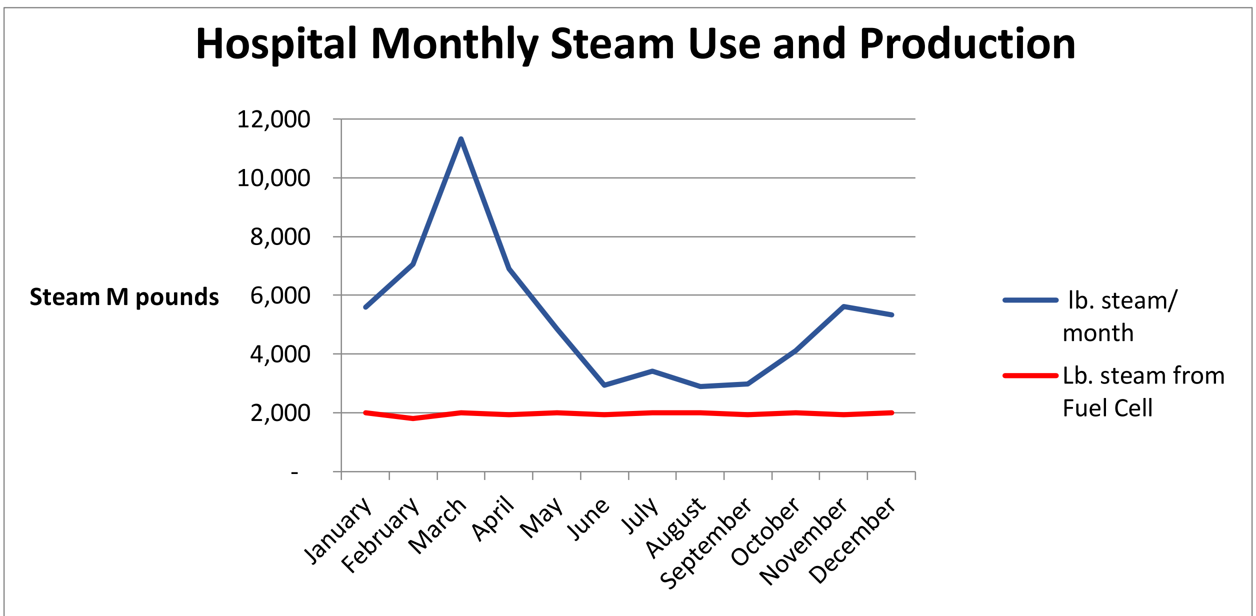


Figure 10: Fuel Cell Steam Production

Natural Gas Consumption Avg. 2013-2015			
	Avg. Therms	Efficiency	Heating MBH
January	430	75%	32,250
February	399	75%	29,925
March	310	75%	23,250
April	139	75%	10,425
May	2	75%	113
June	4	75%	300
July	0	75%	-
August	0	75%	-
September	1	75%	75
October	7	75%	525
November	257	75%	19,238
December	376	75%	28,200

Figure 11: Waste Water Treatment Plant Natural Gas

At present the biogas produced by the anaerobic digester is flared without recovering its heating value.

This project will incorporate a CHP generator that is capable of producing 400 kW of electricity while operating on biogas, natural gas, or a mixture of both. Initially, it will operate on mixture of 25% biogas and 75% natural gas, but future expansion of the digester will increase the percentage of biogas that can be used.

Table 2: Waste Water Treatment Plant Gas Production

Year	Month	Monthly total ft^3	Daily Max ft^3	Daily Min ft^3	Daily Avg ft^3	AVG ft^3/hr
2015	January	1,038,889	56,596	10,716	33,513	1,396
	February	777,705	47,316	13,642	27,775	1,157
	March	178,136	323,465	6,152	38,004	1,584
	April	872,307	47,337	19,435	29,077	1,212
	May	906,403	58,993	13,298	29,239	1,218
	June	933,139	58,993	13,298	29,239	1,296
	July	770,348	42,547	6,861	24,850	1,035
2014	August	854,313	78,452	5,041	28,303	1,148
	September	1,257,996	75,057	14,836	41,933	1,747
	October	1,351,096	92,513	16,523	45,778	1,816
	November	1,151,676	79,810	21,176	37,389	1,600
	December	975,510	102,353	6,044	29,565	1,313
					avg.	1,377

The recovered heat will be used for process heating of the digester as well as for space heating of the Wastewater Treatment Plant operations. The following table shows the expected performance for the biogas fueled CHP generator:

400 kW CHP Generator Caterpillar Model CG132-8												
ISO Heat Rate BTU/kW (LHV)	Fuel input @ full load (LHV) BTU/hr	Natural Gas BTU/ft^3 (LHV)	Digester gas BTU/ft^3 (LHV)	Natural gas flow @ Full load ft^3/hr	Digester gas flow @ Full load ft^3/hr	Avg. digester delivered BTU/hr	Natural gas to mixture BTU/hr	Gas fuel flow at mixture ft^3/hr	% Digester gas	% natural gas	Monthly Natural Gas DTherms	Annual Natural Gas Dtherms
8213	3,285,200	983	600	3,342	5,475.33	826,100	2,459,100	2,502	25%	75%	1,795	21,542

Town Hall – YMCA- Senior Center

Table 3: Combined Natural Gas Loads

Combined Town Hall/YMCA/Senior Center Natural Gas Loads

	Town Hall Therms	Sr. Center Heating Therms	YMCA Therms	Boiler eff.	Town hall MBTU	Sr. Center MBTU	YMCA MBTU	Combined Heating MBTU
January	11,711	10,434	8,188	70	8,198	7,304	5,732	21,233
February	15,851	9,033	9,189	70	11,096	6,323	6,432	23,851
March	11,576	7,184	6,609	70	8,103	5,029	4,626	17,758
April	5,639	3,666	5,036	70	3,947	2,566	3,525	10,039
May		1,344	2,243	70	-	941	1,570	2,511
June		807	1,407	70	-	565	985	1,550
July	2,674	-	1,490	70	1,872	-	1,043	2,915
August	31	-	1,564	70	22	-	1,095	1,117
September		1,517	2,325	70	-	1,062	1,628	2,689
October		1,517	3,793	70	-	1,062	2,655	3,717
November		1,517	6,695	70	-	1,062	4,687	5,748
December		5,090	8,106	70	-	3,563	5,674	9,237
							total	102,365

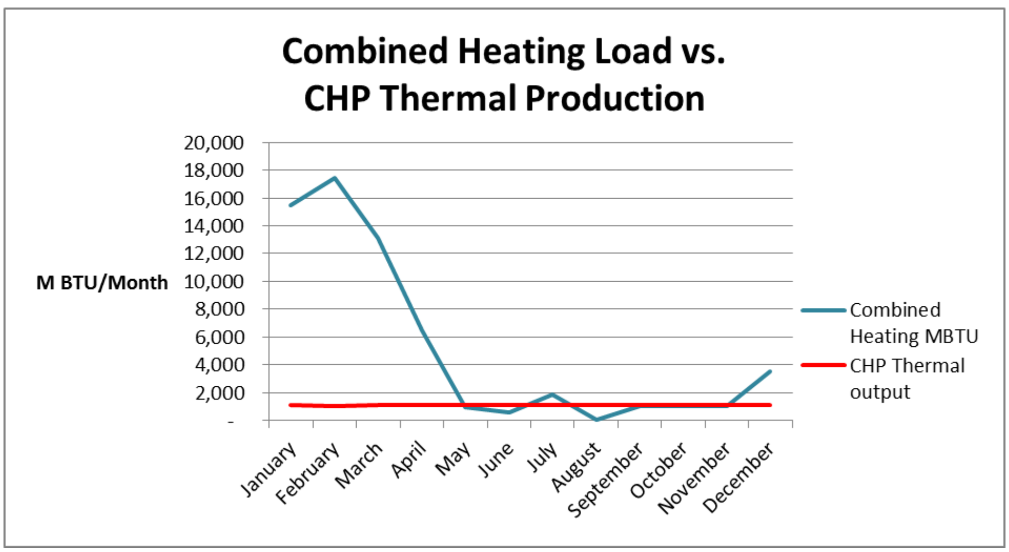


Figure 13: CHP Thermal Production

The recovered heat from the engine jacket water cooling system and the exhaust gas will be used to produce 50 psig steam which will be connected to the Town Hall and Senior Center Heating Systems and will reduce a portion of the natural gas used to heat these facilities.

The heat from the Intercooler system is a lower temperature energy source 111° F. - 104° F. , but it is suitable for heating the pool water at the YMCA. This heat energy will be recovered and will provide heat to the swimming pool water at the YMCA

Task 2.3: Distributed Energy Resource Characterization

The DER assets that will support the microgrid consist of:

- 2.8 MW Fuel Cell
- 2 MW/2MWH energy storage battery-inverter system,
- 400 kw natural gas fueled reciprocating generator/CHP
- 400 kW digester gas fueled generator/CHP, a 1,300kW natural gas fueled peaking generator
- 900 kW diesel peaking/emergency generator (existing)
- 560 kW solar photovoltaic (PV) generation.

The DER will be located at multiple facilities: The Town Hall/YMCA/Senior center complex, the hospital, and the Wastewater Treatment Plant.

All of the DER equipment will be contained within structures that are designed to be weather tight and resistant to rain, snow wind, ice etc. The majority of the microgrid area is not within a FEMA designated Flood Zone, the Wastewater Treatment Plant is located in a Zone X with 0.2% flooding risk per year. The installation of DER in this area will incorporate measures to reduce the potential damage due to flooding.

The energy storage system and natural gas fueled generators are capable of operation 24/7 when needed and are unaffected by weather conditions. The PV systems are by nature affected by overcast conditions which will reduce the output and by snow cover which can reduce or curtail the output. However the capacity of the microgrid to operate in island mode is not affected by reduced output of the PV. The only result would be increased fuel consumption by the generators for the duration of the reduced PV output.

The 1,300 kW and 400 kW natural gas fueled generators and the 400 kW biogas fueled generator are all capable of black start and can be used to restart the microgrid from a total power outage if required. The 2 MW battery-inverter system can also contribute to re-establishing power to the microgrid during a black start event.

Power for operation of the electrical switchgear and for operation of the control system will be provided by a 125 volt DC station service battery system, so all controls and switching functions will be operable in the event of a total electrical outage.

During normal utility operation, the system voltage and frequency are set by the interconnection with the utility. In the event a loss of voltage or an under-frequency condition is detected on any of the PSEG-LI primary feeders that comprise the microgrid distribution, isolation switches will open and those feeders will be connected to the DER.

The DER in normal grid paralleled operation will synchronize and follow the system frequency and voltage set by the grid. Each generator will operate in a fixed power factor mode as long as the utility grid is connected.

In a completely isolated island condition, the two natural gas generators will operate as base load generation in droop mode. The energy storage inverters will provide peaking power and will operate in isochronous mode. System voltage will be set by all generators providing VARS proportional to their power output, while minimizing circulating currents between generators. Control of voltage regulators in island mode will be by the microgrid controller.

The generator protection relays and 113.8 kV feeder breaker relays will have separate settings for island vs. grid paralleled operation to allow for low voltage low frequency ride through when islanded.

Grid paralleled interconnection will meet IEEE-1547 requirements as well as NPCC-A03 low frequency ride through standards. Unintentional islanding will be detected by the 81R function on the primary isolation switches, which will detect a high rate of frequency change and cause the isolation switch to open.

Task 2.4: Electrical and Thermal Infrastructure Characterization

The microgrid incorporates sections of existing PSEG-LI owned 13.8 kV primary overhead distribution feeders 6UL784 and 6UL4K2. Eight new, pole mounted relay-equipped reclosers will be installed to allow the microgrid portions of these distribution feeders be isolated from the remainder of the PSEG-LI system during emergencies.

A new dedicated underground feeder will connect the DER at the Wastewater Treatment Plant to the ring bus at the hospital. This will provide additional reliability and will also simplify the restoration process, by enabling synchronization of the DER to occur at the ring bus.

Each of the reclosers will be equipped with protective functions to detect under voltage and frequency, synchronism and directional overcurrent. Rate of frequency change will be monitored to identify unintentional islanding of a portion of PSEG-LI's system outside of the microgrid.

Upon detection of a loss of the grid source at each recloser, the recloser will automatically open and be held in the open position for a minimum of 5 minutes. Should the utility voltage and frequency return to normal and remains synchronism on both sides of the recloser it will be allowed to reclose once the 5 minute hold has expired.

If all of the reclosers open, the DER will be commanded to switch to island mode and will maintain the microgrid voltage and frequency independently. The reclosers will remain locked open until the utility source voltage and frequency returns and is stable for a minimum of 5 minutes, in compliance with IEEE-547 standards.

Resynchronization will occur as follows: The first feeder with the restored utility voltage will be used for synchronization. That feeder will be isolated from the ring bus (ref: Dwg. OL-2) the reclosers on that feeder will be released to close subject to the live line/dead bus supervision of the sync-check relay on the reclosers. The 400 kW CHP generator at the Town Hall/YMCA/Senior center will be taken off line momentarily. The microgrid will be brought into synchronism with the utility source at the ring bus.

Once synchronized, all of the DER will switch back to grid paralleled operation. The 400 kW CHP generator at the Town Hall/YMCA/Senior center will then synchronize with the microgrid/utility source and will be placed back on line.

The 125 psig steam thermal output from the fuel cell will be piped to the existing hospital’s steam system. The majority of this piping will be underground. The heat transfer equipment will be installed in a sheltered building adjacent to the fuel cell and will be designed to conform to NY state building codes to withstand extreme weather conditions.

The thermal outputs from the 400 kW CHP generator at the Town Hall/YMCA/Senior center will be low temperature hot water to the YMCA for pool heating and 50 psig steam to serve the town hall and senior center buildings. All of these connections will be made underground. The heat transfer equipment will be installed in a sheltered building adjacent to the CHP and will be designed to conform to NY state building codes to withstand extreme weather conditions.

If a failure of portions of the existing overhead primary electrical distribution, the microgrid will still be able to serve all of the critical facilities. The DER at the Town Hall/YMCA/Senior center will be able to supply power independently to those facilities, with some load reduction, if necessary

Task 2.5: Microgrid and Building Controls Characterization

See Appendix C, Control Architecture Diagrams CA-1 and CA-2 for a graphical representation of the control architecture. All microgrid controls will communicate over a dual redundant fiber optic network using SONET fiber communications protocols. The fiber network will be looped, and can operate with the complete loss of either loop and will automatically redirect network traffic in the event one or more cable sections are damaged.

SONET protocol allows both TDM and Ethernet communications over dedicated ePipes that establish low latency high speed communications for time critical operations and conventional packet switched Ethernet for non-time critical operations.

Protective relays and RTU’s will communicate using NERC-IP compliant IEEE-61850 messaging allowing GOOSE and other message formats in a secure environment.

All devices on the control network will have redundant power supplies, at least one of which is DC supplied from the dedicated station service batteries. AC control power via the AC station service system will be used for control power as a redundant source and to power instruments that to not have DC power capability.

Servers

Dual Industrial hardened servers will be installed for each major function. Dual servers will be used for the Microgrid Controller, Data Historian, Event Recorder and HMI servers.

The Data Historian servers will run industry standard PI software for archiving and data retrieval.

The HMI servers will provide operational data to 2 operator workstations, each capable of performing all control and monitoring functions. The HMI software will be industry standard Wonderware.

All devices will receive an IRIG-B time synchronization signal from a GPS clock, distributed over the fiber network and corrected for latency at the multiplexers.

Microgrid Controller

The microgrid controller will monitor and control all interconnection switching devices as well as all distributed energy resources.

During grid paralleled operation, it will provide commands to the energy storage system for charging and discharging as well as kW charging and discharging level and power factor commands. It will also start, stop and monitor the operation of the two 400 kW generators, the 1,000 kW generator and the 900 kW emergency generator. The microgrid controller will issue kW setpoint, voltage regulator mode, and power factor commands. The microgrid controller will monitor the energy storage battery capacity and determine the optimum recharge time and rate.

During Island mode, the microgrid controller will monitor the voltage and frequency of the microgrid and issue voltage commands to the generator voltage regulators as well as to the energy storage inverters to maintain bus voltage. It will also issue kW commands to the Fuel cell and the two 400 kW generators to control the base load power production, while maintaining desired headroom for peaking operation by the energy storage system and the 1,300 kW generator.

Load management

The microgrid controller will also provide the function of load management. All microgrid loads will be categorized into three tiers: Tier 1 is the most critical with must run loads that are not shed for any reason.

Tier 2consists of less critical loads that may be shed temporarily to balance the generation/load ratio of the microgrid while operating in island mode. This could be the result of a sudden unanticipated increase in power demand, or the loss of one or more DER assets.

Tier 3 loads are shed only in a major system emergency and only when necessary to maintain power to the Tier loads, and to prevent complete loss of power to the microgrid.

Under normal grid paralleled operation the load management system will continuously monitor the amount of power being imported from PSEG-LI and will have a load shedding solution ready for implementation should there be a loss of utility power.

In the event there is an unplanned complete loss of utility power, the load management system will immediately shed Tier 2 loads to reestablish the generation/load ratio based on what DER assets were currently on-line. As additional generation is brought on line, the previously shed loads will be restored.

During island mode operation, the load management system will continuously monitor the microgrid load vs. online generating capacity, and will imitate starting of additional generation as necessary to maintain the required spinning reserve margin.

Data Historian

The data historian receives all operational parameters from the DER and switching equipment throughout the microgrid, all voltages, currents power flows, generator and inverter outputs etc. will be recorded on a continuous basis at 1 minute intervals.

The data historian also provides input to the economic dispatch controller for predicting the future demand profile. A report module within the PI software allows fully customizable reports of energy produced and consumed, generator run hours, fuel use emissions data, battery cycles and depth of charge etc...

Event recorder

The event recorder will provide a continuous time-synchronized electronic record of all normal and alarm events within the microgrid. This includes the opening and closing of primary and secondary isolation switches, breaker tripping and closing, time of pick-up and drop out of protective relay functions, DER equipment alarms, telecommunication alarms etc.

Task 2.6: Information Technology (IT)/Telecommunications Infrastructure Characterization

2.6.1: Network and Communications

The following equipment forms the data network and communications backbone for the microgrid, integrating the protection, control and data collection functions into a secure and reliable system with integral redundancy and dedicated high speed communications paths for critical control functions:

A. **Multiplexers –** SEL-ICON, dual protected line modules, dual Ethernet modules (8 LAN points ea.), (1) 125 VDC power supply, (1) 120 VAC power supply

B. **Time Synchronization –** SEL-2047, IRIG-B output, 125 VDC, remote antenna.

C. **RTU –** for non-relay switchgear and load management I/O: SEL-2240 Axion RTAC, 10 or 4 module, as needed, 125 VDC/120VAC power input.

2.6.2: Microgrid Utility Communication

The primary telecommunications media for the microgrid control system will be the redundant, self-healing looped fiber optic network, running SONET protocol. Dedicated pathways will allow both TDM (high speed communications between time critical devices) and conventional packet switched Ethernet.

The communications backbone will only communicate with the outside world through a dedicated gateway that employs user authentication via Radius Server. There will be no open connection to the internet, and no use of common carrier fiber.

Communications with the utility (PSEG-LI) will be via this gateway. PSEG-LI will have full monitoring privileges as well as control functions that will be determined by a future operating agreement.

Outside vendor connect 301 ions via the Web will not be allowed, but limited vendor access will be given to specific equipment through the secure gateway for remote troubleshooting and diagnosis. All communications through the gateway will be logged.

3.0 Commercial Feasibility Summary

3.1: Commercial Viability – Customers

This section describes the commercial terms/relationship between participants in the microgrid project, products expected to be produced by the microgrid and arrangements for sharing of benefits by addressing the required items.

3.1.1: Individuals Affected

Identify the number of individuals affected by/associated with critical loads should these loads go unserved (e.g. in a storm event with no microgrid).

This project will affect the following facilities:

- Huntington Town Hall Building
- Huntington Hospital
- Huntington Wastewater Treatment Plant
- Heckscher Park Museum and Cottage
- Huntington YMCA
- Flanagan Senior Center

The Town of Huntington provides emergency management services to approximately 210,000 residents. The Hospital provides services to the Town of Huntington and surrounding areas; a population of approximately 300,000. The Wastewater Treatment Plant serves approximately 15% of the Town's population, including residential customers and the entire commercial customer base in Huntington Village and part of the commercial areas of Huntington Station. By ensuring reliability during a storm event the microgrid will help attract, retain, and encourage growth in the Town of Huntington and ensure the safety of the residents and those of surrounding areas.

3.1.2: Direct Services

Identify any direct/paid services generated by microgrid operation, such as ancillary services, or indirect benefits, such as improved operation, to the utility or NYISO? If yes, what are they?

The microgrid will provide direct services to the customers and the utility in the form of reducing the utilities transmission and distribution system requirements, reducing the demand on bulk energy suppliers and by providing Frequency regulation and Volt/VAR support at the distribution level. The customers will also see a net reduction in utility costs via the distributed generation assets.

In the event that the PSEG-LI transmission and distribution systems feeding the microgrid experience instability or outage, the microgrid system will provide reliable energy to both critical and non-critical customers. The microgrid's generation assets will be net metered and will not export energy to NYISO markets.

3.1.3: Customers

Identify each of the microgrid's customers expected to purchase services from the microgrid.

It is anticipated that all electric customers within the microgrid will purchase power through PSEG-LI regardless of whether the microgrid is operating in island mode or in grid parallel mode with the PSEG-LI distribution system. Under grid paralleled operation, the microgrid will generate the majority of the energy consumed by the critical facilities owned by the Town of Huntington, Huntington Hospital, and the Huntington YMCA.

The DER assets will be metered, and the energy produced will be shared with the critical facilities via net metering in the ideal case. The remaining non-critical customers within the electrical footprint of the microgrid, will continue to purchase power from PSEG-LI under their current rate structure. The microgrid will not sell power to any PSEG-LI customers directly.

In the event of instability or outage of the PSEG-LI transmission and distribution system, the microgrid will automatically sectionalize, and additional DER assets will be brought on line to support all customers that will be receiving power from the microgrid. The critical facilities will continue to be net metered as previously described. Excess power produced in support of non-critical residential and customer load will be purchased by PSEG-LI. The non-critical residential and commercial customers receiving power while the microgrid is islanded will be billed by PSEG-LI for that power under their existing rate structure.

3.1.4: Other Stakeholders

Identify other microgrid stakeholders; what customers will be indirectly affected (positively or negatively) by the microgrid.

The overall impact to stakeholders is anticipated to be positive. Due to the fuel cell, CHP and solar components, there will be a net reduction in emissions benefitting not only the microgrid area but also all of the surrounding areas. The CHP systems will displace the use and emissions associated with boiler operation and flaring of digester gas, a significant source of GHG pollution within the Town of Huntington.

The community facilities and residences that are included in the microgrid will have access to reliable power during emergencies. This will increase community safety and resiliency as well as fostering economic activity while building community pride as a forward looking and even more desirable place to live.

3.1.5: Owner – Purchase Relationship

Describe the relationship between the microgrid owner and the purchaser of the power.

The microgrid distribution infrastructure will remain under the ownership and operation of PSEG-LI. The microgrid generation assets will be owned and operated under one of two scenarios. Under the first scenario and most likely scenario, all of the generation assets will be owned by a third party as a Microgrid LLC in a for profit scenario. In this scenario, the Microgrid LLC will be investor owned and sign power purchase agreements with the facilities included in the microgrid. Power will be sold to facilities at a reduced rate providing a reduction in operating expenses. The microgrid will have the capacity to fully meet the energy needs of the microgrid participants in terms of electric energy. In addition to the thermal offset at the hospital, the microgrid will significantly reduce the current thermal capacity provided by facility boilers at the Wastewater Treatment Plant, Town Hall, and YMCA via CHP using gas fired reciprocating engine technology, thus providing savings on the electric side and thermal side as well. Under the second scenario, the generation assets will be owned by the Town of Huntington and FuelCell Energy, Inc, the manufacturers and owners of the molten carbonate fuel cell CHP plant located on the hospital grounds that will provide base loaded power and thermal energy to offset the hospital's natural gas consumption. Under this scenario, the Town of Huntington contemplates owning the generating assets located on Town property, but will evaluate the feasibility of contracting generation asset ownership and operation to a third party energy provider.

3.1.6: Operation Type

Indicate which party/customers will purchase electricity during normal operation. During islanded operation? If these entities are different, describe why.

During normal operation in gird paralleled mode, the distribution will operate within the PSEG-LI system as it does currently. The Huntington Hospital, Wastewater Treatment Plant, and Town Hall will operate with the majority of power provided by the fuel cell, CHP, and solar generation assets.

During island mode the microgrid will provide power to all microgrid participants via the utility owned distribution infrastructure.

3.1.7: Contracts

What are the planned or executed contractual agreements with critical and non-critical load purchasers?

Under the likely third party ownership model, the microgrid will operate with power purchase agreements signed between the microgrid participants and the Microgrid LLC. The nature and capacity of generation assets will remain unchanged under this scenario and the microgrid will be able to provide sufficient power to all participants without the need for implementing load shedding strategies. The utility will be responsible for the maintenance of the distribution assets. There will be no new contractual arrangement with the non-critical residential and commercial customers that are within the boundaries of the microgrid. However, the microgrid will provide sufficient power to keep all facilities, critical and non-critical, in operation

Under scenario two, the Town of Huntington will purchase the generation assets to be deployed within the microgrid other than and the hospital, and the Hospital will sign a power purchase agreement with FuelCell Energy, Inc., for the 2.8 MW fuel cell. Each generation asset owner will be responsible for accounting, and managing service agreements for generation assets.

3.1.7: Solicitation of Customers

How does the applicant plan to solicit and register customers (i.e. purchasers of electricity) to be part of their project?

Aside from the customers already included in the microgrid, additional individual residences and businesses will not be directly solicited and registered as customers, their relationship will continue to be with their current energy provider.

3.1.8: Energy Commodities

Are there any other energy commodities (such as steam, hot water, chilled water) that the microgrid will provide to customers?

The microgrid will provide thermal energy in the form of steam to the Huntington Hospital via the fuel cell heat recovery. The microgrid will also provide thermal energy to the Wastewater Treatment Plant for heating the sludge and space heating through the use of a 400 kW reciprocating engine CHP. The Town Hall will receive 50 psig steam which will be connected to the Town Hall CHP system. Heat from this systems' intercoolers will be recovered and will provide heat to the swimming pool water at the YMCA.

3.2: Commercial Viability - Value Proposition

This section describes the value the microgrid is expected to provide directly to its participants, to the community at large, the local electric distribution utility, and the state of New York by the following sections.

3.2.1: Benefits and Costs

What benefits and costs will the community realize by the construction and operation of this project?

The major benefits to the Town of Huntington will be the increased reliability of its energy infrastructure system. The Town of Huntington faced widespread outages during Hurricane Sandy and Town Hall was without power for over ten (10) days. Town officials were unable to coordinate cleanup efforts effectively with utility companies, which delayed the utilities' efforts to restore full service. Huntington Hospital which suffers from low power quality events approximately ten (10) times per year will see additional benefits from power quality improvements stemming from the battery storage component of the microgrid.

The Wastewater Treatment Plant is the oldest on Long Island and is approaching its rated capacity. As such the digester will need to be expanded along with the thermal infrastructure used to maintain its temperature. The proposed CHP will allow the Wastewater Treatment Plant to expand its operation as well as take advantage of the biogas that is currently being flared.

The museum currently does not have backup power and needs to keep the artwork at constant temperature and humidity. As such valuable pieces and in particular those on loan from other museums must be transported out of the museum during outage events. The microgrid will allow the museum to keep valuable pieces in situ. This additional level of security and protection will allow the museum greater access to works on loan from other museums and private collections, providing additional cultural benefits to residents in Huntington and well beyond who are Heckscher patrons.

The microgrid will also enable community centers such as the Huntington YMCA and the Flanagan Senior Center to continue providing services during an outage. During the last outage the YMCA received a loan of a generator and remained open to offer services as a warming center to the community.

The microgrid will also provide an economic benefit to the area in terms of supplying the town, hospital, and YMCA with reduced energy costs.

3.2.2: Impact to Utility

How would installing this microgrid benefit the utility? (E.g. reduce congestion or defer upgrades)? What costs would the utility incur as a result of this project?

PSEG-LI and National Grid, the electric and natural gas utilities, respectively, will both benefit from the implementation of the microgrid:

PSEG-LI will benefit from the microgrid in three (3) ways:

1. The microgrid will provide emergency electricity to PSEG-LI customers,
2. It can provide ancillary services that will benefit the distribution system and
3. It will reduce the peak demand of the Town of Huntington by approximately 3.7 MW

National Grid will also receive an economic benefit through an increase in the sale of natural gas. As the natural gas generation assets are base loaded and will consume consistent quantities of natural gas, long term forecasting of delivery will be assured.

3.2.3: Proposed Business Model

Describe the proposed business model for this project. Include an analysis of strengths, weaknesses, opportunities and threats (SWOT) for the proposed business model.

In both ownership scenarios, all microgrid participants, including the town will continue to be retail customers of PSEG-LI. Power generated by the microgrid generation assets will flow into the microgrid and be metered at the source. A net metering agreement will be negotiated with PSEG-LI to include the Town facilities as well as the Hospital. Each facility will benefit proportionally from the quantity of power consumed from the DER. During normal operation mode, the microgrid does not produce more power than the microgrid consumes on a net basis, thereby making net metering of the microgrid viable. The Fuel Cell at the Hospital and CHP at Town Hall will produce more energy than the end user requires during off peak periods. Currently this means that the fuel cell and reciprocating engine plants would be subject to wholesale rates, which would lower the financial performance of the microgrid. In order for community microgrids to be able to share generation resources effectively, generation assets and critical facilities within the microgrid would need to be net metered. Alternatively, as a result of the direct benefits the microgrid will provide PSEG-LI, a higher feed in tariff than the avoided costs could be negotiated with PSEG-LI to increase the revenue stream of the microgrid in the absence of more comprehensive regulatory changes.

The microgrid participants without installed assets will benefit from emergency electricity services but will not be a direct customer of the microgrid. Instead, PSEG-LI will supply the participants through the net metered power generation assets of the microgrid. The facilities that have installed DER assets will simply pay less for purchased electricity during normal operations based on fuel and operational costs if the assets are owned directly by the Town, or through their respective power purchase agreements with the Microgrid LLC. The revenue streams or savings, will go directly to the Town and FuelCell Energy, Inc. under direct ownership scenario two. In scenario one, the Microgrid LLC will split the revenue stream with the microgrid participants through selling discounted power to the microgrid participants under the terms of the power purchase agreements. The microgrid is financially feasible under both scenarios (with and without net metering), and is discussed in detail in section 3.5 of this report.

The internal and external factors that will play a role in this model are summarized in the table below.

Table 4: SWOT Analysis

Strengths	Weaknesses	Opportunities	Threats
Faces less utility resistance as Utility Distribution Microgrid and is more likely to be viewed as an extension of macrogrid assets.	The regulations are currently not in place that would allow for the net metering of the microgrid.	Can be used by PSEG-LI as a testing ground for grid modernizing technologies.	Lack of policy and regulations.
Provides tailored energy solutions to microgrid participants and increases resiliency.	Relies heavily on utility cooperation.	Provide grid stabilization as a microgrid instead of the destabilizing forces of independent DER's such as wind and solar.	Anti-microgrid utility sentiments.

3.2.4: Unique Project Features

Are there any characteristics of the site or technology (including, but not limited to, generation, storage, controls, information technology (IT), automated metering infrastructure (AMI), other, that make this project unique?

The site is uniquely well positioned to host combined heat and power systems. The Wastewater Treatment Plant has a year round need for thermal energy due to the heat required to maintain the digester sludge. Additionally, Huntington Hospital and the YMCA have year round heat loads due to domestic hot water needs and maintaining indoor pool temperatures.

The microgrid is heavily leveraging existing power distribution architecture enabling it to support the community at relatively low incremental cost. Approximately $1.6 million is associated with upgrades and new infrastructure for distribution and control systems.

3.2.5: Replicable

What makes this project replicable? Scalable?

The Town of Huntington Community Microgrid can be considered a model for future community microgrids by providing DER and innovative solutions to transmission and distribution load relief. The Huntington Community Microgrid is close to highly constrained targeted load areas, where providing peak load reduction will have positive impacts extending from the distribution networks to transmission networks. The Town's suburban location offers significantly lower barriers to entry than inner city microgrid projects as it is not subject to the same space and permitting constraints that limit the types and capacities of DERs. The Town of Huntington Community Microgrid also represents a highly viable cross-section of critical facilities that are indispensable to most communities such as local government, emergency medical care, emergency management, and wastewater treatment. In addition, the structure of the microgrid allows for expansion should this be considered since the distribution network is in place. Conversely, some assets may be taken offline should another, more financially attractive technology arise or should a facility be deemed undesirable and demolished. Although the latter case is unlikely for Huntington, it is something to consider for future microgrid development.

3.2.6: Project Motivation

What is the purpose and need for this project? Why is reliability/resiliency particularly important for this location? What types of disruptive phenomenon (weather, other) will the microgrid be designed for? Describe how the microgrid can remain resilient to disruption caused by such phenomenon and for what duration of time.

The Town of Huntington has historically been a leader on Long Island in the areas of technological advancement and sustainability. The Huntington Wastewater Treatment Plant, celebrating its centennial, was the first of its kind to be constructed on Long Island in 1916. The Town has proactively upgraded the plant over the years to meet federal Clean Water standards, including the installation of a modern denitrification system in 2008, six years ahead of federal EPA mandates. Huntington is also currently the only Town on Long Island that operates a public mass transit system (HART Bus) that provides fixed-route bus service in addition to paratransit service for elderly and disabled residents. Huntington was also the first town on Long Island to employ a LEED certified professional engineer as its Chief Sustainability Officer, who has guided the Town through a series of sustainability and energy efficiency improvement projects to Town owned facilities and buildings since 2009.

The Town of Huntington currently operates an Emergency Operations Center to maintain Town functions during emergencies such as hurricanes and blizzards with skeleton crews. However, Town Hall is equipped with limited backup generation allocated mainly to critical computer systems. During Hurricane Sandy, the Town struggled to coordinate with the local utilities on tree removal and downed lines and its ability to communicate with local residents was restricted. This lack of ability to coordinate with multiple entities due to power loss kept the Town at limited capacity to deal with the emergency for over 10 days. The Hurricane Sandy scenario poses an unacceptable level of risk to the Town and its residents going forward.

Figure 14: Town of Huntington Emergency Operation Center

The Hospital currently serves the entire population of The Town of Huntington plus surrounding communities with an estimated catchment area population of 310,000. While the hospital does currently have backup generation it is entirely diesel and only has approximately two days of backup.

Furthermore, it is only enough to support 60% of hospital operations with emergency and planned procedures requiring case by case evaluation by hospital staff. The microgrid can operate and support the hospital and community loads indefinitely as long as natural gas is not interrupted.

3.2.7: Value Proposition

Describe the project's overall value proposition to each of its identified customers and stakeholders, including, but not limited, the electricity purchaser, the community, the utility, the suppliers and partners, and NY State.

Electricity purchaser – The primary electricity purchasers will be the Town of Huntington and Huntington Hospital, who will have stable, competitive energy rates and reliable power and thermal energy to power their respective buildings throughout the year due to their sited distributed energy resources.

Community – The community will have electricity available during an emergency, indefinitely if natural gas is uninterrupted. This will include a substantial number of residential customers, the YMCA and Heckscher Park Museum. The community will experience a significant reduction in greenhouse gas emissions and the additional system resiliency. These benefits will occur without the need for any associated utility rate increases.

Utility – The benefits to the utility include peak load support and will lead to deferred investments on distribution infrastructure on the part of the utility. There are also intangible benefits to the utility such as an increase in efficiency when dealing with emergency situations. Microgrid deployment across a utilities service area would in many ways allow for automation of distribution and fault recognition.

NY State – New York State will have a microgrid project fully capable of reliable island, black-start capabilities that supports both a community and economic development. The scale of the microgrid is around 6.9 MW and is at a scale that can have impact on the regional energy.

3.2.8: Financial Impact to Purchaser

What added revenue streams, savings, and/or costs will this microgrid create for the purchaser of its power?

The microgrid will create revenue streams for the Town of Huntington in the solar projects, as well as the two CHP projects resulting from electricity savings as well as natural gas savings. The Huntington Hospital will also see a revenue stream due to the reduction in electric and natural gas costs through the fuel cell. The revenue streams to the Town will depend on the ownership model that is eventually adopted for the microgrid. If the Town chooses to directly purchase the generation assets, it will see a slightly higher return on investment as directly financing the generation assets through bonds will be less costly than financing through power purchase agreements with the Microgrid LLC. On the other hand direct ownership of the assets results in increased risk resulting; thus, a scenario where a third party owns all microgrid assets also will be explored.

3.2.9: State Objectives

How does the proposed project promote state policy objectives (e.g. NY REV, RPS)?

This project supports REV by demonstrating distributed energy resources that can reduce capacity requirements and system upgrades to transmission systems. The microgrid includes renewable energy resources as well such as solar, fuel cells, as well as biogas combined heat and power that, in combination, enhances resiliency for microgrid participants and the community. The proposed project also provides a net decrease in emissions due to the renewable energy resources as well as combined heat and power capacity. The Town of Huntington's proposition that it is critical that PSEG-LI/LIPA recognize microgrid assets as being eligible for net metering, authorization that would put the local utility and LIPA in sync with REV objectives by increasing commercial viability of similar projects. This change will lead to increased economic opportunities for various municipalities, investors, and technology manufacturers as well as increased job creation. There will also be additional economic benefits from the avoided costs of increased grid resiliency to local business.

3.2.10: New Technology

How would this project promote new technology (including, but not limited to, generation, storage, controls, IT, AMI, other)? What are they?

The microgrid will act as a testbed where new and emerging technologies can be demonstrated and validated. Individual monitoring of the fuel cell, reciprocating engines, thermal offset technologies, PV, flywheel and battery storage using state-of-the-art controls technologies will occur in real-time. The data generated from the microgrid can be analyzed to determine the best operating parameters for a system of this type and can be used in future microgrid development projects, thus reducing the first cost of discovery.

3.3: Commercial Viability - Project Team

The Contractor shall address no less than each of the following items below in describing the structure of the project team and the roles, strengths and resources of its members and other necessary partners.

3.3.1: Local Partners

Describe the current status and approach to securing support from local partners such as municipal government? Community groups? Residents?

For phase 1 the project team included TRC, the Town of Huntington, Huntington Hospital, the Huntington YMCA, PSEG-LI, National Grid and FuelCell Energy, Inc. In phase 2, the project will look to securing support from community groups, including the Huntington Chamber of Commerce, the Huntington and Huntington Station Business Improvement Districts, sustainability advocacy groups, other stakeholders and homeowners. . The local government has already evidenced its support through its role as the lead applicant for this project.

3.3.2: Team Members

What role will each team member (including, but not limited to, applicant, microgrid owner, contractors, suppliers, partners) play in the development of the project? Construction? Operation?

Table 5: Project Team

Huntington Community Microgrid Project Team		
Organization	**Role Type**	**Role Description**
TRC	Subcontractor	Consulting Engineers: feasibility study.
Town of Huntington	Applicant	Primary microgrid customer, partner and/or potential partial microgrid owner, DER site owner
Huntington Hospital	Microgrid customer.	Microgrid customer, partner and/or potential partial microgrid owner, DER site owner
YMCA	Microgrid customer	Microgrid Electric and Thermal customer.
PSEG-LI	Microgrid supplier/customer, potential partner	Owner of distribution systems that will feed power and natural gas to/from microgrid, customer of microgrid during an emergency
National Grid	Microgrid supplier.	Owner of natural gas distribution.
FuelCell Energy, Inc.	Owner of Fuel Cell	Provide the fuel cell and Electric to Huntington Hospital under a Power Purchase Agreement.

3.3.3: Public/ Private Partnerships

Are public/private partnerships used in this project? If yes, describe this relationship and why it will benefit the project.

The microgrid will involve public/private collaboration and agreements but not a formal legal business partnership. This will ensure the project is mutually beneficial while maintaining appropriate business separation to avoid conflicts of interest.

3.3.4: Applicant Financial Strength

Describe the financial strength of the applicant. If the applicant is not the eventual owner or project lead, describe the financial strength of those entities.

The Town of Huntington has achieved the highest bond rating of AAA from all three rating agencies, Standard & Poor's, Fitch Rating Agency and Moody's Investor's Service from 2010 to 2015, placing Huntington among the best fiscally managed Towns in New York State. For the latest bond issue dated December 8, 2015, all three rating agencies confirmed the Town's AAA rating. These ratings have been upheld for all previously issued bonds as well. This achievement reflects the Town's consistently solid financial position and a low debt with manageable additional capital needs.

The Town is governed by financial policies pursuant to laws of the State of New York. In addition, the Town has adopted and adheres to a set of Financial Management Policies that includes the following policies: Debt Management Policy, Fund Balance Policy, Budget Policy, Investment Policy, Cash Collection Policy, Purchasing Policy, Credit Card/Debit Card Policy, Capital Asset Policy and a Cash, Payments & Deposits Policy. All policies are designed to strengthen internal controls.

3.3.5: Qualifications

For identified project team members, including, but not limited to, applicant, microgrid owner, contractors, suppliers, partners, what are their qualifications and performance records?

About TRC

TRC provides comprehensive services to the energy industry from generation to consumption including: energy generation, power transmission & distribution, energy efficiency, demand response, end-use energy management, renewable energy, and environmental protection. TRC has participated in three NY Prize Microgrid Feasibility Assessments: Endicott Community Microgrid, Brownsville-Van Dyke Community Microgrid, and Town of Huntington Microgrid and acts as the technical advisor to the State of Connecticut Microgrid Pilot Program.

- Incorporated in 1969
- 3,000 employees in 110+ U.S. offices
- Ranked 32nd in ENR's Top 500 Design Firms (2013)
- $434 Million annual revenue
- Proven track record resulting in a repeat business ratio of greater than 80%
- Award-winning Corporate Safety Program

TRC has deep project execution qualifications in the multi-disciplinary fields required to develop a successful micro-grid project. This section highlights specific projects that TRC has executed which highlight expertise in: microgrid development and community planning, power delivery engineering, distributed energy resources, and community engagement.

State of Connecticut Microgrid Pilot Program

TRC is a technical advisor to the Connecticut Department of Energy and Environmental Protection (DEEP), Connecticut Light & Power (CLP), and United Illuminating (UI) for the State of Connecticut Microgrid Pilot Program. The program awarded $24M in 11 microgrid projects through March 2015. The program is currently preparing to commence a third round of awards.

TRC helped establish the project feasibility application process and has supported the evaluation of project plans based on criteria including safety, technical feasibility, societal benefits, economic benefits, financial considerations, configuration of power distribution to customers, and project costs. TRC works closely with DEEP and the Connecticut utilities to select technically viable and economically justifiable microgrid projects for which funding is awarded by DEEP. Successful projects will leverage clean and green energy sources to maintain critical services for cities and towns across the state. Leveraging and developing its microgrid expertise, TRC has:

- Developed the program's technical standards
- Established project evaluation and scoring methods
- Supported the evaluation process
- Presented at educational seminars and webinars

Examples of projects that have received funding from the Connecticut microgrid program: Campus Microgrid Pilot, Wesleyan University, Campus Microgrid Pilot, University of Hartford, Campus Microgrid Pilot, Bridgeport University, Municipal Microgrid Pilot, Hartford Park Street, Municipal Microgrid Pilot, and Town of Woodbridge.

3.3.5: Contractors and Suppliers

Are the contractors and suppliers identified? If yes, who are they, what services will each provide and what is the relationship to the applicant? If no, what types of team members will be required and what is the proposed approach to selecting and contracting?

Contractors are identified in the Table above. The remaining technology suppliers are intentionally not identified or when identified are identified as potential suppliers. The reason is to ensure that the project can select technology solutions that most competitively meet the requirements and needs of the project. Relationships with suppliers will be developed in the design phase as appropriate.

3.3.6: Financers and Investors

Are the project financiers or investors identified? If yes, who are they and what is their relationship to the applicant? If no, what is the proposed approach to securing proposed financing? Will other members of the project team contribute any financial resources?

At this phase of the project the overall project has been assessed for financial feasibility to ensure that the project can be of interest to financers and investors. While initial financers and investors are being considered, none have been formally selected.

3.3.7: Legal and Regulatory Advisors

Are there legal and regulatory advisors on the team? If yes, please identify them and describe their qualifications. If no, what is the proposed approach to enlisting support in this subject area?

Yes, there are legal and regulatory advisors on the team and additional staff available with expertise as the project moves forward.

Shirley Anderson, TRC: Ms. Anderson has a Certificate in Regulatory Economics from the State University of NY at Albany. Ms. Anderson has 39 years of experience in the energy industry. Her background includes extensive program oversight; implementation and coordination experience for utility directed energy efficiency and demand side management programs; as well as deployment activities regarding NYSERDA sponsored programs targeting multifamily buildings and residential energy users. Ms.

Anderson has developed effective negotiation, coordination and collaboration skills in her 30 years of progressively responsible Staff work at the NYS PSC. Commission. She has provided expert testimony, testifying as an expert witness before the NYS Public Service Commission in 10 utility rates cases and generic policy cases. She also testified as an expert witness in a proceeding before the Missouri Public Service Commission. Ms. Anderson was part of a panel that presented testimony to the Department of Energy in Washington, DC. Ms. Anderson testified before the New York City Council in favor of allowing electrical sub metering in multifamily buildings to become eligible for J-51 tax credits.

Elizabeth Weatherby: Ms. Weatherby is an environmental scientist with professional experience in environmental assessment and permitting coordination for power generation, electric transmission and infrastructure projects supporting a variety of clients in the power generation and transmission industry. Proven experience in environmental assessment and permitting services for power generation, electric transmission and renewable energy projects across many states, including New York, New Jersey, Pennsylvania and Connecticut.

The Town will also rely on Beveridge & Diamond, P.C. (B&D) for legal services and advice with respect to the proposed microgrid project moving into stages two and three of competition. B&D has extensive experience in the field of energy project development, including siting, local, state, and federal permitting and certification, contracting, and operational compliance. B&D has also worked with utilities and related service providers on interconnection and power purchase agreements. Their work in this field encompasses alternative energy projects such as solar cell production, waste-to-energy facilities, cogeneration units, as well as issues involving biofuels, biosolids and carbon sequestration. The Firm's experience is drawn from its core practice areas in environmental law, encompassing regulatory compliance, project development, real estate and land use, corporate and deal transactions, and advocacy before local, state and federal agencies. The Firm also has experience advising clients on a range of renewable energy regulatory and incentive programs across the United States, including renewable portfolio standards (RPS), net metering, and various tax incentive programs, and handling development agreements and related contracts for renewable energy development (*e.g.*, renewable energy credit offtake agreements), and carbon offset projects.

B&D's experience extends to the regulatory regime imposed on projects in New York State, including representing independent power producers and project developers before the U.S Environmental Protection Agency, New York State Board on Electric Generation Siting and the Environment, NYS Public Service Commission, NYS Department of Environmental Conservation, and other federal, state and local agencies. Notable Long Island projects where B&D served as legal counsel include (i) the Caithness Long Island Energy Center – a 350 MW natural gas-fired generation facility plant and the first baseload power plant to be developed on Long Island in generations; and (ii) the Stony Brook Cogeneration Facility.

The following will be part of the B&D team supporting the Town's efforts on this project:

Michael Murphy: Michael Murphy's practice is primarily concentrated on energy, land use, regulatory permitting, environmental compliance, contract disputes and litigation matters. Mr. Murphy has represented private clients in a variety of regulatory matters, including permit applications to federal, state, and local agencies, review under New York's State Environmental Quality Review Act (SEQRA), contaminated site remediation programs in New York and New Jersey, administrative enforcement actions and other compliance matters. He also represents private clients in major power plant project proposals. His litigation experience on behalf of private clients includes contract disputes, Superfund, SEQRA, and common law claims based on negligence, trespass, nuisance, fraud, and misrepresentation.

Mr. Murphy has also represented municipal clients on a variety of matters such as governmental remediation cost reimbursement applications, solid waste disposal programs, contract negotiations and interpretation (including long-term solid waste management and disposal agreements, inter-municipal solid waste agreements and municipal property lease agreements) and litigation matters concerning real estate, contract and takings disputes.
In addition to traditional power plant projects, Mr. Murphy's experience, on behalf of private or municipal clients, has involved waste-to-energy and waste gasification-to-energy projects.
Mr. Murphy has been selected by his peers for inclusion in the 2011-2015 editions of *Super Lawyers.* He is also recognized by *Chambers USA* as a leading practitioner in environmental law.

John H. Paul: John H. Paul's practice focuses on environmental and energy law, and environmental quality review of project proposals. His environmental practice focuses on regulatory compliance, permitting, and administrative law, as well as counseling clients on energy, takings, environmental quality review, and land use matters. John has helped obtain, modify and renew permits under state and local programs governing energy facility siting, air, stormwater, solid waste, and wetlands development. John's compliance counseling addresses the handling, transport, and disposal of hazardous materials, as well as compliance with air, water, and solid waste permits. He has advised a wide range of clients on site contamination, remediation, and brownfields development matters. He also drafts and negotiates a wide range of contracts related to asset and property acquisitions, environmental services, construction, and cleanup cost allocation matters. His litigation experience includes representing private, municipal, and corporate clients in regulatory enforcement proceedings, claims under state and federal environmental statutes, commercial disputes, and state statutory and common law. His litigation experience also addresses groundwater contamination and associated claims of property damage and lost profits on property development. John is experienced in hazardous waste cost-recovery and contribution actions and with litigation under New York's Oil Spill and Environmental Quality Review Acts, including litigation concerning land use approvals.

Brook Detterman: Brook Detterman's practice encompasses both traditional environmental matters and emerging issues in the areas of energy and climate change. Brook's experience includes complex environmental litigation, transactional due diligence, and regulatory counseling, with a focus on the Clean Air Act, the Clean Water Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and other state and federal environmental laws.
Brook's regulatory experience includes:

- Helping clients understand and manage renewable energy policies, carbon emissions requirements, domestic and international carbon offset markets, and the emerging regulatory landscape surrounding natural gas extraction and hydraulic fracturing.
- Developing regulatory guidance and strategy for over 30 energy companies on a wide range of environmental issues.
- Advised a midsized western refining company on consent decree compliance, filed motions to protect force majeure claims, and negotiated related consent decree modifications with EPA.

Brook's litigation experience includes:

- Obtaining partial summary judgment for a major utility in Clean Air Act litigation involving thousands of claims, and obtaining favorable settlement with a citizens group.
- Managing discovery, litigation strategy, and joint defense activities for multiple clients in a complex New Jersey Spill Act case involving over three hundred parties and multiyear trial proceedings.
- Serving as primary counsel in Third Circuit appeal of EPA regulatory action directed at electric generating facility.

Brook's transactional experience includes:

- Conducting transactional due diligence and developing risk mitigation strategies for transactions in the mining, energy, transportation, and manufacturing sectors.
- Structured and drafted contracts for the sale, purchase, and brokerage of carbon offset credits.
- Supported multiple carbon offset and renewable energy transactions, including hydroelectric projects under the Clean Development Mechanism, domestic landfill gas-to-energy development, and a novel trans-border carbon offset generation project involving CFC destruction.

Assisting a major international oil company with investments in offshore U.S. oil and gas operations and addressed NEPA issues related to construction of two LNG terminals.

3.4: Commercial Viability - Creating and Delivering Value

The Contractor shall describe the mechanics of ensuring that expected value is delivered to project participants, by addressing no less than the following items below:

3.4.1: Technology Selection

How were the specific microgrid technologies chosen? Specifically discuss benefits and challenges of employing these technologies.

The technologies chosen for the microgrid were selected based on their efficiency, environmental impact and operational characteristics. A fuel cell is an economical and environmentally friendly way to produce base load power especially in a CHP application. The fuel cell was chosen as the primary base load power producer for the microgrid, and located at the hospital where the thermal output can be effectively utilized throughout the year. A digester gas fueled CHP unit will be sited at the Water Treatment Plant to use the available biogas from the digester, and produce low cost power for the microgrid. The thermal output will be used for digester sludge heating and for space heating.

A small gas fueled CHP system will provide lower cost power at the town hall area and will provide heating for the town hall and senior center buildings as well as providing heating for the swimming pools at the adjacent YMCA

Peaking power will be provided primarily by a battery/inverter energy storage system. This was chosen because it does not consume any additional fuel and has no emissions. It also offers operational benefits in frequency regulation and volt/VAR support. Additional peaking capacity for islanded operation will be obtained from a gas fueled generator at the Waste Water Treatment Plant. This is the most economical, while environmentally friendly method of producing power on demand when islanded.

3.4.2: Existing Assets

What assets does the applicant and/or microgrid owner already own that can be leveraged to complete this project?

The microgrid will be designed to incorporate the power output of one existing 900 kW diesel generator at the Waste Water Treatment Plant, to be used as a reserve source of power for the microgrid in island mode only should there be a failure of other microgrid DER assets.

3.4.3: Balance of Generation and Load

How do the design, technology choice, and/or contracts ensure that the system balances generation and load?

The design of the microgrid incorporates base load generation, peaking generation and energy storage to allow the generation to balance at all times with the variable load. Spinning reserve will be provided by the energy storage system to regulate frequency and voltage under rapidly changing conditions.

3.4.4: Permitting

What permits and/or special permissions will be required to construct this project? Are they unique or would they be required of any microgrid? Why?

The base project does not require unique permitting as opposed to the permitting that would be required of its parts: CHP, solar PV, battery, and substation upgrades. PSEG-LI will need to give permission and partner on any upgrades to its distribution systems.

Net metering within a microgrid is not specifically addressed under existing tariffs, which will require accommodation; however this is a common need arising from development of microgrids, especially community microgrids, therefore it is expected that LIPA will revise tariffs necessary to accommodate this transaction.

Considerations for the PV Project

Two types of solar PV system have been assessed for feasibility: roof mounted, ground mounted – carport.

In general, ground mounted solar systems require excavation and concrete foundations, which will increase installation time and cost, as well require different precautions to protect the system from damage and trespassing. The ground mount system will also require an interconnection agreement with the electric distribution/transmission system and any associated easement agreements.

3.4.5: Developing, Constructing, and Operating

What is the proposed approach for developing, constructing and operating the project?

The Town of Huntington is the applicant and project developer at this stage in the process. The project developer role may shift as the project matures as appropriate to the project and means of securing financing. The project will develop where one entity is responsible for development, construction, and operation of the full system or that the Microgrid LLC contracts with separate entities to provide a range of these roles either for the full microgrid system and/or at the subsystem level. At this stage in the project the goal has been to develop a viable project that can be transitioned as appropriate. The process will likely proceed under a Design-Bid-Build scenario for the next two phases of project development. The development and contractual agreements between the microgrid owner and the Town will proceed in accordance with Article 9 of the New York State Energy Law.

EPCs for local governments in New York State are regulated under New York State Energy Law (ENG) Article 9: Energy Performance Contracts in Connection with Public Buildings and Facilities (Appendix A).

Article 9 sets general standards for EPCs in New York State, including the following:

• The law limits the duration of the contract to 35 years or, if shorter, the useful life of the equipment and building.

• EPCs must include a specific liability clause limiting the appropriation of additional monies for the purpose of the contract (see Appendix A: ENG Article 9).

• EPCs in New York can be procured through competitive bid or a written request for proposals in accordance with local policies.

When the Director of Purchasing of the Town of Huntington determines that services fall outside the realm of competitive bidding as in the case of Professional Services that require special/technical skills, training and/or expertise not necessarily available from an individual/entity offering the lowest bid, the Requests for Proposals (RFP) process may be used in place of competitive bidding whenever practical. The use of the RFP demonstrates the Town's intent to rely on a competitive process "to assure the prudent and economical use of public moneys in the best interest of the taxpayers" of the Town "to facilitate the acquisition of goods and services of maximum quality at the lowest cost under the circumstances, and to guard against favoritism, improvidence, extravagance, fraud and corruption" as required by NYS General Municipal Law Section 104-b.

The Town Board will award purchasing contracts to the lowest, responsible bidder recommended by the Director of Purchasing for contracted public work projects, contracted professional services and contracted services through the competitive bidding requirements of General Municipal Law §103.

It should be noted that the general design proposed as part for this microgrid encompasses technologies that are now well-proven and available. As such, the proposed microgrid project imposes no insurmountable barriers to broad participation in the procurement process contemplated by the Town.

3.4.6: Community Benefits

How are benefits of the microgrid passed to the community? Will the community incur any costs? If so, list the additional costs.

The benefits will be passed to the community by the increased reliability of essential Town facilities and increased reliability of power to Huntington Hospital, which currently has to implement restrictions on scheduled surgical procedures during utility outages. In addition the residents within the microgrid footprint will directly benefit through the increased reliability of their electrical service which would be powered by the microgrid for the duration of any utility outage. Further, those residents would not pay any additional cost for the increased level of reliability and resiliency.

The potential cost of increased site emissions associated with CHP at the Town Hall would be offset by a decrease in total GHG emissions from centralized utility generating facilities. In addition, the combined-cycle CHP system is designed to be highly efficient and the solar PV and Fuel Cell do offset emissions as well. The emissions controls on the CHP at the Wastewater Treatment Plant will reduce current emissions as the biogas is currently being flared. SCR emissions controls can reduce the amount of NOx by up to 50%.

3.4.7: Utility Role

What will be required of the utility to ensure this project creates value for the purchaser of the electricity and the community?

The utility, PSEG-LI will be asked to make improvements to the existing distribution system in the form of new distribution automation equipment to isolate the microgrid from the remainder of their system when necessary to island the microgrid, and to make other distribution changes to provide increased reliability, such as undergrounding.

3.4.8: Technology Readiness

Have the microgrid technologies (including but limited to: generation, storage, controls) been used or demonstrated before? If yes, describe the circumstances and lessons learned.

All of the technologies proposed for the microgrid have been used on many other projects, singly and in combination. All are proven, tested commercial technologies, known to be reliable and dependable. All power system controls will be utility grade.

3.4.9: Operational Scheme

Describe the operational scheme, including, but not limited to, technical, financial, transactional and decision making responsibilities that will be used to ensure this project operates as expected.

In scenario one, the microgrid will be owned and operated by a third party investor, who will oversee the operational and maintenance responsibilities as well as handle the negotiations with PSEG-LI and the microgrid participants.

In scenario two, the distributed generation assets owned by the Town will be maintained by service contracts and do not require technical expertise on the part of the Town. The overall operational and maintenance responsibilities will be assumed by the Town but contracted out to an engineering firm. The Town has the financial resources and management skills to administer this project from an accounting perspective.

Under each scenario, PSEG-LI would be responsible for the distribution system.

3.4.10: Billing and Metering

How does the project owner plan to charge the purchasers of electricity services? How will the purchasers' use be metered?

The Town does not plan to directly charge end users for power from the microgrid. All customers, including the town will continue to be retail customers of PSEG-LI. Power generated by the microgrid DER will flow into the microgrid and be metered at the source. A net metering agreement will include the Town facilities as well as the Hospital. These entities will benefit proportionally from the use of the power from the microgrid DER.

3.4.11: Business Replication

Are there business/commercialization and replication plans appropriate for the type of project?

While the Town does not currently have any plans to implement a microgrid in other locations. Once this initial microgrid is installed and operating successfully, the Town will consider replicating community microgrids in other areas of the Town with critical infrastructure. The microgrid business model presents a novel approach to Utility Distribution Microgrids that can be replicated by other local governments across New York State.

3.4.12: Participant Barriers

How significant are the barriers to market entry microgrid participants?

The project does require a significant commitment by all stakeholders involved in the design, construction and operation of the microgrid, DER and control systems in order to achieve the intended benefits. In addition there are legal and tariff issues to be addressed, which will add time and cost. Grant funding, and a PPA for the fuel cell offer partial reimbursement for these costs, but there is still a portion that will be to be funded by the Town or potential investors directly.

3.4.13: Barrier Busting

Does the proposer demonstrate a clear understanding of the steps required to overcome these barriers?

The Town's project team is very well acquainted with these costs and issues and can see the benefits in terms of environment and reliability outweigh the perceived obstacles. The utility, PSEG-LI, has been supportive thus far and continued support will alleviate many of the potential issues associated with a microgrid buildout. Once the community microgrid is operating and providing PSEG-LI with high quality DER, PSEG-LI will be more receptive to continued implementation of community microgrid in their service areas. PSEG-LI has had success in the implementation of large scale fuel cells recently, with installations at Verizon and Home Depots. There is also an active PSEG-LI RFP seeking fuel cells larger than 2MW for implementation in constrained zones. As the microgrid falls within PSEG-LI's Utility 2.0 vision, the barriers to entry will be significantly reduced.

3.5: Financial Viability

The Contractor shall describe the case for financial viability for development and operation of the microgrid by addressing no less than the following items below:

3.5.1: Revenue Streams and Savings

What are the categories and relative magnitudes of the revenue streams and/or savings that will flow to the microgrid owner? Will they be fixed or variable?

The financial viability of the microgrid was analyzed under four scenarios.

Scenario 1A assumes third party ownership and net metering of all microgrid generation assets.

Table 6: Case 1A - Revenue Streams

Microgrid Revenue Streams ($2016) Case 1A – Net Metering Allowed for Microgrid Assets		
Item	**25 Year Annual Average**	**25 Year Total**
Fuel Cell Electricity	$3,837,247.95	$95,931,198.69
CHP1 Electricity	$548,178.28	$13,704,456.96
CHP2 Electricity	$548,178.28	$13,704,456.96
Roof Solar	$59,979.06	$1,499,476.42
Carport1	$44,984.87	$1,124,621.69
Carport2	$74,975.55	$1,874,388.64
Total Revenue	**$5,113,543.99**	**$127,838,599.36**

Key Assumptions:

- Assuming 2.1% annual electric rate escalation and 1.3% annual natural gas rate escalation in market rate available.
- Ability to net meter all microgrid assets
- $0.13 electric PPA sale price to microgrid customers assuming 1.3% annual escalation.

Scenario 1B assumes third party ownership of all microgrid generation assets without net metering.

Table 7: Case 1B Revenue Streams

Microgrid Revenue Streams ($2016) Case 1B – Net Metering Allowed for Microgrid Assets		
Item	**25 Year Annual Average**	**25 Year Total**
Fuel Cell Electricity	$2,707,495.34	$67,687,383.49
CHP1 Electricity	$474,385.05	$11,859,626.21
CHP2 Electricity	$548,178.28	$13,704,456.96
Roof Solar	$59,979.06	$1,499,476.42
Carport1	$44,984.87	$1,124,621.69
Carport2	$74,975.55	$1,874,388.64
Total Revenue	**$3,909,998.15**	**$97,749,953.41**

Key Assumptions:

- Assuming 2.1% annual electric rate escalation and 1.3% annual natural gas rate escalation in market rate available.
- $0.13 electric sale price to microgrid customers assuming 1.3% annual escalation.

- 25% of generation at Town Hall and Huntington Hospital will be subject to wholesale rates and will not be eligible for net metering.

The second scenarios considered below assume town ownership and oversite of generation assets, excluding a PPA with FuelCell Energy, Inc. at the hospital.

Table 8: Case 2B Revenue Streams

Microgrid Revenue Streams ($2016) Case 2A – Net Metering Allowed for Microgrid Assets		
Item	**25 Year Annual Average**	**25 Year Total**
Fuel Cell Electricity	$1,692,227.64	$42,305,691.05
CHP1 Electricity	$805,822.69	$20,145,567.17
CHP2 Electricity	$805,822.69	$20,145,567.17
Roof Solar	$59,979.06	$1,499,476.42
Carport1	$44,984.87	$1,124,621.69
Carport2	$74,975.55	$1,874,388.64
Fuel Cell Thermal	$262,866.72	$6,571,667.99
CHP1 Thermal	$89,607.87	$2,240,196.75
CHP2 Thermal	$89,607.87	$2,240,196.75
Total Revenue	**$3,925,894.96**	**$98,147,373.63**

Key Assumptions:

- Assuming 2.1% annual electric rate escalation and 1.3% annual natural gas rate escalation in market rate available.
- Ability to net meter all microgrid assets at $0.17/kWh

The next scenario assumes that the microgrid Fuel Cell and CHP assets will not be net metered.

Table 9: Case 2B Revenue Streams

Microgrid Revenue Streams ($2016) Case 2B – Subject to Wholesale Rates		
Item	**25 Year Annual Average**	**25 Year Total**
Fuel Cell Electricity	$1,098,730.11	$27,468,252.75
CHP1 Electricity	$617,864.80	$15,446,619.88
CHP2 Electricity	$805,822.69	$20,145,567.17
Roof Solar	$59,979.06	$1,499,476.42
Carport1	$44,984.87	$1,124,621.69
Carport2	$74,975.55	$1,874,388.64
Fuel Cell Thermal	$262,866.72	$6,571,667.99
CHP1 Thermal	$89,607.87	$2,240,196.75
CHP2 Thermal	$89,607.87	$2,240,196.75
Total Revenue	**$3,144,439.54**	**$78,610,988.03**

Key Assumptions:

- Assuming 2.1% annual electric rate escalation and 1.3% annual natural gas rate escalation in market rate available.
- 25% of generation at Town Hall and Huntington Hospital will be subject to wholesale rates and will not be eligible for net metering.

3.5.2: Project Incentives

What other incentives will be required or preferred for this project to proceed? How does the timing of those incentives affect the development and deployment of this project?

For the project to be profitable, only New York Prize funding is required, however the project will take advantage of available incentives for renewables including NY Sun for the solar installations.

3.5.3: Project Capital and Operating Costs

What are the categories and relative magnitudes of the capital and operating costs that will be incurred by the microgrid owner? Will they be fixed or variable?

Under scenarios 1A and 1B, with third party ownership of all assets the capital costs are represented below. The additional capital costs come from the purchase of the 2.8 MW fuel cell.

Table 10: Case 1A and 1B Costs

Microgrid Costs ($2016)		
Item	**Capital Cost**	**Annual Operating Cost**
Initial Design and Planning	$1,225,983	$461,000
Capital Investments	$18,829,382	
Microgrid Total (15% contingency)	**$22,879,692**	**$461,000**

Key Assumptions:

- Year 1 = 2017
- Annual operating costs based on an annual average over a 25 year financial cash flow analysis

Under scenarios 2A and 2B, with town ownership of assets and a power purchase agreement with FuelCell Energy, Inc, the capital investments are represented below.

Table 11: Case 2A and 2B Costs

Microgrid Costs ($2016)		
Item	**Capital Cost**	**Annual Operating Cost**
Initial Design and Planning	$1,113,983	$461,000
Capital Investments	$11,139,835	
Microgrid Total (15% contingency)	**$13,924,793**	**$461,000**

Key Assumptions:

- Year 1 = 2017
- Annual operating costs based on an annual average over a 25 year financial cash flow analysis

3.5.4: Profitability

How does the business model for this project ensure that it will be profitable?

The business model has assessed risk and investigated the impact of various scenarios. Under all scenarios considered the net 25 year cash flow was positive with a 10% discount rate. The microgrid was most sensitive to changes in the prices of natural gas as well as the negotiated price for excess generation with PSEG-LI. The worst case scenario evaluated, assuming a higher feed in tariff cannot be negotiated and excess power is sold at the avoided cost to the utility (scenario 1B) provides an IRR of 11% including an assumed 7 Million in NY prize funding for the next two phases.

3.5.5: Financing Structure

Describe the financing structure for this project during development, construction and operation.

The financing structure is dependent on the next stage of project development.

3.6: Legal Viability

The Contractor shall describe the legal terms and conditions and other requirements necessary to develop and operate the microgrid by addressing no less than the items below:

3.6.1: Project Ownership Structure

Describe the proposed project ownership structure and project team members that will have a stake in the ownership.

In scenario one, all of the generation assets will be owned by a third party, Microgrid, LLC. In scenario two, the individual microgrid assets will be owned by the owners of the location in which they are sited, with the exception of the fuel cell which will be owned by FuelCell Energy, Inc., and will sell power to the Hospital through a power purchase agreement.

3.6.2: Project Ownership

Has the project owner been identified? If yes, who is it and what is the relationship to the applicant? If no, what is the proposed approach to securing the project owner?

The proposed microgrid will be a Utility Distribution Microgrid. PSEG-LI will continue to own and operate the distribution while the microgrid participants or a third party will own the generation assets.

3.6.3: Site ownership

Does the project owner (or owners) own the site(s) where microgrid equipment/systems are to be installed? If not, what is the plan to secure access to that/those site(s)?

Yes the land is owned by a combination Huntington Hospital and The Town of Huntington.

3.6.4: Customer Privacy

What is the approach to protecting the privacy rights of the microgrid's customers?

The privacy rights of individual customers on the microgrid will be protected because with the exception of the named critical facilities which are owned by the Town of Huntington, Huntington Hospital, and the Huntington YMCA no other customer account data will be accessed. The microgrid will be transparent to the individual small commercial and residential customers that are included in the electrical footprint of the microgrid. There will be no change in metering or billing to those customers. They will remain customers of PSEG-LI under existing tariffs. Power that they receive when the microgrid is islanded will be metered and billed under the same tariffs. The microgrid will receive compensation from PSEG-LI for all power generated during island operation that exceeds the consumption of the critical facilities, which will be owned by the microgrid participants or a third party. The rate of reimbursement by PSEG-LI for excess power produced when islanded should reflect the value of that power in maintaining customer service during an emergency.

3.6.5: Regulatory Considerations

Describe any known, anticipated, or potential regulatory hurdles, as well as their implications that will need to be evaluated and resolved for this project to proceed. What is the plan to address them?

The transfer of power from the distributed generation resources to the microgrid critical facilities relies on utilizing hardened portions of the existing PSEG-LI distribution system. The preferred financial arrangement would be to net meter the generation assets as well as the critical facilities. Present PSEG-LI tariffs do not permit net metering from CHP resources. The Town believes that net metering should be allowed in any microgrid, and that this need extends to many community microgrid projects, in multiple utility service territories, that serve the community at large. Net metering of microgrid assets allows assets in beneficial locations such as locations where waste heat use can be maximized, to be sized to generate more power than that location can use. It also allows for microgrids to share generation assets in such a way that keeps the overall efficiency of the generation maximized. Without such a mechanism for sharing generation, community microgrids would be forced to either build separate distribution systems or scale back generation. Such restrictions would oppose the progress that REV is trying to achieve and minimize the potential benefits that Utility Distribution Microgrids are poised to provide NY State. The Town believes the PSC should undertake a review of this situation and a policy change be made. We understand that the agency is taking steps in relation to these types of issues as part of the REV Initiative, but, given LIPA's unique utility status, attention to these issues also may be required by the State Legislature to ensure that the benefits of these programs are available on Long Island.

Task 4: Benefit-Cost Analysis Summary Report

Site 2 – Town of Huntington

PROJECT OVERVIEW

As part of NYSERDA's NY Prize community microgrid competition, the Town of Huntington has proposed a microgrid that will combine a diverse mix of generation and storage technologies. To assist with completion of the project's NY Prize Stage 1 feasibility study, IEc conducted a screening-level analysis of the project's potential costs and benefits. This report describes the results of that analysis.

Huntington is a community of approximately 203,000 residents located on the north shore of Long Island's Suffolk County. In recent years, storms have created service interruptions, including an eight-day outage following Hurricane Sandy. The proposed microgrid would serve several customers:

- Huntington Hospital, a 288-bed facility;
- The Huntington wastewater treatment plant (WWTP);
- The Huntington YMCA;
- Huntington Town Hall;
- The Flanagan Senior Center, a service, recreational, and advocacy facility;
- The Heckscher Park Museum; and
- The Heckscher Park Cottage, a small office building.

The project's design involves several fossil-fuel based generators, including two conventional natural gas generators; a natural gas-based fuel cell; and a pre-existing diesel generator (located at the WWTP). The design also features combined heat and power (CHP) capabilities, including a CHP generator fed by a mix of natural gas and digester gas from the WWTP; solar generation capability; and battery storage, which supports the fuel cell and facilitates load shifting. As planned, the microgrid would supply all the power needs of the affiliated customers and would ensure power during regional power outages, including 24-hour service for the hospital, WWTP, and museum.

METHODOLOGY AND ASSUMPTIONS

In discussing the economic viability of microgrids, a common understanding of the basic concepts of benefit-cost analysis is essential. Chief among these are the following:

- *Costs* represent the value of resources consumed (or benefits forgone) in the production of a good or service.
- *Benefits* are impacts that have value to a firm, a household, or society in general.
- *Net benefits* are the difference between a project's benefits and costs.
- Both costs and benefits must be measured relative to a common *baseline* - for a microgrid, the "without project" scenario - that describes the conditions that would prevail absent a project's development. The BCA considers only those costs and benefits that are *incremental* to the baseline.

This analysis relies on an Excel-based spreadsheet model developed for NYSERDA to analyze the costs and benefits of developing microgrids in New York State. The model evaluates the economic viability of a microgrid based on the user's specification of project costs, the project's design and operating characteristics, and the facilities and services the project is designed to support. Of note, the model analyzes a discrete operating scenario specified by the user; it does not identify an optimal project design or operating strategy.

The BCA model is structured to analyze a project's costs and benefits over a 20-year operating period. The model applies conventional discounting techniques to calculate the present value of costs and benefits, employing an annual discount rate that the user specifies – in this case, seven percent.[1] It also calculates an annualized estimate of costs and benefits based on the anticipated engineering lifespan of the system's equipment. Once a project's cumulative benefits and costs have been adjusted to present values, the model calculates both the project's net benefits and the ratio of project benefits to project costs. The model also calculates the project's internal rate of return, which indicates the discount rate at which the project's costs and benefits would be equal. All monetized results are adjusted for inflation and expressed in 2014 dollars.

With respect to public expenditures, the model's purpose is to ensure that decisions to invest resources in a particular project are cost-effective; i.e., that the benefits of the investment to society will exceed its costs. Accordingly, the model examines impacts from the perspective of society as a whole and does not identify the distribution of costs and benefits among individual stakeholders (e.g., customers, utilities). When facing a choice among investments in multiple projects, the "societal cost test" guides the decision toward the investment that produces the greatest net benefit.

The BCA considers costs and benefits for two scenarios:

Scenario 1: No major power outages over the assumed 20-year operating period (i.e., normal operating conditions only).

Scenario 2: The average annual duration of major power outages required for project benefits to equal costs, if benefits do not exceed costs under Scenario 1.[2]

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[1] The seven percent discount rate is consistent with the U.S. Office of Management and Budget's current estimate of the opportunity cost of capital for private investments. One exception to the use of this rate is the calculation of environmental damages. Following the New York Public Service Commission's (PSC) guidance for benefit-cost analysis, the model relies on temporal projections of the social cost of carbon (SCC), which were developed by the U.S. Environmental Protection Agency (EPA) using a three percent discount rate, to value CO_2 emissions. As the PSC notes, "The SCC is distinguishable from other measures because it operates over a very long time frame, justifying use of a low discount rate specific to its long term effects." The model also uses EPA's temporal projections of social damage values for SO_2, NO_x, and $PM_{2.5}$, and therefore also applies a three percent discount rate to the calculation of damages associated with each of those pollutants. [See: State of New York Public Service Commission. Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision. Order Establishing the Benefit Cost Analysis Framework. January 21, 2016.]

[2] The New York State Department of Public Service (DPS) requires utilities delivering electricity in New York State to collect and regularly submit information regarding electric service interruptions. The reporting system specifies 10 cause categories: major storms; tree contacts; overloads; operating errors; equipment failures; accidents; prearranged interruptions; customers equipment; lightning; and unknown (there are an additional seven cause codes used exclusively for Consolidated Edison's underground network system). Reliability metrics can be calculated in two ways: including all outages, which indicates the actual experience of a utility's customers; and excluding outages caused by major storms, which is more indicative of the frequency and duration of outages within the utility's control. In estimating the reliability benefits of a microgrid, the BCA employs metrics that exclude outages caused by major storms. The BCA classifies outages caused by major storms or other events beyond a utility's control as "major power outages," and evaluates the benefits of avoiding such outages separately.

RESULTS

Table 1 summarizes the estimated net benefits, benefit-cost ratios, and internal rates of return for the scenarios described above. The results indicate that even if there were no major power outages over the 20-year period analyzed (Scenario 1), the project's benefits would exceed its costs by roughly 10 percent.

Since the Scenario 1 results suggest a benefit-cost ratio greater than one, this report does not provide a detailed analysis of the impact of major power outages under Scenario 2. Consideration of Scenario 2 would further increase the project's already positive benefit-cost ratio. Based on a combination of information provided by the project team and estimates from the DOE's ICE Calculator, major power outage benefits are on the order of $1.6 million per day of outage.

Table 1. BCA Results (Assuming 7 Percent Discount Rate)

ECONOMIC MEASURE	ASSUMED AVERAGE DURATION OF MAJOR POWER OUTAGES	
	SCENARIO 1: 0 DAYS/YEAR	SCENARIO 2
Net Benefits - Present Value	$2,750,000	Not Evaluated
Benefit-Cost Ratio	1.1	Not Evaluated
Internal Rate of Return	6.8%	Not Evaluated

Figure 1 and Table 2 present the detailed results of the Scenario 1 analysis.

Figure 1. Present Value Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)

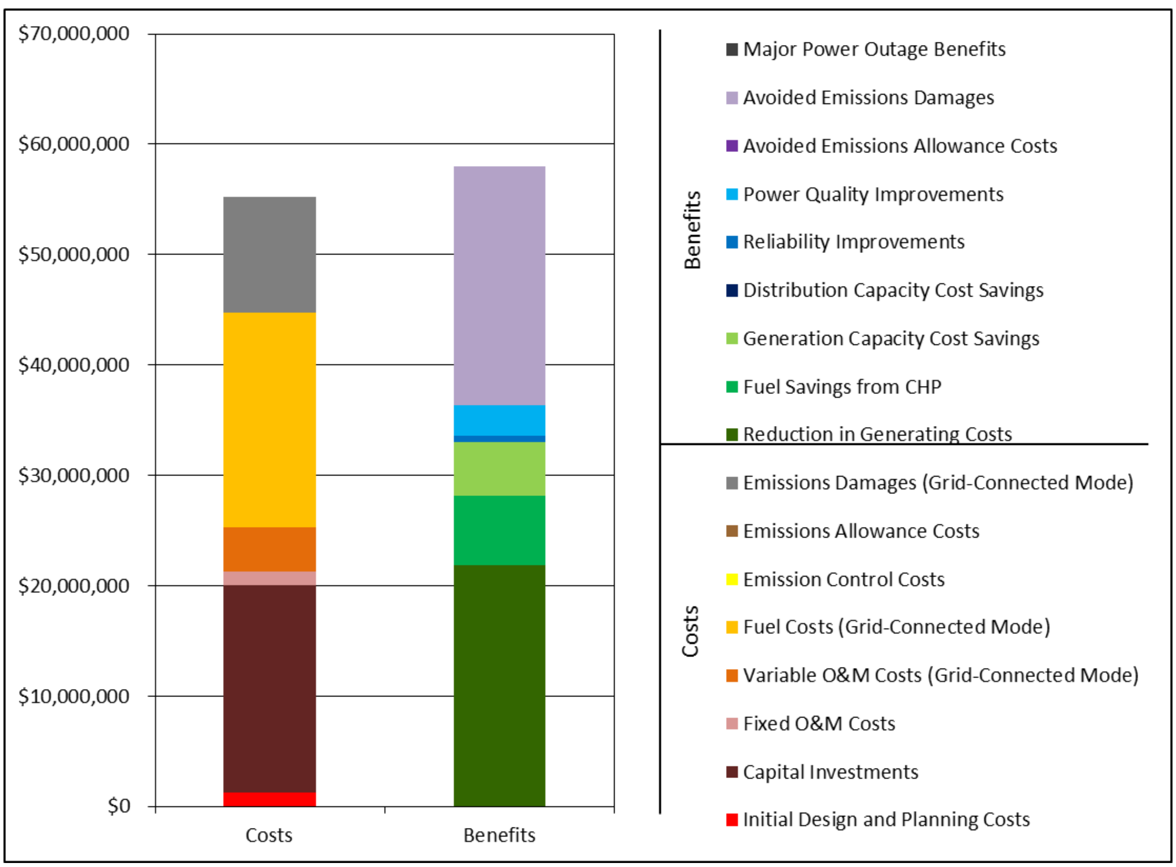

Table 2. Detailed BCA Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)

COST OR BENEFIT CATEGORY	PRESENT VALUE OVER 20 YEARS (2014$)	ANNUALIZED VALUE (2014$)
Costs		
Initial Design and Planning	$1,230,000	$108,000
Capital Investments	$18,800,000	$1,590,000
Fixed O&M	$1,190,000	$105,000
Variable O&M (Grid-Connected Mode)	$4,030,000	$356,000
Fuel (Grid-Connected Mode)	$19,500,000	$1,720,000
Emission Control	$0	$0
Emissions Allowances	$0	$0
Emissions Damages (Grid-Connected Mode)	$10,500,000	$684,000
Total Costs	**$55,200,000**	
Benefits		
Reduction in Generating Costs	$21,800,000	$1,930,000
Fuel Savings from CHP	$6,320,000	$558,000
Generation Capacity Cost Savings	$4,840,000	$427,000
Distribution Capacity Cost Savings	$0	$0
Reliability Improvements	$587,000	$51,800
Power Quality Improvements	$2,800,000	$247,000
Avoided Emissions Allowance Costs	$11,000	$967
Avoided Emissions Damages	$21,600,000	$1,410,000
Major Power Outage Benefits	$0	$0
Total Benefits	**$58,000,000**	
Net Benefits	**$2,750,000**	
Benefit/Cost Ratio	**1.1**	
Internal Rate of Return	**6.8%**	

Fixed Costs

The BCA relies on information provided by the project team to estimate the fixed costs of developing the microgrid. The project team's best estimate of initial design and planning costs is approximately $1.2 million. The present value of the project's capital costs is estimated at approximately $18.8 million, incorporating roughly thirty components. The major contributors to capital costs are the fuel cell; the 1.3 MW natural-gas-fueled generator installed at the WWTP for peaking power; the energy and storage inverter (for peaking and volt-ampere reactive support); the three solar arrays; and the CHP generator units installed at the YMCA and WWTP. The present value of the microgrid's fixed operations and maintenance (O&M) costs (i.e., O&M costs that do not vary with the amount of energy produced) is estimated at approximately $1.2 million, or $105,000 annually.

Variable Costs

The most significant variable cost associated with the proposed project is the cost of natural gas and diesel to operate the system's fuel-based generators. To characterize these costs, the BCA relies on estimates of fuel consumption provided by the project team and projections of fuel costs from New York's

2015 State Energy Plan (SEP), adjusted to reflect recent market prices.[3] The present value of the project's fuel costs over a 20-year operating period is estimated to be approximately $19.5 million.[4]

The BCA also considers the project team's best estimate of the microgrid's variable O&M costs (i.e., O&M costs that vary with the amount of energy produced). The present value of these costs is estimated at approximately $4.0 million.[5]

In addition, the analysis of variable costs considers the environmental damages associated with pollutant emissions from the distributed energy resources that serve the microgrid, based on the operating scenario and emissions rates provided by the project team and the understanding that none of the system's generators would be subject to emissions allowance requirements. In this case, the damages attributable to emissions from the microgrid's fuel-based generators are estimated at approximately $684,000 annually. The majority of these damages are attributable to the emission of CO2. Over a 20-year operating period, the present value of emissions damages is estimated at approximately $10.5 million.

Avoided Costs

The development and operation of a microgrid may avoid or reduce a number of costs that otherwise would be incurred. These include generating cost savings resulting from a reduction in demand for electricity from bulk energy suppliers. The BCA estimates the present value of these savings over a 20-year operating period to be approximately $21.8 million. Cost savings would also result from fuel savings due to the combined heat and power systems. The BCA estimates the present value of fuel savings over the 20-year operating period to be approximately $6.32 million. These reductions in demand for electricity from bulk energy suppliers and heating fuel would also avoid emissions of CO_2, SO_2, NO_x, and particulate matter, yielding emissions allowance cost savings with a present value of approximately $11,000 and avoided emissions damages with a present value of approximately $21.6 million.[6]

In addition to the savings noted above, development of a microgrid could yield cost savings by avoiding or deferring the need to invest in expansion of the conventional grid's energy generation or distribution capacity.[7] The project team estimates the capacity available for the provision of peak load support to be approximately 5.7 MW per year, based on estimates of output from the new CHP systems, photovoltaic arrays, and fuel cell during system peak.[8] Based on these figures, the BCA estimates the present value of

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[3] The model adjusts the State Energy Plan's natural gas and diesel price projections using fuel-specific multipliers calculated based on the average commercial natural gas price in New York State in October 2015 (the most recent month for which data were available) and the average West Texas Intermediate price of crude oil in 2015, as reported by the Energy Information Administration. The model applies the same price multiplier in each year of the analysis.

[4] The CHP unit planned for the WWTP would be fueled by a mix of natural gas (75 percent) and digester gas from the treatment system (25 percent). The gas the digester produces is both a product of the project and an input to the production of heat and power, therefore, the analysis of fuel costs assigns the digester gas a net cost of zero. The costs associated with producing the gas are fully reflected in the cost of installing, operating, and maintaining the digester.

[5] The project team indicates that its variable O&M cost estimate ($11 per MWh) includes maintenance of the CHP systems, the fuel cell, and the generators. It is unclear if maintenance of the existing generator is included in the variable O&M figure, but since the existing generator is used only during outages, its contribution to variable O&M costs is likely to be minimal.

[6] Following the New York Public Service Commission's (PSC) guidance for benefit-cost analysis, the model values emissions of CO_2 using the social cost of carbon (SCC) developed by the U.S. Environmental Protection Agency (EPA). [See: State of New York Public Service Commission. Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision. Order Establishing the Benefit Cost Analysis Framework. January 21, 2016.] Because emissions of SO_2 and NO_x from bulk energy suppliers are capped and subject to emissions allowance requirements in New York, the model values these emissions based on projected allowance prices for each pollutant.

[7] Impacts on transmission capacity are implicitly incorporated into the model's estimates of avoided generation costs and generation capacity cost savings. As estimated by NYISO, generation costs and generating capacity costs vary by location to reflect costs imposed by location-specific transmission constraints.

[8] The project team originally credited the full nameplate capacity of the solar resources in providing peak load support. The analysis assumes that these resources would be available 15 percent of the time; this assumption is consistent with the project team's estimate of solar availability over the course of the year.

the project's generating capacity benefits to be approximately $4.8 million over a 20-year operating period.[9]

The project team has indicated that the proposed microgrid would be designed to provide reactive power support to the New York Independent System Operator (NYISO). Whether NYISO would select the project to provide these services depends on NYISO's requirements and the ability of the project to provide support at a cost lower than that of alternative sources. Based on discussions with NYISO, it is our understanding that the markets for ancillary services are highly competitive, and that projects of this type would have a relatively small chance of being selected to provide support to the grid. In light of this consideration, the analysis does not attempt to quantify the potential benefits of providing such services.

Reliability Benefits

An additional benefit of the proposed microgrid would be to reduce customers' susceptibility to power outages by enabling a seamless transition from grid-connected mode to islanded mode. The analysis estimates that development of a microgrid would yield reliability benefits of approximately $52,000 per year, with a present value of $587,000 over a 20-year operating period. This estimate is calculated using the U.S. Department of Energy's Interruption Cost Estimate (ICE) Calculator, and is based on the following indicators of the likelihood and average duration of outages in the service area:[10]

System Average Interruption Frequency Index (SAIFI) – 0.72 events per year.

Customer Average Interruption Duration Index (CAIDI) – 81.6 minutes.

The estimate takes into account the number of small and large commercial or industrial customers the project would serve; the distribution of these customers by economic sector; average annual electricity usage per customer, as provided by the project team; and the prevalence of backup generation among these customers. It also takes into account the variable costs of operating existing backup generators, both in the baseline and as an integrated component of a microgrid. Under baseline conditions, the analysis assumes a 15 percent failure rate for backup generators.[11] It assumes that establishment of a microgrid would reduce the rate of failure to near zero.

It is important to note that the analysis of reliability benefits assumes that development of a microgrid would insulate the facilities the project would serve from outages of the type captured in SAIFI and CAIDI values. The distribution network within the microgrid is unlikely to be wholly invulnerable to such interruptions in service. All else equal, this assumption will lead the BCA to overstate the reliability benefits the project would provide.

Power Quality Benefits

The power quality benefits of a microgrid may include reductions in the frequency of voltage sags and swells or reductions in the frequency of momentary outages (i.e., outages of less than five minutes, which are not captured in the reliability indices described above). The analysis of power quality benefits relies on the project team's best estimate of the number of power quality events that development of the

[9] The project team initially proposed distribution cost savings equivalent to the nameplate generating capacity of the microgrid; however, the microgrid would continue to rely on the utility's distribution network, and the team's estimate of costs does not include major investments to expand or maintain that network. Therefore, the analysis excludes any potential distribution cost savings. Sensitivity analysis suggests that crediting the project with an impact on distribution capacity requirements equivalent to the project's nameplate generating capacity would yield a benefit of $2.65 million over a 20-year operating period.

[10] www.icecalculator.com.

[11] http://www.businessweek.com/articles/2012-12-04/how-to-keep-a-generator-running-when-you-lose-power#p1.

microgrid would avoid each year. Specifically, the project team foresees six to 10 power quality events per year at the hospital; the analysis employs the midpoint of this range (eight). The model estimates the present value of this benefit to be approximately $2.8 million over a 20-year operating period. If the hospital already has systems in place to protect against voltage sags, swells, and momentary outages, this estimate is likely to overstate the power quality benefits the project would provide; however, power quality benefits are a small component of the project’s total benefits, and the benefit-cost ratio is largely unaffected by their inclusion.

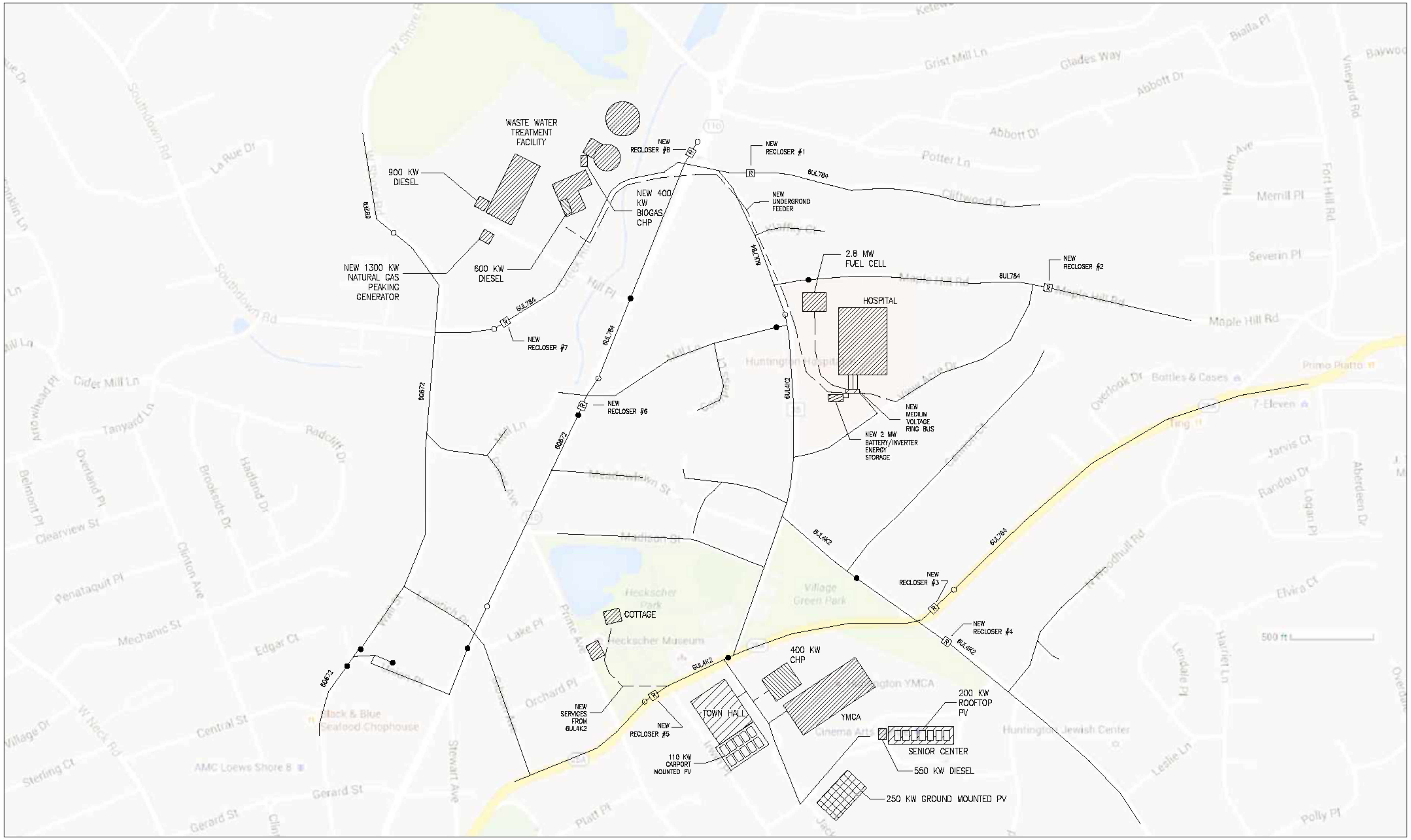
Summary

The analysis of Scenario 1 yields a benefit/cost ratio of 1.1; i.e., the estimate of project benefits exceeds costs by about 10 percent. Accordingly, the analysis does not consider the potential for the microgrid to mitigate the impact of major power outages in Scenario 2. Consideration of such benefits would further increase the net benefits of the project’s development.

Appendix A: Layout Plans and Electrical One Line Diagrams

TOWN OF **HUNTINGTON**
LONG ISLAND, NEW YORK

TRC
Results you can rely on



LEGEND

- ○ EXISTING NORMALLY OPEN SECTIONALIZING SWITCH
- ● EXISTING NORMALLY CLOSED SECTIONALIZING SWITCH
- [R] NEW REMOTELY OPERATED RECLOSER WITH RELAY

TRC 124 GROVE ST SUITE 205
FRANKLIN MA, 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
C	ADDED PV, ENERGY STORAGE AND 1300 KW GENERATOR	2/17/2016	WFM		
B	ADDED RECLOSERS , UNDERGROUND AND NEW SWITCHGEAR	12/10/15	WFM		
A	ISSUED FOR INTERNAL REVIEW	.	.	.	.

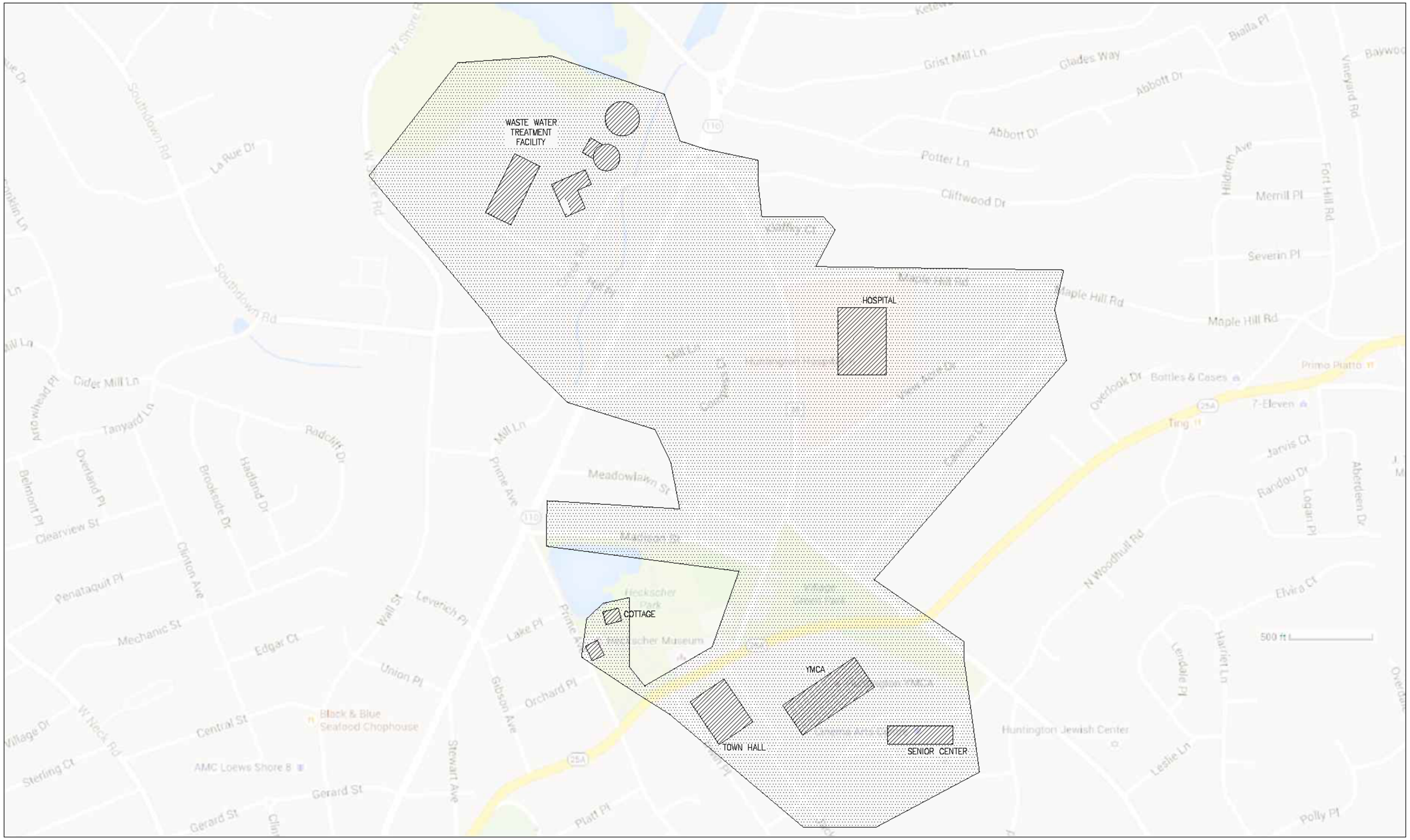
WFM DESIGNED
WFM DRAWN
CHECKED
APPROVED
REVIEW 1
REVIEW 2
2/17/16 DATE
AS NOTED SCALE

TOWN OF HUNTINGTON, NY
COMMUNITY MICROGRID
LAYOUT PLAN

TRC

LP-1

REV. C



TRC 124 GROVE ST SUITE 205
FRANKLIN MA, 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
A	ISSUED FOR INTERNAL REVIEW	12/11/15	WFM	-	-

WFM DESIGNED
WFM DRAWN
- CHECKED
- APPROVED
REVIEW 1
REVIEW 2

TOWN OF HUNTINGTON, NY
COMMUNITY MICROGRID
LAYOUT PLAN
AREA INCLUDED IN MICROGRID

12/10/2015 DATE
AS NOTED SCALE

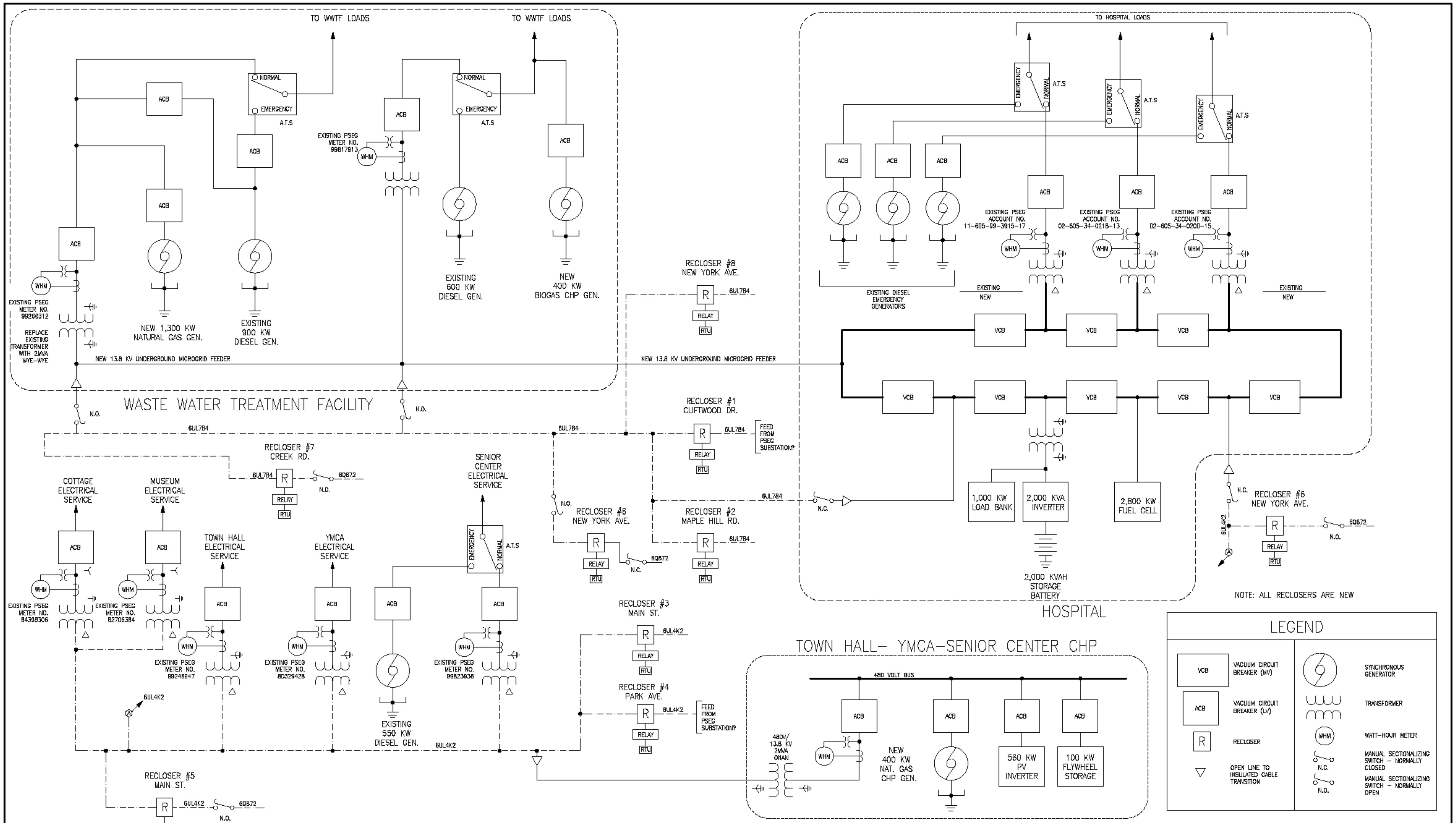
TRC

LP–2

REV. A

TOWN OF **HUNTINGTON**
LONG ISLAND, NEW YORK

TRC Results you can rely on



TRC 125 GROVE ST SUITE 205
FRANKLIN MA, 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
D	REVISED WWTF GENERATOR CAPACITY	2/10/2016	WFM		
C	REVISED PV CAPACITY	2/5/2016	WFM		
B	RELACED MOS WITH RECLOSERS/ADDED LOAD BANK, REVISED GENERATION AT WWTF	12/28/15	WFM		
A	ISSUED FOR INTERNAL REVIEW	12/14/15	WFM	.	.

WFM DESIGNED
WFM DRAWN
CHECKED
APPROVED
REVIEW 1
REVIEW 2

TOWN OF HUNTINGTON, NY
COMMUNITY MICROGRID
SIMPLIFIED ELECTRICAL ONE-LINE DIAGRAM

2/10/2016 DATE
N.T.S. SCALE

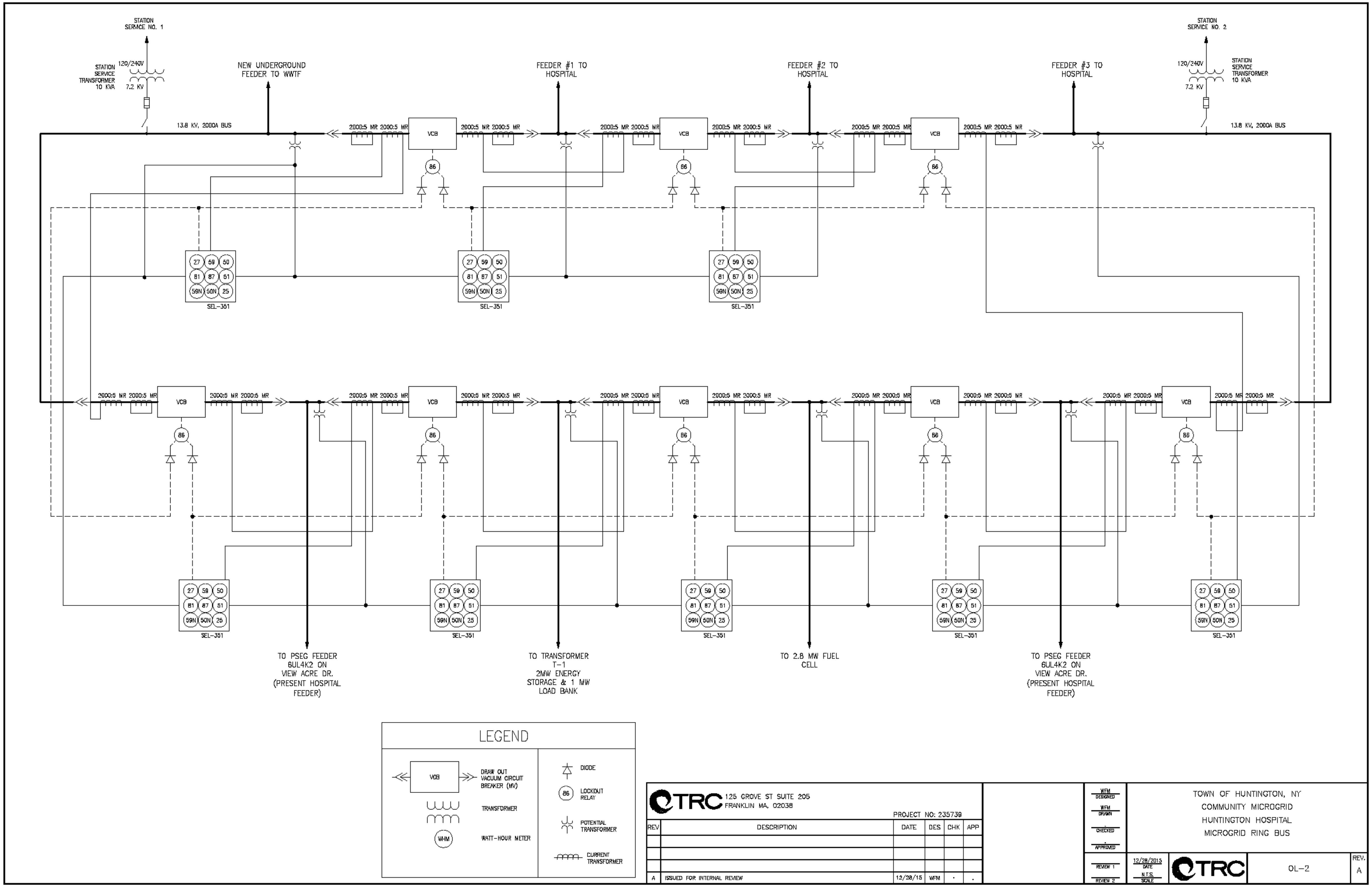
TRC

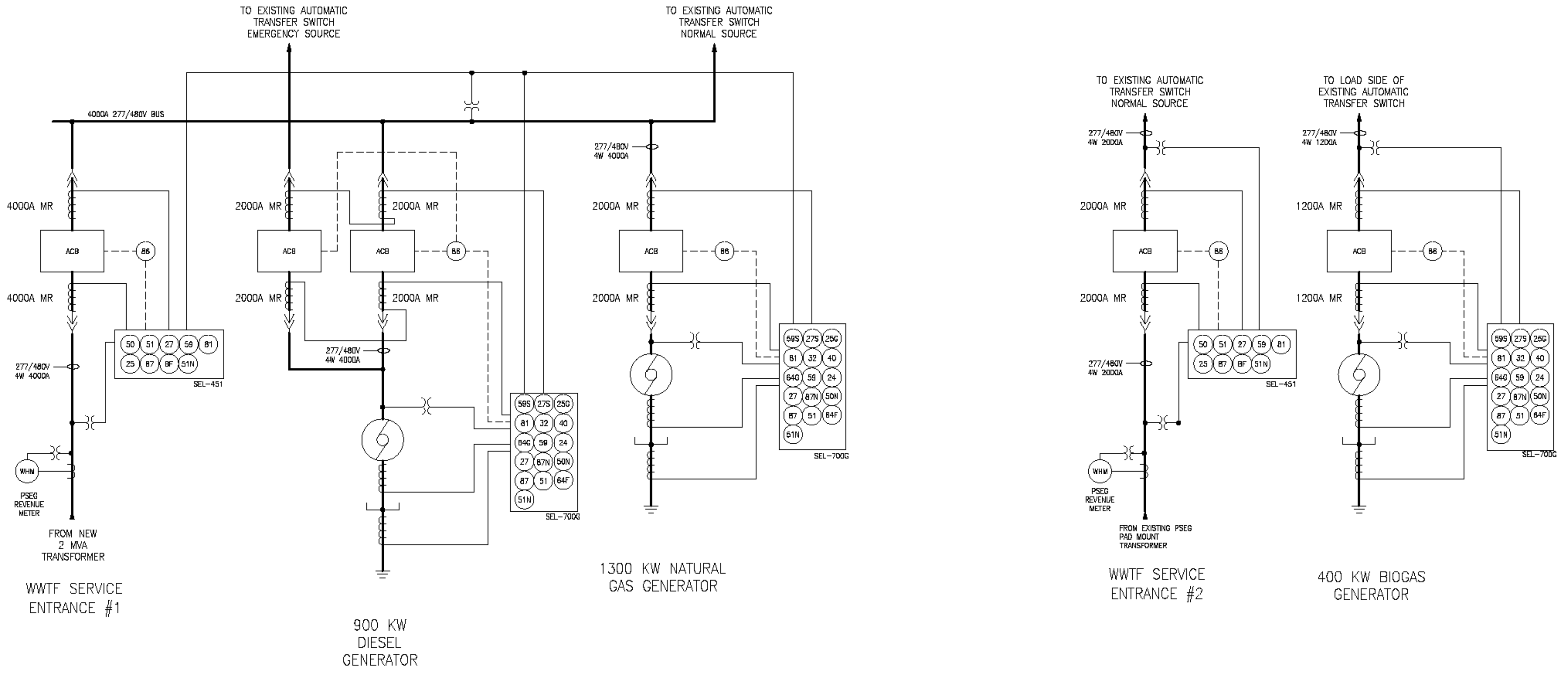
OL-1

REV. D

Appendix B: Utility Interconnection Diagrams

TOWN OF HUNTINGTON
LONG ISLAND, NEW YORK





LEGEND

24	VOLTS/HZ
25	SYNCH CHECK
25G	GENERATOR SYNCH CHECK & AUTO SYNCHRONIZER
27	GENERATOR UNDERVOLTAGE
27S	BUS UNDERVOLTAGE
32	DIRECTIONAL POWER
40	LOSS OF FIELD
50N	NEUTRAL OVERCURRENT
51	TIME OVERCURRENT
51N	NEUTRAL OVERCURRENT
59	GENERATOR OVERVOLTAGE
59S	BUS OVERVOLTAGE
59N	NEUTRAL OVERVOLTAGE
64F	FIELD GROUND
64G	STATOR GROUND
87	CURRENT DIFFERENTIAL
87N	NEUTRAL CURRENT DIFFERENTIAL
81	OVER/UNDER FREQUENCY
86	LOCK OUT

VCB — DRAW OUT VACUUM CIRCUIT BREAKER

ACB — DRAW OUT AIR CIRCUIT BREAKER

CURRENT TRANSFORMER

POTENTIAL TRANSFORMER

NOTES

1. ALL SWITCHGEAR TO BE LOW VOLTAGE INDOOR METAL CLAD TYPE, ARC FLASH PROTECTED
2. TRIP AND CLOSE POWER TO BE 125 VOLT DC
3. ALL BREAKER CUBICLES TO HAVE 120VAC ANTI-CONDENSATION HEATERS.
4. TRIP AND CLOSE POWER TO BE 125 VOLT DC.
5. ALL BREAKER CUBICLES TO HAVE 120VAC ANTI-CONDENSATION HEATERS.
6. WWTF SERVICE #2 AND 400 KW GENERATOR TO BE IN SEPARATE FREE STANDING CUBICLES.
7. ALL PT'S ARE 3-PHASE WYE-WYE 120V SECONDARY.

TRC 125 GROVE ST SUITE 205
FRANKLIN MA. 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
B	REVISED WWTF GENERATOR CAPACITY	2/10/2016	WFM		
A	ISSUED FOR INTERNAL REVIEW	12/28/2015	WFM	-	-

WFM DESIGNED
WFM DRAWN
CHECKED
APPROVED
REVIEW 1
REVIEW 2
2/10/2016 DATE
N.T.S. SCALE

TOWN OF HUNTINGTON, NY
COMMUNITY MICROGRID
HUNTINGTON WASTEWATER TREATMENT FACILITY
MICROGRID INTERCONNECTION SWITCHGEAR

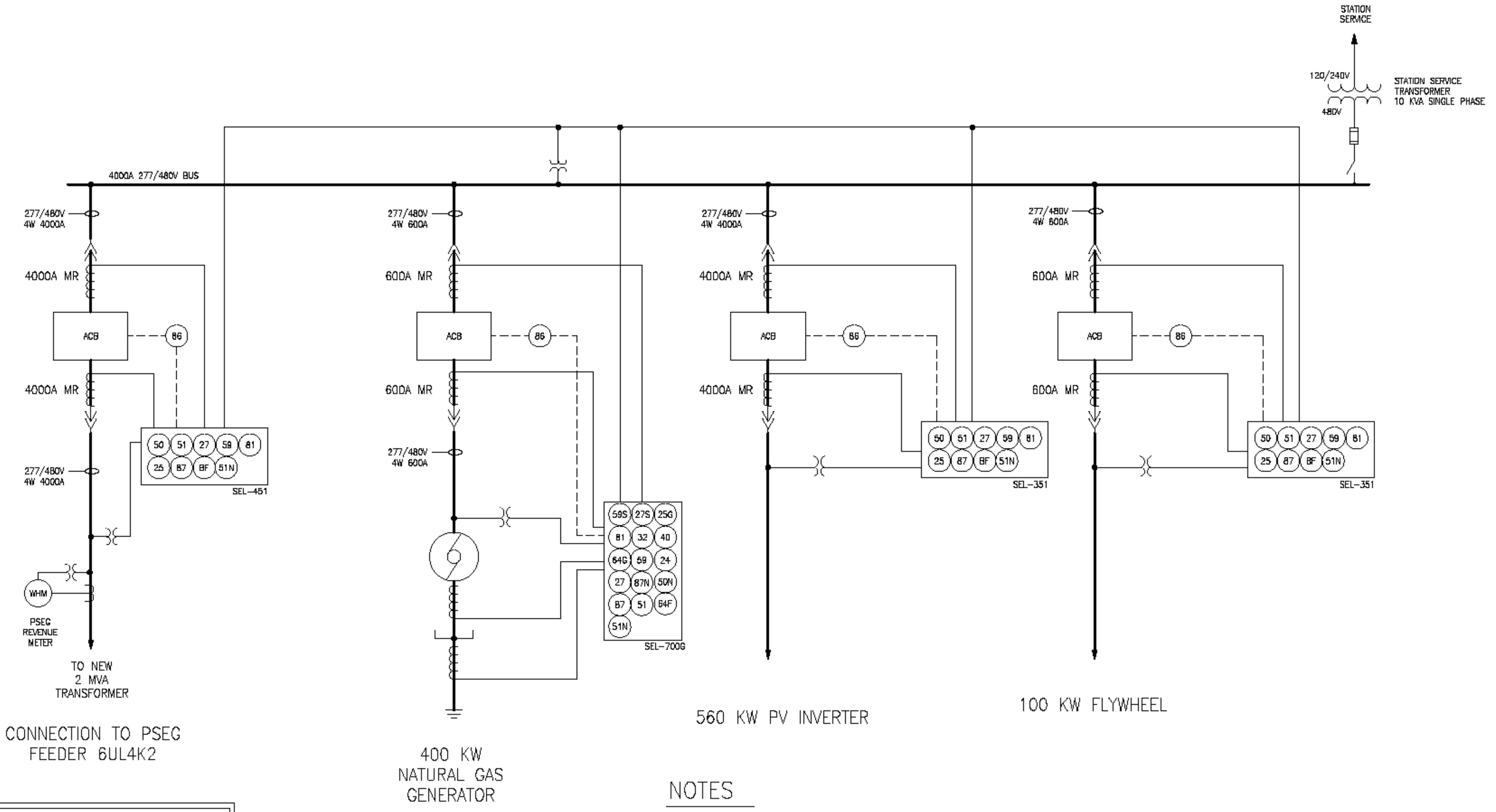
TRC

OL-3

REV. B

TOWN OF HUNTINGTON
LONG ISLAND, NEW YORK

TRC Results you can rely on



NOTES

1. ALL SWITCHGEAR TO BE LOW VOLTAGE INDOOR METAL CLAD TYPE, ARC FLASH RESISTANT
2. TRIP AND CLOSE POWER TO BE 125 VOLT DC
3. ALL BREAKER CUBICLES TO HAVE 120VAC ANTI-CONDENSATION HEATERS.
4. TRIP AND CLOSE POWER TO BE 125 VOLT DC.
5. ALL BREAKER CUBICLES TO HAVE 120VAC ANTI-CONDENSATION HEATERS.
6. ALL PT'S ARE 3-PHASE WYE-WYE 277V/120VOLT.

LEGEND

24	VOLTS/HZ
25	SYNCH CHECK
25G	GENERATOR SYNCH CHECK & AUTO SYNCHRONIZER
27	GENERATOR UNDERVOLTAGE
27S	BUS UNDERVOLTAGE
32	DIRECTIONAL POWER
40	LOSS OF FIELD
50N	NEUTRAL OVERCURRENT
51	TIME OVERCURRENT
51N	NEUTRAL OVERCURRENT
59	GENERATOR OVERVOLTAGE
59S	BUS OVERVOLTAGE
59N	NEUTRAL OVERVOLTAGE
64F	FIELD GROUND
64G	STATOR GROUND
87	CURRENT DIFFERENTIAL
87N	NEUTRAL CURRENT DIFFERENTIAL
81	OVER/UNDER FREQUENCY
86	LOCK OUT

ACB — DRAW OUT AIR CIRCUIT BREAKER

CURRENT TRANSFORMER

POTENTIAL TRANSFORMER

TRC 125 GROVE ST SUITE 205
FRANKLIN MA, 02038
PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
B	REVISED PV CAPACITY	2/5/2016			
A	ISSUED FOR INTERNAL REVIEW	12/28/15	WFM	.	.

WFM DESIGNED
WFM DRAWN
. CHECKED
. APPROVED
REVIEW 1
REVIEW 2
2/5/2016 DATE
N.T.S. SCALE

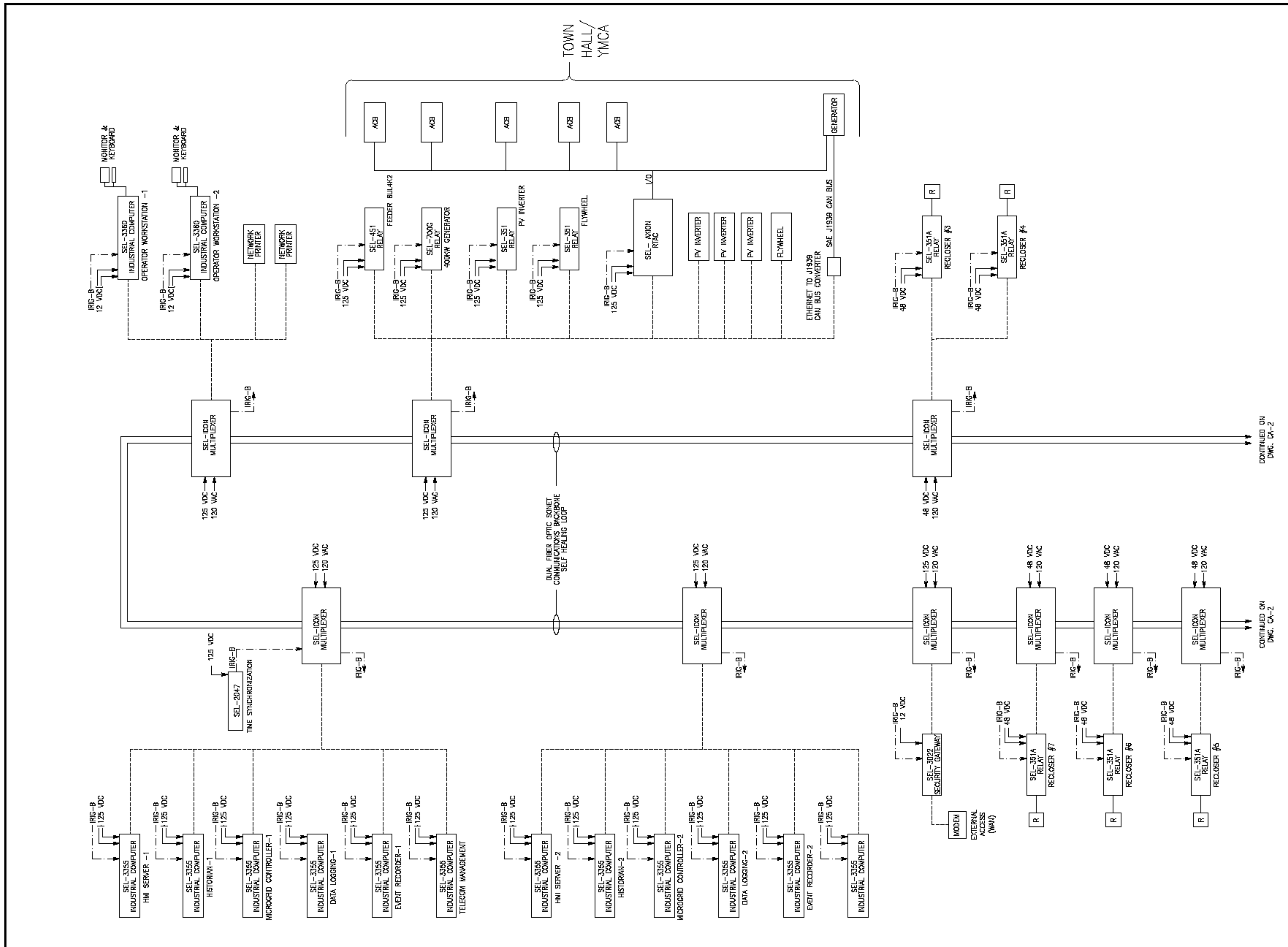
TOWN OF HUNTINGTON, NY
COMMUNITY MICROGRID
HUNTINGTON TOWN HALL/SR. CENTER/YMCA
MICROGRID INTERCONNECTION SWITCHGEAR

TRC
OL-4
REV. B

Appendix C: Controls Diagrams

TOWN OF HUNTINGTON
LONG ISLAND, NEW YORK

TRC Results you can rely on



TRC 125 GROVE ST. SUITE 205
FRANKLIN MA 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
A	FOR INTERNAL REVIEW	2-2-2016	WFM	-	-

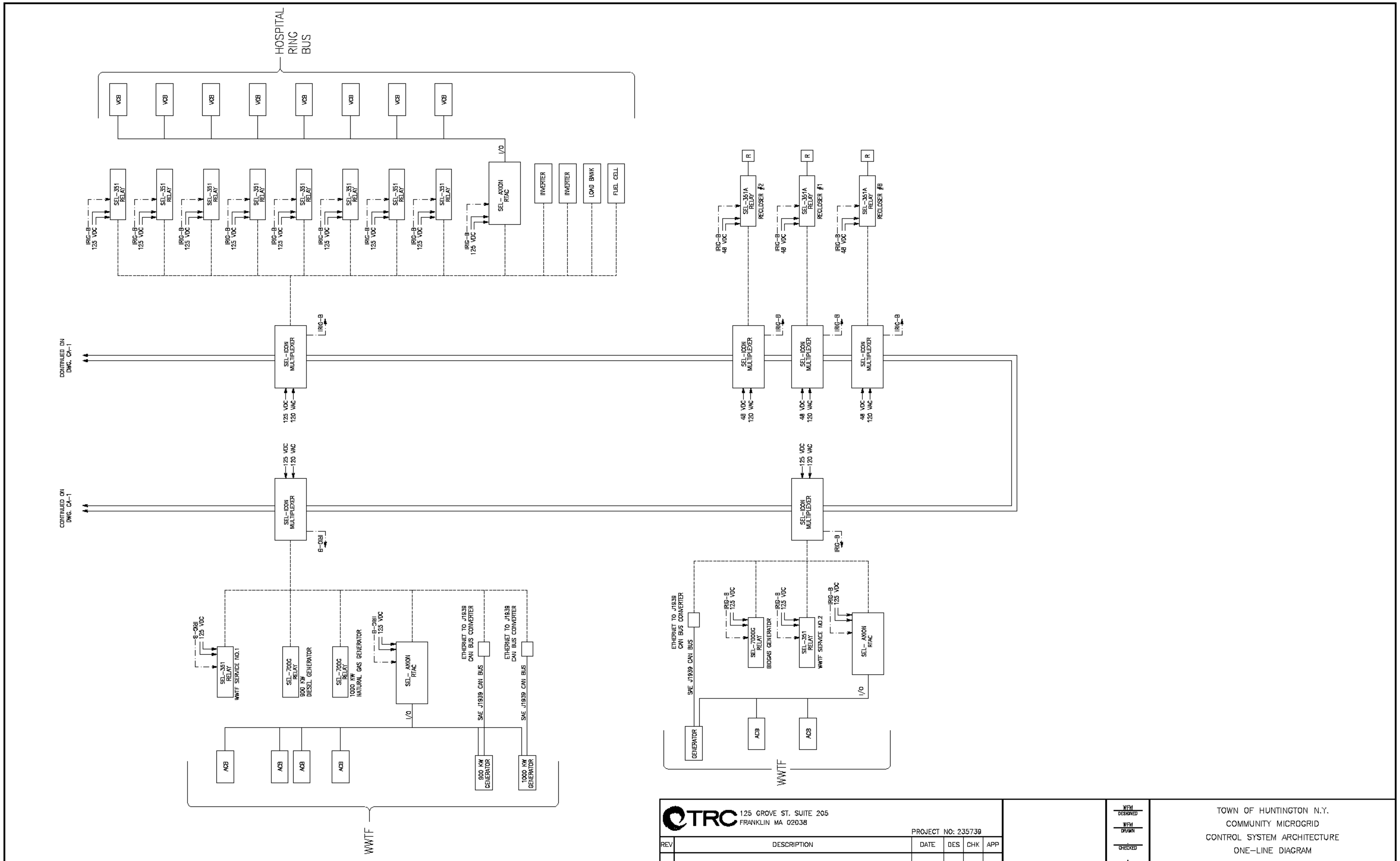
WFM DESIGNED
WFM DRAWN
CHECKED
APPROVED
REVIEW 1
REVIEW 2
2-2-2016 DATE
NOT TO SCALE SCALE

TOWN OF HUNTINGTON N.Y.
COMMUNITY MICROGRID
CONTROL SYSTEM ARCHITECTURE
ONE-LINE DIAGRAM

TRC

CA-1

REV. A



TRC 125 GROVE ST. SUITE 205
FRANKLIN MA 02038

PROJECT NO: 235739

REV	DESCRIPTION	DATE	DES	CHK	APP
A	FOR INTERNAL REVIEW	2-2-2016	WFM	-	-

WFM	DESIGNED
WFM	DRAWN
	CHECKED
-	APPROVED
	REVIEW 1
	REVIEW 2
2-2-2016	DATE
NOT TO SCALE	SCALE

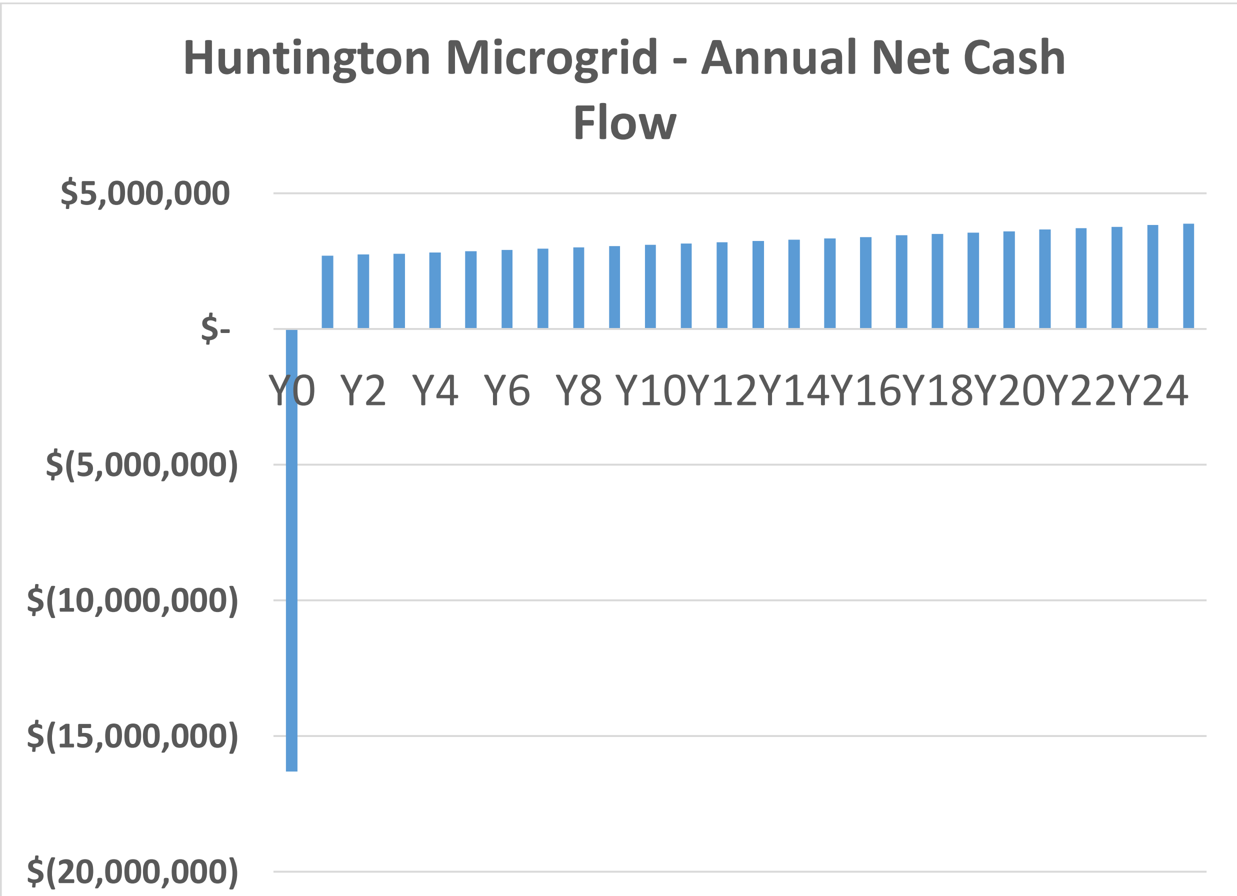
TOWN OF HUNTINGTON N.Y.
COMMUNITY MICROGRID
CONTROL SYSTEM ARCHITECTURE
ONE-LINE DIAGRAM

TRC

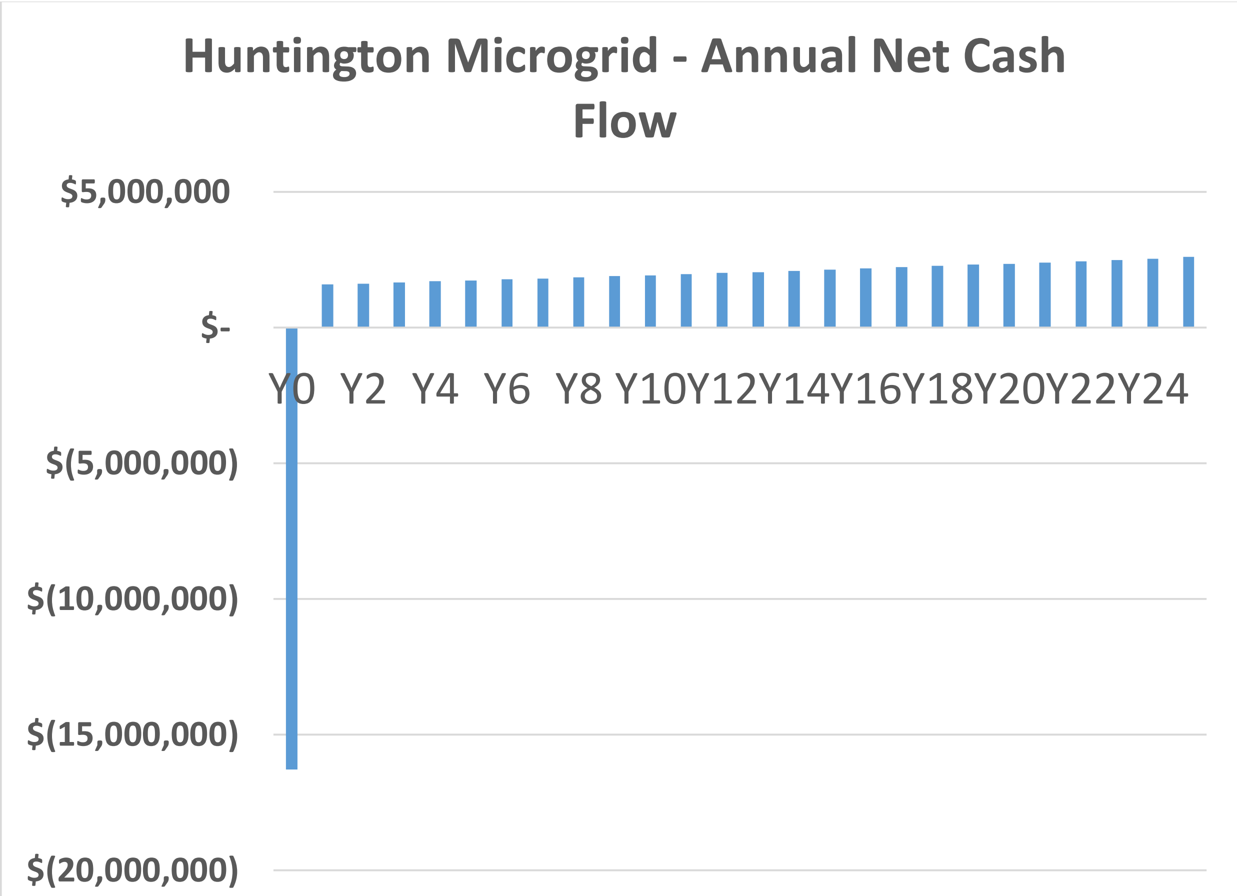
CA-2

REV. A

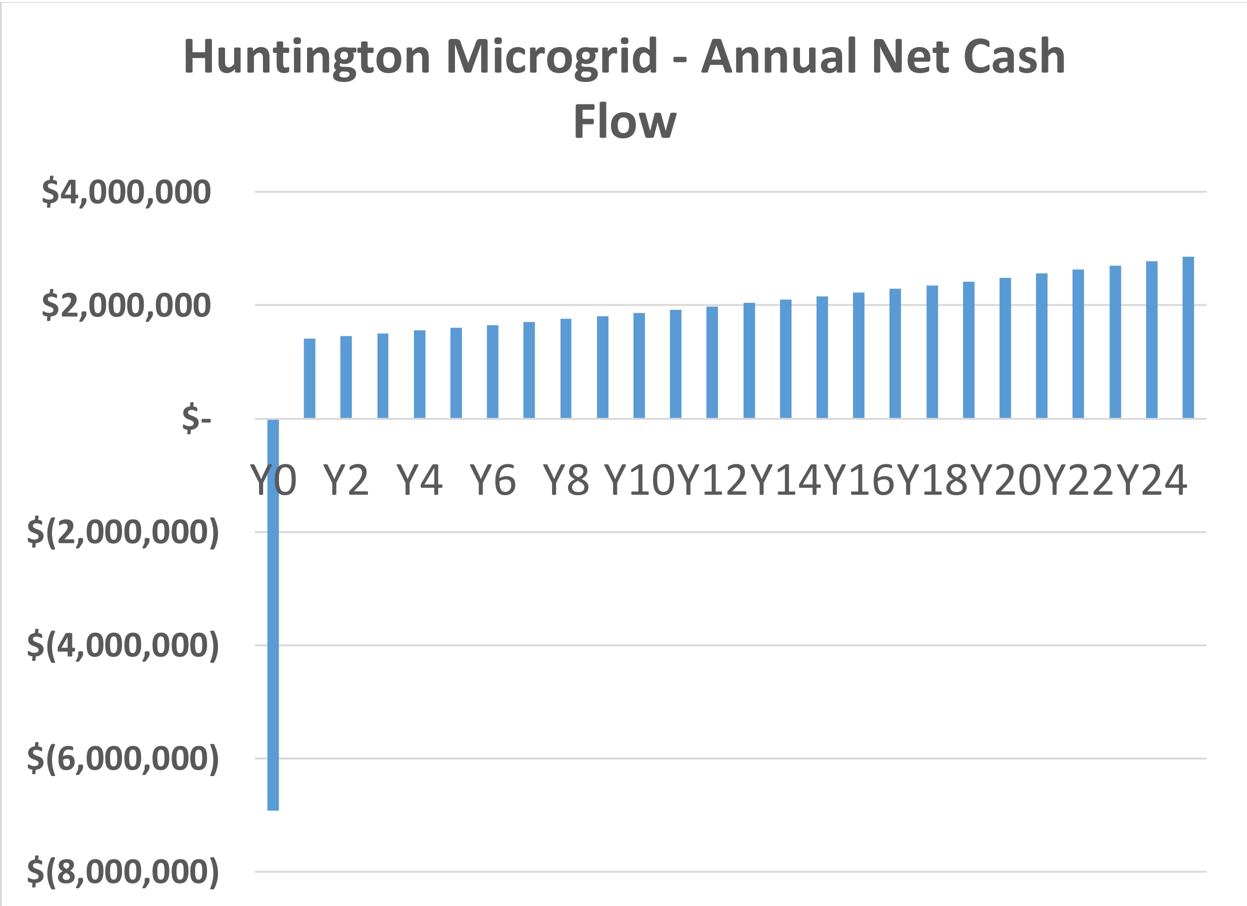
Appendix D: Scenario 1A Cash Flow Diagram



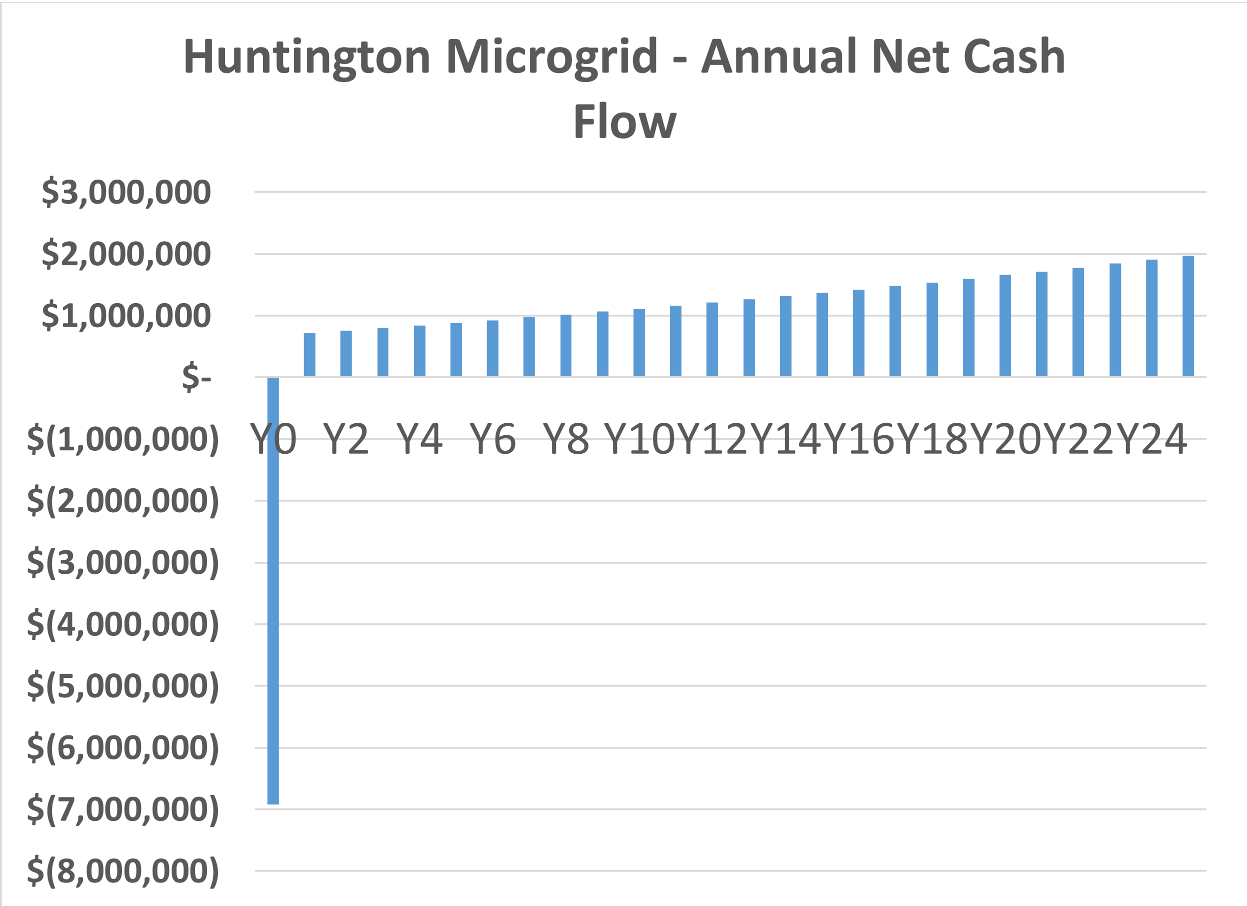
Appendix E: Scenario 1B Cash Flow Diagram



Appendix F: Scenario 2A Cash Flow Diagram



Appendix G: Scenario 2B Cash Flow Diagram



Appendix H: Capital Costs

Description	Function	quantity	Unit Cost	Cost basis[1]	sub total	
Town Hall/ YMCA/ Sr. Center						
Generator No.1 Caterpillar CG-132-8 400 kW, 480V Natural Gas fuel, CHP	CHP unit. Provides power to Microgrid via PSEG primary distribution, CHP provides thermal energy to YMCA Pool heating, and Town Hall steam system.	1	ea	vb	$477,371	
100 kW Beacon Flywheel Storage unit	PV smoothing	1	ea	est	$45,400	
480 volt switchgear	CHP/PV/storage paralleling for Town Hall/YMCA generation	1	ls	vb	$220,000	
Protective relays and RTU	Microgrid communications and control	1	ls	est	$25,000	
2 MVA step up transformer	480V / 13.8 kV generation step-up	1	ea	est	$450,000	
Prefab bulding	Shelter for generator, switchgear & CHP equip.	1	ls	est	$100,000	
excavation and foundations		1	ls	est	$25,000	
power and control wiring		1	ls	est	$80,000	
mechanical piping and insulation	Connect CHP to YMCA and Town Hall	1	ls	est	$200,000	
Senior Center Rooftop Solar		1	ea	est	$700,000	
Solar Carport 1		1	ea	est	$750,000	
Solar Carport 2		1	ea	est	$1,250,000	
					└---->	$4,322,771
WasteWater Treatment Plant						
Generator No.1 Caterpillar CG-132-8 400 kW, 480V 25% digester gas, 75% Natural Gas CHP	CHP generation utilizing digester gas/ Natural gas mix Designed to operate on up to 100% digester gas if availble.	1	ea	vb	$589,450	
Switchgear for Generator No. 2		1	ls	vb	$55,000	
New service entrance switchgear WWTF #2	Provide control of interconnection with PSEG.	1	ls	vb	$55,000	
WWTF #1 new service entrance and paralleling switchgear	Interconnection with PSGE/ paralling of existing 900 kW diesel and new 1,000 kW natural gas generator	1	ls	vb	$165,000	
Protective relays and RTU	Microgrid communications and control	1	ls	est	$30,000	
Generator No. 3 Caterpillar G3516B, 1312 KW, 480 volt, natural gas fuel	Peaking generator non-CHP.	1	ea	est	$1,500,000	
excavation and foundations		1	ls	est	$40,000	
power and control wiring		1	ls	est	$120,000	
mechanical piping and insulation		1	ls	est	$100,000	
					└---->	$2,654,450

Description	Function	quantity	Unit Cost	Cost basis[1]	sub total	
Huntington Hospital						
2.8 MW Fuel Cell	Base load power for microgrid, CHP provides steam to hospital		PPA		$7,500,000	
Mechanical System Interconnection	Connection to Existing Hospital Steam System				$190,000	
Microgrid primary Ring Bus switchgear	Connection of two PSEG primary feeders, Hospital electrical services and fuel cell	1	ls	vb	$480,000	
Energy storage battery/inverter	2 MW inverter charge/discharge capacity 2 MWH battery capacity for peaking and volt/VAR support.	1	ls	est	$1,800,000	
Protective relays and RTU	Microgrid communications and control	1	ls	est	$60,000	
excavation and foundations		1	ls	est	$125,000	
power and control wiring		1	ls	est	$200,000	
mechanical piping and insulation		1	ls	est	$250,000	
					└---->	$10,605,000
New Underground feeder	Connects WWTF to Ring bus at hospital	0.464	$900,000/ mile	est	$417,614	
					└---->	$417,614
Communications and controls						
control hardware	Data historian ,economic dispatch, microgrid controller, event recorder and other miscellaneous servers	1	ls	est	$250,000	
network configuration	configure network, systems integration	1	ls	est	$180,000	
	Microgrid control software	1	ea	vb	$400,000	
					└---->	$830,000
					subtotal	$18,829,835
					Engineering design and permitting	$1,225,382
					15% Contingency	$2,824,475
					Total project budget	$22,879,692