Attachment C

STATEMENT OF WORK
Detailed Engineering Design, Commercialization, Financial and Business Plan Assessment

Contract Title:
Contractor:
Project Number:

DEFINITIONS

1. **The Project** is defined as:

In this detailed engineering design and commercialization, financial and business plan assessment, [enter project sponsor name], along with its partners,[enter municipality name, local utility name, other participant names] shall provide a detailed assessment of microgrid options for [enter community name]. [Describe participating customers, critical public service facilities involved, populations impacted and other key attributes that reasonable characterize the project].

2. **The Project Objectives** are defined as:

The goal of the proposed project is to perform an audit-grade detailed engineering design and commercialization, financial and business plan for building and operating a community microgrid for the purpose of maintaining electric services for the participating customers/facilities and the community at large in [enter community name] at times when weather events or other emergencies severely disrupt the capacity of the local electrical distribution and transmission systems to serve essential customer needs. The proposed project will consist of three phases. The first phase will focus on the microgrid detailed technical design. This will include the distributed energy resources sizing, quantity, and location; identification of all required environmental and regulatory permits; identification of any real property or right-of-way acquisition; identification of the energy efficiency and demand response options; identification of electrical configuration; performance of steady state and transient voltage studies; impact of any renewable generation; system protection strategies, failure mode analysis, optimization analyses; and specification of microgrid communication and controls. This will also include the specification and cost design, including, but not limited to the preparation of cost estimates, system drawings and specifications for the microgrid's distributed energy resources, electric distribution, load management and microgrid communication and controls systems. The second phase will focus on the commercialization, financial, legal and business plans including project development planning associated with the construction, operations and management of the microgrid system. The final phase of the assessment will include a cost and benefit analysis for the final microgrid design.

3. **Contractor** is defined as:

4. **Subcontractors** are defined as:

Additions and/or Substitutes are allowed subject to written approval of Project Manager and formal modification to this Agreement.

Task 0 – Project Management and Progress Reporting

0.0 Responsibility

The Contractor shall provide all project management activities necessary for the performance of this Statement of Work, which shall include the following activities:

a. Coordinate the work of the contractor's employees and those of sub-contractors and equipment vendors that are undertaking tasks described in this Statement of Work;
b. Ensure control over the project budget and adherence to the project schedule; and
c. Provide all project reporting to NYSERDA as specified in this Statement of Work.

0.1 Progress Reporting

The Contractor shall submit bi-monthly progress reports to NYSERDA's Project Manager no later than the 15th of the month following each reporting period. The Progress Reports shall include information on the following subjects, in the order indicated, with appropriate explanation and discussion:

a. Name of contractor;
b. Title of the project;
c. Agreement number;
d. Reporting period;
e. Project progress including a summary of progress, findings, data, analysis, results and field-tests results from all tasks carried out in the covered period;
f. Planned work for the next reporting period;
g. Identification of problems;
h. Planned or proposed solutions to identify problems described in (f) above;
i. Ability to meet schedule, reasons for and solutions to, slippage in schedule;
j. Schedule-percentage completed and projected percentage of completion of performance by calendar quarter-may be presented as a bar chart or milestone chart; and
k. Budget- analysis of actual costs incurred in relation to the budget and analysis of projected costs anticipated in relation to budget.

Deliverable(s): Written Periodic Progress Reports.

0.2 Project Kick-off Meeting

The Contractor shall hold a project kick-off meeting **within thirty days** from the contract execution date. The Contractor shall coordinate with NYSERDA's Project Manager to arrange the meeting at a mutually convenient time and place. The Contractor is encouraged to invite representatives of sub-contractors and equipment vendors, if applicable. The purpose of this meeting shall be to finalize the strategies for accomplishing the objectives of this work. In a timely manner, the Contractor shall submit to NYSERDA's Project Manager a brief report summarizing the issues discussed and decisions made, if any, during this meeting.

Deliverable(s): A brief report regarding the project kickoff meeting.

0.3 Project Completion Meeting

The Contractor shall conduct a project completion meeting, which shall occur within a time period covering **15 days prior to and 15 days following** the submission of the draft Final Written Document.

The Contractor shall coordinate with NYSERDA's Project Manager to arrange the meeting at a mutually convenient time and place.

Deliverable(s): A brief report regarding the project completion meeting.

0.4 Project Metrics Reporting

The Contractor shall submit, to NYSERDA's Project Manager, a prepared analysis and summary of metrics addressing no less than the anticipated energy, environmental and economic benefits that the completed **Detailed Engineering Design, Financial and Business Plan Assessment** anticipates will be realized by the project. All estimates shall reference credible sources and estimating procedures, and all assumptions shall be documented. The Contractor shall make every effort to quantify and document benefits and incorporate them into the Final Report and technology transfer activities as required in this agreement.

Deliverable(s): Written Metrics Report

PROJECT TASKS

The detailed engineering design and commercialization, financial and business plan assessment must fully address a multitude of questions as delineated in the work tasks identified below. The technical analyses shall calculate the energy impacts through sound engineering practices such as modeling or spreadsheets. NYSERDA requires access to view assumptions used in the energy analysis. If utilizing proprietary software or spreadsheets please discuss with NYSERDA an appropriate solution to sharing assumptions and results.

Note: Estimation of the costs and benefits at this stage of the NY Prize competition (Detailed Engineering Design, Financial and Business Plan Assessment) is expected to be accurate within +/- 10%. The emphasis at this stage of analysis is on conducting a detailed, audit-grade engineering design and commercialization, financial and business plan analysis that establishes a compelling basis for competing for the financing, build out and operation of a community microgrid.

Task 1: Develop Detailed Technical Design Configuration and Costs

The Contractor shall conduct a detailed assessment of the technical design and system configurations for the proposed community microgrid in accordance with the following sub tasks:

Task 1.1 Microgrid Capabilities

The Contractor shall demonstrate that the proposed microgrid has the following minimum required capabilities:

- The primary generation source capacity cannot be totally diesel fueled generators.
- A combination of generation resources must provide on-site power in both grid-connected and islanded mode;
- Must be able to form an intentional island;
- Must be able to automatically separate from grid on loss of utility source and restore to grid after normal power is restored;

- 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 hrs per day and 7 days per week utilization of the power produced by these resources.
- 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.
- Include a means for two-way communication and control between the Community Grid 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.
- Provide power to at least one, but preferably more, physically separated 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.
- Must include an uninterruptible fuel supply or minimum of one week of fuel supply on-site.
- Demonstrate that critical facilities, local generation and associated fuel supplies are resilient to the forces of nature that are projected to be typical to and pose the highest risk to the location/facilities in the community grid taking into consideration potential impacts as predicted in the 2011 ClimAID report and 2014 ClimAID update[1]. Describe how the microgrid can remain resilient to disruption caused by such phenomenon and for what duration of time.
- Provide black-start capability.

The Contractor shall indicate to what degree the microgrid includes the following preferred capabilities:

- 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, etc;
    - Include an active network control system that optimizes demand, supply and other network operation functions within the microgrid;
    - Include energy efficiency and demand response options to minimize new microgrid generation requirements; **Note: The contractor shall perform Level II energy efficiency audits and demand response options for all the major loads (ex: commercial and industrial buildings) in the microgrid.**
    - 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);
    - Coordinate with the Reforming the Energy Vision (REV) work to provide a platform for the delivery of innovative services to the end use customers;
    - Take account of a comprehensive cost/benefit analysis that includes, but is not limited to, the community, utility and developer's perspective;
    - 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;

[1] http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Report.pdf and http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAid-Report.pdf

- 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;
- 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.)

- 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.

Task 1.1 Deliverables: Documentation of the work conducted under Task 1.1, Microgrid Capabilities.

Task 1.2 Microgrid Configuration and Design

The Contractor shall provide a detailed written description of the various components of the microgrid as defined below. The components shall include, but are not limited to, distributed energy resources (DER), electric power distribution infrastructure, site and load characterization including fuel specifications, site ambient operating conditions, water and other utility supplies, and associated controls and communications. The documentation shall describe how these components jointly work together in meeting the design objectives and performance criteria of the microgrid. This documentation shall include a description of the systems and sub-systems that are part of the microgrid and shall include descriptions of the sequences of operations and interaction between the various systems. Where possible, the design documentation shall reference the design intent. Design documentation shall include at a minimum, the following elements:

- Reference layout and one-line diagrams, piping and instrumentation, as well as a communications and controls schematics.
- Layout diagram document; that describes:
  - The location of the generating facilities, fuel sources, distribution equipment (e.g., transformers, switches, junction/pull boxes) and critical facilities using United States Geological Services (USGS) topographic map or other professional mapping systems;
  - All equipment and facilities properly labeled for clear cross-reference with the one-line electrical and system piping and instrumentation diagrams.
  - Proposed routing of wires, cables, piping, instrumentation, etc from the generating facility to all critical facilities (including estimated distances in feet);
  - Property lines, easements and boundary of public rights of way;
  - Existing underground and overhead (when applicable) utilities;
  - The point of common coupling recommended by the customer to the utility grid.
- A one-line electrical diagram that includes:
  - The complete microgrid system including all connections to critical facilities all generation sources and electric storage facilities using American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) standard electrical symbols;
  - Points of Common Coupling (PCC) recommended by the customer to the utility grid;
  - Transformer winding configuration and grounding method;
  - Clearly labeled states of all switch positions (ex: N.O./N.C.) when in utility mode;
  - Location and type of isolation switch;
  - Protection and control schemes including circuit breakers, switches and fuses;
  - Protective relaying with all active ANSI/IEEE protection functions shown using numerical designation;

    - Generator grounding connection type and ground resistance in both parallel and island mode;
    - All protection schemes as required in Interconnection Guidelines including but not limited to the following:
        - All instrument transformers (current and voltage) including ratios and polarity;
        - Instrument test and isolation switches;
        - All protection and control relays;
        - Utility revenue meters and instrument transformers including ratio and polarity;
        - Generator metering connections;
        - Panel meters, synchronization meters and synchronizing lights;
        - Supervisory Controls and Data Acquisition (SCADA) transducer connections and locations.
        - Location of the Microgrid Local Controller (MLC) and its connections to generators and switching devices.
- Communications and Controls Schematics that includes, but is not limited to the following:
    - Diagrams showing physical device location cabling and/or antenna mounting using USGS topographic map or other professional mapping systems
    - Drawings showing all interconnected devices, physical transfer medium (ex: copper, fiber, radio), protocols, information being transferred
    - Points of cyber interconnection recommended by the customer to the utility grid
- Piping and Instrumentation Diagrams that includes, but is not limited to the following:
    - Instrumentation and designations
    - Mechanical equipment with names and numbers
    - All valves and their identifications
    - Process piping, sizes and identification
    - Miscellaneous - vents, drains, special fittings, sampling lines, reducers, etc
    - Permanent start-up and flush lines
    - Flow directions
    - Interconnections references
    - Control inputs and outputs, interlocks
    - Interfaces for class changes
    - Seismic category
    - Quality level
    - Annunciation inputs
    - Computer control system input
    - Vendor and contractor interfaces
    - Identification of components and subsystems delivered by others
    - Intended physical sequence of the equipment

<u>Sub Task 1.2.1 Site Characterization</u>

The Contractor shall include documentation on topography, site size, elevation, environmental and ambient conditions, and other site considerations including, but not limited to the following:

- Site ambient weather conditions (outdoor design maximum and minimum, average temperature)
- Site access for heavy equipment deliveries
- Availability of natural gas or any other fuel resources (quantity, pressure, etc)
- Description of existing gas and electric distribution infrastructure (electrical system configuration types involved(e.g. spot network, looped system)
- Municipal services available (water, sewer, etc)

- General building code requirements
- Boundary noise limits
- Elevation above Sea Level
- Relative Humidity
- Design Wind Speed (Uniform Construction Code(UCC))
- Design Wind Exposure (UCC)
- Snow Load (New York Building Code)
- Seismic Coefficients (UCC)
- Design Wet Bulb Temperature

Sub Task 1.2.2 Fuel Specifications

The Contractor shall provide information on the fuel supply (if applicable) for the microgrid project including, but not limited to the following:

- Natural gas component analysis (ex: Methane, Ethane, Sulfur etc.)
- Other fuel types (ex: Diesel, Liquefied Propane, Kerosene, etc)
- Heating value
- Gas supply pressure
- Ignition point
- Theoretical flame temperature (ex: air/fuel ratio)
- Maximum Flame Velocity
- Relative density
- Security of fuel supply

Sub Task 1.2.3 Water and Other Utility Supplies

The Contractor shall document the availability and capacity of the water, sewer and any other utilities supplies necessary for operation of the microgrid including, but not limited to:

- Constituent/Parameter and concentration (hardness, total dissolved solids, alkalinity, minerals, pH etc.)
- Quantity and pressure available
- Sources of effluent
- Sources of supply
- Security of supply

Task 1.2 Deliverables: Documentation of the work conducted under Task 1.2, Microgrid Configuration and Design.

Task 1.3 Performance Criteria

The Contractor shall provide quantitative metrics or performance criteria associated with each objective of the proposed microgrid. This shall include, but not be limited to, characterizing the load that needs to be served by the microgrid, and operational performance of all systems and equipment. The Contractor shall also describe codes and standards and other compliance requirements that are, or are likely to be, applicable to the microgrid operation.

Sub Task 1.3.1 Electrical and Thermal loads to be served by the microgrid

The Contractor shall describe in detail the electrical and thermal loads being served by all/or a part of the microgrid and characterize such loads in terms of how they will be served in islanded mode:

- Critical Facility (a building/load that can never lose power)
- Discretionary Facility (a building/load which may or may not sustain power based on priority during outages)
- No power with islanding (a building/load that does not serve a role in maintaining public health and safety)
- Small/No automation (a load such as a parking lot light that is too small to justify cost of automation)

Sub Task 1.3.2 Quantitative Performance Requirements

The Contractor shall provide quantifiable metrics on the microgrid design and performance, such as:

- Maximum allowable capacity for DERs, such as PV and energy storage
- Allowed voltage and frequency variations in grid connected and islanded modes during normal operations and contingencies
- Transition time from grid-connected to islanded mode after a fault
- Does manufacturers and/or developers have guarantees or warranties on their equipment or systems. Note specific time periods and who is responsible for these warranties. (Distinguish between product and performance warranties)

Sub Task 1.3.3 Codes, Standards and Regulations

The Contractor shall describe all codes, standards and regulations that are or may be applicable to and impact on the operation of the proposed microgrid such as, but not limited to, the following:

- Applicable building codes
- ASME codes & standards
- ANSI/IEEE/IEC codes & standards
- FCC Codes and Standards
- OSHA and NYS Department of Health
- NERC and Utility Interoperability & Cyber Security
- NYISO Interconnection Standards, Methods & Procedures
- Utility Electric Transmission and Substation Design Standards
- Utility Gas Transmission, Metering & Regulating Station Standards
- National Fire Prevention Code
- NOx, SO2 and CO2 emission limits
- Proposed control technology(s) if known
- Potential NSR, NESHAP, SIP impacts
- NYS DEC regulations

Task 1.3 Deliverables: Documentation of the work conducted under Task 1.3, Performance Criteria.

Task 1.4 Distributed Energy Resources Analysis

The Contractor shall provide detailed documentation that describes the Distributed Energy Resources (DER) that comprise all or a part of the project microgrid configuration and document how such resource(s) interact(s) with the balance of microgrid system components, including, but not limited to, the characteristics identified below by resource type. The Contractor shall describe for each DER in the project, weather enclosure and any other needs for infrastructure hardening. Such description shall include, but not be limited to, documentation demonstrating that critical facilities, local generation and associated fuel supplies are resilient to the forces of nature that are typical to and pose the highest risk to the location/facilities in the community microgrid including the potential impacts as predicted in the

2011 ClimAID report and 2014 ClimAID update[2]. Include documentation of any past and future measures that will improve the electrical infrastructure's resiliency to inclement weather and environmental conditions. This DER shall include, but not be limited to:

Solar - Photovoltaic

Site Characteristics
- Location, approximate area

Module Types
- Power output (DC/AC), AC Voltage, Type of panel, Design isolation, Tilt angle limitations
- Mounting and tracking system requirements, foundation requirements.

Inverters
- Peak output rating (KW), Nominal AC voltage, Power factor, Efficiency (MMPT)
- Single phase/three phase, Allowed total harmonic distortion (for example, THD <5%)
- Operating temperature range, Reactive power capability and sizing

Controls
- List of control functions performed by the controller, Curtail able power output
- Plant power factor control capabilities, Start/stop of equipment

Communication
- Type of communication technology (Fiber/wireless), Communication protocol
- Hardware for data collection and communication to the central SCADA server

Integration with Microgrid
- Commands received from the microgrid controller
- Data/information exchanged with the microgrid

Reciprocating Engine

Electrical Performance
- Standby and continuous ratings, Voltage, Power factor

Engine
- Engine type / design, Governor capability, Emission characteristics /controls

Alternator
- Alternator Design, Excitation system type (ex: brushless), Short-circuit capability

Controls
- Automatic remote starting/stopping, Frequency and voltage regulation, Isochronous and droop operation , Protection, Metering

Communication
- Type (ex: RS232, Modbus, etc)

Integration with Microgrid
- Commands received from the microgrid controller, Data/information exchanged with the microgrid, Operating requirements under different conditions

Gas Turbine

Electrical Performance
- Continuous rating, Voltage, Power factor, Start-up time, Part-load characteristics

[2] http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Report.pdf and http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAid-Report.pdf

- Ramp rates, Black start capability

Turbine
- Engine design, Governor capability, Emission characteristics / controls, Multi-Fuel capability

Generator
- Generator Design, Excitation system type (ex: brushless), Short-circuit capability

Controls
- Automatic remote starting/stopping, Frequency and voltage regulation, Isochronous and droop operation, Protection, Metering

Communication
- Type (ex: RS232, Modbus, etc)

Integration with Microgrid

Commands received from the microgrid controller, Data/information exchanged with the microgrid, Operating requirements under different conditions

Microturbine

Electrical performance
- Power output, Voltage, 3-phase/single phase, Frequency, Target efficiency

Fuel requirements
- Inlet pressure

Emission requirements

Required operating modes: (ex: Grid-parallel, dual-mode, or grid-isolated electrical generation)

Integration with Microgrid
- Commands received from the microgrid controller, Data/information exchanged with the microgrid, Operating requirements under different conditions

Fuel Cell

Electrical performance
- Power output, Target efficiency, Output Voltage, Output Frequency

Fuel requirements
- Input fuel pressure requirements

Water consumption requirements

Emission requirements

Integration with Microgrid
- Commands received from the microgrid controller, Data/information exchanged with the microgrid, Operating requirements under different conditions

Combined Heat and Power (CHP) System

Heat Recovery
- Exhaust temperature, Exhaust flow, Pressure, Available heat energy, Efficiency

Heating Hot Water System
- Hot water temperature, pressure and velocity

Chemical treatment system

Cooling water system

Piping and Instrumentation systems

Battery / Energy Storage

Sizes and ratings of the battery and PCS Inverter

- Power and Energy Rating, Voltage and current ranges, Target Roundtrip Efficiency ratings, Maximum ramp rate requirements, Maximum charge and discharge rates, Number of hours the system can operate at rated power , Power quality and voltage and current harmonic distortion levels

Required Operation Modes:

- Self-maintenance mode, standby mode, shutdown mode, islanding mode

Control and communications characteristics and capabilities

- Active power control, reactive power control, frequency and voltage control modes, high-voltage and low-voltage ride through, auto island functionality with synchronization back to grid, black start capability

Protection requirements
Grounding arrangements
Metering and monitoring
Integration with Microgrid
Commands received from the microgrid controller, Data/information exchanged with the microgrid,
Operating requirements under different conditions

Uninterruptable Power Supplies (UPS)

System Capacity - sufficient ampere-hour rating to maintain UPS output at full capacity

- Battery Capacity
- AC Input
  - Voltage (line-to-line), Number of phases, Voltage Range, Frequency
  - Total harmonic current distortion (primary line)

AC Output
General Description: Rectifier/charger unit, inverter, transformers, synchronizing equipment, input and output circuit breakers, and accessories as required for operation
Integration with Microgrid

- Commands received from the microgrid controller
- Data/information exchanged with the microgrid

Operating requirements under different conditions

Demand Response, Building, Energy and Lighting Management Systems

Type of Heating Ventilating and Air Conditioning (HVAC) system and demand response strategy for HVAC such as thermostat set-point adjustment, smart cycling etc.
Lighting fixtures and lighting control strategy employed such as wireless advanced lighting control systems or centralized dimming control system
Load shedding priority for demand response
Protocol for communication (ex: OpenADR) with the utility and rest of the microgrid
Protocol for communication (ex: BacNet) with building end-use equipment and wireless communication technologies (ex: WiFi, ZigBee)

Task 1.4 Deliverables: Documentation of the work conducted under Task 1.4, Distributed Energy Resources Analysis.

Task 1.5 Distributed Energy Resources Design

The Contractor shall provide the sizing and design for the DERs such as electrical generators, energy storage devices, Combined Heat and Power (CHP) systems, and Demand Response (DR) that are a part of the microgrid including information on the design procedures and tools used to evaluate the economic and technical feasibility of DER technology options considered. The Contractor shall provide the inputs and assumptions used in the analysis included, but not be limited to the following:

- Load profiles for non-curtail able and deferrable electrical and thermal loads
- Data for existing and proposed DERs and their source
  - Economic parameter (capital, fixed and variable Operation and Maintenance (O&M) costs)
  - Thermal Resource
    - Fuel costs
    - Heat rates for thermal plants
    - Emission characteristics
  - Hydro Resource
    - Stream flow or other information
  - PV and Wind Resource
    - Hourly profiles for PV and wind generation, data sources, if applicable
  - Electric Storage Resource
    - Efficiency, maximum charge/discharge rate, minimum and maximum state of charge, etc.
  - Demand response (Percentage of loads that can be curtailed, scheduled etc.)
  - Utility tariff (for grid-connected mode)
  - Other assumptions (electricity price in grid-connected mode, operating reserves, economic modeling assumptions etc.)

The Contractor shall provide supporting analysis that shows the adequacy of the DERs and thermal generation resources to continuously meet electrical and thermal demand during steady state operations.

Sub Task 1.5.1 Variable Output Resources

The Contractor shall show how variations in generation can be accommodated during steady state operations. If a variable generation source such as PV with a smart inverter is included as a part of the microgrid, the effect of the smart inverter functions within the steady-state analysis shall be documented. If energy storage is a part of the microgrid, storage system response (charge and discharge operations) shall be described.

Sub Task 1.5.2 CHP and Dispatchable Resources

The Contractor shall provide information pertaining to the modeling applied and data used in determining the size and capabilities of chosen resource options as follows:

- Information on the design procedures and tools used to design a CHP system, if applicable
- Detailed description of the dynamic modeling, including a description of the model used, key input assumptions, sensitivity runs, and model validation comparing modeling results with actual equipment performance, where possible.
- Summaries of individual case simulations along with detailed output reports underlying the summaries. Assessment of the relative accuracy for bandwidth/confidence interval of the modeling results.
- List of major thermal equipment and other gas consuming appliances existing within microgrid facilities.

- Documentation of data analysis employed to quantify thermal loads – using facility specific details, gas consumption, and Building Management System data, including any correlations to predict thermal loads as a function of outdoor temperature as well as weekly and daily operating patterns
- Present data indicating the relationships that determine the daily and hourly variations in thermal requirements across twelve (12) consecutive months
- Potential for CHP applications using combined thermal and electric load data – include several options for detailed dynamic system modeling
- Required and available space and physical electrical and thermal connections required for the CHP asset(s)
- Result from thermodynamic modeling used to develop the cycle design basis, heat and materials balances, and operating performance data forecasts for the CHP asset
- Ability for the CHP asset(s) to meet the following requirements/limitations:
  - Existing/planned fuel and electrical infrastructure
  - Efficiency requirements
  - Physical size limitations
  - Noise limitations
  - Emissions requirements
- Inputs and assumptions used in the analysis, such as
  - Recent, energy gas and electric bills.
  - Current and projected gas (or other fuel) and electric rates.
  - average hourly use patterns for each type of energy (on a seasonal basis if appropriate) with thermal energy uses segregated by type/quality (e.g., temperature, pressure, form [steam, hot water, hot air])
  - tables and/or graphs showing daily and annual use profiles for each form of energy (e.g., electric/steam/hot water/chilled water)
  - description of computer modeling methods used

Sub Task 1.5.3 Energy Efficiency (EE) and Demand Response (DR) Design Analysis

The Contractor shall document analyses showing baseline energy use characteristics of the building(s) such as non-coincident peak load, energy usage, energy intensity (ex: energy/sqft) by type of end use such as heating, cooling, lighting and other end uses. The Contractor shall describe all options to reduce building loads through energy efficiency as well as load shedding or other demand response schemes and their relationship to chosen distributed generation options. Such documentation shall include, but not be limited to, calculations showing load reductions assumed from energy efficiency, including loads shed by dimming lights and other lighting control measures, loads shed by cycling HVAC units and other HVAC demand response measures and loads shed by cycling refrigeration units and other refrigeration demand response measures. The Contractor shall describe how generation and demand-side resource options will be coordinated.

Task 1.5 Deliverables: Documentation of the work conducted under Tasks 1.5, Distributed Energy Resources Design.

Task 1.6 Power Distribution Systems Design
The Contractor shall design and specify all electrical distribution system components and equipment. The electrical distribution systems shall include, but not be limited to:

Power Distribution Equipment:

- Feeders (Overhead, Underground)

- Grounding Equipment
- Voltage Transformers
- Current Transformers
- Voltage Regulators
- Inverters
- Disconnects
- Manual, Automatic Transfer Switches
- Relays
- Capacitors
- Chokes/Inductors
- Harmonic Filters
- Meters (various)
- Sensors (various)

Power Distribution System Controls and Protection Equipment:

- Switch Gear
- Switches
- Circuit Breakers
- Protective Relays
- Reclosers
- Fuses
- Surge Arrestors
- Lighting Arrestors
- Transient Overvoltage Surge Suppressors

The Contractor shall identify and provide information on all electric distribution components and equipment that will be a part of the microgrid infrastructure, including basic system components, protection equipment, and meters and sensors as described in the subtasks below. Such documentation shall include pre-existing as well as new planned components. Include the following information in your design, as applicable, while describing the design of each component and how it interacts with the rest of the system.

<u>Sub Task 1.6.1 Power Distribution Equipment</u>

The Contractor shall provide information on basic equipment ratings, ranges, and specifications (vary by equipment):

- Voltage (input, output, control, operating, etc.)
- Current
- Frequency
- Reactive power
- Discharge current
- Capacitance
- Losses
- Thermal characteristics
- Electrical configuration
- Mechanical components
- Installation arrangement
- Other

The Contractor shall, where applicable, provide information on the functional specifications for control requirements.

- Bidirectional power flow control
- Reactive power support
- Power factor correction
- Ride-through (voltage, frequency)
- Harmonics mitigation
- Smoothing functions
- Peak power limiting
- Other

The Contractor shall, where applicable, document any non-standard and/or developmental features and requirements needed for microgrid operation.

Sub Task 1.6.2 Power Distribution System Controls and Protection Equipment

The Contractor shall provide information on the following equipment ratings, ranges, and specifications for that equipment selected to be used in the microgrid (vary by equipment):

- Voltage
- Current
- Reactive power
- Discharge current
- Capacitance
- Thermal characteristics
- Other

The Contractor shall, where applicable, provide information on the functional specifications for control and protection requirements that address the following:

- BIL
- Fault Withstand Capability
- Response time
- Surge capacity
- Breaking capacity
- Thermal characteristics
- Electrical configuration
- Mechanical components
- Installation arrangement
- Other

The Contractor shall document any non-standard and/or developmental features and requirements needed for microgrid operation.

Sub Task 1.6.3 Meters and Sensors

The Contractor shall provide a description of the design of metering and sensors required for the microgrid system, that includes documentation on how this equipment interacts with the balance of system components including, but not be limited to the following:

The Contractor shall provide information on basic specifications for monitoring requirements

- Meter/Sensor Type
- Data type(s) collected

- Data resolution
- Accuracy
- Sensitivity/Precision
- Other

The Contractor shall provide information on the functional specifications for communications requirements

- Communication protocol
- Data logging features
- Response time
- Reliability
- Alarms
- Other

The Contractor shall document any non-standard and/or developmental features and requirements needed for microgrid operation.

Task 1.6 Deliverables: Documentation of the work conducted under Task 1.6, Power Distribution Systems Design.

Task 1.7 Microgrid Control Functionality

Sub Task 1.7.1 Functionality

The Contractor shall conduct analyses on design options for the microgrid. These options should cover all the key controls and management capabilities of the microgrid under normal operations, as well as during disturbances. These operational scenarios shall cover capabilities including, but not limited to the following:

- Balancing supply and demand on different time-scales in islanded and grid-connected modes
- Management of energy storage in real time
- Demand side management such as load shedding and shifting
- Active and reactive power management of supply-side resources in different time scales
- Seamless transition or black start for loss of connection with the main grid
- Microgrid operation for loss of gas supply to the DERs
- Islanding and resynchronization with the main grid
- Provision of ancillary services

The Contractor shall also develop a sequence of operations to meet the microgrid's design intent and the options provided above. The sequence of operation should describe the response times and the interactions between the components of the microgrid for each case developed.

Task 1.7 Deliverables: Documentation of the work conducted under Tasks 1.7, Microgrid Controls Functionality.

Task 1.8 Microgrid Controls and Communications Design

The Contractor shall design the controls and communication functions of the microgrid controls identified in Task 1.7 Functionality, including, but not limited to, those functional areas identified in the sections below, the Contractor shall elaborate on the role of the controls and how it interacts with the rest of the system using system block diagrams, data flow diagrams, or control sequence diagrams

where possible to explain the operation of the microgrid controller. The Contractor shall outline any needs for controls and communication infrastructure hardening and describe in detail past and future measures that will secure the electrical infrastructure's resiliency to the forces of nature (inclement weather and environmental conditions) that are typical to and pose the highest risk to the location/facilities in the community grid including the potential impacts as predicted in the 2011 ClimAID report and 2014 ClimAID update[3] . Such document shall include a description of all pre-existing and new equipment, actions, and protocols.

Sub Task 1.8.1 Microgrid Monitoring and Protection

The Contractor shall document how the microgrid controller will monitoring system conditions including, but not limited to the following:

- Requirements for monitoring microgrid load, DERs and the status of the power distribution network, such as voltage, frequency etc.
- Requirements regarding data logging and alarm functions.
- Requirements regarding how long the data should be archived and stored.
- Requirements for coordination of protection settings.

Sub Task 1.8.2 Fault Response

The Contractor shall describe requirements regarding how the controls will sense faults in the microgrid and act/perform during and immediately after a fault including, but not limited to the following:

- Requirements on how the controller senses the microgrid voltage and frequency aberrations.
- Requirements regarding specific actions to be performed by the controller to correct faults, such as opening breakers to non-critical loads.
- Requirements regarding specific actions to be performed by the controller when restoring loads after a fault such as closing breakers in a priority order and maintaining stability of the grid.

Sub Task 1.8.3 Voltage and Frequency Control

The Contractor shall provide information on how the controls will monitor and regulate voltage and frequency of the microgrid including, but not limited to the following:

- Requirements regarding the voltage and frequency range to be maintained by the controller under normal conditions and after a fault, if different from ANSI standards.
- Requirements for alarms when voltage and frequency are outside the range.
- Requirements regarding actions to be performed by the controller (such as changing VARs from DERs, islanding and load shedding etc.) when voltage and frequency are not within the range.
- Requirements for how quickly the voltage and frequency deviations should be corrected.

Sub Task 1.8.4 Switchgear Management

[3] http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Report.pdf and http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAid-Report.pdf

The Contractor shall describe controls capabilities with respect to switchgear operations, the conditions under which switchgear needs to be operated and the speed of their operation.

Sub Task 1.8.5 Transition to Island Mode

The Contractor shall describe the microgrid system's controls capabilities required for seamless and non-seamless transition to islanded mode including, but not limited to the following:

- Requirements on how the controls will manage load and DERs for a seamless and non-seamless transition to islanded mode
- Requirements on how the controls will command the operation of DERs in transition to islanded mode
- Requirements regarding the sequence of load shedding and DER operations for non-seamless transition
- Requirements regarding the sequence of operations prior to and after a seamless transition.
- Requirements on how the microgrid controls with interact with DER controls and smart inverters in transition from grid-connected to islanded mode to maintain frequency and voltage

Sub Task 1.8.6 Black Start Sequence

The Contractor shall provide information on control capabilities for black start including, but not limited to the following:

- Requirements on how the low voltage network is energized using DERs
- Requirements regarding the sequence of operation of controllable generators and energy storage devices
- Requirements regarding the sequence of connecting controllable loads
- Requirements for synchronizing remaining generators and load pickup.

Sub Task 1.8.7 Island Mode Operation

The Contractor shall provide documentation on control capabilities required for operation in islanded mode including, but not limited to the following:

- Requirements on the sequence of generator operations for balancing load and generation.
- Requirements on demand side management and load shedding for balancing load and generation.
- Requirements on how the microgrid controls interacts with BMS and LCS, energy storage etc. during island mode

Sub Task 1.8.8 DER Optimization and Dispatch

The Contractor shall provide information on the capabilities of the microgrid controller to optimize and dispatch DER, Demand Response (DR) and other microgrid resources including, but not limited to the following:

- Requirements for load, renewable generation and electricity price forecasting.
- Requirements for maximizing the use of green energy.
- Requirements for integrating energy storage in the optimization and dispatch.

- Requirements for optimizing voltage settings for regulators and capacitors for minimizing losses.

Sub Task 1.8.9 Energy and Ancillary Service Market

The Contractor shall provide information on capabilities of the microgrid controller to enable participation in the New York Independent System Operator(NYISO) energy and ancillary service market including, but not limited to the following:

- Requirements for the microgrid controls to communicate with NYISO market system.
- Requirements for the microgrid controls to calculate bid prices for energy and ancillary services.
- Requirements for the microgrid controls for settlement support.

Sub Task 1.8.10 Communications Infrastructure

The Contractor shall describe communication functionality necessary for the safe and reliable operation of the microgrid including identifying communication equipment on the layout diagram and include a communications schematic including, but not limited to the following:

- Requirements for the microgrid controls or microgrid-attached components to interface with existing area networks
- Requirements for the microgrid controls or microgrid-attached components to interface with existing Advanced Metering Infrastructure (AMI) systems
- Requirements for the microgrid controls or microgrid-attached components to interface with existing wide area or backhaul networks
- Requirements for the microgrid controls or microgrid-attached components to support specific communications protocols or transport level data models

Sub Task 1.8.11 Integration with External Systems

The Contractor shall identify and describe the allowed communication protocol(ex: IP, DNP3, MODBUS, OPC, IEC 61850 etc.) for each controller and the commands to be exchanged (ex: for PV controller - low voltage ride through, frequency ride through, volt/VAR control, and frequency droop compensation commands to the Solar PV systems). Such description shall include a detailed narrative of how the microgrid controls will interface and communicate with the other controllers in the microgrid including, but not limited to the following:

- Building Management Systems
- Energy Management Systems
- Lighting Management Systems
- Distribution Management Systems
- Protective relays
- Photovoltaic controllers
- Fuel Cell controllers
- Energy Storage controllers
- CHP controllers
- Diesel generator controllers
- Load controllers
- Fire alarm systems
- SCADA

- Energy Market Systems, Energy Aggregators

Sub Task 1.8.12 Cyber-Security

The Contractor shall provide a detailed narrative describing cyber-security requirements including, but not limited to the following:

- Requirements with respect to security architecture and design
- Requirements(federal and State) for distributed energy resource providers to protect sensitive data
- Specific access control requirements, human and machine authentication and authorization
- Specific encryption requirements
- Specific physical security mechanisms

Sub Task 1.8.13 Hardware and Software Requirements

The Contractor shall provide a detailed narrative on the hardware and software requirements listed below for the microgrid controls including, but not limited to the following:

- Computers and servers
- Redundancy requirements
- UPS backup
- Operating system
- Monitors and peripherals
- Microgrid Administration and Configuration application
- Microgrid monitoring and control application
- Software Developer and integration toolkits
- Microgrid Energy Management System (MGEMS)

Sub Task 1.8.14 Application Requirements

The Contractor shall provide a detailed narrative of any specific application requirements including, but not limited to the following:

- Requirements regarding Human Machine Interface HMI requirements such logging, interactive help, alarming and system administration
- Requirements regarding visualization tools to visually monitor and control the microgrid.
- Requirements for historian and data storage. Specification regarding historian (ex: OSI Soft Pi Historian). Specifications with respect to scan rates, data archiving, event log etc.
- Requirements for specific screens for displaying of each component. Example, for LV Switchgear (Switchgear status, individual phase and ground currents, phase-to-phase and phase-to-neutral voltages, VARS, PF, Frequency, watts, watt demand, watt hours)
- Requirements for microgrid model for offline simulation

Task 1.8 Deliverables: Documentation of the work conducted under Tasks 1.8, Microgrid Controls and Communications Design.

Task 1.9 Microgrid Load Analysis

The Contractor shall perform a power quality analysis as well as load characterization to characterize the load served by the microgrid in islanded and grid-connected mode. This analysis should show that the power quality supplied by the microgrid will adequately serve critical loads. These results should also be used as a condition to determine when to island. The Contractor shall provide all the relevant data and analysis related to the electrical and thermal loads to be served by the microgrid including, but not limited to the following:

- Review of recent energy, gas and electric bills
- Review of current and projected gas (or other fuel) and electric rates.
- Provide sub-hourly profile (usage pattern) for the thermal and electrical loads served by the microgrid for one year (or typical one-week period by season) in grid-connected and islanded modes
- Provide any information on the load served by the microgrid, such as critical loads that need to be served, discretionary loads, curtailable loads and DSM
- Provide detailed information on the breakdown of energy usage, such as:
    - motor/inductive loads
    - heating and cooling
    - incandescent lighting
    - florescent/LED lighting
    - switch-mode power supply
    - For thermal loads - temperature, pressure, form (steam, hot water, hot air)
    - others
- If large motors are a part of the load, perform motor starting analysis
    - Inventory motors over 1 HP
    - Calculate starting current for large motors
    - Document operating schedules of motors
    - Calculate maximum possible starting current requirements
    - Otherwise, provide rationale on why such a study is not required
- Design a load shedding scheme
    - Perform steady-state power quality studies to evaluate the requirements at the point of common coupling (PCC) with customer-specified requirements for grid connected and islanded operations.
    - Provide a description of how the non-essential loads will be shed while going from grid-connected to islanded mode.
    - Finalize the priority of load shedding in islanded mode

Task 1.9 Deliverables: Documentation of the work conducted under Task 1.9, Microgrid Load Analysis.

Task 1.10 Power Distribution System Modeling and Simulation

The Contractor shall perform the required analysis pertinent to its project and describe why certain elements of modeling and simulation including, but not limited to the following:

<u>Sub Task 1.10.1 Steady-state Load Flow Analysis</u>

The Contractor shall perform a load-flow analysis assessing system behavior of a microgrid system during grid tied and islanded modes. Analysis should verify adequate equipment ratings and show that no voltage or thermal overload conditions occur during grid tied and islanded modes. The Contractor shall perform steady-state thermal, voltage, and frequency analyses using the power flow or a comparable program for summer and winter peak load conditions in the microgrid. The Contractor shall

provide all steady-state power flow simulations and modeling results for each category listed below to ensure all issues have been adequately addressed.

- Provide information of the steady-state models (DER device/feeder level). This will be used to establish baseline characterization and line and equipment loading
- Perform steady state simulation of the response of DER and microgrid controller during normal operations (grid tied and islanded mode). Document the generation and load matching capabilities of DER during normal operations (grid tied and islanded mode).
- Document maximum voltage drop (or rise) caused by DER along the distribution feeder during grid tied and islanded modes and for heavy and light loads.
- Document voltage and frequency control capabilities of the distribution feeder during grid tied and islanded modes.
- Provide results of steady-state calculations to corroborate the ratings of the electrical infrastructure.
- Performance steady state simulation to observe and document compliance with prevailing standards to maintain the voltage according to ANSI C84.1-2006 standards — specifically, the required voltage range for microgrid islanded steady-state operation is 0.95 per unit (pu)<V< 1.05 pu at the PCC
- Describe the ability of the DER to control system voltage including multiple generators operating in parallel per standards.
- Perform a steady state simulation to observe and document frequency compliance with prevailing standards and ability to maintain the frequency in the range 59.3 Hz < f < 60.5 Hz — a range consistent with the frequency range for an area EPS and suitable for most loads — barring customer-specific requirements that may override this range
- Assess the impact of the microgrid on distribution system losses at point of interconnection in both grid-tied and islanded modes.
- Assess the impact of the microgrid on distribution system power factor in the study area at point of interconnection in both grid-tied and islanded modes

Sub Task 1.10.2 Short Circuit and Protection Analysis

The Contractor shall analyze how the proposed microgrid will provide required short circuit protection in both grid-connected and islanded states. This shall include the development of microgrid protection requirements within the Point of Common Coupling (PCC) with the utility and will need to be guided by the following three general principles, in order of priority:

- Prevent injury to personnel and ensure public safety.
- Prevent or minimize equipment damage.
- Minimize loss of load within the above identified constraints.

The Contractor shall conduct a Short Circuit analysis to evaluate the impact on system protection and demonstrate adequacy of existing circuit breakers, other fault current interrupting devices, and related equipment within the study area. Based on the protection studies conducted by the Contractor, the electrical distribution system upgrades, as well as additional switchgear modifications in terms of types and placement within the microgrid, shall be identified. The Contractor shall identify key parameters that will be metered and monitored (ex: voltage, frequency, real power, reactive power current, switch status points, relay status points, etc.). This analysis shall be performed in accordance with the serving utility's protection and interconnection requirements. This analysis shall address, including, but not limited to the, issues identified below:

- Provide detailed information on the transformer connections[4] and the models that will be utilized.
- Identify the DER types (inverter or synchronous based) and document the models utilized for the analysis
- Provide results of short-circuit calculations that:
  - Determine the magnitude of fault current
  - Identify fault detection means within the microgrid
  - Identify overvoltage and over current sensing capabilities
  - Evaluate adequacy of protection devices (i.e. breakers, fuses, recloses, switches) to protect key circuit components and limit the extent of a grid outage
  - Determine the appropriate coordination and settings for protection devices
  - Microgrid system impacts to different fault types
  - System protection coordination for all operating modes.
  - Investigate the impact of reverse power flow, increased clearing times, and increased fault magnitudes from the use of certain variable DER (e.g. PV)
- Provide documentation/analysis that the following issues have been considered and addressed:
  - Unintentional islanding
  - Back-feed energization. Detection and clearance of all faults normally detected and cleared by the area electric power system (EPS) protection system e.g. downed conductors, open conductors, ground faults, etc.
  - Energization outside microgrid boundaries
  - Effective grounding for all operating modes, compatibility with utility system and effective detection
  - Temporary Overvoltage

Sub Task 1.10.3 System Dynamics study

The Contractor shall conduct dynamic stability and response analysis for summer peak and light load conditions to determine the impact of the microgrid during islanded mode. These studies shall be performed to demonstrate voltage and control, load-frequency control, and load-rejection as a result of voltage and frequency variations. These studies shall evaluate the performance of the system for contingencies, and address issues including, but not limited to, transient stability, dynamic stability (i.e. damping), critical clearing time, coordination of protection and control systems, and performance of any special protection devices that may be affected. The objective of these analyses is to characterize the level of distribution support provided by the microgrid and the impact of these technologies on interconnected distribution systems in both a short and long duration basis.

The Contractor shall provide any modeling and simulation results for each area of interest listed below; ensure all issues listed under the area of interest have been adequately addressed. The Contractor shall provide the test cases used to test adequate system capabilities and performance.

- Show the adequacy of the DERs and thermal generation resources to continuously meet electrical and thermal demand during steady state and dynamic operations.
- Identify equipment required to ensure safe and efficient operation under steady state, startup, shut down, and transient operations
- Include a detailed description of the dynamic modeling, including a description of the model used, key input assumptions, sensitivity runs, and model validation comparing modeling results with actual equipment performance, where possible.

- Include both summaries of individual case simulations along with detailed output reports underlying the summaries. Assess the relative accuracy for bandwidth/confidence interval of the modeling results.
- Develop a dynamic simulation model that can be used to validate and optimize the operational and control system design.

Sub Task 1.10.4 Grid Synchronization

The Contractor shall provide documentation describing the approach for synchronization (e.g. active sync, sync check, open transition), describing the equipment that would be needed to achieve safe synchronization, describing the microgrid's ability to protect both utility and microgrid equipment during synchronization, and describe the microgrid's ability to control voltage, frequency, and phase angle- pursuant of IEEE 1547-2003. The Contractor shall conduct an islanding study that demonstrates the ability to island and transition that addresses the following:

- Describes how desirable islanding conditions (e.g. microgrid failure) are detected.
- Demonstrates how disconnect and reconnect switching protocols for transitioning will be carried out (manual or automatic).
- Evaluates additional electrical infrastructure required for automatic operations. (For example, can isolation be achieved automatically using motorized breakers?)
- Indicates if over current protection, fuse or relay settings will be modified during islanded conditions
- Indicates if additional fault-current detection and mitigation measures will be required
- Describes any additional controls and possibly additional switching devices necessary to design a seamless transfer environment
- Indicates to what extent, if any, and under what conditions, ancillary services, such as black start, voltage or frequency support to the grid will be unavailable because of islanding

With respect to other key capabilities to operate seamlessly with the electric distribution grid, the Contractor shall conduct analyses and describe the following functionalities for the proposed microgrid:

- The ability to energize the microgrid from a de-energized state (black start capability), without help from an external source(even in microgrid's designed for seamless transitions, black starts may be needed in some cases)
- The microgrid's ability to perform cold-load pickup - the extra load following an extended interruption due to loss of the normal diversity between customers
- The microgrid's ability to provide inrush - many components draw a high, short-lived inrush; the largest component magnetizes the magnetic material in transformer; motors also draw inrush.
- The start-up reliability of each DER, where applicable.
- The ability of renewable generation's to provide black start capability (typically not a resource for black-start capability based upon its intermittent nature and lack of frequency support functionality), where applicable.
- The microgrid satisfies the start-up current requirements (e.g. stiffness) for loads.
- The microgrid accounts for part-load characteristics of each DER, if applicable.
- The schedules for the maintenance and forced outage rates of the DER, if applicable.
- The capability of each DER with respect to:
    - Accepting startup and shutdown commands
    - Accepting AGC and dispatch signal
    - Maintaining voltage
    - Operating in isochronous mode
    - Operating in droop mode

- Capabilities for full load unit trip, both manual and automatic
- Line tripping and reclosing operations
- Accounting for/accommodating single and three phase faults within and outside the microgrid
- Capacity for emergency load pick up
- Accounting for major equipment malfunctions

The Contractor shall perform and document the results from detailed dynamic analyses to determine the stability of the system during and after fault conditions, evaluating at a minimum, the following:

- For high renewable penetration, evaluate bulk system stability (grid-connected)
- For high system penetration of inverters, evaluate distribution stability under both no control and advanced control functionality

Task 1.10 Deliverables: Documentation of the work conducted under Tasks 1.10, Power Distribution System Modeling and Simulation.

Task 1.11 Harmonics and Flicker Studies

Sub Task 1.11.1 Harmonics Study

The Contractor shall conduct harmonic analysis to establish that the voltage and current harmonic levels within the microgrid are acceptable. Simulation results shall be compared with the IEEE 519 standards to check to see if voltage and current limits are within satisfactory levels. The Contractor shall conduct analyses that capture the resonance conditions within the microgrid.

Sub Task 1.11.2 Flicker Study

The Contractor shall conduct analysis of flicker. The Contractor shall include consideration of the following issues in such analysis:

- Flicker emissions should be measured against/compared with limits set forth by IEC 61000-3 and IEEE 1453.1 for corresponding voltage levels
- Flicker emissions for each DER asset
- Flicker emissions at the point of common coupling(s) (PCC)
- Allocation of emissions limits for each load or generation source that fluctuates
- Remediation devices used to reduce flicker

Deliverables: Documentation of the work conducted under Tasks 1.11, Harmonics and Flicker Studies.

Task 2: Microgrid Commercial/ Financial Business Plan

The Contractor shall conduct an audit-grade analysis of the commercial and financial feasibility of the proposed microgrid project as specified in the following set of tasks. The Contractor shall also develop a twenty (20) year business plan financial statement pro forma showing estimated yearly cash flows for the microgrid project.

Task 2.1 Project Team

The Contractor shall clearly delineate team members' and suppliers' roles and responsibilities associated with microgrid ownership, operation/administration and control. The Contractor shall specify what

organization(s) will act in the capacity of the microgrid project company or some other incorporated special purpose organization and define what responsibilities these organizations shall have with respect to the planning, development, financing, construction, commissioning, ownership, and operation of the microgrid project assets and project economics. To the extent there are numerous parties involved in aspects of microgrid project administration, the Contractor shall describe the contractual/business relationship between each party with respect to the microgrid project.

Task 2.2 Commercial Viability - Customers

The Contractor shall describe the commercial terms and relationships between the community, government and the purchasers of microgrid products and service including arrangements for sharing of benefits by addressing no less than the following questions:

- How is "community" defined for this project? This may include, but is not limited to local residents and local businesses that do not directly receive generation from the microgrid and may or may not use/purchase services provided by the microgrid.
- Who, within the community, is specifically expected to use the services provided by the microgrid during normal operation? During islanded operation? Conversely, are there members of the community that will specifically not use the services that the microgrid offers?
- Does the community have an agent acting on its collective behalf? Are there multiple agents representing multiple interests? How are the differing opinions of community stakeholders being considered throughout the project?
- Are there users or beneficiaries of the microgrid services that are not part of the local community? Specifically, does the user of the microgrid service have any customers that would be indirectly affected during normal or islanded operation?
- Who are rate-payers and/or government constituents/tax-payers outside of the local community affected by this microgrid project? In what ways are they directly or indirectly affected? How will society at large be affected by this project?
- Are there emissions or emissions reductions that can be realized by society? Are there other benefits or costs?
- Are there other stakeholders that are directly or indirectly affected by the microgrid? For example, this could include entities that are not part of the local community, do not purchase/use services from the microgrid, and/or are not ratepayers.
- In what way or form has the local government supported this project? Describe the legal relationship between the project developers and/or owners and the local government. What ongoing requirements does the project administrator have to the local government? Attach the letter of commitment from the local government.
- What role, if any, will the state and federal governments (other than regulators) play in supporting this specific project? What offices within these governments has the project engaged with?
- Describe each load that will be served during normal operation and during islanded mode. Identify the type of load (electricity, thermal), primary user of that load, who pays the bills, if and how the load will be reduced during islanding and the proportion of generation that will be attributed to that load.

- Who is acting on behalf of the loads that are served by the microgrid? This could include, but is not limited to, the owner of the building(s) served, tenant of the building(s), or agent of the building(s). What is the possibility that this entity could change throughout the lifetime of the project?
- Who is the counter-party on any electricity sale agreements for electricity generated by the microgrid? How is this counter-party related to the loads served by the microgrid? What is the credit worthiness of that entity? Is there any risk that their relationship to the loads could change (for example, if they move)?
- Does the microgrid have any customers that are simply purchasing net metering credits as a result of the generation? What is the purpose of this arrangement rather than directly providing electricity? Do these customers receive other services from the microgrid?

Task 2.3 Microgrid Services

The Contractor shall fully identify the products and services the microgrid will provide to the purchasers of microgrid power, community members, governing bodies, and the local distribution utility given the technologies involved by addressing no less than the following questions:

- What microgrid services are most important to the community in normal operation? During islanded operation? How was this determination made? How do the priorities differ amongst different members and stakeholders of the community? Are there any specific groups that are the target of this microgrid project's services?
- Does the government (local, state or federal) fund any of the loads that are served by the microgrid? This could include such things as health and safety or other public services. If yes, how does the government, directly or indirectly, benefit from the microgrid?
- Are the net metering credits held by the microgrid project company or are they sold to its users? Does the project company retain ownership of the net metering credits or are they passed directly to the user/customer? Is the recipient of the net metering credits also receiving direct electricity service from the microgrid or are they a remote purchaser?
- Does the microgrid provide any capacity services to loads under normal conditions or when islanded? If yes, how much and how often? How does providing such capacity affect the microgrid’s ability to provide other services to its other users? How are decisions made as to when to provide capacity to the users versus other options? Does this differ between normal and islanded operation?
- Does the microgrid provide capacity services to other DER assets serving the user(s) of the microgrid? How does the capacity support those resources? What is the arrangement to provide such capacity?
- Does the microgrid sell electricity directly to the utility (or other macrogrid entities) through a bi-lateral agreement or other mechanism? Alternatively, does it sell in the wholesale market? What percentage of electricity is provided via these options? Why is electricity sold to the utility or wholesale market rather than to a direct customer?
- Is the microgrid providing any demand response services to the utility or New York Independent System Operator (NYISO) market? If yes, what services are being provided? Are these services under contract or provided simply as a bi-product of the microgrid's operation? Are the Demand Response (DR) services resulting directly from microgrid assets or is the microgrid a pass-through for customer-sited DR?

- Does the microgrid provide any capacity services to the utility or NYISO market? If yes, how much and how often? How does providing such capacity affect the microgrid's ability to provide services to its other users?
- Is the microgrid providing any ancillary services to the utility or NYISO market? If yes, what services are being provided? Are these services under contract or provided simply as a bi-product of the microgrid's operation?

Task 2.4 Value Proposition

Sub Task 2.4.1 Business Model

The Contractor shall develop a clearly defined, reasonable, and comprehensive business model that considers all participants, types of assets involved, relevant value streams, risks to operation and financial viability. The Contractor shall provide evidence and examples of where this business model has been employed prior to this project and alternatively, shall describe what new business models are being advanced and establishes an approach to verify assumptions/hypotheses.

Additionally, the Contractor shall:

- Describe the overall business model for the microgrid. How will the microgrid balance competing interests between the user, the community and the utility? How will different microgrid assets and other DER be balanced?

- Describe how the business model and the project's design facilitate participant learning and can be replicated.

Sub Task 2.4.2 Community Value Proposition

The Contractor shall present a clear and compelling case that the benefits to the local community outweigh associated costs and risks by addressing no less than the following questions:

- Does the microgrid help to provide any critical or non-critical services to the community during normal operation? If so, which? Why is the microgrid used to provide these services? How does this differ, if at all, from such operation that would occur without the microgrid?
- For loads served during islanded mode, how does the microgrid help to provide critical or non-critical services to the community that would otherwise not be available? What is the quantitative or qualitative measurement of benefit to the community from those services?
- Are there local residents or local businesses that will benefit directly or indirectly from the microgrid? If yes, how so and how many? How where the recipient residents selected?
- Does the presence of this microgrid and/or other microgrids affect the electricity supply, electric distribution service rates, or thermal service rates charged to ratepayers? This could include, but is not limited to, cost for interconnection, administration, or ownership of the microgrid. If rates increase, justify the cost given the context of the cost/benefit analysis completed for this analysis?
- Does this project provide any direct or indirect health, safety and security benefits? Would these benefits have been available to the community if the microgrid had not existed? If yes, at what cost? How is the microgrid a better option?
- Are there specific reliability issues that this microgrid is addressing (with respect to all rate-payers other than the customer of the microgrid user)? Are these issues specific to the utility feeder, substation, region, NYISO zone, or other?

- How will the community benefit from the microgrid? Identify specific values to the community and quantify such value in dollars or other meaningful metric. Who are the direct beneficiaries? Who are the indirect beneficiaries?
- What costs will the community incur from the construction (including construction management and administration) and operation of this microgrid? How are those costs monetized? How do the costs compare with the potential benefits?
- Does the community and/or society-at-large benefit from any reduced emissions due to the installation of the microgrid? How are these reductions in emissions quantified? What benefit is expected from the reductions? Which groups will directly, and indirectly benefit?
- Is the community and/or society-at-large affected by any emissions originating from the microgrid? How are these effects in emissions quantified? What is the impact to the community? Is the project taking any actions to mitigate these effects? Which groups will be directly and indirectly affected?
- Does the microgrid owner/operator or project/operating company (project company) receive any emissions allowances to offset emissions from its generation? If yes, are these services required? Why? Under what regulation or requirement? From whom? What form of emissions allowances are provided? What are the agreements required to receive these allowances?
- Does the project company receive any Renewable Energy Credits/Attributes to offset emissions from its microgrid generation? If yes, are these services required? Why? Under what regulation or requirement? From whom?
- How do tax payer funds that support the microgrid affect, directly or indirectly, the local community? Is the community in favor of such tax funds being used? Why?
- How will this project (including the microgrid and its suppliers) support job creation? What impacts will be realized by the local community? What impacts will be realized by the broader stakeholder community including state, national and international?
- What education is the microgrid administrator providing to the community stakeholders including, but not limited to, members of the local community, rate payers, and government constituents and society-at-large? How does this help the microgrid? What benefits does it provide to these stakeholders?

Sub Task 2.4.3 Grid Value Proposition

The Contractor shall present a clear and compelling case that the benefits to utility stakeholders outweigh associated costs and risks by addressing no less than the following questions:

- How much electricity does the loads to be served by the microgrid use from the utility or other supplier prior to connecting to the microgrid? How much will this electricity demand be decreased due to the installation of the microgrid? How will the load profile of participating customers change? How will such changes impact on the local distribution system?
- Will the microgrid affect the amount of electricity that the broader community and rate-payer base would use as provided by the utility or third-party suppliers? How would that affect that entity and their ability to operate?
- Will the microgrid help the utility or transmission operator defer upgrades to their system that would otherwise have been needed? If yes, in what way (be specific)? Are only some or all costs avoided? Which ones?
- Will the microgrid improve daily operations of the local distribution system or help mitigate strain on the local distribution system from local power outages? If yes, in what way (be

specific)? How is the use of the microgrid to improve operation better or worse than other alternatives available to the local distribution company (utility)?

- How will costs associated with interconnection and/or upgrade costs and administration costs (for contracts or during operation) be accounted for?
- Will the microgrid increase or decrease the amount of electricity that third-party suppliers sell directly to customers or impact revenues received by other load-serving entities? Are such impacts quantifiable? How will the amount of thermal services procured by loads now served by the microgrid be changed due to any thermal services provided by the microgrid? How will the microgrid affect the amount of thermal services that the broader community and rate-payer base would use as provided by the district heating company?
- Does the project qualify for any Renewable Energy Credits or other renewable attributes? In what market does the project qualify? Are the credits sold to load serving entities? Or are they retired and why was that decision made?
- If this project qualifies for renewable energy credits or attributes, are any provided to the utility? To others? If yes, under what arrangement are they provided? Why are such credits required?
- Does this project generate any emissions allowances that can be used or purchased by the utility or other generators to offset their emissions? Under what program(s) does this project qualify?
- Do the loads served by the microgrid provide any demand response services directly to the utility or in the NYISO market? Did the user provide such services before the microgrid was installed? If not, why is this now being provided?
- Is the microgrid acting as an aggregator of DR or other DER resources for the utility or NYISO? How does this support or help that entity's operations?
- Does the utility or NYISO currently use or plans to use a third party demand response aggregator? How will the operation of the microgrid change or affect the services that it will use from this aggregator? How could or would the microgrid provide those services instead?
- What costs does the utility or NYISO incur when using a third-party demand response aggregator? What funding is used to pay for these costs? Will these costs be increased or decreased with operation of the microgrid?
- Does any customer sited DER provide any benefits (including improved operation, deferred upgrade costs, other) directly to the utility or into NYISO? Any services (including capacity, ancillary services, DR)? Did the customer-sited DER provide such services before the microgrid was installed? If not, why is this now being provided?

Sub Task 2.4.3 Other Stakeholder Value Proposition

The Contractor shall present a clear and compelling case that the benefits to governing entities and project suppliers outweigh associated costs and risks by addressing no less than the following questions:

- How will this project support and demonstrate the New York's Reforming the Energy Vision (REV) goals? Is this project demonstrating any desired attributes beyond those specific to community microgrids?
- How is this project supported by the public policies of the federal, state, and local governments, authorities having jurisdiction (including environmental and energy regulators), and public funding agencies? Be specific about each agency involved and how this project meets those objectives.

- What are the suppliers getting out of their relationship with the project company (other than lessons learned or payment for products and services)? Do they have other strategic reasons for wanting to participate in this project? How will this project help grow their businesses?

Sub Task 2.4.4 Purchaser Value Proposition

The Contractor shall present a clear and compelling case that the benefits to purchasers of microgrid power outweigh associated costs and risks by addressing no less than the following questions:

- If the representative of the loads is purchasing electricity or thermal energy from the microgrid rather than from the utility or other third-party supplier, is the user saving money on its electricity/thermal supply/distribution purchases? What benefits is the microgrid providing to the representative of the load? How are these savings calculated? What is the likelihood that these savings will be maintained over the life of the project? Are there any contractual mechanisms to guarantee a savings?
- Does the user/purchaser of the microgrid's services use any fuel for their own thermal resource generation? Will the amount of fuel that they purchase change with the installation of the microgrid? How will this change affect the purchaser? Will there be any other indirect savings? Will the microgrid provide any energy services that will reduce the amount and/or cost of fuel to the loads?
- Do any of the loads served by the microgrid receive electricity or thermal energy from other DER during normal operation, either on-site or remote? During islanded operation? What is the nature of that agreement? How will that relationship and electricity flow affect the amount or timing of when the microgrid can provide electricity?
- What services does any other customer-sited DER provide? Are the services provided coincident with the microgrid or at other times? How will the delivery of that service be managed in conjunction with the microgrid's operation?
- Does the microgrid project company provide any incentive to the other on-site DER owners to adjust generation during normal operation? During islanded operation?
- Has or will the customer-sited DER be able to monetize the benefits (other than direct services) provided to the macrogrid? Is any of this compensation affected or adjusted due to the presence of the microgrid?
- Will the user of the microgrid provide any demand response services directly to the utility or NYISO? Did the user provide such services before the microgrid was installed? If not, why is this now being provided?
- If the loads served by the microgrid or other customer-sited DER previously provided DR services to the utility or NYISO, but now provides those to the microgrid, has the customer's financial payment or incentive for the DR from other programs been reduced? How does this affect the overall financial benefit to the user?
- For paid services that are made available during islanded mode (such as a store), what benefit does this provide to the owner or representative of the load? Is this benefit that would have been otherwise lost without the microgrid and/or benefit that is in addition to that which it receives normally?
- How much will the user of the microgrid reduce its usage from the utility? Is this a significant amount? What portion of its usage? Will the customer incur any penalties or changes in rates for this?

- Does the microgrid provide any other energy benefits directly to the loads (such as improved power quality, desired generation type) that would not be available from the utility?
- Is this project company, through and operating affiliate / administrator providing any energy management services to the loads served by the microgrid? To other loads? To other customer-sited DER? If yes, what are those services? What are the responsibilities of the microgrid administrator?
- How would the rates and price signals from the utility, or others, for supply and distribution services (including time of use or other) affect the way in which the loads are used? Will the microgrid monitor these price signals? How does it affect the operation?
- What education is the microgrid administrator providing to the users of the microgrid including, but not limited to the representative of the loads as well as representatives for other on-site energy resources? How does this help the microgrid? What benefits does it provide to these stakeholders?
- What costs does the representative of the load or other DER incur when using a third-party demand response aggregator? What is the basis for the cost? Is it a fee or some other basis? Will this costs be increased or decreased with operation of the microgrid?

Task 2.5 External Support

Sub Task 2.5.1 Community and Government Support

The Contractor shall identify the ways in which community and government stakeholders will contribute to the project by addressing no less than the following questions:

- Will the community and other stakeholders provide support to the development, construction, and/or operation of the microgrid? If so, please describe how these entities will help this project

Sub Task 2.5.2 Financiers

The Contractor shall identify financiers supporting the project and describe the process/criteria used in their selection by addressing no less than the following questions:

- Who is providing equity and debt to finance the project? Are they considered the primary owner or simply the investor? How were the equity investors and debt providers found and chosen? Describe how microgrid ownership and operations may be impacted by the structuring of investments?

Sub Task 2.5.3 Grid Support

The Contractor shall identified utility and non-utility stakeholders (e.g., NYISO, third party electric, heating and cooling service providers) and described in some detail what each of their roles will be relative to the viable operation of the microgrid project by addressing no less than the following questions:

- Who is the local distribution company (i.e. utility)? Are they a regulated utility, a municipal utility, or other? What is their participation in the microgrid project team?
- Will NYISO be involved in the development, construction or operation of the microgrid project? If so, in what way? Are they simply a market facilitator or will they have an active role?

- Are there any load serving entities or other generators involved in or related to this microgrid project? This may include entities that currently serve the loads that will be served by the microgrid or that will serve the microgrid? What, if any, is their participation in the microgrid?
- Is there a district heating company involved or related to this microgrid project? This may include district heating companies that currently serve the loads to be served by the microgrid. What, if any, is their participation in the microgrid?
- Is the microgrid receiving any electricity from the utility or third party suppliers? How much electricity is expected to be used and when? What assets of the microgrid be affected if there were an outage? Why did the microgrid choose to purchase from that entity?

Sub Task 2.6 Project Planning and Construction Management Services

Sub Task 2.6.1 Project Planning

By addressing no less than the questions presented below, the Contractor shall develop a reasonable project schedule and project management plan to ensure the schedule is maintained and supplier and other work requirements are appropriately coordinated. Such plan shall include a scope of work and project approach that is reasonable, exhaustive, and extensive and executable upon any award to construct and operate a microgrid under a subsequent stage of this NY Prize competition.

- What is the project schedule and proposed plan of action to ensure the project meets proposed schedule?
- What is the scope of work for the project manager? What sort of reports will they prepare? On what interval? To whom?
- Has a project manager been involved in the development of the feasibility study or audit grade design? If no, who has been primarily responsible for management? If yes, is this project manager the same for this phase and the construction phase?
- Describe the scope of engineering services to be completed by each engineering firm.
- What engineering has been completed to date? What is left to be completed?
- Provide a detailed scope of work describing what the construction firm will be responsible for as well as who will complete each task.
- Has the construction firm provided any support or review of the audit-grade design? How has their feedback been incorporated?
- Which equipment will be provided directly by the construction company? I.e., which equipment is the construction company responsible for procuring?
- Who will the construction firm report to? What will they report and how regularly?
- What is the proposed construction schedule? How will the scheduled be managed to minimize delays?
- What development services have been completed to date? What are left to be completed? What is the schedule for completing any remaining services?
- What is the scope of work for the developer? For what duration of the project are they involved? To whom do they report?
- Describe the property which will be used for the microgrid installation? Is it suitable in its current state or will it need site improvements or civil work?

- What legal work has been completed to date and what is left to be completed? What is the timeline for completing all legal documents?
- What environmental permits or licenses are necessary to develop and operate the microgrid? What work has been completed to date and what is left to complete?

Sub Task 2.6.1.1 Construction Management Services

The Contractor shall prepare a Construction Management Services plan that includes tasks associated with the inspection and general supervision of construction to check the contractor's work for compliance with the drawings and specifications and quantity and quality control. For this task the Contractor's construction management services plan shall address no less than the following questions.

- Describe plans for conducting quality tests necessary to verify conformance with technical specifications concerning minimum quality requirements, including the verification of in-place quantities and other records reflecting any as-built facility(ies).

- Describe plans for preparing inspection reports, copies of field measurement notes, test results or other documentation that will be essential for verifying and otherwise certifying contractor's requests for payments.

- Describe all plans for monitoring construction to identify needed adjustments in design as dictated by actual field conditions, codifying such contract amendments and for changes affecting alignment and detail or dimensions shown on drawings, amending drawings accordingly.

- Describe other plans for managing construction including, but not limited to, providing horizontal and vertical control in the form of benchmarks and baselines to be used by the contractor in staking the construction, review and approval of shop drawings, and project coordination.

Sub Task 2.6.2 Suppliers

By addressing no less than the questions presented below, the Contractor shall identify selected suppliers of equipment, technologies, engineering and project management services, software and any other products and services necessary for the construction, testing/commissioning and operation of the microgrid, indicate ways in which each will contribute to the project and provide evidence that each have been thoroughly vetted according to appropriate criteria and have the qualifications necessary to implement the project as designed subject to any award to construct and operate a microgrid under a subsequent stage of this NY Prize competition.

- For each technology to be used (hardware or software), describe the state of its use in the market. I.e. how long has the product been on the market? How many have been installed and successfully used? Is this a pilot of the technology?
- Who are the equipment and software manufacturers for the microgrid? What is the financial strength of each manufacturer? What are their qualifications and track record? Provide any references.

- What equipment and/or software is provided by each manufacturer? Has any of that been ordered or supplied yet? Provide data sheets.
- Who are the fuel suppliers? What is the process for ensuring fuel supplies for the operation of the microgrid?
- Who will be the project manager for this project? What are their qualifications and track record? Provide references.
- Who is completing the engineering of the microgrid? Why were they chosen? What are their qualifications and track record? Provide any references.
- Who will be the general contractor for the construction of the project? What are their qualifications and track record? How local are they to the site? Provide references for similar projects.
- Who will be responsible for the day to day operation of the assets (excluding system control)? Who will receive and respond to system alarms/alerts? Who will be responsible for the ongoing maintenance of the assets? What are their qualifications and track record? Who will perform the labor?
- What services is the legal counsel providing? For example, are they simply preparing documents or are they providing advice on other matters such as business model or regulatory filings? What other services? Which legal firm has or will prepare the documents needed to establish legal ownership of the microgrid project? What are their qualifications and experience?
- For consultants retained what services are being acquired, what is the status of such work and what are their qualifications and track record for similar projects?
- Who owns the property on which the microgrid will be installed? Is the property owner-occupied or leased? If leased, what is the leasing arrangement?
- Who is providing insurance for this project? What are their qualifications?
- Is there a third party aggregator that is working with the microgrid project company, the users of the microgrid or the local distribution company? What is that company's qualifications for supporting this project? What services do they offer? What programs have they been a part of previously?

2.6.2.1 Supplier Agreements

By addressing no less than the questions presented below, the Contractor shall demonstrate that it has established written and contractual agreements with the suppliers to obtain explicit support and secure any needed services.

- What is the relationship between the developer and the administrator of the microgrid? Does this differ during the development phase versus construction versus operation? Are any of these relationships secured under contract?
- Describe the relationship and contractual arrangements with each equipment/software supplier. Specifically, have any commitments been made to ordering from a specific supplier?
- Describe the relationship and contractual arrangements with each equipment/software supplier. Specifically, have any commitments been made to ordering from a specific supplier?
- Describe the relationship and contractual arrangements with the project management. For example, will project management tasks be completed internal to the project administration or subcontracted? How will the quality of the project management be evaluated?

- Describe the relationship and contractual arrangements with each engineering and consulting firm. How does/will the contracts evaluate and manage quality of the engineering and consulting services? What risks exist to this agreement?
- Describe the relationship and status of the contractual arrangements with the construction firm. Are there any contractual mechanism to support the project schedule and quality of work?
- Will the construction firm provide a workmanship warranty? If yes, what is the guarantee?
- Describe the relationship and contractual arrangements with the system controller. For example, will the control tasks be completed internal to the project administration or subcontracted? How will the quality of the project management evaluated? What penalties if the system is not properly managed (however that is defined)?
- If Operations and Maintenance (O&M) is not completed by the project administrator, describe the relationship and contractual arrangements with the firm responsible for O&M. What are the risks and risk management measures taken in those agreements?
- What is the legal arrangement between the microgrid company and the property owner? What is the current status? Provide any letter of commitment, lease option, lease, license, or other evidence of site control.
- What is the relationship between the legal counsel and the project? Is this done by internal legal counsel or external? If external, what are the existing contracts or agreements for services?
- Is the fuel supply secured under contract or purchased as needed? If contracted? How long is the contract for? What are the conditions?
- What insurance coverage does this project have? Is it covered during construction? Is it covered during operation? What are the general terms and insurance services received from the provider?

Task 2.6.3 Engineering, Procurement and Construction (EPC) Costs

The Contractor, by addressing no less than the following questions, shall identify and quantify EPC and all supplier costs and justify their magnitude.

- Provide an itemized budget of all of the construction costs by scope item (e.g., engineering, permitting, procurement, construction. Provide an explanation as to how these costs were derived and by whom. For all costs inputs, identify those that are fixed and those that are estimated. For labor, provide estimates that align with the construction schedule. For equipment, will the project incur additional cost from ordering through another firm?
- Complete a project budget spreadsheet summarizing all upfront capital expenditures that are needed to construct the project. Add notes and descriptions as to what is included in each category.
- How does the cost of the equipment/software compare to other options available in the market? Justify any cost premiums.
- How will the developer be repaid for any development expense spent to day or to be spent prior to bringing in other sources of capital?
- Will the developer be reimbursed for their services if they are not the owner of the microgrid? Justify the costs of these development fees.
- Is the project administrator paid or given any budget for administering the project? If yes, how much and on what basis? If now, how will the project be managed and what is the expected costs for that administration?

- Provide a justification for the engineering costs. For example, how does this budget reflect the complexity of project design?
- Provide a justification for the consultant costs. For example, what services is the consultant providing that could not be provided by the project administrator?
- Describe the budget allocation for project management. How will costs be managed? What is the risk of cost overrun?
- What is the cost for legal services? What has been spent to date and what is expected to be spent?
- What upgrade/interconnection costs are known at this time? What is the possibility of interconnection cost increases? When are payments for interconnection costs due to the utility?
- Will the project incur any additional costs for local distribution system or transmission upgrade costs? How does this differ from other interconnection costs paid to the local distribution company? What is the justification for the cost? When are the amounts due? What is the expectation of staying within budget for these costs?
- What costs will the project incur for any interconnection application fees? This could include, but is not limited to initial application fees, study fees, or program entrance fees. How are these costs determined? What costs are known at this time? When must they be paid?
- What costs will the project incur for any environmental permits that it must secure? This could include, but is not limited to, local, state or federal permits. How are these costs determined? What costs are known at this time? When must they be paid?
- What costs will the project incur for any local permits that it must secure? This could include, but is not limited to building and electrical permits. How are these costs determined? What costs are known at this time? When must they be paid?
- What contingencies have been included in cost budgets?

Sub Task 2.6.4 Operating Costs

The Contractor, by addressing no less than the following questions, shall identify and quantify all operating costs and justify their magnitude.

- Describe the rate structure for that part of the microgrid project company responsible for Operations and Maintenance (O&M) or if applicable a third-party provider of O&M services. Is it fixed price or labor and materials? Why? How do these costs compare to other distributed generation projects?
- Describe the budget allocation for the administration of system controls. How will costs be managed? What fees does the project company pay to the administrator of the microgrid? Are these costs borne internally as general and administrative costs or are they paid to an outside entity? What are the cost expectations up through construction (part of EPC cost) and what are the costs throughout the operation of the project?
- Will the microgrid owner pay any lease payment or other to use the property for the microgrid? If yes, how was this price determined? How does it compare to other similar energy projects? Will a financial reserve be maintained to pay for any replacement parts in the future?
- Will a financial reserve be maintained to pay for any replacement parts or major maintenance in the future? How has this reserve been derived?
- How stable is the cost of fuel? What actions have been or will be taken to hedge against price fluctuations?

- How much is the microgrid project company expected to have to pay the utility or third-party suppliers for electricity supply and distribution service charges? How much of the rates are volumetric versus fixed? How will any fixed charges affect the economics of the microgrid? How will fixed charges support the utility? Are the rates fixed or variable? Is the usage under contract or subject to tariff?
- Are there administration costs for the interconnection agreements or other agreements with the utility that will be passed on to the microgrid? To what extent are those costs known now?
- What is the cost of the wheeling services provided to the microgrid to be able to transfer electricity to its customers? What is the basis for payment and how often are payments made? Are these costs passed through to the customer?
- Does the microgrid project company pay any incentives to the representatives/users of the loads for DR or other services? Any payments to representatives/owners of other DER? What is the form of those payments? Specifically, what is the cost and how often is it incurred by the microgrid?
- Does the microgrid company provide any incentive to the loads to adjust demand during normal operation? During islanded operation? What are the costs? At what level and what are the conditions in which payment is or is not required? How are these structured to promote desired behavior from user?
- What is the cost to the microgrid for incentives paid to other DERs' representatives for adjustment of their generation or load to meet the requirements of the microgrid? At what level, frequency and under what conditions are the payment required?
- What costs will the project incur for needing to buy emissions allowances or offsets from the utility or other sellers? Why is this purchase needed? What are the arrangements and contracts secured for these costs? What are the risks to cost changes?
- What costs will the project incur for needing to buy renewable energy credits or attributes from the utility or other sellers? Why is this cost stream needed? What are the arrangements and contracts secured for these costs? What are the risks to cost changes?
- What costs will the project incur if using a third-party demand response aggregator? What are the terms of those payments? Are they known via a contract or are they subject to change.
- What are the insurance premiums paid by the project company to insure the installation? Are there any costs during the construction phase? What value of equipment is covered by these cost?
- What financing costs or fees will be incurred?

Sub Task 2.7 Creating Value

Sub Task 2.7.1 Assets

By addressing no less than the questions presented below, the Contractor shall identify/define the assets that will be owned by the microgrid project company, and assets that will be used to serve purchasers of services that are not owned by the microgrid project company, describe the role that each asset will play in the project and provide evidence that such assets are feasible to implement.

- How is the microgrid defined? What assets are considered part of the microgrid, for the purpose of this assessment? What are the boundaries and delivery points of the project? What other switchgear is needed for the installation? What is the testing that has been done on the equipment to ensure it complies with interconnection requirements?

- For each asset in the microgrid, describe who the owner of that piece of equipment is. If there are multiple owners of the microgrid's assets, what are the relationships and/or contractual agreements between the owners to reconcile potentially differing interests?
- For each asset in the microgrid, describe its purpose and why it is needed for the microgrid to be able to provide the services it is contractually obligated to provide. For any equipment not needed for contractual obligations, describe why it is needed or included in the project? In summary, please justify the cost of all equipment in the microgrid.
- For each asset in the microgrid, describe where this equipment has been used before (i.e. on past microgrid projects). Is the product still in prototype phase? Is it commercial? What are the warranties? Are there any risks that manufacturer won't be able to meet warranty requirements over the lifetime of the project?
- What are the interconnection requirements of the utility for the microgrid? What is the status of the interconnection study? What upgrades or interconnection equipment are known to be required at this time and what items are still to be determined?
- Describe the generating assets. Are there designated generators for each load, are they dispatched as needed, or are they treated as a single generator? How are multiple generating assets balanced?
- What type of generators are used for this project? What is the split between renewable and fuel generators? What are the risks or shortcomings of each technology? What are the preferences and advantages of each technology?
- What, if any, storage types are used for this project? Why were they selected to be implemented? How will they be sited and used with respect to the other equipment and assets? What are the advantages of using storage? What are the disadvantages? What are the risks to using storage?
- What distribution equipment will be part of the microgrid? Will these be installed new or is there existing infrastructure to be used? Will the distribution be owned by the microgrid owner and/or by the local distribution company?
- Does this project include an investment-grade audit and plan for efficiency? Will such improvements improve the operation of the microgrid? Are these improvements considered part of the microgrid assets? If not, are they considered other on-site DER?
- Do any of the loads served by the microgrid provide DR services to the microgrid? If so, what loads provide such services and when? What, if any, action is required by the user of the loads to adjust usage?
- What is the other DER, either on-site or remote, that will interact with the microgrid project? This could include, but is not limited to, distributed generation, storage, distribution systems, building management systems, or smart metering. Will any of these resources be leveraged by the microgrid to create better value for the customer?
- Does any of the customer-sited DER provide any services (capacity, ancillary services) to the microgrid? If so, what DER provide such services and when? What, if any, action is required by the other DER owner to deliver such services?
- Is the user of the microgrid also served by any other DER during islanded operation? What services does that DER provide? Are the services provided coincident with the microgrid or at other times? How will the delivery of that service be managed in conjunction with the microgrid's operation?

- Who will act on behalf of the other DER that will interact with the microgrid? Do they have any experience in interfacing their equipment with a microgrid? Explain their understanding.
- Does the customer pay the representative of the DER for the services provided? If so, what is the structure of those payments?

Sub Task 2.7.2 Control & Monitoring

By addressing no less than the questions presented below, the Contractor shall describe the control schemes necessary to ensure that the microgrid will reliably provide all proposed services and is feasible given the available resources for system control and describe a clear and defensible strategy for measuring and verifying the flow of power and services between the microgrid, purchasers, and the grid.

- What are the control systems that are proposed to be used for this project? How does this technology support the control schemes desired by the contracts? Will the equipment include automatic DR controls or software?
- How will the system be monitored and operated on a day-to-day basis? Describe the protocol for receiving system alerts, assessing the problem, responding to the problem.
- How often is the system monitored and controlled by the system controller? Ongoing, hourly, daily? Is this supported with automatic systems? How periodic will the system publish a report on conditions?
- How does the control system (hardware/software) prioritize loads and generation in normal operation? In islanded operation? Is the prioritization based on technology? Contractual arrangements? Maximum revenue? Any other priorities?
- What is the energy mix generated in normal operation by the microgrid? In islanded operation? Is the mix of electricity, heating and cooling prioritized to one of those streams? If yes, why is that selection made and how is the system controlled for optimal operation?
- What control will the utility or transmission operator have over the microgrid? Why will such controls be required and/or preferred? How will the controls be managed with respect to the project company being able to serve its customers?
- Does the microgrid maintain any control of the loads served by the microgrid or other customer-sited DER? Is such control automatic, manual or a combination? What control functions are possible?
- If loads or other on-site DER are not controlled directly by the controls hardware and software, as managed by the system controller, how will the system controller notify the user of the loads/DER that they must adjust behavior?
- How are decisions made as to when to provide capacity to the utility or NYISO versus other options? Does this differ between normal and islanded operation?
- What control does the utility or transmission operator have over the loads served by the microgrid? For what reasons does such control exist? Will this control change once the microgrid is operating? If yes, in what way? How is this change being managed?
- What control does the utility or transmission operation have over other DER serving the users of the microgrid? Why does such control exist? Will this control change once the microgrid is operating? If yes, in what way? How is this change being managed?

- Does the representative of the loads or other customer-site DER currently use or plans to use a third party demand response aggregator? How will the operation of the microgrid change or affect the services that it will use from this aggregator?
- Is the microgrid using any demand response aggregation services from a third party provider? If yes, what do those services entail? What are the benefits and drawbacks to working with a third-party provider? How will the microgrid manage the requirements of the aggregator with the requirements of its customers/user?
- What is the proposed measurement and verification approach? How will the microgrid assets be adjusted if they are not performing as expected? Who will take responsibility for measurement and verification? To whom is this entity responsible for reporting?

Sub Task 2.7.3 Distribution Strategy

By addressing no less than the questions presented below, the Contractor shall describe technically feasible mechanisms for distributing electricity to loads, as well as balancing supply and demand, in both normal and islanded modes and describe processes to ensure that the data necessary to operate the microgrid economically and safely is available.

- Describe the electricity delivery services that are provided to loads during normal operation and islanded operation. Is the electricity delivered directly through microgrid distribution system or using the utilities' distribution system? What is the point of delivery? Is it delivered behind the meter of the load? Which specific loads.
- Describe the delivery of thermal services that are provided to loads during normal operation and islanded operation. Are such thermal services delivered directly through the microgrid distribution system or using a district heating/cooling system? What is the point of delivery? Which if any, specific loads are served?
- What is the electric and thermal load profile of the loads that are served in normal operation? In islanded operation? Does the microgrid provide electricity in a way to match the load profile? What, if any issues, could arise if they are not matched?
- How much electricity and/or thermal energy is purchased by the loads during normal operation? During islanded operation? Is the schedule for load from the microgrid fixed or variable? Does the customer have a preference in terms of which generation is used to meet their load? Are there any other requirements in how or when electricity is provided?
- What system impact studies have been completed by the local distribution company? What were the results of any completed studies? What studies are remaining to be completed and what are the issues left to resolve?
- Will the microgrid have access to the historical meter data and/or ongoing usage data? What access will the local distribution company need to provide for access to that data? How will the microgrid ensure that the data is protected and private?
- Is the utility providing any wheeling services for the electricity to be transferred to the customer of the microgrid? Describe the need and mechanics of those services.

Sub Task 2.7.4 Maintenance

The Contractor shall develop and describe a maintenance strategy that proactively addresses potential issues to ensure reliable operation and addresses no less than the following questions:

- Provide a scope of work for the preventative maintenance that will be performed on the microgrid assets? Provide a relative ranking of which preventative maintenance measures are most and less important.
- Describe the protocol of notifying the microgrid administrator/owner about any major issues related to the system's operation or maintenance? How often are reports generated and circulated?
- Does the microgrid carry, for its entirety, any workmanship warranties? Who is providing such warrantees and to whom? What is covered by these warranties and for what term?
- What equipment replacements are expected over the life of the system? Which are major and planned for and which will be dealt with as problems arise?
- How will equipment be procured for ongoing maintenance? Will a spare parts inventory be held or will equipment be ordered as needed?

Sub Task 2.7.5 Reliability

The Contractor shall present evidence that the chosen equipment and operational strategies will ensure reliable delivery of power in both connected and islanded modes by addressing no less than the following questions:

- What is the expected time that the system is expected to operate in islanded mode? How long can the system operate in islanded mode? Is there any equipment that is specifically required to allow the microgrid to operate for that long?
- Are certain assets dedicated to certain loads, or may all loads be served from any generator? How does the pairing of generation and load support the microgrid's reliability? Are the other technologies or methods used to support reliability?
- What fuel (not electricity) is required to operate the microgrid? How reliable is the fuel source? What is the method for delivery?
- Describe how the microgrid can remain resilient to forces of nature that have the potential to become more typical to the area served by the microgrid and pose the highest risk to microgrid operation including the potential impacts as predicted in the 2011 ClimAID report and 2014 ClimAID update[5] .
- What fuel (not electricity) is used by the loads served when the microgrid is not operating (primarily for heating)? How reliable is the fuel source? What is the method for delivery?
- Describe approach or contractual mechanisms for ensuring reliability of the fuel source.

Sub Task 2.7.6 Taxes

By addressing no less than the following questions, the Contractor shall quantify all taxes that may be levied on the project and provide evidence that such levies are reasonable.

- Will the project company be required to pay state corporate income taxes? What is the basis for these tax calculations? What is the assumed tax rate and how was it assessed? Will any exemptions or credits be provided?

[5] http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Report.pdf and http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAid-Report.pdf

- Will the project company be required to pay federal corporate income taxes? What is the basis for these tax calculations? What is the assumed tax rate and how was it assessed? Will any exemptions or credits be provided?
- Will the project company be responsible for paying property taxes on the microgrid equipment and/or on the property where the microgrid will be installed? This may include, but is not limited to, real property and personal property taxes. Will the project pay the taxes as they are assessed or has the project company arranged any structured tax arrangement (such as a Payment In Lieu of Taxes, or PILOT for property taxes)?
- Will sales or services taxes be assessed on any of the products and services purchased by the microgrid project company? What are the regulations or laws that require or exempt sales tax on these items or services?
- Will the project company be responsible for paying taxes on the sale of energy services it sells, such as a gross receipts tax? Are these taxes due on sale of electricity and/or thermal energy services? What laws or regulations dictate that the project must or may not pay these taxes?
- Will this project benefit from any local, state, or federal tax incentives such as tax credits or tax exemptions? If so, what must be done to qualify for these incentives? When are these incentives or credits financially realized?

Task 2.8 Project Profit and Revenues

Sub Task 2.8.1 Profitability

The Contractor shall complete a project proforma spreadsheet (See Attachment D) summarizing all revenue and cost flows over the lifetime of the project. The completed proforma shall have appropriate notes and annotations as to what is included. The Contractor shall define profitability(examples include internal rate of return, net present value, payback period or return on equity), provide a basis for calculating profitability, indicate on whose basis these calculations are presented(e.g. project owner, project investor) and identify specific impediments (regulatory, legal and market-oriented)to profitability.

Sub Task 2.8.2 Revenue

By addressing no less than the questions presented below, the Contractor shall describe the revenue streams that are feasible given equipment, operational, legal, and other constraints, for times when the microgrid is operating in parallel with or connected to the macrogrid and at times when operating in islanded mode. Such assessment shall identify revenue streams that are clearly available and appropriate as well as identify revenue streams that have the potential to increase profitability but are not yet quantifiable and/or dependable.

- Is there a guaranteed minimum revenue stream for electricity in normal operation? In islanded operation? For example, is there a minimum load that the customer must use from the microgrid? Alternatively, is the off-taker responsible for purchasing all generation by the microgrid? Is there a maximum that they will purchase? Some other arrangement?
- Are there any penalty payments owed to the loads served by the microgrid or other customer-sited DER if the microgrid does not deliver the amount of electricity or thermal services it has committed to providing? How are these shortfall payments calculated? What are the risks that this will occur? What production guarantees are made and how likely is it that production models will vary?
- What is the rate structure for payment of electricity and thermal energy provided to the loads during normal operation? Does the customer pay a rate set in a contract or is it an index against

other rates (e.g. LDC electric rates, net metering credit, alternate thermal costs)? Does the rate have an escalation? If yes, is it fixed?

- Are there any premium payments for electricity or thermal energy provided during islanded operation? To what extent does the project financial success depend on a percentage of revenue coming from islanded operation?
- Is there some other structure by which the electricity or thermal energy generated by the microgrid supports the financials of the project? For example, if the microgrid is owned by the recipient of the electricity services, are the electricity savings considered?
- What revenue does the microgrid company earn from sale of electricity in the wholesale market or directly to the utility? Is this sale under contract or through some other mechanism? How firm is the pricing?
- Will any of the electricity provided to the utility be credited via net metering? How much net metering credits will the microgrid generate? How are these credits calculated (i.e. what tariff rate) and are the rates under contract or subject to tariff changes? What is the projection for net metering credit rates for the lifetime of the project? What is the total value of net metering credits that the project is expected to receive?
- What revenue does the microgrid project receive from sale of net metering credits to its users/customer? How is the price for the net metering credit determined? Is it fixed or variable? What are the risks in to the revenue streams due to changes in net metering credit rate?
- Is the owner of the loads or other customer-sited DER charged a penalty if they do not adjust demand as requested during normal operation? During islanded operation? At what price level and under what conditions will there be a penalty charge?
- What revenue does the microgrid earn from providing energy management services to the loads served by the microgrid? To other customer-sited DER? To other? What is the structure of the payments? What are the terms of the agreements?
- Is the microgrid project company paid for capacity services provided to its users? To the utility? Into NYISO? What is the form of those payments? Are they under contract or other? What is the amount of the payment and how often is it received?
- Is the project company receiving financial payment or incentive for demand response and/or ancillary services provided to the utility or into NYISO? If yes, describe the structure of those payments, including, but not limited to, a summary of the frequency and risk to payments. If no, is it anticipated that any payments will be available in the future and describe the likelihood of that occurring?
- Does the utility or transmission operator provide any financial incentive for siting the microgrid in particular areas that would help defer transmission upgrades? What is the amount of the incentive and when is it paid?
- What revenue, if any, will the microgrid company receive from the sale of renewable energy credits? Are these revenue streams secured under contract or will they be sold on some other basis? What is the likelihood that the project will receive the REC revenue outlined in the proforma? What are the risks? Who is the counter-party? Are they sold directly to a buyer or through some other intermediary or broker?
- What revenue, if any, will the microgrid company receive from the sale of emissions allowances? Are these revenue streams secured under contract or will they be sold on some other basis? What is the likelihood that the project will receive the associated revenue outlined

in the proforma? What are the risks? Who is the counter-party? Are they sold directly to an LDC or through some other intermediary or broker?

- Will the microgrid be able to monetize the benefits (other than direct services) provided to the macrogrid (such as improved operation, deferred upgrades, mitigated system strain during outages)? What is the form of direct or indirect payment? Is this under contract?

Task 2.9 Project Financing

Sub Task 2.9.1 Government Financing

By addressing no less than the questions presented below, the Contractor shall describe sources of government financing that effectively leverage NY Prize funds and present no conflict with NY Prize objectives.

- How much funding is the applicant going to match? What guarantees does the microgrid project provide to NYSERDA that those project funds will be secured so that the project is able to progress?
- What will design prize money be used for? How will it help to progress this project? Could the project have been completed without the NY Prize funding?
- Is this project being funded or financed from public programs other than from NY Prize? From whom is this project receiving public funding and/or financing? This may include, but is not limited to, NYSERDA, DOE, or the local government. What percentage of total project budget is funded by incentives? Would the project move forward without such incentives?
- Have the incentives been secured? What is the timing for those incentives and does it align with the timing of the NY Prize incentives? If these funds are not secured yet, what is the likelihood and process for securing such funds?
- What ongoing requirements does the project have to comply with as a result of incentives it has received? What are the consequences if the project administrator does not complete these requirements?
- Is this project dependent on receiving government incentives that are funded by taxes? If so, what is the likelihood that those funding sources will exist or change with government budget changes?
- Is the project utilizing any public financing, such as municipal bonds, loan guarantees or other? If yes, how did this project secure those funds? What portions of the project are supported by such funding?
- If the project is utilizing public financing, what are the terms and rates of repayment? What are the risks to not being able to repay?

Sub Task 2.9.2 Private Financing

By addressing no less than the questions presented below, the Contractor shall describe all agreements with financiers to secure financing, including describing sources of debt and equity financing, including any project financing provided by the project developer or project suppliers, and identify the terms of such financing.

- Describe the contractual relationship between the equity provider(s) and the project company. Are the equity providers in any way considered owners of the project company?
- What is the contractual agreement between the equity provider and the project administrator? Does the equity investor exercise any control over the administration of the microgrid?

- What are the contracting and financing vehicles used to secure debt? What are the terms and conditions of receiving and repayment of debt?
- In what way is the equity firm providing funding/financing to the project company? Are they providing capital or other? When are these funds dispersed?
- What is the financial return of the project to the equity investor(s)? Is this paid back in annual dividends or will the equity providers earn a return as owner(s) of the project?
- What is the status of receiving all equity funding for the project? Has any been provided to fund development of the project? What is remaining to be secured? What are the steps necessary to secure such funding?
- Is this project receiving debt services to finance this project? If yes, how much debt is provided? Is capital provided in one lump sum, based on milestones achieved, or regular payments?
- What is the interest rate of the debt? What fees and costs apply? What is the schedule for repayment? What are the risks to not being able to repay? What is the likelihood of those risks?
- What is the status of receiving all debt funding for the project? Has any been provided to fund development of the project? What is remaining to secure? What are the steps necessary to secure such funding?
- Has the "developer" funded any of the development costs of this project (outside of funding provided by NY Prize)? What is the source of such funding? How much has been spent to date and how much is expected to be spent prior to construction starting?

Task 2.10 Legal Terms and Conditions

Sub Task 2.10.1 Management of Regulation

By addressing no less than the following questions, the Contractor shall provide evidence that it understands the regulatory environment, can identify significant regulatory barriers/risks that would impede implementation of the proposed project, and presents options or measures to consider to mitigate such risks.

- What are the current policies driving this project? How will the project be affected, on an ongoing basis, due to changes in leadership within the federal, state, or local governments and funding agencies? What are the most severe and/or most likely risks to policy changes that could unexpectedly affect the projects operation and/or economics now or in the future?
- What are the energy regulators that have jurisdiction over this project? This may include FERC, NY DPS, or other local authorities? Under what authority to do they (or do they not) have jurisdiction?
- What are the regulatory requirements that the members of the "macrogrid" must comply with in being involved in this microgrid? Are there any regulations that pose barriers to the utilities or others being involved in the project? How does the project propose to address these barriers?
- How will the project be affected, on an ongoing basis, due to changes in energy regulation? What are the most severe and/or most likely risks to regulatory changes that could unexpectedly affect the projects operation and/or economics now or in the future?
- What are the current energy regulations (at federal, state, or local level) that are relevant to this project? How does this project address and satisfy all of those regulations?
- Where is this system to be installed? Does it require crossing right-of-ways to deliver electricity? Please be as clear as possible and include diagrams.

- Is this project located on a single parcel or address or does it span multiple parcels? If the latter, does that pose any issue or benefit in terms of interconnection standards? Are there any legal or regulatory reasons why this would be a problem?
- What are the environmental regulators that have jurisdiction over this project? This may include EPA, NY Dept. of Environmental Conservation (DEC), or other local authorities? Under what authority to do they (or do they not) have jurisdiction?

Sub Task 2.10.2 Ownership Structure

The Contractor, by addressing no less than the following questions, clearly articulates an ownership structure for the microgrid project, provides evidence that such structure is legally allowed, and contractually binding for all assets, electricity and thermal product.

- Who is the owner of the microgrid? If it is a special purpose entity or some other project company, which entities or companies have equity interest in that project company? Are there other entities that would be considered part of the project company that would be separate from the project administration? Who is responsible for managing the budget and financial performance of the microgrid project company?
- What is the governance structure for the project company?
- What is the legally defined boundaries of the microgrid project? Are they all owed by the same entity? If not, how are the agreements arranged such that different ownership is accommodated for a single project?
- Which entity or entities own the project company? Through what mechanism or contract do they own the project company? Will ownership change throughout the course of the project (e.g. from development/construction to operation)? What is the planned or potential unplanned change in ownership?
- Describe the ownership of the electricity generated by the microgrid. At what point is it owned by the microgrid company? At what point is its ownership transferred? What is the delivery point? Is it transferred to any other third party?
- Who owns the distribution lines that will deliver the electricity? If it is the LDC, does the microgrid have permission to operate on those lines and what are the agreements required to be allowed to do that? If it is the microgrid owner (other than the LDC), are there any restrictions on where these wires can be installed?

Sub Task 2.10.3 Rights to Operate/Permits and Approvals

By addressing no less than the following questions, the Contractor demonstrates that the requisite permits and approvals necessary to legally implement and operate the proposed project can be obtained.

- What special approvals, if any, are required from energy and environmental regulators for this project to be constructed or operated? Will there be any approval or review process with any local authorities/committees? What is the status of the permit applications and what is the likelihood or risks to receiving such approvals? Are there any ongoing compliance documents to file?
- What local permits will be required for the construction or operation of the microgrid? This may include, but is not limited to, building, electrical, or zoning permits. What is the schedule and likelihood of securing such permits? Are there any ongoing compliance documents to file?

- Is the property properly zoned to be able to install the microgrid project? If not, what permits or approvals are necessary?
- Has a title search been completed for the property where the microgrid is to be installed? If no, are there any risks that the project would not have legal authority to be installed on the desired site? If yes, what was the result of the title search and are there any specific or special requirements with which must be complied?

Task 2.11 Operating Agreements

Sub Task 2.11.1 Energy Service Agreements

By addressing no less than the questions presented below, the Contractor shall demonstrate that it has established written and contractual agreements with the utility stakeholders and microgrid service purchasers to obtain explicit support and secure any needed services.

- What contractual relationships exist between the microgrid and the entities of the macrogrid (including, but not limited to, the Local Distribution Company (LDC), the Regional Transmission Owners (RTO), Load Serving Entities (LSE), and District Heating Companies)? These may include, but are not limited to, interconnection agreements and contracts for electricity and other energy services. Which agreements are executed at this point and which must be executed? Which agreements are for the full project lifetime and which are for shorter terms?
- Describe the contractual relationship between the microgrid owner and the purchaser of the electricity and/or thermal energy. Is there a contract for the sale of electricity or are the entities related? What are the major terms and conditions of the contract? Are there any generation guarantees and/or penalties for not delivering? Are there other guarantees (workmanship, other) or conditions and possible penalties? How does the contract(s) address prioritization of loads served in normal and islanded operation?
- What contractual relationships exist to account for the ownership of net metering credits? Are the credit recipients subject to change? What is the likelihood that they would be changed?
- What is the relationship between the load representative (i.e. the counterparty on any agreements with the microgrid company) and the loads? How is the relationship secured (by contract or other? What is the risk that this relationship could change?
- What is the contractual relationship between the representatives of the other DER and the loads? Are they the same entity? Do they have an agreement for sale of services? Are they a nearby entity? Is there some other arrangement? Will those arrangements need to be adjusted due to the new microgrid? If so, in what way and are there any obstacles to those changes?
- Describe the contractual relationship between the other DER representative and the microgrid? How will the two sets of assets interface to serve the customer/user? Do the contracts outline ways in which the resources are prioritized? In the event that the customer cannot pay both, which resources have priority to receive payment for services?
- Describe the relationship between the other DER representative and the DER equipment. Are they the project owner and/or operator? Is the customer acting on behalf of other equipment they use? Is there another piece of the microgrid that is considered, for whatever reason, separate from that which is applying for NY Prize funding?

2.11.2 Other Stakeholder Agreements

By addressing no less than the questions presented below, the Contractor shall demonstrate that it has

established written and contractual agreements with the local community and governing bodies to obtain explicit support and secure any needed services.

- Describe all local support that has been formalized. Attach any letters of commitment or support for this project from community representatives or organizations.
- If the community has an agent acting on their behalf, what is the relationship between the agent and the community? What are the responsibilities of the agent and what authority do they have to act on behalf of the community?
- For incentives not yet secured, has the application for incentive been submitted? Summarize the list of requirements. Do they vary in any way from the requirements of NY Prize?
- Describe the contractual relationship for public financing? Has it been secured? Who are the counter parties? How are risks managed within the agreements? What obligations does the microgrid have other than repayment?

Deliverable: Documentation of all work conducted under Task 2, Microgrid Commercial/ Financial Business Plan.

Task 3: Develop Information for Benefit Cost Analysis

The Contractor shall develop and provide the information for the data capture and facility questionnaire information sheets required to support an independent evaluation of project costs and benefits for this stage of analysis.

Sub Task 3.1 Facility and Customer Description

The Contractor shall list and describe all facilities that will be served by the microgrid. For each facility:

- Indicate the rate class to which the facility belongs (i.e., residential, small commercial/industrial, large commercial/industrial).
- Indicate the economic sector to which the facility belongs (e.g., manufacturing, wholesale and retail trade, etc.).
- Indicate whether multiple ratepayers are present at the facility (e.g., multi-family apartment buildings).
- Indicate the facility's average annual electricity demand (MWh) and peak electricity demand (MW). For facilities with multiple ratepayers, indicate average annual and peak demand per customer, rather than for the facility as a whole.
- Indicate the percentage of the facility's average demand the microgrid would be designed to support during a major power outage.
- In the event of a multi-day outage, indicate the number of hours per day, on average, the facility would require electricity from the microgrid.
- Provide the information for the data capture and facility questionnaire information sheets required

Sub Task 3.2 Characterization of Distributed Energy Resources

The Contractor shall describe the Distributed Energy Resources (DER) the microgrid would incorporate, including for each:

- Energy/fuel source.

- Nameplate capacity.
- Estimated average annual production (MWh) under normal operating conditions.
- Average daily production (MWh/day) in the event of a major power outage.
- For fuel-based DER, fuel consumption per MWh generated (MMBtu/MWh).

Sub Task 3.3 Capacity Impacts and Ancillary Services

The Contractor shall provide estimates of the following services/value the microgrid is expected to provide, as applicable:

- The impact of the expected provision of peak load support on generating capacity requirements (MW/year).
- Capacity (MW/year) of demand response that would be available by each facility the microgrid would serve.
- Associated impact (deferral or avoidance) on transmission capacity requirements (MW/year).
- Associated impact (deferral or avoidance) on distribution capacity requirements (MW/year).
- Ancillary services to the local utility (e.g., frequency or real power support, voltage or reactive power support, black start or system restoration support)
- Estimates of the projected annual energy savings from development of a new combined heat and power (CHP) system relative to the current heating system and current type of fuel being used by such system
- Environmental regulations mandating the purchase of emissions allowances for the microgrid (e.g., due to system size thresholds)
- Emission rates of the microgrid for CO_2, SO_2, NO_x, and PM (emissions/MWh).

Sub Task 3.4 Project Costs

The Contractor shall provide the following cost information for the microgrid:

- Fully installed costs and engineering lifespan of all capital equipment.
- Initial planning and design costs.
- Fixed operations and maintenance (O&M) costs ($/year).
- Variable O&M costs, excluding fuel costs ($/MWh).
- What is the maximum amount of time each DER would be able to operate in islanded mode without replenishing its fuel supply? How much fuel would the DER consume during this period?

Sub Task 3.5 Costs to Maintain Service during a Power Outage

For each facility the microgrid would serve, the Contractor shall describe its current backup generation capabilities, if any, by providing the following information:

- Fuel/energy source of each existing backup generator.
- Nameplate capacity of each existing backup generator.
- The percentage of nameplate capacity at which each backup generator is likely to operate during an extended power outage.
- Average daily electricity production (MWh/day) for each generator in the event of a major power outage, and the associated amount of fuel (MMBtu/day) required to generate that electricity.
- Any one-time costs (e.g., labor or contract service costs) associated with connecting and starting each backup generator.

- Any daily costs ($/day) (e.g., maintenance costs) associated with operating each backup generator, excluding fuel costs.
- Given a widespread power outage (i.e., a total loss of power in the surrounding area), describe and estimate the costs of any emergency measures that would be necessary for each facility to maintain operations, preserve property, and/or protect the health and safety of workers, residents, or the general public. Please include costs for one-time measures (e.g., total costs for connecting backup power) and any ongoing measures (expressed in terms of average costs per day). Specify these costs for two scenarios: (1) when the facility is operating on backup power, if applicable, and (2) when backup power is not available.

Sub Task 3.6 Services Supported by the Microgrid

For facilities that provide fire, emergency medical, hospital, police, wastewater, or water services, the Contractor shall:

- Estimate the population served by each facility.
- Describe how a power outage would impact each facility's ability to provide services. If possible, estimate a percentage loss in the facility's ability to serve its population during a power outage, relative to normal operations (e.g., 20% service loss during a power outage), both when the facility is operating on backup power and when backup power is not available.

For residential facilities, the Contractor shall:

- Describe the type of housing the facility provides (e.g., group housing, apartments, dormitory, nursing home, assisted living, etc.).
- Estimate the number of residents that would be left without power during a power outage.

Deliverable: Documentation of the work conducted under each sub-task under Task 3, Develop Information for Benefit Cost Analysis.