Burlington Electric Department & Burlington International Airport Microgrid Request for Proposal

In partnership with the Department of Energy, Sandia National Laboratories, and Clean Energy States Alliance

Contents

INTRODUCTION

Thank you very much for your Burlington International Airport (the “Airport”) Microgrid RfI submission. Based on the information we received in the Request for Information ("RfI"), we have narrowed the project focus in this Request for Proposal (“RfP”). We are requesting a proposal with the following characteristics:

- At least 1 MW and 4 MWh of battery storage with an approximate C-ratio of ¼, and the ability to fully charge and discharge daily.
- The ability to power the Airport in an outage.
    - The ability to continue solar array operation after an outage.
- The ability to tie-in additional microgrid assets in the future.
- Sized to fit in the ~2,000 sq. ft. available at the Airport.

Although discussed in the RfI, we are not currently requesting a “bumpless” solution, nor are we planning on adding additional backup generation, and we are delaying connecting the existing backup generation.

The storage will be located directly adjacent to the northern end of the Airport distribution circuit. As the exact site is already determined and site specifications are below, we do not believe a site visit is required. But, if there is enough interest, we are willing to organize a site visit and will adjust the schedule accordingly.

RFP RESPONSE GUIDELINES

The RfP response should consist of three parts:

- A 3-page overview containing a summary of the proposal
- The attached work breakdown structure
- Additional requirements submitted as appendices

Several RfI responses had text mentioning other costs. For the RfP, we aim to make an "all-in" cost comparison between proposals. To that end, as part of your response, we are requesting the attached work breakdown spreadsheet with this RfP. Please include the attached work breakdown document with your response. If there are other costs that have to be estimated, please provide such estimates and let us know how we can make the estimates more definite.

We may wish to add new components (backup generation, solar, storage, etc.) to the microgrid in the future. Please outline the process and cost that would be involved. These components could include the existing backup generation or new components.

Please describe in detail how the microgrid would respond to an outage, both when power is lost and when power and the solar array is restored.

BED expects that it will purchase a turnkey system, but remains open to other arrangements, including Energy Storage as a Service. If relevant to your proposal, please provide a sample contract for Energy Storage as a Service. Please also provide a sample warranty for each type of financing proposed.

REQUIREMENTS

3-Page Summary

The requested 3-page summary should, at a minimum, cover the following subjects:

- Your organization
- Your proposed solution, including:
    - Description of Energy Storage
    - Communications and Cybersecurity for Data and Controls
    - Proposed Interconnection Details
- A high-level proposed timeline for the project
- Price or Financing Arrangement

Overview

Under the awarded contract, the selected entity will design, build, ship, install, and commission the specified microgrid system. The system will be required to have a minimum energy capacity rating of four megawatt-hours (4 MWh) at a discharge rate of one megawatt (1 MW) as measured at the AC secondary and shall be capable of that output throughout its life (minimum of 10 years). New construction must meet all applicable codes as well as follow any applicable Burlington Electric Department construction standards. In addition to the installation of the energy storage system, the proposal must identify a solution to restore and continue operation of the adjacent solar array in an outage, and the installation of a SCADA controlled/monitored disconnect switch at the point of power supply on the primary distribution network. In addition to the infrastructure noted above, a solution for communication between the BED control center at 585 Pine Street and the listed devices at the Burlington International Airport is expected within the scope of this project.

Site Infrastructure

The existing site location, near the traffic control tower is within the airport security perimeter fence, adjacent to an existing taxiway to Gate 1. The site has no previous structural work completed in preparation for the battery energy storage system. The electrical point of connection will require a step-up transformer from the secondary voltage output of the energy storage system and underground primary cable to connect the transformer to the Primary Connection Point at termination cabinet "MTC#AP1". The trenching and interconnection facilities from the existing termination cabinet to the site location will be the responsibility of the proposer. The project will approximately occupy the space depicted in Figure 1, while meeting the following set of requirements:

- The security fence depicted in Figure 1 in solid blue, requires a 5 ft. clear zone from any object. This clear zone is represented by a blue dotted line.
- The Gate 1 Lead-in line in solid red, requires a 55 ft. clear zone for airport traffic. This clear zone is represented by a red dotted line.

The remaining Battery Energy Storage System ("BESS") site area with estimated dimensions is depicted in black in Figure 1. Measures are estimates and subject to variation.

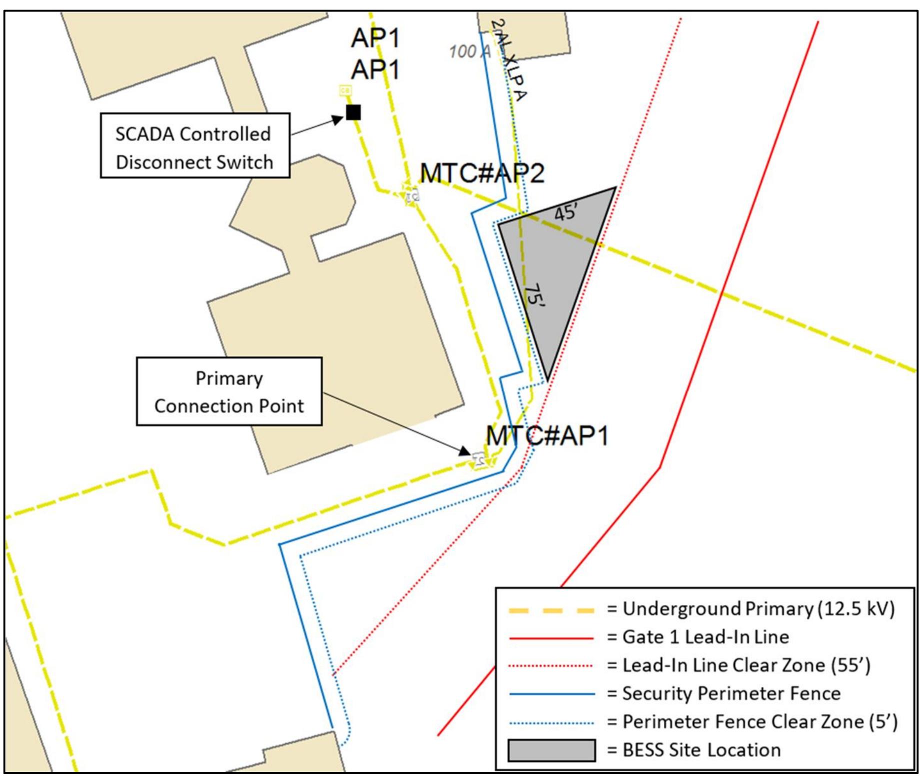

Figure 1 – Bird's Eye View of the Site Location (with Primary Circuit)

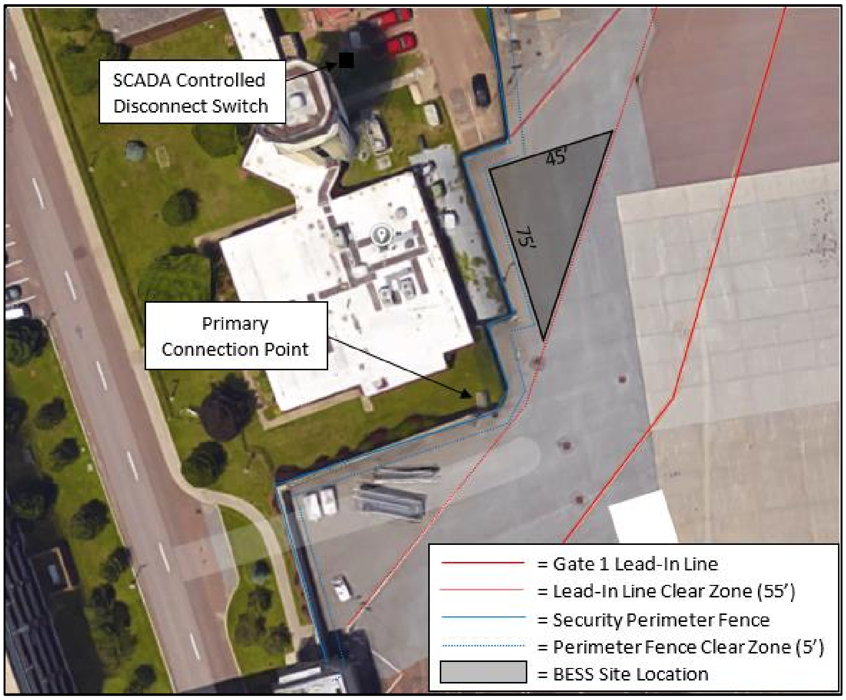

Figure 2 – Bird's Eye View of the Site Location (Satellite)

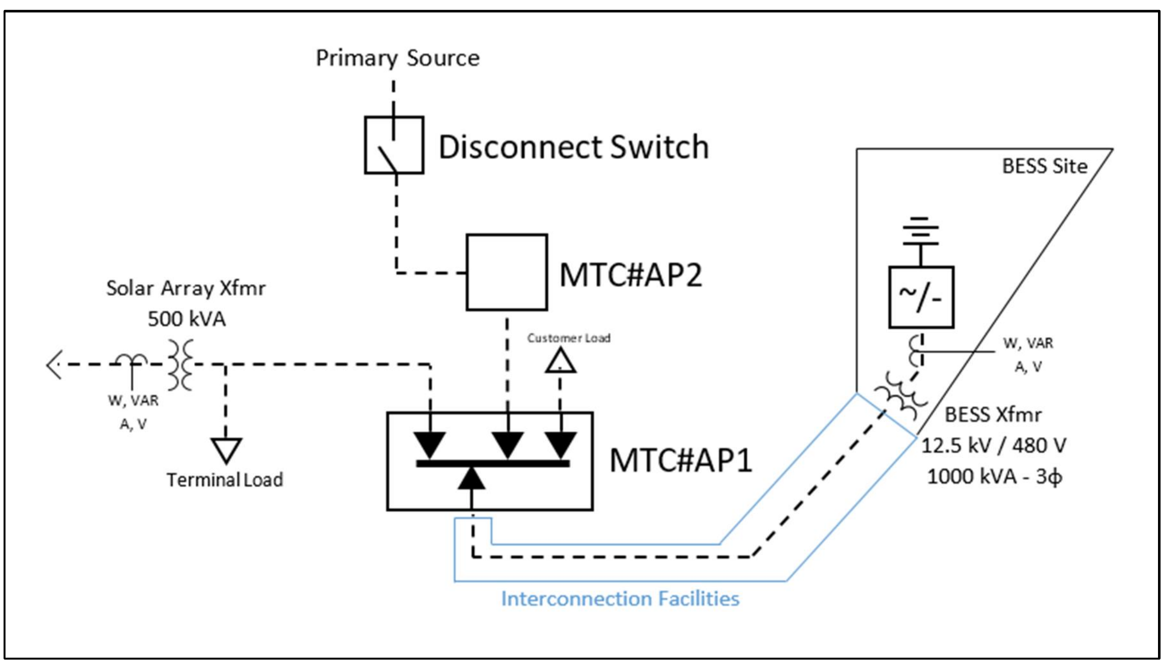

Figure 3 – General One Line Diagram of Energy Storage Interconnection Facilities

Additional Systems

To be able to island the Airport, a remote controlled and monitored disconnect switch is required to be installed at the point of primary service from the Green Mountain Power distribution network. The purpose of the disconnect switch is to isolate the airport circuit from the Green Mountain Power ("GMP") distribution supply when the source is lost. The device must detect and operate upon loss of source from the GMP distribution network. This device must also be able to be synchronized and reclosed both automatically or by BED operators remotely to reconnect to the GMP distribution network. The communications of the switch will require the addition of a SCADA remote terminal unit.

BED would like the solar array at the Airport to be able to resume operation during an outage, so as to increase the amount of ride-through. As such, adding reclosing capability to the circuit breaker for the solar array should be included in the proposal.

Any control devices used for protection and/or control should be by Schweitzer Engineering Laboratory, to maintain consistency with rest of the BED system.

Financial Arrangements

BED's FY18 (ending June 2018) budget includes microgrid funds, but they are sized for the (substantially smaller) Pine Street project rather than the Airport. The soonest that BED could budget for the Airport Microgrid would be its FY19 budget (July 1, 2018-June 30, 2019). BED would be especially interested in proposals which either include possible financing arrangements and/or an "Energy Storage as a Service" proposal allowing the project to potentially go forward in FY18. BED is also interested in turnkey proposals where expenses would be predominantly incurred in FY19.

Energy Storage System

The Energy Storage ("ES") system will be a complete system including a three-phase step-up transformer to 12.5 kV, three-phase inverter(s), AC and DC electrical protection, battery management system, energy management system, controls and interface, data acquisition system, and all balance of plant components. The system and its installation will need to meet all applicable codes, IEEE standards and certifications. Performance specifications are listed below as well as definitions of the parameters. All units are with respect to the AC output of the system.

Table 1 - ES system performance specifications

Parameters	Units	Requirements
Rated Active Continuous Discharge Power	MW	>= 1
Rated Active Continuous Charge Power	MW	>= 1
Rated Reactive Power	MVAR	>= 1
Rated Apparent Power	MVA	>= 1
Available Discharge Energy	MWh	>= 4
Recommended Discharge Energy	MWh	>= 4
Max AC Current	Amps	Up to 1600

Output Voltage Range	V_{AC}	480
Phase		3 - phase
Charge Duration	Hours	Up to 8
Recommended Charge Power	MW	>= 1
Typical Charge Time	Hours	Up to 12
System Latency	Seconds	0.05
ESS Roundtrip Efficiency	%	≥70
Cycle Life Rating	Cycles	≥3600
Expected Energy Discharge	MWh	3600
Ambient Temperature Range	°C	-40 to 50
Humidity Range	%	0 to 100

Performance Specification Definitions:

Rated Active Continuous Discharge Power – The maximum steady state power at which the ES system can continuously discharge for the energy storage component's entire specified State of Charge range

Rated Active Continuous Charge Power – The maximum steady state power at which the ES system can continuously accept for the energy storage component's entire specified State of Charge range

Rated Reactive Power – The maximum continuous reactive power (active power = 0) that the ES system can provide before overheating

Rated Apparent Power – The maximum continuous active or reactive power (leading and lagging) that the ES system can provide without exceeding maximum operating temperature

Available Discharge Energy – The accessible energy that can be provided by the ES system when discharging at rated power at the end of 10 years

Recommended Discharge Energy – The quantity of manufacturer-defined usable energy after 10 years of the asset when subjected to daily or more frequent cycling

Max AC Current – The maximum AC current that the ES system can provide into the grid continuously and can be charged by the grid continuously without exceeding the maximum operating temperature

Output Voltage Range – The range of AC grid voltage under which the ES system will operate

Phase – Desired number of phases for the system

Charge Duration – The maximum amount of time required for the ES system to be charged at rated charge power from minimum State of Charge to its maximum State of Charge

Recommended Charge Power – Recommended charge power while staying within the manufacturer's rated guidelines on State of Charge and internal temperatures after 10 years of the asset subjected to daily or more frequent cycling

Typical Charge Time – The nominal amount of time required for the ES system to be charged from minimum Stat of Charge to its rated maximum State of Charge, including any time for a resting period needed between a full or partial charge or discharge cycle.

System Latency – Time measured between when the control signal is sent and the ES system responds to the signal by changing the discharge or charge power value by more than 1% of the control set point

ESS Roundtrip Efficiency – Total roundtrip efficiency of the ES system defined as the ratio of the delivered discharge energy to the delivered charge energy at the Power Conditioning System output terminals at the time of installation and after 10 years. Specified roundtrip efficiency must be met for the following cycles.

- 100% Depth of Discharge Cycles, Full Rated Power
- 100% Depth of Discharge Cycles, 75% Rated Power
- 100% Depth of Discharge Cycles, 50% Rated Power
- 100% Depth of Discharge Cycles, 25% Rated Power
- 10% Depth of Discharge Cycles, Full Rated Power
- 10% Depth of Discharge Cycles, 75% Rated Power
- 10% Depth of Discharge Cycles, 50% Rated Power
- 10% Depth of Discharge Cycles, 25% Rated Power

Cycle Life Ratings – The number of cycles that the energy storage system can perform for a minimum of 10 years, independent of calendar life degradation, at specified depth of discharge after which electricity storage becomes inoperable or unusable for a given duty cycle:

- Cycle life at 100% Depth of Discharge Power
- Cycle life at 90% Depth of Discharge Power
- Cycle life at 80% Depth of Discharge Power
- Cycle life at 70% Depth of Discharge Power
- Cycle life at 60% Depth of Discharge Power
- Cycle life at 50% Depth of Discharge Power
- Cycle life at 40% Depth of Discharge Power
- Cycle life at 30% Depth of Discharge Power
- Cycle life at 20% Depth of Discharge Power
- Cycle life at 10% Depth of Discharge Power

Expected Energy Discharge – This is the minimum amount of energy that the energy storage system must produce during the 10 years in operating service

Ambient Temperature Range – The ambient temperature range in Celsius that the ES system needs to be able to normally operate

Humidity Range – The humidity range in percent that the ES system needs to be able to normally operate

Cybersecurity

The airport is not currently attached to BED's SCADA system, but as aspects of the microgrid must be attached to BED's SCADA network, those portions must remain isolated to that network, with no connection to the Internet or any other business network. Where SCADA connectivity not is used, all traffic must be sent via IPSEC encrypted tunnels utilizing our existing IPSEC infrastructure. In general, any Ethernet/IP based traffic must meet common cybersecurity standards.

BED's Dispatch department will need to be able to operate the system during outages and based on market signals. This could be accomplished via SCADA or some alternative method. Network and data flow diagrams will be required as part of the response to clarify the connectivity and determine cybersecurity requirements. If the system will not be controlled by SCADA, please discuss how to securely integrate it with existing SCADA operations.

Data Acquisition and Monitoring

For the system verification of working and meeting performance specifications, the system must produce and store data on-site for at least 30 days. Data should be collected at the terminals of the inverter(s) and at the location of the interconnection. Partners must be able to remotely retrieve 30 days of data from the system.

The required data with the minimum Sample Rate is listed below. The time stamp should be tied back to a precision time reference, such as GPS time.

Table 2 – Communications/Metering Flow of Data assuming Energy Storage is controlled by SCADA

Device	Controls / Metering	On-Site Remote Terminal Unit	Point of Control and Data Storage
Energy Storage Array	Controls/Metering ↔	RTU ↔	Burlington Electric Department Dispatch
Disconnect Switch	Controls ↔		

Table 3 – Data Points and Sample Rates

Data Point	Source	Device(s)	Sample Rate Minimum	Values
AC Real Power	Total System	Energy Storage, Solar Array	1 Sample/min	value, max, min, avg
AC Reactive Power	Total System	Energy Storage, Solar Array	1 Sample/min	value, max, min, avg
AC Voltage	Total System	Energy Storage, Solar Array	1 Sample/min	value, max, min, avg
AC Current	Total System	Energy Storage, Solar Array	1 Sample/min	value, max, min, avg
Events: Errors, Warnings, Faults	Total System and Each String/module	Energy Storage	1 Sample/min	flag
Operation Events	Total System	Energy Storage, Disconnect Switch	1 Sample/min	value
Operator Commands	System Controller	Energy Storage, Disconnect Switch	1 Sample/min	value

Due to the remote location of the distribution circuit, the BED primary circuit does not have any means of communication, or controls to and from the BED operations center at 585 Pine Street in Burlington.

Communication solutions (communication transmission, RTU, etc.) are to be included in the proposal scope. In addition to data acquisition, functional control will be required to operate the system from the BED operations center. Communication systems must also provide control to a new disconnect switch at the primary source location for islanding capabilities.

In general, the data acquisition requirements will be to capture AC performance, as well as safety alarms for operations outside of normal operating limits (current, voltage, temperature, component failures, etc.). The ability for BED to add or select additional datapoints at a later time should be covered in your response.

Application

In addition to providing a back-up power supply to the Airport in the event there is a loss of source, the energy storage system will be used for peak load shaving, energy arbitrage, and other wholesale market actions as economical. The system will be used in conjunction with the existing solar array on the primary circuit as a pilot platform for microgrid control technologies. While the size of the energy storage array and solar array may not be adequate to run a self-sustained microgrid, the control logic and communication concepts will be utilized and evaluated for future projects on the Burlington Electric Department distribution network and at the Burlington International Airport.

As such, BED desires a system with the ability to meet the PNNL-22010 "Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems" and stay within performance specifications previously mentioned. For the Frequency regulation and Islanded microgrid the ES system must be able to track the signal at least 95% of the time outlined in PNNL 22010 Section 7.4.5. As Peak Shaving, Frequency Regulation, and Microgrid operations are the three primary benefits streams of the system, the system should be able to meet these criteria:

- Peak Shaving (PNNL-22010 Section 5.1.3.3)
- Frequency Regulation (PNNL-22010 Section 5.2.2)
- Islanded Microgrids (PNNL-22010 Section 5.3.2)

BED plans to participate in the ISO-NE markets (either as a behind-the-meter resource and/or as an ISO-NE recognized unit) on a daily basis, and, as such, requires at least daily cycling from the system.

Safety

Burlington Electric Department and the Burlington International Airport will work with the successful candidate to develop an installation and operation safety plan. The safety plan, prepared primarily by the selected entity, will be approved by all parties. This plan must document the safety training of any personnel who will be needed to perform work at the site, along with the step-by-step procedure for their work and foreseeable contingencies.

The system itself must be thoroughly analyzed for safety and primary hazard screening. These analyses will be completed by the selected entity and approved by all parties as part of the larger safety package.

Documentation Deliverables

As part of this proposal, the bidder shall provide all pertinent information concerning their system. Documentation will include, but not be limited to: system specifications, safety considerations, systems installed and operating, operational data to show systems success in various applications, general shop drawings, data acquisition system, inverter, battery monitoring and site controller specifications.

Electrical Design Parameters

- **BESS Requirements**: Refer to Energy Storage Section
- **Harmonics**: Harmonics must be within IEEE standards
- **Spill Containment**: If ES system contains hazardous liquid, secondary spill containment must be in place
- **Personnel Safety**: Personnel must follow the safety program that is approved between BED and offeror
- **Fire Protection**: Protection against fires must be in place such as a sprinkler and not just an alarm. Offeror must describe fire suppression system if required by ES system and reasoning behind fire suppression design.
- **Spare Parts and Equipment**: Please provide spare parts that typically wear down within 5 years or less inside and outside the ES system.
- **Warranty**: As part of this contract, a 1-year warranty and 10-year performance guarantee from date of commissioning will be required.

Permitting

Airport-Specific

Any work within the Secured Area at the Airport will require an airport escort. The Airport will provide an operations personnel for escorting with advanced notice. Significant work within the Secured Area, requires the contractor to be badged. The badging process includes fingerprinting at the local sheriff’s office, a security threat assessment, and a half-day security class. The cost is $85 per person.

Any contracts that are executed with the Airport will be subject to FAA Contract Provisions, in addition to City of Burlington contract provisions. The previously provided Combined Federal Contraction Provisions document includes a table on page 3 that lists the applicable contract provisions in the rightmost column for Non-AIP Contracts.

Any development projects at the Airport will require that the consultant submit a Notice of Proposed Construction or Alteration (FAA Form 7460-1). This form can be filed electronically at https://oeaaa.faa.gov/oeaaa/external/portal.jsp.

Vermont-Specific

As part of this process, BED will file for a Certificate of Public Good with the Vermont Public Service Board. Assistance from the vendor is likely to be limited to matters like providing wiring diagrams and product sheets.

SCHEDULE

Due to a desire to reduce load during the 2018 ISO-NE peak, the system will need to be activated by the second quarter of 2018. Please provide a timeline for design, manufacture, shipment, installation, and commissioning activities.

BUDGET

Using the attached cost breakdown file, provide a breakdown cost of design, procurement, shipping, placement on pad, all cable and connections to distribution panels commissioning, service contract, decommissioning, recycling and 1 or more year warranty. Performance specification for the ES system must be maintained for at least 10 years. If the ES system needs to be replaced within the 10 years include the replacement cost.

OTHER/CONFIDENTIALITY

Confidentiality Requirements: If portions of the RfP response are to remain confidential, information must be included clearly describing which portions of the package the proposer considers confidential along with justification as to why the information would be considered confidential under Vermont law and Vermont Public Service Board rules. BED is subject to very liberal public disclosure laws, so any RfP responses including proprietary/confidential materials should have those materials clearly marked and segregated, and include specific justifications as to why the materials must remain confidential.

SELECTION PROCESS

There will not be any formal response opening meeting. Submissions will be opened and reviewed immediately following the submittal deadline. Evaluation will include cost effectiveness, credentials, ability to meet stated operational goals, and controllability. During the evaluation process, BED reserves the right to request additional information or clarifications during response review. BED also reserves the right to terminate the process following RfP response review if, in BED's sole discretion, no viable responses are received. Nothing in this RfP shall obligate BED to proceed with any proposals.

SUBMITTAL AND TIMELINE

All RfPs must be received by BED no later than 5:00 EST, July 11, 2017. Please submit via email, in either Word format or PDF format. Email to the attention of Casey Lamont (clamont@burlingtonelectric.com) with “Airport – RfP” in the subject line. BED will contact the entities with their decision by August 11, 2017.

Preliminary Schedule

RfP Released	**9-May-17**
Written Questions Due to BED	24-May 17
Question Responses Provided	6-June 17
Conference Call	20-June 17
Submittal Due	11-July 17